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Karanja (Lad), Dist. Washim 444105 (M.S.), India
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Mathematics

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Dynamic Analysis of Renyi Holographic Dark Energy with Hubble's IR Cut-off

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ABSTRACT
The present study deals with investigation of Hypersurface-homogeneous cosmological model with Renyi holographic dark energy (RHDE) in the confines of the $f(R)$ gravity. The shear scalar is assumed to be proportional to the expansion scalar in order to achieve the precise solutions of the field equations. Analysis of the solution of cosmological model is done by taking the time-varying deceleration parameter into account. The Hubble horizon is used as an infrared (IR) cutoff when examining the RHDE. Numerous kinematical as well as physical characteristics of the model are also examined. Moreover, regarding the parameter K that appear in the space-time metric, three physically feasible cosmological cases are described. We found that the outcomes of our study align with recent observational data.
Keywords: Renyi holographic dark energy, Homogeneous-hypersurface, $f(R)$ gravity.

1. Introduction
According to observational cosmic evidence, the expansion of our Universe is presently occurring more rapidly [1-4]. The force driving the universe's cosmic expansion is dark energy (DE), which possesses negative pressure and makes up 70% of the peculiar ingredient [5-8]. Notwithstanding all the evidence, the DE issue in theoretical physics remains unsolvable. In an effort to provide a description of the DE and explain the cosmic acceleration of the cosmos, researchers are delving further into modified gravity. With the introduction of the arbitrary function of Ricci scalar R in Einstein-Hilbert action, the $f(R)$ theories represent the most basic alterations to General Theory of Relativity (GTR). As a generalisation of Einstein's relativity, Buchdahl [9] presented $f(R)$ gravity in an effort to explain the universe's fast expansion and the evolution of its structures. Numerous researchers have investigated $f(R)$ gravity in different cosmological scenarios [10–20]. Among the several modified theories of gravity, $f(R)$ gravity is deemed highly suitable models with significant cosmological value.

From the standpoint of black hole physics, the holographic principle that first put out by G't Hooft [21] seems to be a suitable fit for the explanation of dark energy, which is why holographic dark energy (HDE) has become the stronger contender. As suggested by Susskind [22] and Bousso [23], the holographic principle states that a system's entropy rises with surface area rather than volume. Extending this, a unique cosmic application of the holographic principle was introduced by Fischer and Susskind [24] and Cohen et al. [25], eclipsing the realm of black hole physics. The analysis provided in [26–29] demonstrates how these HDE models then correlate with current observational data. A number of entropy generalisations have now been used to illustrate and build different cosmological models, such as the Tsallis [30,31], Sharma–Mittal [32], and Renyi [33] holographic DE models. Since Renyi HDE exhibits more stability on its own in the non-interacting universe, numerous researchers have recently focused on RHDE in a variety of cosmological situations, as stated in [34–41].

This study explores the analysis of hypersurface-homogeneous space-time with RHDE in the given context of $f(R)$ gravity, considering time varying deceleration parameter. This is how the paper is organised. Section 2 discusses the hypersurface-homogeneous space–time, along with Field equations incorporating pressureless dark matter, and the RHDE model. Section 3 presents the deduction of the metric potentials considering the proportionately connection between the expansion scalar and shear scalar. Sections 4 addresses physical and kinematical properties of the model. Finally, Section 5 includes the discussion and conclusions.

2. Metric and Field Equations

For $f(R)$ gravity, its action is presented by

$$S=\int\sqrt{-g}\,\left(f(R)+L_m\right)d^4x, \tag{1}$$

where $f(R)$ denotes the general function of the Ricci scalar R and L_m stands for the usual matter Lagrangian.

The action (1) is varied with respect to the metric $g_{\mu\nu}$ to derive the associated field equations expressed as

$$F(R)R_{\mu\nu}-\frac{1}{2}f(R)g_{\mu\nu}-\nabla_\mu\nabla_\nu F(R)+g_{\mu\nu}\nabla^\mu\nabla_\mu F(R)=-(T_{\mu\nu}+\overline{T}_{\mu\nu}), \tag{2}$$

where $F(R)\equiv df(R)/dR$, ∇_μ is the covariant differentiation, $T_{\mu\nu}$ stands for the standard matter energy momentum tensor emanating from the Lagrangian L_m and $\overline{T}_{\mu\nu}$ stands for energy momentum tensor of RHDE.

Several authors have studied hypersurface-homogeneous models with much interest, which is expressed as

$$ds^2=-dt^2+A^2(t)dx^2+B^2(t)\left[dy^2+\Sigma^2(y,K)dz^2\right], \tag{3}$$

where A and B are the scale factors such that they are functions of t only and $\Sigma(y,K)=\sin y, y, \sin hy$ for $K=1,0,-1$ respectively.

Katore et al. [42] studied the hypersurface-homogeneous space–time with anisotropic dark energy (DE) in Brans-Dicke gravity. Verma et al. [43] and Katore and Shaikh [44] explored this space–time in Saez–Ballester gravity. Shekh and Ghaderi [45] discussed a hypersurface-homogeneous space-time, incorporating an interacting holographic dark energy (HDE) model with Hubble's and Granda–Oliveros IR cut-offs while Vinutha et al. [46] used Renyi HDE to investigate it with the Hubble horizon in the Saez-Ballester gravity as an IR cut-off.

The scalar curvature R for the metric (3) turns out to be

$$R=2\left[\frac{\ddot{A}}{A}+2\frac{\dot{A}\dot{B}}{AB}+2\frac{\ddot{B}}{B}+\frac{\dot{B}^2}{B^2}+\frac{K}{B^2}\right] \tag{4}$$

where '$\cdot$' stands for the differentiation with respect to cosmic time t.

For pressureless matter along with RHDE, the energy momentum tensors are given by

$$T_{\mu\nu}=\rho_m u_\mu u_\nu;\ \overline{T}_{\mu\nu}=(\rho_r+p_r)u_\mu u_\nu+g_{\mu\nu}p_r, \tag{5}$$

where ρ_m stands for the energy density of matter, p_r and ρ_r denote pressure and energy density of the RHDE respectively, u_μ are components of the four-velocity vector of fluid for which the relation $g_{\mu\nu}u^\mu u^\nu=-1$ holds.

Using equations (2) and (5), the field equations are expressed as

$$F\left[\frac{\ddot{A}}{A}+2\frac{\dot{A}\dot{B}}{AB}\right]-\frac{1}{2}f(R)-2\frac{\dot{B}}{B}\dot{F}-\ddot{F}=-p_r, \tag{6}$$

$$F\left[\frac{\ddot{B}}{B}+\frac{\dot{A}\dot{B}}{AB}+\frac{\dot{B}^2}{B^2}+\frac{k}{B^2}\right]-\frac{1}{2}f(R)-\left(\frac{\dot{A}}{A}+\frac{\dot{B}}{B}\right)\dot{F}-\ddot{F}=-p_r, \tag{7}$$

$$F\left[\frac{\ddot{A}}{A}+2\frac{\ddot{B}}{B}\right]-\frac{1}{2}f(R)-\left(\frac{\dot{A}}{A}+2\frac{\dot{B}}{B}\right)\dot{F}=\rho_m+\rho_r. \tag{8}$$

3. Solution of the Field Equations

The scale factor, which depends on time, is used to define the deceleration parameter. As a result, it always encourages researchers to look into the time-varying deceleration parameter as opposed to the constant one. Investigating this parameter is therefore of interest to us. The particular form of the time-varying deceleration parameter that we have examined is given by

$$q=-1+\frac{\beta}{1+a^{\beta}} \tag{9}$$

where a denotes average scale factor and $\beta>0$ is a constant.

Using the relation $q=-1+\frac{d}{dt}\left(\frac{1}{H}\right)$ and solving equation (9), we obtained

$$H=1+\frac{1}{a^{\beta}} \tag{10}$$

where unity is taken into consideration for the integrating constant.
And integrating the equation (10) yields

$$a(t)=\left(e^{\beta t+\gamma}-1\right)^{1/\beta} \tag{11}$$

where γ is the integration constant.

Using the relation $a(t)=\frac{1}{1+z}$, where z stands for the redshift, we obtained

$$t(z)=\frac{1}{\beta}\left\{\log\left[1+\frac{1}{(1+z)^{\beta}}\right]-\gamma\right\} \tag{12}$$

Using the relation (12), the deceleration parameter (9) in terms of redshift (z) is expressed as

$$q(z)=-1+\frac{\beta}{1+(1+z)^{-\beta}} \tag{13}$$

The parameter that characterises how the universe's expansion has evolved is called the deceleration parameter. In instances when the universe is decelerated over time, this parameter is positive $(q>0)$ and it is negative $(q<0)$ during the accelerating expansion of the cosmos. The behaviour of the deceleration parameter (q) against redshift (z) is depicted in Fig. 1 and we observed that the value of the deceleration parameter lies in the range $-1\le q<0$ which resemble with the current observational data indicating the accelerating model.

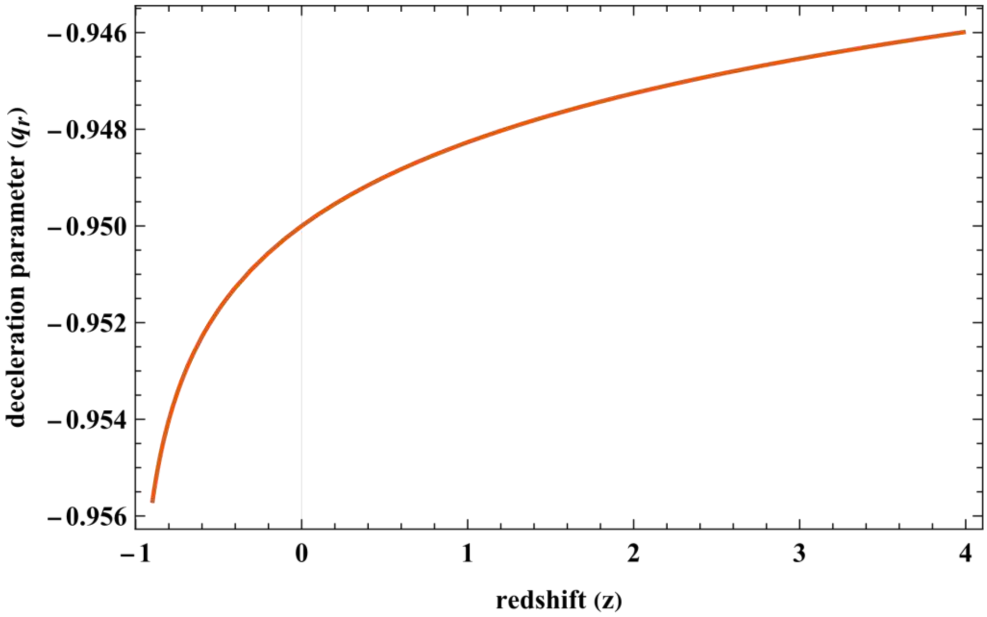

Fig. 1. The behaviour of deceleration parameter (q) against redshift (z) for $\beta = 0.0125$.

To obtained the precise solutions to the field equations (6)-(8), we now take into consideration that the expansion scalar is proportional to the shear scalar, which is represented as $A = B^l$ with $l \neq 1$ as an arbitrary constant.

Using $a^3 = AB^2 = V$, we get

$$A(z) = (1+z)^{-\frac{3l}{(l+2)}} \tag{14}$$

and

$$B(z) = (1+z)^{-\frac{3}{(l+2)}} \tag{15}$$

Both the metric potentials A as well as B have constant value at $z = 0$. This indicates that there is no initial singularity in our model and afterwards, it increases rapidly with the evolution of z that completely concurs with the Big-Bang model of the Universe. Moreover, we consider the result $F \propto a^m$ as determined by Kotub Uddin et al. [47], where m is an arbitrary integer. By taking $m = -2$, we get $F = c_1 a^{-2}$, with c_1 as a constant and using equation (11), it becomes

$$F = c_1 (1+z)^2 . \tag{16}$$

4. Physical and kinematical properties

Using equations (10)-(11), the Hubble parameter (H) in terms of the redshift (z) can be expressed as

$$H(z) = 1 + (1+z)^{\beta} . \tag{17}$$

The mean anisotropic parameter is obtained as

$$\Delta = \frac{32}{75}\left[\frac{2l}{(l+2)}\left(1+(1+z)^{\beta}\right)\right]^2 . \tag{18}$$

The anisotropic parameter (18) has constant value at $z = 0$ and vanishes at $z \to -1$ thereby satisfying the isotropization of the Universe.

The RHDE density has the form

$$\rho_r = \frac{3d^2}{8\pi L^2}\left(1+\pi\delta L^2\right)^{-1} , \tag{19}$$

where d and δ are constants as taken in [48].

Without collapsing into a black hole, the RHDE principle ought to be constrained by an infrared cutoff scale $L = 1/H$. Applying this restriction, the energy density for RHDE becomes

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$$\rho_r = \frac{3d^2\left(1+(1+z)^{-\beta}\right)^2}{8\pi\left(1+\pi\delta\left(1+(1+z)^{-\beta}\right)^{-2}\right)} \tag{20}$$

Using the equations (14)-(15), the Ricci scalar (4) reduces to

$$R = 2\left[K(1+z)^{\frac{2l}{(l+2)}} + \frac{l}{(l+2)^2}(1+z)^{\beta}\left(1+(1+z)^{\beta}\right)\left(18l\left(1+(1+z)^{-\beta}\right)-5b(l+2)\right)\right]. \tag{21}$$

The scalar function $f(R)$ is found to be

$$f(R) = \frac{lKc_1}{(l+1)}(1+z)^{\frac{4(l+1)}{(l+2)}} - \frac{2l\beta c_1}{(l+2)^2(\beta+2)}(10\beta+5l\beta-36l)(1+z)^{\beta+\frac{6l+4}{(l+2)}}$$
$$+\frac{2l\beta c_1}{(l+2)^2(\beta+1)}(10\beta+5l\beta-18l)(1+z)^{2\beta+\frac{6l+4}{(l+2)}}. \tag{22}$$

The energy density of matter (ρ_m) is obtained as

$$\rho_m = \frac{c_1 l(1+z)^{2(\beta+1)}}{2(\beta+1)(l+2)^2}\left(40+\left(42l-4\beta(l-5)\right)\right)+\frac{c_1 l(1+z)^{\beta+2}}{2(\beta+2)(l+2)^2}\left(40(4+\beta)-8l(\beta-21)\right)$$
$$-\frac{Kc_1 l(1+z)^{\frac{4(1+l)}{2+l}}}{2(l+1)}+\frac{c_1 l(1+z)^2}{2(l+2)^2}(42l+40)-\frac{3d^2\left(1+(1+z)^{\beta}\right)^4}{8\pi\left(\left(1+(1+z)^{\beta}\right)^2+\pi\delta(1+z)^{4\beta}\right)}. \tag{23}$$

The pressure (p_r) of Renyi HDE is found to be

$$p_r = -2c_1(1+z)^{2-\beta}\left(1+(1+z)^{-\beta}\right)\beta+2c1(1+z)^{2(1+\beta)}\left(1+(1+z)^{-\beta}\right)^2(2+\beta)+\frac{c_1 lK(1+z)^{4\left(\frac{l+1}{l+2}\right)}}{2(1+l)}$$
$$-\frac{c_1 l(1+z)^{2(1+\beta)}}{(l+2)^2}\left[\left(1+(1+z)^{-\beta}\right)\left(11l\left(1+(1+z)^{-\beta}\right)-5(2+l)\beta\right)-4(l+2)\left(1+(1+z)^{-\beta}\right)^2\right]$$
$$-\frac{c_1 l\beta(1+z)^{2(1+\beta)}}{(\beta+1)(\beta+2)(l+2)^2}\left[\left((23l+10)\beta+\left(1+(1+z)^{-\beta}\right)(1+\beta)\left(5\beta(2+l)-36l\right)\right)\right]. \tag{24}$$

Using barotropic equation of state, $p_r = \omega_r\rho_r$, the EoS parameter (ω_r) turns out to be

$$\omega_r = \frac{8\pi c_1(1+z)^2}{3d^2\left(1+(1+z)^b\right)^2}\left(\left(1+(1+z)^b\right)^2+\pi\delta\right)$$
$$\times\left[\begin{array}{l} -\frac{l\beta\left(1+(1+z)^{-\beta}\right)^{-2}}{(\beta+1)(\beta+2)(l+2)^2}\left((10+23l)\beta+\left(1+(1+z)^{-\beta}\right)(1+\beta)\left((2+l)5\beta-36l\right)\right) \\ +2(2+\beta)-2\beta\left(1+(1+z)^{-\beta}\right)^{-1}+\frac{lK}{2(1+l)}\left(1+(1+z)^{-\beta}\right)^{-2}(1+z)^{\frac{2l}{2+l}-2\beta} \\ -\frac{l}{(2+l)^2}\left(4(2+l)-\left(1+(1+z)^{-\beta}\right)^{-1}\left(11l\left(1+(1+z)^{-\beta}\right)-5(2+l)\beta\right)\right) \end{array}\right]. \tag{25}$$

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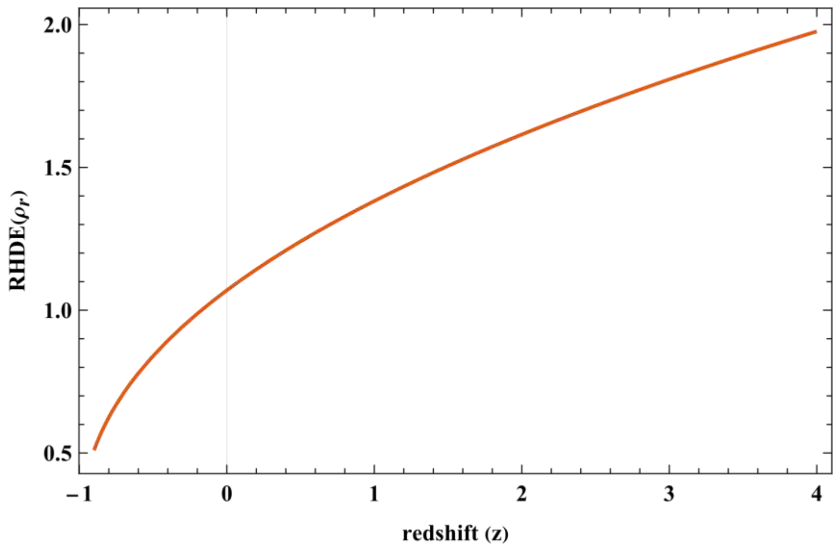

Fig. 2. The plot of RHDE (ρ_r) against redshift (z) for $d = 2$, $\delta = -1$ and $\beta = 0.0125$.

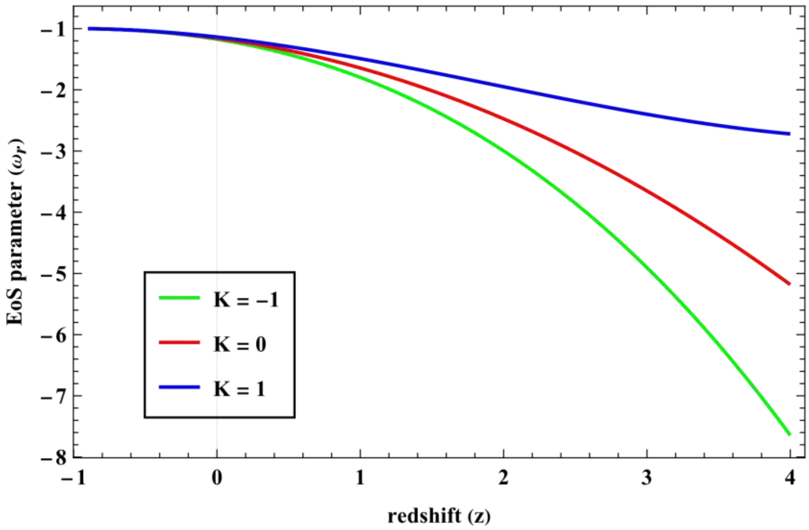

Fig. 3. The plot of EoS parameter (ω_r) against redshift (z) for $d = 2$, $l = 2$, $\delta = -1$ and $\beta = 0.0125$.

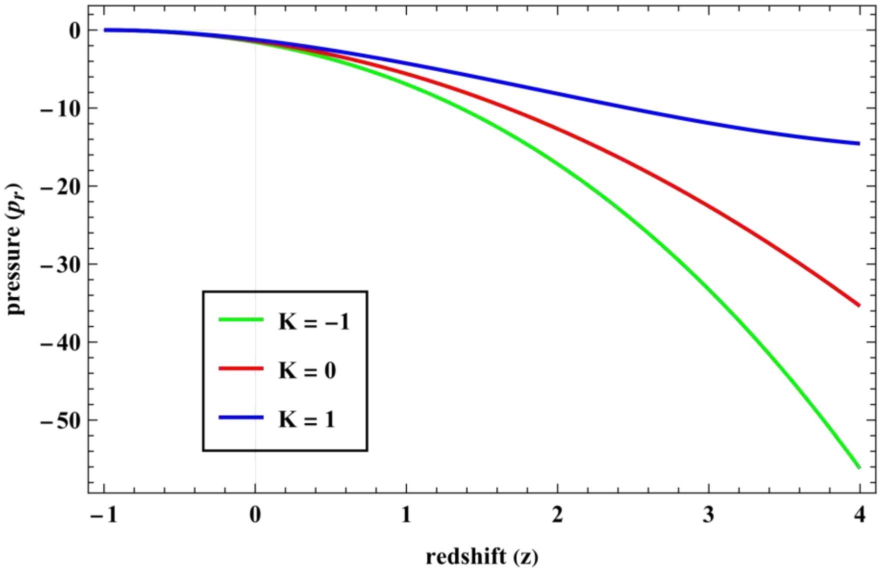

Fig. 4. The plot of pressure (p_r) against redshift (z) for $d = 2$, $l = 2$, $\delta = -1$ and $\beta = 0.0125$.

We obtain the graphical presentations of all these parameters with evolution in the redshift (z) for three cases of K by taking the appropriate choice of various constants involved in it. The plot of RHDE (ρ_r) against redshift (z) as presented in the Fig. 2 show a clear trend of increasing behavior of the RHDE (ρ_r) with passage of redshift. The behaviour of EoS parameter (ω_r) up against redshift (z) is presented in the Fig. 3 and it varies from $\omega_r < -1$ i.e. from phantom-dominated region in the past whereas it tends to a value close to -1 in the near future indicating the ΛCDM model. Consequently, the current value of EoS parameter (ω_r) in our model aligns closely with recent observational data. As depicted in the Fig. 4, we observed that the pressure (p_r) is negative over the course of progression of redshift which imply the speeding up behaviour of our model concurs with the investigations of Samanta [49].

5. Conclusions

In this paper, we explored the analysis of Hypersurface-homogeneous cosmological model with Renyi holographic dark energy (RHDE) in the confines of the $f(R)$ gravity. The shear scalar is taken to be proportional to the expansion scalar in order to obtained the precise solutions of the field equations and is analysed by assuming the time-varying deceleration parameter (q). Both the metric potentials have constant value at $z=0$ which indicates that there is no initial singularity in our model and afterwards, it increases rapidly with the evolution of z that completely concurs with the Big-Bang model of the Universe. As depicted in Fig. 1, negative value of deceleration parameter (q) indicates the accelerating model. Moreover, its value lies in the range $-1 \le q < 0$ which resemble with the current observational data. Regarding the parameter K that appear in the space-time metric, three physically feasible cosmological cases are described. The RHDE (ρ_r) is investigated by considering the Hubble horizon as an infrared (IR) cutoff and it show a clear trend of increasing behavior with passage of redshift as depicted in Fig. 2. The behaviour of EoS parameter (ω_r) versus redshift (z) as depicted in the Fig. 3 shows that it varies from phantom-dominated region in the past whereas it tends to a value close to -1 in the near future indicating the ΛCDM model. As depicted in the Fig. 4, the pressure (p_r) is negative over the course of progression of redshift (z) which provides additional backing for the universe to be expanding faster. The outcomes attained and the behaviour of our model as seen align with the recent observational evidence of the universe.

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Dark Energy of Bianchi Type – I Cosmological model with Electromagnetic Field in f(T) Theory

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Abstract:
This research paper delves into the intriguing realm of dark energy within the framework of the $f(T)$ theory applied to the Bianchi Type-I cosmological model, coupled with the presence of an electromagnetic field. Dark energy, a mysterious component driving the accelerated expansion of the universe, continues to challenge our understanding of fundamental physics. The $f(T)$ theory, an extension of teleparallel gravity, provides an alternative perspective to General Relativity, where T is the torsion scalar. To determine the nature and physical properties of the model, we considered $f(T) = T$. Our investigation incorporates this modified theory into the Bianchi Type-I cosmological model, considering the influence of an electromagnetic field on the cosmic evolution. Some physical aspects of the model are also investigated.
Keywords: Dark energy, $f(T)$ theory of gravity, Bianchi Type-I cosmological model, Electromagnetic field.

1. Introduction

The whole universe is studied in the field of Cosmology. This vast universe is actually the collection of galaxies. Cosmology studies the gigantic structure of universe. According to modern astrophysical observations in recent years, the universe is not only expanding but also accelerating continuously after 'Big Bang'. It has been increasing from an initial state with high density and high temperature. This is proved by cosmological experiments, such as 'The measurement of type-Ia supernovae (SNeIa)', 'The cosmic microwave background (CMB)', 'large scale structure (LSS)' etc [1-7]. The theory of expansion and acceleration of the universe and its contents are explicitly explained by the Cosmological Models. It has been discovered that Dark Energy plays an important role in the expansion of universe. However, the driving force behind this accelerating expansion of the universe is still a subject of debate [8]. The matter in our universe is ruled by the Dark Energy (68%) and Dark Matter (26.8%) and the remaining (4.5%) is occupied by the other ordinary matter [9-11]. The concept of dark energy and dark matter is one of the difficult and indeterminate problems of modern cosmology. The dark energy is described by the equation of state (EoS) parameter $\omega = p/\rho$, where p and ρ represents pressure and density of dark energy. To explain the acceleration of universe, the simplest parameter for dark energy is the cosmological constant, which represents the energy density associated with vacuum ($\omega = -1$). So many researchers have investigated dark energy problem [12-14].

When General theory of relativity failed to explain the problems like initial singularity, horizon and flatness, it was modified by introducing the term $f(R)$ in Einstein- Hilbert action. It is known as $f(R)$ theory of gravitation [15]. In order to explain how dark energy and dark matter as well as late-time acceleration exist in the universe, there exist several modified theories of gravity with different cosmological implications, such as $f(R)$, $f(T)$, $f(R,T)$, $f(G)$, $f(R,G)$, $f(Q)$, $f(Q,T)$ etc. $f(R)$ theory of gravitation could be the key to understanding the late-time cosmic acceleration (Carroll et al. 2004) [16]. Nojiri and Odintsov (2003b) [17], Carroll et al. (2004), and Capozziello et al. (2003) provide a concise overview of $f(R)$ -gravity. This modified gravity has recently been demonstrated to explain the Universe' late-time accelerated expansion. Harko et al. (2011) have proposed more general model of modified gravity theory $f(R,T)$ where R is Ricci Scalar and T is the trace of energy momentum tensor [18]. While Modifying the General Relativity on a large scale, such as the scalar-tensor theories, $f(R)$ theory, $f(T)$ theory etc. is an alternate way to accommodate the current accelerating expansion of the universe. Among these theories, the generalized teleparallel theory of gravity has recently attracted a lot of attention as a potential explanation for Dark Energy. In the Lagrangian of teleparallel gravity, the torsion scalar T, is substituted by its generic function $f(T)$ in this generalization [19-20]. $f(T)$ gravity is based on Weitznbock geometry. Gravitation is attributed in this theory to the torsion of a space-time with zero curvature, which acts as a force [21]. This research paper delves into the intriguing realm of dark energy within the framework of the $f(T)$ theory applied to the Bianchi Type-I cosmological model, coupled with the presence of an electromagnetic field. Dark energy, a mysterious component driving the accelerated expansion of the universe, continues to challenge our understanding of fundamental physics. The $f(T)$ theory, an extension of teleparallel gravity, provides an alternative perspective to General Relativity, where T is the torsion scalar.

Further, Wely put forward an extension of Riemannian geometry, in which he established the first unified theory of gravity and electromagnetism, where the non- metricity of spacetime generated the electromagnetic field. As a result, the symmetric teleparallel representation is the third generalization of General Relativity. The development of dark energy parameter for spatially homogeneous and anisotropic Bianchi type-I universes within the context of $f(T)$ theory of gravity investigated by Chirde and Shekh [22]. Jamil et al. have investigated the model of dark energy interacting in $f(T)$ cosmology, considering dark energy to be a perfect fluid and selecting a specific cosmologically viable form $f(T)=\beta\sqrt{T}$ [23]. Dent et al. have studied $f(T)$ cosmology at the levels of background and disturbance [24]. Daouda et al. have created the $f(T)$ gravity model reconstruction using holographic dark energy [25]. Sharif and Azeem have explored the actions of the dark energy's state parameter and energy density equation in the setting of $f(T)$ gravity by using anisotropic LRS Bianchi type-I universe model [26]. V. J. Dagwal investigated tilted two forms of dark energy in $f(T)$ theory of gravity [27]. V. J. Dagwal investigated tilted congruence with big rip singularity in $f(T)$ theory of gravity [28]. M. Z. Bhatti et al. studied an electromagnetic influence on hyperbolically symmetric sources in $f(T)$ gravity [29].

This paper focusses on the application of $f(T)$ theory to the Bianchi type-I cosmological model, enriched by the inclusion of an electromagnetic field, in an effort to elucidate the mysteries surrounding of dark energy. We explore the ways in which the electromagnetic field influences the cosmic evolution and its potential impact on the characteristics of dark energy. The magnetic field has important role at the cosmological scale and is present in galactic and intergalactic spaces. We explore the physical characteristics of the model in the presence of electromagnetic field in the framework of $f(T)$ gravity. In section 2, formulation of $f(T)$ theory of gravity. Section 3, Metric and field equations. Section 4, solutions of the field equation. Section 5, Some physical aspects of the model, and lastly section 6 is the conclusion of overall solutions.

2. Formulation of $f(T)$ Theory of Gravity

In this section, we will give a formal idea of $f(T)$ gravity, where T is referred to as torsion scalar. The $f(T)$ gravity is defined as

$$S_{f(T)}=\int\sqrt{-g}[f(T)+L_m]\,d^4x \tag{1}$$

Where, differential function of the torsion scalar T is given by $f(T)$ and L_m is the representation for matter field Lagrangian.

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The set of orthogonal vector fields is associated with metric tensor by the relation
$g_{\emptyset\tau} = \eta_{ij} h^i_\phi h^i_\tau$ with Minkowski metric $\eta_{ij} = diag(1,-1,-1,-1)$. (2)
We find the torsion scalar by using the relation as follows

$$T = S_\rho^{\tau\phi} T^\rho_{\tau\phi} \tag{3}$$

Where the antisymmetric tensor $T^\rho_{\tau\phi}$ gives the following definition of the tensor torsion's component, $T^\rho_{\tau\phi} = \bar{\Gamma}^\rho_{\phi\tau} - \bar{\Gamma}^\rho_{\tau\phi}$ (4)
where the component of the Weitzenb$\ddot{o}$ck connection are defined as $\bar{\Gamma}^\rho_{\phi\tau} = h^\rho_i \partial_\phi h^i_\tau$
(5)
and antisymmetric tensor is

$$S_\rho^{\tau\phi} = \frac{1}{2}(K_\rho^{\tau\phi} + \delta^\tau_\rho T^{\alpha\phi}{}_\alpha - \delta^\phi_\rho T^{\alpha\tau}{}_\alpha) \tag{6}$$

Where the contortion tensor is

$$K_\rho^{\tau\phi} = -\frac{1}{2}(T^{\tau\phi}{}_\rho - T^{\phi\tau}{}_\rho - T^{\tau\phi}{}_\rho) \tag{7}$$

The teleparallel theory of gravity's modified field equation is attained by pursuing variation on the action of equation (1) with reference to tetrad field.

$$h^\rho_i S_\rho^{\tau\phi} \partial_\tau(T) f_{TT} + \left[\frac{1}{\sqrt{-g}}\partial_\tau\left(\sqrt{-g} h^\rho_i S_\rho^{\tau\phi}\right) - h^\rho_i T^\alpha_{\tau\rho} S_\alpha^{\phi\tau}\right] f_T + \frac{1}{4} h^\phi_i f(T) = \frac{1}{2} k^2 h^\rho_i T^\phi_\rho + E^\phi_\rho$$
(8)

Where, $k^2 = 8\pi G, f_T = \frac{df}{dT}$, $f_{TT} = \frac{d^2 f}{dT^2}$, while T^ϕ_ρ is the Dark Energy's energy momentum tensor and E^ϕ_ρ is an electromagnetic field stress tensor which is given by Lichnerowicz [30].

$$T^\phi_\rho = diag(\rho_m, -p_m, -p_m, -p_m) \tag{9}$$

Where ρ_m and p_m are the energy density and matter pressure.
And

$$E^j_i = 4\pi\left[h_i h^i\left(u_i u^j + \frac{1}{2} g^j_i\right) - h_i h^j\right] \tag{10}$$

Where h_i is the magnetic flux defined by

$$h_i = \frac{\sqrt{-g}}{8\pi} \epsilon_{ijkl} F^{kl} u^j \tag{11}$$

The magnetic field generated will be in the yz-plane, if the current is flowing in the x-axis direction. From this we get $h_1 \neq 0, h_2 = h_3 = h_4 = 0$. Using equation (10), it is clear that F_{23} will be the only component of F_{ij} which is non-vanishing and all other components vanish. Where F_{ij} is the electromagnetic field tensor which satisfies the Maxwell equations

$$F_{[ij;\alpha]} = 0, \ \left(F^{ij}\sqrt{-g}\right)_{;j} = 0 \tag{12}$$

gives

$$F_{23} = constant = l \tag{13}$$

3. Metric and $f(T)$ Field Equation

We have considered the metric of the space time of Bianchi type-I is in the form

$$ds^2 = -dt^2 + A^2 dx^2 + A^2 dy^2 + A^2\left(1 + \beta \int \frac{dt}{A^3}\right)^2 dz^2 \tag{14}$$

Where A is the function of cosmic time t only.
For the dark energy, the energy momentum tensor in eq. (9) and the electromagnetic field in eq. (10) the field equation (8) in $f(T)$ theory of gravity for the space time Bianchi type-I as

$$-4\left[\frac{\ddot{A}}{A} + \frac{2\dot{A}^2}{A^2} + \frac{\beta\dot{A}}{A^4\left(1+\beta\int\frac{dt}{A^3}\right)}\right] f_T - 4\left[\frac{\dot{A}}{A} + \frac{\beta}{2A^3\left(1+\beta\int\frac{dt}{A^3}\right)}\right]\dot{T} f_{TT} + f = 2k^2\rho_m - \frac{l^2}{2\pi A^3\left(1+\beta\int\frac{dt}{A^3}\right)^2} \tag{15}$$

$$4\left[\frac{\ddot{A}}{A} + \frac{2\dot{A}^2}{A^2} + \frac{\beta\dot{A}}{A^4\left(1+\beta\int\frac{dt}{A^3}\right)}\right] f_T + 4\left[\frac{\dot{A}}{A} + \frac{\beta}{2A^3\left(1+\beta\int\frac{dt}{A^3}\right)}\right]\dot{T} f_{TT} - f = 2k^2 p_m + \frac{l^2}{2\pi A^3\left(1+\beta\int\frac{dt}{A^3}\right)^2} \tag{16}$$

$$4\left[\frac{\ddot{A}}{A}+\frac{2\dot{A}^2}{A^2}+\frac{\beta\dot{A}}{A^4\left(1+\beta\int\frac{dt}{A^3}\right)}\right]f_T+4\frac{\dot{A}}{A}\dot{T}f_{TT}-f=2k^2p_m+\frac{l^2}{2\pi A^3\left(1+\beta\int\frac{dt}{A^3}\right)} \tag{17}$$

$$f-4\left[\frac{3\dot{A}^2}{A^2}+\frac{2\beta\dot{A}}{A^4\left(1+\beta\int\frac{dt}{A^3}\right)}\right]f_T=-2k^2p_m-\frac{l^2}{2\pi A^4\left(1+\beta\int\frac{dt}{A^3}\right)^2} \tag{18}$$

Here, the dot over a field variable represents the differentiation with respect to time t.
The torsion scalar T is obtained by using Eqs. (3-7) as

$$T=\frac{6\dot{A}^2}{A^2}+\frac{4\beta\dot{A}}{A^4\left(1+\beta\int\frac{dt}{A^3}\right)} \tag{19}$$

And $$\dot{T}=4\left[\frac{3\dot{A}\ddot{A}}{A^2}-\frac{3\dot{A}^3}{A^3}+\frac{\beta\ddot{A}}{A^4\left(1+\beta\int\frac{dt}{A^3}\right)}-\frac{4\beta\dot{A}^2}{A^5\left(1+\beta\int\frac{dt}{A^3}\right)}-\frac{\beta^2\dot{A}}{A^7\left(1+\beta\int\frac{dt}{A^3}\right)^2}\right] \tag{20}$$

4. Solution of the Field Equation

The equations from (15) to (18) are four field equations with five unknowns A, β, f, p_m, ρ_m. So, to find a determinate solution we take one additional constraint. Consider that the shear scalar is proportional to the expansion scalar.

We solve the above nonlinear equations with the help of special law of variation of Hubble's parameter given by Berman which gives in the constant deceleration parameter produced by the relation,

$$q=-\frac{a\ddot{a}}{\dot{a}^2} \tag{21}$$

Here a is the scalar factor, where $a=a(t)=\left[A^3\left(1+\beta\int\frac{dt}{A^3}\right)\right]^{\frac{1}{3}}$ (22)

By using Eqs. (21) and (22), we get

$$a=(k_1t+k_2)^{\frac{1}{1+q}}\ ;q\neq-1 \tag{23}$$

Where $k_1\neq0,\ k_2$ are integrating constants.
According to the proposed law, the variation of the mean Hubble parameter for the Bianchi type-I metric given as

$$H=\gamma a^{-r}=\gamma\left[A^3\left(1+\beta\int\frac{dt}{A^3}\right)\right]^{\frac{-r}{3}} \tag{24}$$

where $\gamma>0, r\geq0$ are constant and Hubble parameter is defined by $H=\frac{\dot{a}}{a}$
by using this we get,

$$q=r-1 \tag{25}$$

with the help of Eqs. (22) and (23) we get

$$A=(k_1t+k_2)^{\frac{3}{r(3+n)}} \tag{26}$$

$$\left(1+\beta\int\frac{dt}{A^3}\right)=(k_1t+k_2)^{\frac{3n}{r(3+n)}} \tag{27}$$

The equations (19), (26) and (27) gives,

$$T=6k_1\left[\frac{9}{[r(3+n)(k_1t+k_2)]^2}+\frac{2\beta}{r(3+n)(k_1t+k_2)^{\frac{3+r}{r}}}\right] \tag{28}$$

From the equations (26) and (27), equation (14) as

$$ds^2=-dt^2+(k_1t+k_2)^{\frac{6}{r(3+n)}}dx^2+(k_1t+k_2)^{\frac{6}{r(3+n)}}dy^2+(k_1t+k_2)^{\frac{6(1+n)}{r(3+n)}}dz^2 \tag{29}$$

The energy density-pressure relationship is defined by the EoS as,

$p_m=\omega\rho_m$ where ω is EoS parameter (30)

From equation (15) and (16), we get

$$p_m=-\rho_m \tag{31}$$

From equation (30) and (31), we get

$$\omega=-1 \tag{32}$$

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From equation (18) and taking $f(T) = T$, we get the pressure of the matter as follows,

$$p_m = \frac{1}{2k^2}\left[T - \frac{l^2}{2\pi(k_1t+k_2)^{\frac{6(2+n)}{r(3+n)}}}\right] \tag{33}$$

And energy density is $\rho_m = \frac{-1}{2k^2}\left[T - \frac{l^2}{2\pi(k_1t+k_2)^{\frac{6(2+n)}{r(3+n)}}}\right]$ (34)

5. Some physical aspects of the model

By using the physical parameters which is calculated below, we will conclude the physical properties of the model (29).

Spatial Volume,

$$V = (k_1t + k_2)^{\frac{3}{r}} \tag{35}$$

The Mean Generalized Hubble's Parameter is,

$$H = \frac{k_1}{r(k_1t+k_2)} \tag{36}$$

The scalar expansion θ and shear scalar σ^2 are respectively given as,

$$\theta = \frac{3k_1}{r(k_1t+k_2)} \tag{37}$$

$$\sigma^2 = 3\left[\frac{nk_1}{r(3+n)(k_1t+k_2)}\right]^2 \tag{38}$$

The Anisotropy Parameter,

$$\Delta = 2\left(\frac{n}{3+n}\right)^2 \tag{39}$$

6. Conclusion

We have studied the Bianchi type-I cosmological model in the presence of electromagnetic field in $f(T)$ theory of gravity, in which the dark energy in the universe is present. Here it has been assumed that $f(T) = T$ and the equation of state in the form of $p_m = \omega\rho_m$ and then it is found that $p_m = -\rho_m$. From this, we get result $\omega = -1$ which generates a physically viable form of $f(T)$ that describes the acceleration of the universe at present epoch. From this we can say that in our cosmological model the epoch exists. from the equation (37) it is observed that the expansion factor θ is decreasing function of 't' and approach to 0 as $t \to \infty$. From equation (34) the energy density ρ_m approaching to 0 as $t \to \infty$. Since $\lim_{t\to\infty}\frac{\sigma}{\theta} = constant$, the model is not isotropic for the future large value of t. Our model (29) starts with a big-bang at $t = 0$ and the expansion in the model increases as time increases. For this model the spatial volume $V \to \infty$ as $t \to \infty$. The torsion scalar T decreases when the cosmic time t increases and it is zero when t is infinite. The Electromagnetic field used in the model does not affect the expansion and acceleration of the universe. The Anisotropic parameter of the expansion is found to be constant.

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3

In Search of Naked Singularities

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Abstract:
In this article we investigate into the enigmatic nature of black holes, emphasizing their concealment behind event horizons and the recent analogy of "whatever happens inside the horizon, stays inside the horizon," very little information about it has been made available. The narrative explores the intricacies of black hole horizons, acknowledging their role in shielding the breakdown of general relativity near the singularity. The cosmic censorship hypothesis is discussed as a concept to prevent the emergence of "naked singularities" that to escape the rays by event horizons, challenging the determinism of general relativity. This article advocates for an open-minded approach to the prospect of finding naked singularities, emphasizing their significance as laboratories for testing theories of quantum gravity and the potential implications for our understanding of black hole physics and cosmology. The uncertainties surrounding the appearance of naked singularities and their potential detection through astrophysical phenomena, such as gamma-ray bursts and fast radio bursts, underscore the need for continued exploration and observation.

Keywords : Naked Singularity, Event Horizon, Apparent Horizon, Cosmic Censorship Hypothesis

Introduction:
Anticipating the fate of an exceptionally massive star, it is conjectured that neither a white dwarf nor a neutron star will be its ultimate destination. Instead, the star is anticipated to undergo a profound gravitational collapse in the concluding phases of its life cycle. The intricacies of this late-stage evolution are projected to be influenced by quantum gravitational effects. As of now, the absence of a definitive quantum theory of gravity hinders us from offering precise insights into these final stages. Nevertheless, classical general relativity can be invoked to contemplate the expected outcomes. Although the classical theory provides predictions, the absence of a quantum gravity framework prompts the acknowledgment that quantum corrections may potentially align with or modify these classical prognostications in the yet-undeveloped realm of quantum gravity.
Ninety years after Einstein proposed the general theory of relativity, a comprehensive understanding of the theory's predictions regarding the final outcome of gravitational collapse remains elusive. This perplexing situation is closely tied to our incomplete grasp of the overall global properties embedded in Einstein's equations solutions. Notably, the most significant strides in investigating gravitational collapse have come from Hawking and Penrose's singularity theorems [1]. In the specific context of gravitational collapse, these theorems reveal that the formation of a trapped surface during the collapse of a compact object, constructed from physically reasonable matter, triggers the emergence of a gravitational singularity in the spacetime geometry (under the assumption of the non-existence of closed time-like curves). A gravitational singularity implies an incomplete evolution of geodesics in the spacetime. It is plausible that the occurrence of a gravitational singularity during the collapse of a star may coincide with a curvature singularity, characterized by the divergence of one or more curvature scalars.

The specific criteria leading to the formation of a trapped surface remain elusive within the current understanding of gravitational collapse, representing a significant gap in our comprehension of this phenomenon. Despite this uncertainty, the focus of this discussion does not delve into the intricacies of these conditions. Rather, we proceed with the assumption that a gravitational singularity inevitably materializes, either through the fulfillment of singularity theorems or alternative pathways. It is worth noting, however, that in the context of highly massive collapsing stars, typical astrophysical parameters often align in a manner conducive to the formation of a trapped surface during the process of gravitational collapse.

It is possible that the singularity remains elusive to an observer located at a considerable distance due to the incapacity of light to break free from the collapsing celestial body. This is essentially indicative of the formation of a black hole. The singularity, a point of infinite density at the core, becomes concealed from external observation by the event horizon. The event horizon delineates the boundary of the spacetime region encircling the singularity, acting as a barrier that prevents any communication with a distant observer.

The resolution of whether gravitational collapse culminates in the formation of a black hole or a naked singularity remains an enigma, awaiting a conclusive determination from Einstein's equations. Despite the pursuit of clarity, the definitive answer remains elusive. It prompts the question: does it truly matter? Indeed, the distinction holds profound significance. In the event of a naked singularity, the ability to prescribe arbitrary data on the singular surface could lead to the complete forfeiture of predictability regarding the singularity's future. Conversely, if the singularity is concealed behind an event horizon, predictability is retained, at least within the spacetime region external to the horizon. The uncertainty surrounding this outcome underscores the complexities inherent in understanding the ultimate fate of gravitational collapse.

Numerous individuals view naked singularities with trepidation, considering them a potential catastrophe for the principles of general relativity and the entire field of physics. The concern stems from the idea that naked singularities could introduce a complete unpredictability into their future trajectories. Nonetheless, there exists an optimistic perspective that challenges this fear. By assuming that the ultimate theory of gravity will maintain predictability in a suitable sense, the occurrence of naked singularities within general relativity could serve as a crucial signal necessitating modifications to the theory. Rather than being a disaster, this rare signal might enhance our comprehension of gravitation. Alternatively, some proponents see naked singularities as valuable assets for astrophysics, postulating that these phenomena could act as extraordinary energy sources through the emission of light from high curvature regions near the singularity. Moreover, there is a viewpoint asserting that a quantum theory of gravity might altogether circumvent singularities. However, the debate underscores the importance of understanding the distinctive behaviors of spacetime regions deemed naked in classical theory, even if quantum gravity avoids singularities, as it holds relevance to black-hole astrophysics[2-8]

2. Black Hole

A black hole is a region of spacetime where gravity is so strong that nothing no particles or even electromagnetic radiation such as light can escape from it. The theory of general relativity predicts that a sufficiently compact mass can deform spacetime to form a black hole.

A black hole horizon which takes the additional benefit of hiding an embarrassment of the theory that predicts it. Whatever matter falling into a black hole which ends up into the singularity where the curvature of space-time diverges and Einstein’s equations of general relativity fully break down. Fortunately, our inability to determine the where abouts of infalling matter as its density turns about this singularity has no influence on the outside world, which remains hidden by the horizon.

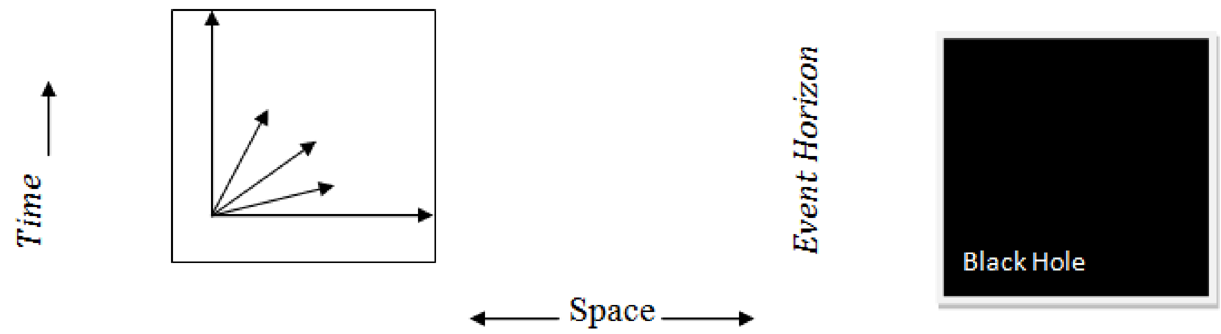
Black holes are the end point of massive stars' evolution. Studying them provides insights into the life cycles of stars and the processes leading to their demise. Supermassive black holes are believed to reside at the centers of most galaxies, influencing their structure and evolution. Understanding the interplay between black holes and galaxies is crucial for comprehending the large-scale structure of the universe.

It seems that the singularity is not visible to a far-away observer because light is not escaping the collapsing star. This is essentially what we mean when we say that a black-hole has formed. The singularity is hidden from view by the event horizon, which is the boundary of that space-time region surrounding the singularity which cannot communicate with the far-away observer

3. Event Horizon

In astrophysics, an event horizon is a boundary beyond which events cannot affect an observer. The term was coined by Wolfgang Rindler. The event horizon is a theoretical boundary in spacetime that marks the point of no return for any object or light that crosses it. Once something passes the event horizon, it is destined to fall into the black hole and can never escape.The event horizon is formed during the gravitational collapse of massive objects, such as dying stars. As matter collapses under its own gravity, the density and gravitational pull become so intense that even light cannot escape from beyond the event horizon.

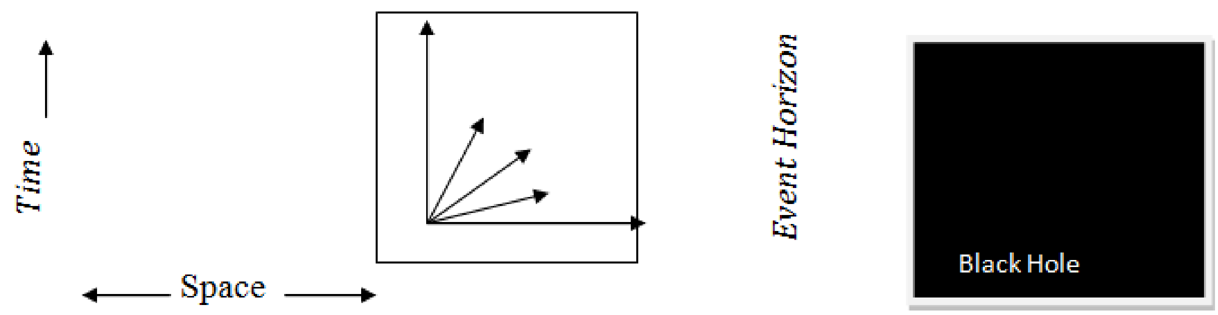
The event horizon is characterized by its spherical shape around the central singularity of a black hole. The size of the event horizon depends on the mass of the black hole. For non-rotating (Schwarzschild) black holes, the event horizon is a perfect sphere. For rotating (Kerr) black holes, the event horizon is more complex, taking on an oblate spheroid or distorted shape



due to the effects of rotation.

Particle is Far away from the black hole, it can move in any direction, as it shown by the set of arrows. It is restricted only by the speed of light.

Particle is closer to the black hole, space-time starts to deform. There are different paths going towards the black hole than paths moving away.



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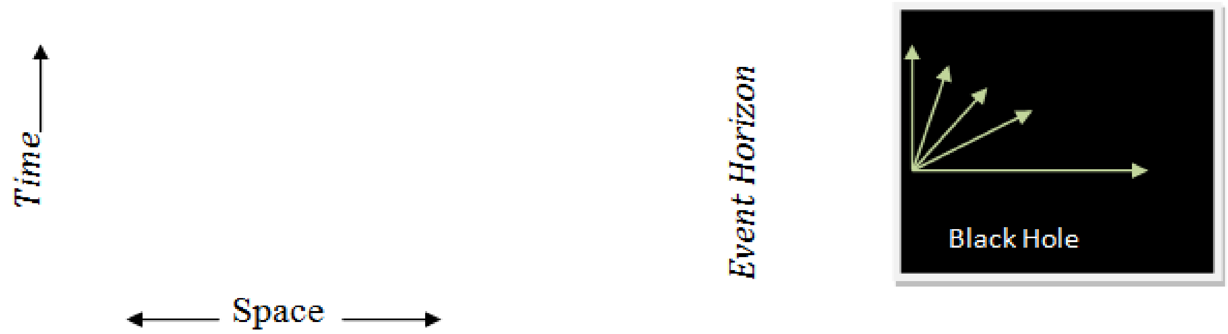

Particle is Inside of the event horizon, all paths bring the particle closer to the center of the black hole. It may no longer possible for the particle to escape.

4. Conclusion:

The emergence of a black hole, marked by the formation of an event horizon, adds another layer of intrigue to the cosmic drama. The singularity, residing at the core with infinite density, becomes cloaked behind the event horizon, preventing any external observation. The determination of whether gravitational collapse culminates in the formation of a black hole or a naked singularity remains an enigma, raising profound questions about predictability and the very fabric of general relativity.

The distinction between a black hole and a naked singularity holds profound significance, as it dictates the predictability of the future trajectory of the singularity. The potential existence of naked singularities challenges our understanding of predictability within general relativity, yet it also presents an opportunity for refining the theory in the face of unexpected phenomena.

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4

Bianchi type-V Modified Holographic Ricci Dark Energy Model In $f(R,T)$ Gravity

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Abstract:
In the present study, we deal with the spatially homogeneous and anisotropic Bianchi type-V cosmological model in the presence of $f(R,T)$ theory of gravity. We have used energy momentum tensor of Modified Holographic Ricci Dark Energy. In order to find an exact solution of the field equations of the model, the model presented is based on a unique condition of periodically time varying deceleration parameter. The physical and geometrical characteristics of the universe model have been studied.

1. Introduction:

The purpose of modern cosmology is to determine the large-scale structure of the Universe. The astronomical observations of type-Ia supernovae experiments [Riess et al. (1998), Perlmutter et al (1998, 1999, 2003), Hoftuft et al. (2009), Bennett et al. (2003), Spergel et al. (2003)] suggest that the observable Universe is undergoing an accelerated expansion. According to the modern observations by Riess et al. (1998) our Universe is going through a phase of accelerated expansion that put new route in modern cosmology. A natural generalization is to choose a more general action in which the standard Einstein-Hilbert action is replaced by an arbitrary function of the Ricci scalar R (Nojiri and Odintsov (2003a, b)) (i.e, $f(R)$) and is the name applied to $f(R)$-gravity. This modified theory may point this late-time cosmic acceleration (Carroll et al. (2004)). Recently, the dark energy models, which are inspiring many astrophysicists, are the holographic dark energy models. According to the holographic principle, the number of degrees of freedom in a bounded system should be finite and is related to the area of its boundary discussed by Sahoo et al. (2016). It is argued that this model may solve the cosmological constant problem and some other issues. Several aspects of holographic dark energy have been investigated by Sahu et. al. (2017) and Mishra et al. (2016). Tiwari et al. (2018, 2020), Pawar (20214, 2016), Khade (2022, 2023) have investigated different models in $f(R,T)$ theory.

The outline of this paper as follows: Basic formalism of $f(R,T)$ theory is given in Section 2; the model and the solutions of the field equations for Bianchi-type V universe are obtained the physical and geometrical characterization of the model is represented in Section 3; and the conclusions are given in Section 4.

2. Basic Formalism of $f(R,T)$ Theory

The $f(R,T)$ theory of gravity is the generalization or modification of General Relativity (GR). In this theory, the modified gravity action. Which can be varied with respect to the metric tensor g_{ij} to obtain the gravitational field equation for $f(R,T)$ gravity. The functional $f(R,T)$ can be chosen in many ways corresponding to viable models. In the present work, we have considered the functional as,

$$f(R,T) = R + 2f(T) \tag{1}$$

where $f(T)$ is an arbitrary function of the trace of the energy-momentum tensor. The corresponding field equations become,

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$$R_{ij} - \frac{1}{2} R g_{ij} = \kappa T_{ij} + 2 f_T T_{ij} + \left[f(T) \theta_{ij} + 2 P_\Lambda f_T \right] g_{ij},$$
(2)

Where f_T denotes the partial derivative of f with respect to T.
Assuming $f(T) = \lambda T$, λ being constant.

$$T_j^i = diag[-1, w_x, w_y, w_z] \rho_\Lambda = diag[-1, w_\Lambda, (w_\Lambda + \delta), (w_\Lambda + \gamma)] \rho_\Lambda$$
(3)

Here we have used the EoS parameter w given by

$$w_\Lambda \rho_\Lambda = P_\Lambda$$
(4)

And w_x, w_y, w_z are the directional EoS parameters along x, y, z axes respectively. For simplicity we use $w_\Lambda = 1$.

3. The Model and Solutions:

We consider the spatially homogeneous and anisotropic Bianchi type-V space-time described by the line element,

$$ds^2 = -dt^2 + A^2 dx^2 + B^2 e^{2x} (dy^2 + dz^2)$$
(5)

Where A and B are functions of cosmic time t only.
We have energy momentum tensor as

$$T_{ij} = T_{ij}' + \overline{T_{ij}}$$
(6)

Now using a co-moving coordinate system, the field Eqn.(2) with the help of Eqn.(6) and Eqn.(3) for the metric Eqn.(5), can be explicitly written as,

$$2\frac{\ddot{B}}{B} + \frac{\dot{B}^2}{B^2} - \frac{1}{A^2} = \lambda(8P_\Lambda + \rho_M) + P_\Lambda$$
(7)

$$\frac{\ddot{A}}{A} + \frac{\ddot{B}}{B} + \frac{\dot{A}\dot{B}}{AB} - \frac{1}{A^2} = \lambda(8P_\Lambda + \rho_M) + P_\Lambda$$
(8)

$$\frac{\ddot{A}}{A} + \frac{\ddot{B}}{B} + \frac{\dot{A}\dot{B}}{AB} - \frac{1}{A^2} = \lambda(8P_\Lambda + \rho_M) + P_\Lambda$$
(9)

$$2\frac{\dot{A}\dot{B}}{AB} + \frac{\dot{B}}{B^2} - \frac{3}{A^2} = \lambda(6P_\Lambda + 3\rho_M + 2\rho_\Lambda) + P_\Lambda + \rho_M$$
(10)

$$\frac{\dot{B}}{B} - \frac{\dot{A}}{A} = 0$$
(11)

Here an over head dot indicates differentiation with respect to cosmic time t.
The average scale factor $a(t)$ of the Bianchi type - V space-time is defined as

$$a = (AB^2)^{\frac{1}{3}}$$
(12)

The spatial volume of the metric is

$$V = a^3 = AB^2$$
(13)

The directional Hubble parameters are

$$H_x = \frac{\dot{A}}{A} \qquad H_y = H_z = \frac{\dot{B}}{B}$$
(14)

The average Hubble parameter is

$$H = \frac{\dot{a}}{a} = \frac{1}{3}\frac{\dot{V}}{V} \tag{15}$$

$$H = \frac{1}{3}\left[\frac{\dot{A}}{A} + \frac{2\dot{B}}{B}\right] \tag{16}$$

$$\theta = 3H \tag{17}$$

$$H = \left[\frac{\dot{A}}{A} + \frac{2\dot{B}}{B}\right] \tag{18}$$

The dynamical scalar expansion θ and shear scalar σ^2 are

$$\sigma^2 = \frac{1}{2}\left[\frac{\dot{A}}{A} - \frac{\dot{B}}{B}\right]^2 \tag{19}$$

The average anisotropic parameter Δ is defined as

$$\Delta = \frac{1}{3}\sum_{i=1}^{3}\left[\frac{H_i - H}{H}\right]^2 \tag{20}$$

In order to find the solution such a system, one more relation is required. Hence, we carry out a law of variation of deceleration parameter (DP). The time varying DP is important in evolution of the universe. Its phase transition in expansion may be well explained by the time varying DP. Now, we adopt the following periodic time varying DP Shen and Zhao (2014).

$$q = m\cos(kt) - 1 \tag{21}$$

Here m and k are positive real numbers.
Using the definition of DP as

$$q = \left[\frac{-\dot{H}}{H^2} - 1\right] \tag{22}$$

the integration of Equation (21) gives the Hubble parameter H as

$$H = \frac{K}{m\sin(Kt) + K_1} \tag{23}$$

HereK_1 is a constant of integration. Here we may choose $K_1 = 0$ and then Hubble parameter becomes

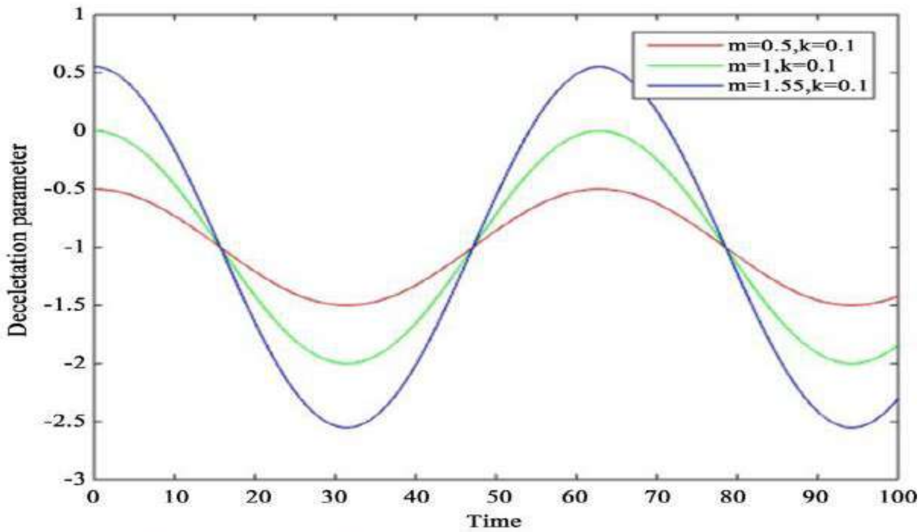

Figure 1. DP vs time in the units of Gyrs.

$$H = \frac{K}{m\sin(Kt)} \tag{24}$$

Using the definition of Hubble parameter as a $H = \frac{\dot{a}}{a}$ & in Equation (24), the average scale factors a is obtained as

$$a = a_0\left[\tan\left(\frac{Kt}{2}\right)\right]^{\frac{1}{m}} \tag{25}$$

where a_0 is a constant of integration

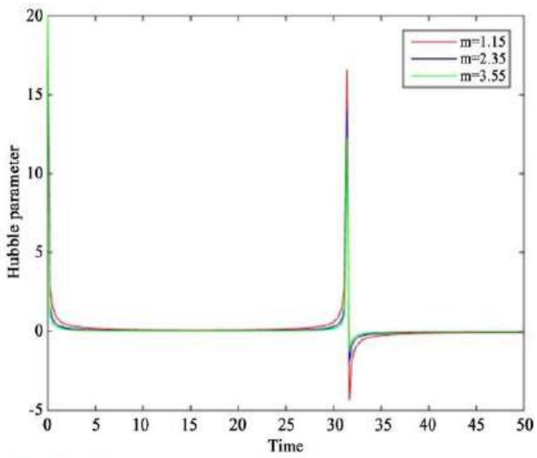

Figure 2. Hubble parameter vs time.

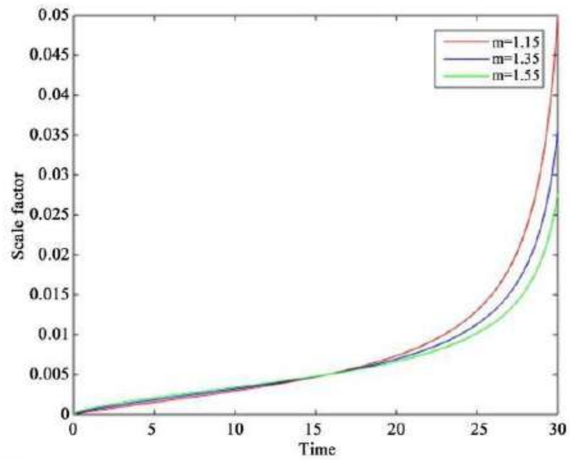

Figure 3. Scale factor vs time.

parameter and the scale factor in time with the units of giga years.
For our model, the directional Hubble parameters are obtained as follows:

$$H_x = \frac{K}{m\sin(Kt)} + \frac{2K_1}{3{a_0}^3\left[\tan\left(\frac{Kt}{2}\right)\right]^{\frac{3}{m}}} \tag{26}$$

$$H_y = H_z = \frac{K}{mSin(Kt)} - \frac{K_1}{3{a_0}^3\left[\tan\left(\frac{Kt}{2}\right)\right]^{\frac{3}{m}}} \tag{27}$$

The anisotropisation in expansion of the model is given by the parameter Δ which is defined and found as

$$\Delta = \frac{2{K_1}^2 m^2 Sin^2(Kt)}{9K^2{a_0}^2\left[\tan\left(\frac{Kt}{2}\right)\right]^{\frac{6}{m}}} \tag{28}$$

The expansion scalar θ is

$$\theta = 3H = \frac{3K}{m\sin(Kt)} \tag{29}$$

The shear scalar σ^2 is found as

$$\sigma^2 = \frac{{K_1}^2}{3{a_0}^6\left[\tan\left(\frac{Kt}{2}\right)\right]^{\frac{6}{m}}} \tag{30}$$

$$A = \alpha B \tag{31}$$

Where α is constant of integration and for simplicity we choose
$\alpha = 1$

$$A = B \tag{32}$$

Now from Equations (7), (8) and (32), we obtain the metric potentials

$$A = B = a = a_0 \left[tan\left(\frac{Kt}{2}\right)\right]^{\frac{1}{m}} \tag{33}$$

$$w_\Lambda \rho_\Lambda = P_\Lambda \tag{34}$$

Also from Eqn.(2.2.5),(2.3.2),(2.3.3) and (2.5.9) we have the matter-energy density given by

$$\rho_m = \frac{1}{(2\lambda+1)} \left\{ \frac{2K^2 cos(Kt)}{msin^2(Kt)} + \frac{KK_1}{3a_0{}^3 2^{\frac{3}{m}}} \frac{1}{[sin(Kt)]^{\frac{6}{m}}} - \frac{2K_1{}^2}{3a_0{}^6\left[tan\left(\frac{Kt}{2}\right)\right]^{\frac{6}{m}}} - \frac{KK_1}{a_0{}^3 msin(Kt)\left[tan\left(\frac{Kt}{2}\right)\right]^{\frac{3}{m}}} - \frac{2}{a_0{}^2\left[tan\left(\frac{Kt}{2}\right)\right]^{\frac{2}{m}}} \right\} \tag{35}$$

Now from Eqn.(2.2.5),(2.3.2),(2.3.3) and (2.4.2) the modified holographic Ricci dark energy density and pressure is determined as

$$\rho_\Lambda = \frac{1}{(8\lambda+1)} \left\{ \frac{-2(3\lambda+1)K^2 cos(Kt)}{(2\lambda+1)msin^2(Kt)} + \frac{(3\lambda+2)KK_1}{3(2\lambda+1)a_0{}^3 2^{\frac{3}{m}}} \frac{1}{[sin(Kt)]^{\frac{6}{m}}} + \frac{3K^2}{msin^2(Kt)} - \frac{(3\lambda+2)KK_1}{(2\lambda+1)a_0{}^3 msin(Kt)\left[tan\left(\frac{Kt}{2}\right)\right]^{\frac{3}{m}}} + \frac{(4\lambda+1)K_1{}^2}{3(2\lambda+1)a_0{}^6\left[tan\left(\frac{Kt}{2}\right)\right]^{\frac{6}{m}}} - \frac{(4\lambda+1)}{(2\lambda+1)a_0{}^2\left[tan\left(\frac{Kt}{2}\right)\right]^{\frac{2}{m}}} \right\} \tag{36}$$

4. Conclusion

We have studied the modified holographic Ricci dark energy model in $f(R,T)$ theory of gravity by using anisotropy Bianchi type-V. In order to obtain the solutions of field equations, we used EoS $w_\Lambda \rho_\Lambda = P_\Lambda$. We see that the average scale factor is zero at initially. It increases in cosmic time and changes periodically. The metric potentials are vanish initially it means our model has point type singularity. All the cosmological parameters $\rho_m,\ \rho_\Lambda,\ \theta, \sigma\ and\ \Delta$ are infinite initially and they preserve their periodic behavior in time. Also, we have explained and discussed the kinematical and dynamical character of the model that all the quantities are infinite initially and they preserve their periodic behavior against the cosmic time.

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5

Bianchi Type-V Dark Energy Cosmological Model In $f(R,T)$ Gravity

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Abstract:

In the present paper, spatially homogeneous and anisotropic Bianchi type-V dark energy cosmological model has been investigated in the framework of $f(R,T)$ gravity with an appropriate choice of the function $f(R,T)$. In order to get a deterministic solution, we have use plausible physical condition that the shear scalar σ is proportional to scalar expansion θ, which leads to the relationship between metric potentials $B = C^n$. The mathematical condition that EoS parameter ω is proportional to skewness parameter δ is also considered to derive field equations. It is observed that the cosmological model obtained is free from initial singularity, i.e. at $t = 0$.

Some important cosmological parameters of this model are also discussed. The spatial volume in this model increase as t increases, which confirms accelerated expansion of the universe. It is observed that the EoS parameter, skewness parameters, Hubble parameter, shear scalar, scalar of expansion, energy density and pressure of dark energy in the model are functions of cosmic time and vanish for large t while they diverge for $t = 0$. The physical significance of deceleration parameter, jerk parameter, statefinder pair is also discussed in the light of the recent scenario of accelerated expansion of the universe and cosmological observations.

Keywords: Bianchi type-V, $f(R,T)$ theory, dark energy.

1. Introduction:

The recent cosmological observations [1-7] have confirmed the accelerated expansion of the universe. These observations also confirm that an exotic energy with large negative pressure called dark energy (DE) is the reason for this late time acceleration. Dark energy is considered to be the best candidate to explain cosmic acceleration. It is now believed that the energy constitution of the universe has 5 % ordinary matter, 27 % dark matter and 68 % dark energy. Thus dark energy cosmological models become an interesting subject of investigation for several authors.

Dark energy is usually characterized by the equation of state (EoS) parameter given by $\omega(t) = \frac{p}{\rho}$ which is not necessarily constant, where p is the fluid pressure and ρ is energy density. Caroll and Hoffman [8], Ray et al. [9], Akarsu and Kilinc [10], Yadav and Yadav [11], Pradhan et al. [12], Amirhashchi [13] have studied dark energy models with variable EoS parameter. Shaikh and Wankhede [14] have derived dark energy model with EoS parameter for hypersurface-homogenous space-time filled with perfect fluid in $f(R,T)$ gravity.

In recent years, several modified theories of gravity have been proposed to understand presence of dark energy, dark matter and the mechanism behind late-time acceleration of the universe. Harko *et al.* [15] have developed a new modified theory of gravity known as $f(R,T)$ gravity. This modified theory has attracted many researchers because this theory is supposed to provide natural gravitational alternative to dark energy. Adhav [16], Sharif and Zubair [17] and Mahanta [18] have investigated Bianchi type-I cosmological model in $f(R,T)$ gravity.

Naidu *et al.* [19], Ahmed and Pradhan [20], Pawar *et al.* [21] have studied the Bianchi type-V cosmological model in the framework of $f(R,T)$ gravity. Shaikh and Bhoyar [22] studied plane symmetric universe in $f(R,T)$ gravity. As a result of above studies, this theory seems to be more convenient to explain the accelerating phase of the universe.

The study of Bianchi type-V cosmological models plays an important role in the study of universe and the study is more interesting as these models contain isotropic special cases and permit arbitrary small anisotropy levels at some point of time. Bianchi type-V universe is the natural generalization of open universe in Friedmann-Robertson-Walker (FRW) models with negative curvature and hence its study is important in the context of the dark energy (DE). The study of Bianchi type-V cosmological models has attracted many researchers in recent time as these models contain some specific isotropic cases and allow arbitrary small anisotropy level at any instant of cosmic time. These models are generalized version of FRW models with negative curvature. Lorenz [23], Ram and Singh [24], Baillie and Madsen [25], Beesham [26], Banerjee and Sanyal [27], Venkateswarulu and Reddy [28], Roy and Prasad [29], Camci et al. [30], Pradhan et al. [31], Bali and Singh [32], Ram et al. [33] and Singh [34] are some authors who have investigated Bianchi type-V cosmological models. Diksha Trivedi, A. K. Bhabor [35] studied -five dimensional LRS Bianchi type-V string cosmological models in scalar-tensor theory of gravitation. C. Mahanta *et al.*[36] study Bianchi type-V universe in $f(R,T)$ theory of gravity with time varying cosmological constant and a quadratic equation of state.

Inspired by above discussion and investigations, in this paper, we have studied spatially homogeneous and anisotropic Bianchi type-V dark energy cosmological model in the framework of $f(R,T)$ gravity. This research paper is organized as follows: In section 2, metric and field equations for Bianchi type-V metric are given. In section 3, we have obtained solutions of field equations. In section 4, we have derived some physical parameters. In section 5, we have given conclusion.

2. Metric and field equation:

We consider the spatially homogeneous and anisotropic Bianchi type-V space-time

$$ds^2 = dt^2 - A^2dx^2 - e^{-2mx}\left(B^2dy^2 + C^2dz^2\right), \tag{1}$$

where A, B, C are functions of cosmic time t only and m is a constant.

The energy momentum tensor for anisotropic dark energy is given by

$$T_\nu^\mu = diag\left[\rho, -p_x, -p_y, -p_z\right] = diag\left[1, -\omega_x, -\omega_y, -\omega_z\right]\rho \ , \tag{2}$$

where ρ is the energy density of the fluid and p_x, p_y, p_z are the pressures along x, y and z axes respectively. Here ω is the EoS parameter of the fluid and ω_x, ω_y and ω_z are the EoS parameters in the directions of x, y and z axes respectively. The energy momentum tensor can be parameterized as

$$T_\nu^\mu = diag\left[1, -\omega, -(\omega+\gamma), -(\omega+\delta)\right]\rho \tag{3}$$

For the sake of simplicity we choose $\omega_x = \omega$ and the skewness parameters γ and δ are the deviations from ω on y and z axes respectively.

The field equations of $f(R,T)$ gravity are derived from variational principle. The action of $f(R,T)$ gravity is given by

$$S = \frac{1}{2k}\int f(R,T)\sqrt{-g}\ d^4x + \int L_m\sqrt{-g}\ d^4x \ , \tag{4}$$

which can be varied with respect to the metric tensor $g_{\mu\nu}$ to obtain the gravitational field equation for $f(R,T)$ gravity as

$$f_R(R,T)R_{\mu\nu}-\frac{1}{2}f(R,T)g_{\mu\nu}+f_R(R,T)(g_{\mu\nu}\nabla^{\mu}\nabla_{\mu}-\nabla_{\nu}\nabla_{\nu})=kT_{\mu\nu}-f_T(R,T)\,T_{\mu\nu}-f_T(R,T)\theta_{\mu\nu}\ , \quad (5)$$

where $\theta_{\mu\nu}=g^{\alpha\beta}\dfrac{\partial T_{\alpha\beta}}{\partial g_{\mu\nu}}$ and $T_{\mu\nu}$ is energy momentum tensor.

Here $f_R=\dfrac{\partial f(R,T)}{\partial R}$, $f_T=\dfrac{\partial f(R,T)}{\partial T}$, ∇_{μ} is covariant derivative. $k=\dfrac{8\pi G}{c^4}$, where G and c are the Newtonian Gravitational constant and speed of light in vacuum respectively.

Three different cosmological models of $f(R,T)$ gravity are possible as given by Harko *et al.* [8]. In the present work, we have considered the functional as

$$f(R,T)=R+2f(T), \quad (6)$$

where $f(T)$ is an arbitrary function of the trace of the energy-momentum tensor.
Now, the corresponding field equations become,

$$R_{\mu\nu}-\frac{1}{2}Rg_{\mu\nu}=kT_{\mu\nu}+2f_TT_{\mu\nu}+[f(T)+2p_{\wedge}f_T]g_{\mu\nu}, \quad (7)$$

where f_T denotes the partial derivative of f with respect to T.
With particular choice of the function (Harko *et al.* 2011) $f(T)=\lambda T$, where λ is arbitrary constant and assuming commoving coordinate system, the field equations (7) for the metric (1) with the help of (2), (3) leads to following system of equations

$$\frac{\ddot{B}}{B}+\frac{\ddot{C}}{C}+\frac{\dot{B}\dot{C}}{BC}-\frac{m^2}{A^2}=\rho\left[(8\pi+2\lambda)\omega-(1-3\omega-\gamma-\delta)\right]-2\lambda p\ , \quad (8)$$

$$\frac{\ddot{A}}{A}+\frac{\ddot{C}}{C}+\frac{\dot{A}\dot{C}}{AC}-\frac{m^2}{A^2}=\rho\left[(8\pi+2\lambda)(\omega+\gamma)-(1-3\omega-\gamma-\delta)\right]-2\lambda p\ , \quad (9)$$

$$\frac{\ddot{A}}{A}+\frac{\ddot{B}}{B}+\frac{\dot{A}\dot{B}}{AB}-\frac{m^2}{A^2}=\rho\left[(8\pi+2\lambda)(\omega+\delta)-(1-3\omega-\gamma-\delta)\right]-2\lambda p\ , \quad (10)$$

$$\frac{\dot{A}\dot{B}}{AB}+\frac{\dot{B}\dot{C}}{BC}+\frac{\dot{A}\dot{C}}{AC}-\frac{3m^2}{A^2}=-\rho\left[8\pi+2\lambda+(1-3\omega-\gamma-\delta)\right]-2\lambda p\ , \quad (11)$$

$$\frac{2\dot{A}}{A}-\frac{\dot{B}}{B}-\frac{\dot{C}}{C}=0\ , \quad (12)$$

here an overhead dot indicates differentiation with respect to cosmic time t.

We shall now define the physical parameters which will be useful in solving the field equations and in the physical discussion of the solution.

The average scale factor of the Bianchi type-III space-time is $a(t)=(ABC)^{\frac{1}{3}}$. (13) The spatial volume of the metric is $V=a^3(t)=ABC$. (14)

Directional Hubble parameter are $H_1=\dfrac{\dot{A}}{A}, H_2=\dfrac{\dot{B}}{B}, H_3=\dfrac{\dot{C}}{C}$. (15)

The mean Hubble parameter $H=\dfrac{\dot{a}}{a}=\dfrac{1}{3}\dfrac{\dot{V}}{V}=\dfrac{1}{3}\left(\dfrac{\dot{A}}{A}+\dfrac{\dot{B}}{B}+\dfrac{\dot{C}}{C}\right)$. (16)

The scalar expansion $\theta=\left(\dfrac{\dot{A}}{A}+\dfrac{\dot{B}}{B}+\dfrac{\dot{C}}{C}\right)$. (17)

The shear scalar $\sigma^2 = \frac{1}{2}\sigma_{ij}\sigma^{ij} = \frac{1}{3}\left[\left(\frac{\dot{A}}{A}\right)^2 + \left(\frac{\dot{B}}{B}\right)^2 + \left(\frac{\dot{C}}{C}\right)^2 - \frac{\dot{A}\dot{B}}{AB} - \frac{\dot{B}\dot{C}}{BC} - \frac{\dot{A}\dot{C}}{AC}\right].$ (18)

The mean anisotropy parameter is defined as $A_m = \frac{1}{3}\sum_{i=1}^{3}\left(\frac{H_i - H}{H}\right)^2.$ (19)

In terms of the metric potentials, the Ricci scalar R for the Bianchi type-III is expressed as

$$R = 2\left(\frac{\ddot{A}}{A} + \frac{\ddot{B}}{B} + \frac{\ddot{C}}{C} + \frac{\dot{A}\dot{B}}{AB} + \frac{\dot{B}\dot{C}}{BC} + \frac{\dot{A}\dot{C}}{AC} - \frac{m^2}{A^2}\right). \quad (20)$$

Deceleration parameter q is known to be a measure of cosmic acceleration, it is given by

$$q = \frac{-\ddot{V}V}{\dot{V}^2}. \quad (21)$$

3. Solution of field equations:

Solving (12) gives

$A^2 = \alpha BC$, where α is constant.

Without loss of generality, by taking $\alpha = 1$, we get

$$A^2 = BC \quad (22)$$

Subtracting (9) from (10), we get

$$\frac{\ddot{B}}{B} - \frac{\ddot{C}}{C} + \frac{\dot{A}}{A}\left(\frac{\dot{B}}{B} - \frac{\dot{C}}{C}\right) = 0 \quad (23)$$

The field equations (8)–(12) are five independent equations in seven unknowns, $A,\ B,\ C,\ \rho,\ p,\ \delta$ and ω. Hence in order to get a deterministic solution two more conditions are necessary. We consider the following conditions:

i) We take the plausible physical condition; the shear scalar σ is proportional to scalar expansion which gives $B = C^n$. (24)

ii) The EoS parameter ω is proportional to skewness parameter δ (mathematical condition) such that $\omega + \delta = 0$.

(25)

Using (12) and (22) in (23), we get

$$2\ddot{C} + \frac{\dot{C}^2}{C} = \frac{3n^2 - 2n}{C}. \quad (26)$$

Let $\dot{C} = f(C)$. (27)

Hence (26) leads to

$$\frac{d}{dc}\left(f^2\right) + \left(\frac{1}{C}\right)f^2 = \frac{3n^2 - 2n}{C}. \quad (28)$$

Solving (28), we obtained

$$C = (k_1 t + k_2), \quad (29)$$

$$B = (k_1 t + k_2)^n, \quad (30)$$

$$A = (k_1 t + k_2)^{\frac{n+1}{2}}, \quad (31)$$

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where $k_1 = \left(3n^2 - 2n\right)^{\frac{1}{2}}$ and k_2 is constant of integration. (32)

Now, the metric (1) becomes

$$ds^2 = dt^2 - \left(k_1 t + k_2\right)^{\frac{n+1}{2}} dx^2 - e^{-2mx}\left[\left(k_1 t + k_2\right)^n dy^2 + \left(k_1 t + k_2\right) dz^2\right] \quad (33)$$

4. Physical parameters of model:

The volume V is obtained as

$$V = ABC = \left(k_1 t + k_2\right)^{\frac{3(n+1)}{2}} \quad (34)$$

Average Scale factor a is given by

$$a(t) = V^{\frac{1}{3}} = \left(k_1 t + k_2\right)^{\frac{(n+1)}{2}} \quad (35)$$

The directional Hubble parameters are

$$H_1 = \frac{\dot{A}}{A} = \frac{(n+1)k_1}{2t(k_1 t + k_2)}, \quad H_2 = \frac{\dot{B}}{B} = \frac{nk_1}{(k_1 t + k_2)}, \quad H_3 = \frac{\dot{C}}{C} = \frac{k_1}{(k_1 t + k_2)} .$$

(36)

The mean Hubble parameter H is given by

$$H = \frac{\dot{a}}{a} = \frac{1}{3}\frac{\dot{V}}{V} = \frac{1}{3}\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B} + \frac{\dot{C}}{C}\right) = \frac{3(n+1)k_1}{(k_1 t + k_2)} . \quad (37)$$

The scalar expansion θ is given by

$$\theta = 3H = \frac{9(n+1)k_1}{(k_1 t + k_2)} . \quad (38)$$

The shear scalar σ obtained as

$$\sigma^2 = \frac{1}{2}\sigma_{ij}\sigma^{ij} = \frac{1}{3}\left[\left(\frac{\dot{A}}{A}\right)^2 + \left(\frac{\dot{B}}{B}\right)^2 + \left(\frac{\dot{C}}{C}\right)^2 - \frac{\dot{A}\dot{B}}{AB} - \frac{\dot{B}\dot{C}}{BC} - \frac{\dot{A}\dot{C}}{AC}\right]$$

$$= \frac{1}{48}\left[\frac{k_1^{\,4}\left(13n^4 - 28n^3 + 18n^2 - 4n + 1\right)}{(k_1 t + k_2)^4}\right] . \quad (39)$$

The anisotropy parameter A_m obtained as

$$A_m = \frac{1}{3}\sum_{i=1}^{3}\left(\frac{H_i - H}{H}\right)^2 = \frac{1}{18}\left[\frac{25}{4} + \frac{(n+2)^2}{(n+1)^2} + \frac{(2n+3)^2}{(n+1)^2}\right] . \quad (40)$$

The deceleration parameter q is given by

$$q = \frac{d}{dt}\left(\frac{1}{H}\right) - 1 = -\frac{(3n+2)}{3(n+1)} \quad (41)$$

Red Shift Z is given by

Jerk Parameter $j = \frac{\dddot{a}}{H^3 a} = \frac{n^3 + 4n + 3}{27(n+1)^3}$ (42)

The pair of state finder $\{r, s\}$ diagnostic has defined and obtained as below

$$r = 1 + 3\frac{\dot{H}}{H^2} + \frac{\ddot{H}}{H^3} = 1 - \frac{1}{(n+1)} + \frac{2}{9(n+1)^2} \tag{43}$$

$$s = \frac{r-1}{3\left(q - \frac{1}{2}\right)} = -\frac{18(n+1)+4}{9(n+1)(6n+5)} \tag{44}$$

Subtracting (8) from (11) and using (29-31), we get

$$\rho = \frac{1}{(8\pi + 2\lambda)}\left[\frac{k_1^{\,2}\left(-n^2+4n+1\right)}{2(k_1 t + k_2)^2} - \frac{2m^2}{(k_1 t + k_2)^{n+1}}\right] = -p\,, \tag{45}$$

since in the case of accelerated expansion we have $\rho + p = 0$.

Subtracting (8) from (9) and using (25), (29-31), we get

$$\omega = -1 + \frac{1}{\rho(8\pi + 2\lambda)}\left[\frac{k_1^{\,2}\left(-5n^2+2n+1\right)}{4(k_1 t + k_2)^2}\right] = -\delta\,. \tag{46}$$

Subtracting (9) from (10) and using (29-31), we get

$$\gamma = \frac{1}{\rho(8\pi + 2\lambda)}\left[\frac{k_1^{\,2}\left(3n^2-2n-1\right)}{2(k_1 t + k_2)^2}\right]. \tag{47}$$

5. Conclusion:

In this paper, we have studied Bianchi Type-V Dark Energy Cosmological Model In $f(R,T)$ Theory of Gravitation. We have following concluding remarks:

- The model obtained has no singularity for $n > 0$.
- The spatial volume of this model becomes infinite as $t \to \infty$, which shows that the universe starts with zero volume and expands uniformly.
- The Hubble parameter H the expansion scalar θ and shear scalar σ decrease as time increase. The positive value of Hubble parameter and expansion scalar throughout the evolution shows that the universe is expanding gradually.
- Since $\frac{\sigma}{\theta} =$ constant, the model remains anisotropic except.
- It is observes that anisotropic parameter $A_m \neq 0$. Thus model is anisotropic
- The declaration parameter q is negative, which indicate our model is accelerating as desire.
- We observed that EoS parameter is evolving with a negative sign, which may be established from the current accelerated expansion of the universe. We also observed that initially universe expand with quintessence $\omega > -1$ region and at late time it approaches the cosmological constant $\omega = -1$ scenario.
- It is interesting to note that EoS parameter takes a negative value which is supported by SNe-Ia data.
- We observes that energy density is decreasing function of time and it vanishes as $t \to \infty$.
- From the same figure we take a note that pressure of dark energy (fluid) is negative as we desire and it vanishes in large time limit.
- In our model jerk parameter is positive throughout the evolution of the universe indicating accelerated expansion of the universe.
- The pair of state finder diagnostic is determine, which shows that our model does not approach to ΛCDM limit.

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6

(m,n)-Type Holographic Dark Energy Cosmological Model in $f(R,G)$ Gravity

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Abstract
Existing investigations dedicated to the self-propelling investigation of $(m,n)-$Type HDE cosmological model within the circumstance of theory of gravity with Lagrangian be the impulsive function of Ricci scalar R and Gauss-Bonnet invariant G, say $f(R,G)$ gravity. Exact solutions of the field equations correspond to power law which provides singular model. Also some physical and kinematical aspects and its behavior with the present day universe of the cosmological model have been discussed.

Keywords:- $(m,n)-$*Type HDE,* $f(R,G)$ *Gravity, Bianchi Type-I line element.*

1. Introduction

Dark Energy (DE) is a speculative type of energy that applies a negative, horrendous strain, acting like something contrary to gravity. It has been guessed to represent the observational properties of far off kind Ia supernovae, which show the universe going through a speed up time of development [1-6]. DE is an extraordinary type of energy that saturates all of room and will in general expand the pace of extension of the universe. There are normally two different ways for displaying the DE, initial a specific parametrization and second changes of gravity at extremely huge scope. To find the DE condition of state from observational information there are three significant ways which are tackling the scalar field conditions, constructing a useful structure for condition of state boundary, and playing out a boundary free methodology. Contrasting the new observational information and different models of DE. The vacuum energy thickness and a dynamical scalar field are two significant possibilities for DE. Thus, the condition equation of state (EoS) related with the vacuum energy thickness is consistent and is an element of time in conventional core situations [7-9]. Number of researchers and Authors studied another form of DE called the Holographic Dark Energy (HDE). HDE models depend on a field hypothetical connection between shorts in the bright and in the infrared energy domains. Various decisions of the infrared end lead to various models and also found that the thickness of the Universe is autonomous of space shape [10-11]. [12] Laid out a correspondence between the HDE models with the quintessence scalar field DE models in the Bianchi Type-V universe. Core potential and the elements of the quintessence scalar field are recreated for this anisotropic speeding up model of the universe. studied [13-19] minimally interacting and five dimensional HDE models. Some of the authors [20-25] discussed the dynamics, cosmic evolution and consequences of HDE models of the Universe with reference to different theories of the cosmic Universe. Signature flipping of isotropic homogeneous space-time with HDE in $f(G)$ gravity concentrated by [26] and [27]got another class of HDE models in LRS Bianchi Type-I. Also there are different forms of HDE models like Tsallis HDE and Barrow HDE models that had investigated [28-29].

So by above discussion of DE and HDE here in this context we have consider a (m,n)-Type HDE cosmological models having its kinematical and physical sense which gives a agegraphic-like DE models [30-31]. For this (m,n)-Type HDE cosmological models here we have consider a modified gravity theory to explaining the behavior of the present day universe.As, there are so many modification of action in General Relativity (GR) are obtained, such as $f(R), f(R,T), f(G), f(R,G), f(T), f(T,B)$ etc. These reasonably different modified theories are an endeavor to construct a semi-classical theme within which GR and most of its self-made options are often recovered. An undemanding and one of the best modification to GR is that the $f(R,G)$ theory of gravity, which is the function of Ricci-scalar (R) and Gauss-Bonnet gravity (G) [32].

Till now several models of $f(R,G)$ theory are planned. Described [33] energy bounds in $f(R,G)$ gravity theory while [34] investigated the dynamics of inflation and DE model of the Universe. Later on [35] devoted to the thermo-dynamical aspects of relativistic hydrodynamics in $f(R,G)$ gravity and also [36] constructed a time varying deceleration parameter model in the $f(R,G)$ gravity theory.

With reference to above discussion and extension in the area of cosmology our article is organized as follows:

In Section 2, we present the $f(R,G)$ gravity and cosmology basics. The metric solutions of a particular $f(R,G)$ model are presented in Section 3 with the special; form of HDE called (m,n)-Type HDE. The physical and kinematical behavior of the model with the (m,n)-Type HDE, are done in Section 4. The concluding remarks are given in Section 5.

2. Metric and $f(R,G)$ gravity

We consider a LRS Bianchi Type-I space-time of the form

$$ds^2 = dt^2 - A^2 dx^2 - B^2\left(dy^2 + dz^2\right), \tag{2.1}$$

where, A and B are the potential functions of cosmic time t only.

So many authors [37-39] contemplated the above said model because of its physical importance that it's solid and anisotropic, from which the method of isotropization of the universe is studied through the passage of time conjointly play a significant role in understanding and outline of the first stages evolution of the universe. Therefore, the model devouring anisotropic background that approaches to property at late times is a lot of correct for the outline of entire evolution of the universe.

The $f(R,G)$ gravity is a fascinating addition to Einstein's theory of gravity. The action that applies to this gravity the most generally is

$$S = \frac{1}{2k}\int d^4x\sqrt{-g}\left\{R + f(G) + S_M(g^{ij},\phi)\right\}, \tag{2.2}$$

where , g is the metric determinant, $S_M(g^{ij},\phi)$ is the matter action, $k = 16\pi^2G^2$ R is the Ricci Scalar and G is the Gauss-Bonnet invariant defined by:

$$G = R^2 - 4R_{rs}R^{rs} + R_{rs\alpha\beta}R^{rs\alpha\beta}, \tag{2.3}$$

Where the notations R_{rs} and $R_{rs\alpha\beta}$ are occupied for the Ricci and Riemann tensor respectively.

Variation of standard action (2.2) with respect to metric (2.1) gives the following gravitational field equation:

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$$R_{\alpha\beta}-\frac{1}{2}g_{\alpha\beta}R=kT_{\alpha\beta}^{mat}+\Sigma\alpha\beta,$$

$$Where,\Sigma\alpha\beta,=\begin{bmatrix}\nabla_\alpha\nabla_\beta f_R-g_{\alpha\beta}\Xi f_R+2R\nabla_\alpha\nabla_\beta f_G-2g_{\alpha\beta}\Xi ff_G-4R_\alpha^\lambda\nabla_\lambda\nabla_\beta f_G\\-4R_\beta^\lambda\nabla_\lambda\nabla_\alpha f_G+\Xi_{\alpha\beta}f_G+4g_{\alpha\beta}R^{\alpha\beta}\nabla_\alpha\nabla_\beta f_G\\+4g_{\alpha\beta}R^{rs}\nabla_r\nabla_s f_G.4R_{\alpha rs\beta}\nabla^r\nabla^s f_G\\-\frac{1}{2}g_{\alpha\beta}\left(f_RR+f_GG-f(R,G)\right)+(1-f_R)\left(R_{\alpha\beta}-\frac{1}{2}g_{\alpha\beta}R\right)\end{bmatrix} \tag{2.4}$$

Here, ∇_α represents the covariant derivative.

$f_R\equiv\frac{\partial}{\partial R}f(R,G)$ And $f_G\equiv\frac{\partial}{\partial G}f(R,G)$ gives the partial derivatives of $f(R,G)$ with respect to R and G respectively.

In this work, we use some kinematical and physical quantities toward the solution of field equations and the behavior of the cosmos by $f(R,G)$ gravity model of the form:

$$f(R,G)=f_0R^{\tau-1}G^{-\tau}. \tag{2.5}$$

Where, $f_0>0$ be constant.

For the values of constant τ, two types of gravity models are recovered:

I) $f(R)$ gravity model corresponding to $f_0=1,\tau=0$ and

II) $f(G)$ gravity model corresponding to $f_0=1,\tau=1$.

The energy momentum tensor for dark matter (DM) and HDE is taken as,

$$T_{ij}=\rho_{matt}u_iu_j+\left(\rho_{de}+p_{de}\right)u_iu_j+p_{de}g_{ij}. \tag{2.6}$$

Here, ρ_{matt} is the matter density of DM, ρ_{de} being the energy density and p_{de} is the pressure. Modern cosmology is concerned with a key question: where did DE come from Holographic dark energy (HDE) model is one of the many solutions that have been suggested to tackle this complex puzzle [40].

3. Field Equations and Solutions of (m,n) Type HDE Model

In the extent of HDE source given in equation (2.6), the field equations (2.4) corresponding to the metric (2.1) lead to the following set of linearly independent differential equations of the form:

$$\left\{\left[\frac{\dot{A}}{A}+2\frac{\dot{B}}{B}\right]\dot{f}_R-12\frac{\dot{A}}{A}\frac{\dot{B}^2}{B^2}\dot{f}_G+\frac{1}{2}\left(Rf_R+Gf_G-f\right)+\left[2\frac{\dot{A}}{A}\frac{\dot{B}}{B}+\frac{\dot{B}^2}{B^2}\right]f_R\right\}=\rho_{matt}+\rho_{de} \tag{3.1}$$

$$\left\{-\ddot{f}_R-2\frac{\dot{B}}{B}\dot{f}_R+8\frac{\dot{B}}{B}\frac{\ddot{B}}{B}\dot{f}_G+4\frac{\dot{B}^2}{B^2}\ddot{f}_G-\frac{1}{2}\left(Rf_R+Gf_G-f\right)+\left[2\frac{\ddot{B}}{B}+\frac{\dot{B}^2}{B^2}\right]f_R\right\}=p_{de} \tag{3.2}$$

$$\left\{\begin{matrix}-\ddot{f}_R-\left[\frac{\dot{A}}{A}+\frac{\dot{B}}{B}\right]\dot{f}_R+4\left[\frac{\dot{B}}{B}\frac{\ddot{B}}{B}+\frac{\dot{B}}{B}\frac{\ddot{A}}{A}\right]\dot{f}_G+4\frac{\dot{A}}{A}\frac{\dot{B}}{B}\ddot{f}_G-\frac{1}{2}\left(Rf_R+Gf_G-f\right)\\+\left[\frac{\ddot{A}}{A}+\frac{\ddot{B}}{B}+\frac{\dot{A}}{A}\frac{\dot{B}}{B}\right]f_R\end{matrix}\right\}=p_{de} \tag{3.3}$$

Here, A,B are the potential functions of cosmic time and the overhead dot denotes the derivative with respect to cosmic time. We have expressed the above field equations from (3.1) to (3.3) into $f(R,G)$ gravity form. Also we've chosen to frame the cosmological model in this instance using an assumed scale factor. Additionally, we must ascertain the pressure, matter density and energy density with respect to cosmic time in order to frame a cosmological model of the universe. We adopt the power law form of the scaling factor, $a = \eta^{1/3}(t)^{\frac{\gamma}{3}}$ to handle the extremely non-linear Eqs. (3.1) and (3.3). The use of such a scale factor was made to replicate the change from a decelerating to an accelerating expansion of the universe. To get the formulas for the pressure, matter density and energy density in terms of cosmic time, this can be substituted in Eqs. (3.1)– (3.3). We find that the matter density, energy density and pressure have complicated expressions, so we choose to display them graphically. These special cases that we have discussed in the form of (m,n)-Type HDE models and that have been mentioned in the following section.

(m,n)-Type H.D.E: -

The idea of (m,n)-Type HDE is the extension of HDE with the parameters m and n with the chosen IR cut-off as

$$L = \frac{1}{a^m(t)} \int_0^t a^n(t')dt'. \tag{3.4}$$

Specifically, for a few explicit upsides of (m,n) the condition of state can normally develop cross ghost split even without presenting cooperation among DE and dark matter (DM). Additionally when (m,n) take some particular worth all the age graphic-like DE models can be recuperated. This development is likewise relevant to the models with summed up future occasion skyline as the holographic size in a similar soul. For age-like holographic models, when $m=n$ it appears to be that DE has a similar way of behaving as the prevailing fixing in the early epochs of the universe which infer that DE may be bound together with DM. In any case, we need to acquaint some component with make DE go amiss from DM state, and at last become predominant and be answerable for the speed increase of the universe.

Now for the construction of (m,n)-Type HDE models we define the energy density [41-43] as

$$\rho_{de} = \frac{3b^2}{L^2}, \tag{3.5}$$

here b is treating as a constant and L is given by (3.4).

Now let us define the different kinematical parameters of the model which help us to describe the characteristics of the universe in the following ways.

The spatial volume and average scale factor severally outline as

$$V = \sqrt{-g} = AB^2 \tag{3.6}$$

$$a = V^{1/3} so, a = \left(AB^2\right)^{1/3} \tag{3.7}$$

The special law of variation of Hubble's parameter which yields a constant value of deceleration parameter of the universe, according to Berman's law:

$$q = \frac{d}{dt}\left(\frac{1}{H}\right) - 1 \tag{3.8}$$

The generalized mean Hubble parameter that expresses the enlargement rate of the reference frame, is given as

$$H = \frac{\dot{a}}{a} \tag{3.9}$$

Where, a is the average scale factor which is given by:

$$a = \eta^{1/3}(t)^{\frac{\gamma}{3}} \tag{3.10}$$

The use of such a scale factor (3.10) was made to replicate the change from a decelerating to an accelerating expansion of the universe. Due to this importance many candidates [44-49] have used this model to express their finding in this concept.
From equations (3.7) and (3.10), the metric potential comes out to be and we take $A = B^{\xi}; \xi \neq 0$ with this we get the values of A and B as follows:

$$A = \eta_2^{\xi} (t)^{\frac{3\xi}{\gamma(\xi+2)}} \tag{3.11}$$

$$B = \eta_2 (t)^{\frac{3}{\gamma(\xi+2)}} \tag{3.12}$$

With the help of (3.11-3.12) spatially homogeneous and anisotropic locally rotationally symmetric Bianchi type-I cosmological model with (m,n)-Type HDE source within the framework of $f(R,G)$ theory of gravity becomes:

$$ds^2 = dt^2 - \left[\eta_2^{\xi} (t)^{\frac{3\xi}{\gamma(\xi+2)}}\right]^2 dx^2 - \left[\eta_2 (t)^{\frac{3}{\gamma(\xi+2)}}\right]^2 \left(dy^2 + dz^2\right) \tag{3.13}$$

4. Physical and Kinematical Properties of the Model

The Ricci Scalar and Gauss-Bonnet Invariant G with the values of metric potentials (3.11) and (3.12) for the model (2.1) is written in the following way:

$$R = \frac{-6\left[3\xi^2 - \gamma\xi + (\xi+2)^2 + 6\xi + 9\right]}{\gamma^2 (\xi+2)^2 \left(t^2\right)} \tag{4.1}$$

and

$$G = \frac{648\left[\xi - \gamma(\xi+2) + 2\right]}{\gamma^4 (\xi+2)^4 \left(t^4\right)} \tag{4.2}$$

As we have constructed our model on the basis of $f(R,G)$ gravity theory and hence both R and G behaves with the same properties for the resulting model by choosing the power law of the form $a = \eta^{1/3}(t)^{\frac{\gamma}{3}}$. The Figure 1 shows that how both R and G behaves with the given power law model.

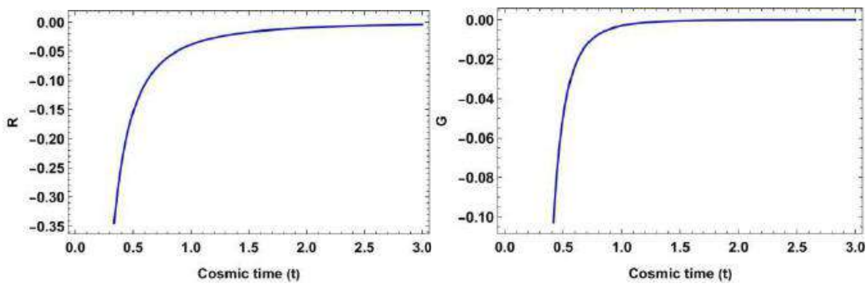

Figure 1 Behavior of Ricci Curvature and Gauss-Bonnet versus cosmic time with the appropriate choice of constants $\gamma = 14.2$ and $\xi = 2.1$.

Calculated energy density of the (m,n)-Type HDE model by using the potential functions (3.11) and (3.12) utilizing (3.4-3.5) is as:

$$\rho_{de} = \left[\frac{b^2}{3(\gamma\, n+3)^2}\right] \eta^{\frac{2(m-n)}{3}} (t)^{\frac{2}{3}[\gamma(m-n)-3]} \tag{4.3}$$

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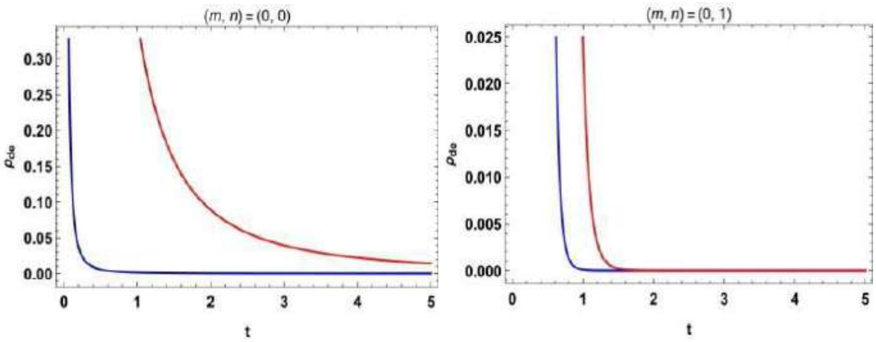

Figure 2 Behavior of energy density of (m,n)-Type HDE versus cosmic time with the appropriate pair respectively as $(m,n)=(0,0),(0,1)$ and choice of constants $\gamma=14.2, b=3.1 \quad \& \, 0.2.$

Utilizing (4.3) in (3.1) having the potential functions given by (3.11) and (3.12) the (m,n)-Type matter energy density of the modelis found out as:

$$\rho_{matt}=\left\{\begin{array}{l} f_0\left[\begin{array}{l}\dfrac{3(\tau-1)}{\gamma\, t}\left\{-\tau\dfrac{\dot{G}}{G}+(\tau-2)\dfrac{\dot{R}}{R}\right\} \\ +\dfrac{324\,\tau\,\xi}{\gamma^3(\xi+2)^3(t^3)}\left\{-(\tau+1)\dfrac{R\dot{G}}{G^2}+(\tau-1)\dfrac{\dot{R}}{G}\right\} \\ -R+\left\{\dfrac{(\tau-1)(18\xi+9)}{\gamma^2(\xi+2)^2}\right\}\end{array}\right]\dfrac{R^{\tau-1}}{G^{\tau}} \\ -\left[\dfrac{b^2}{3(\gamma\, n+3)^2}\right]\eta^{\frac{2(m-n)}{3}}\;(t)^{\frac{2}{3}[\gamma(m-n)-3]}\end{array}\right\} \tag{4.4}$$

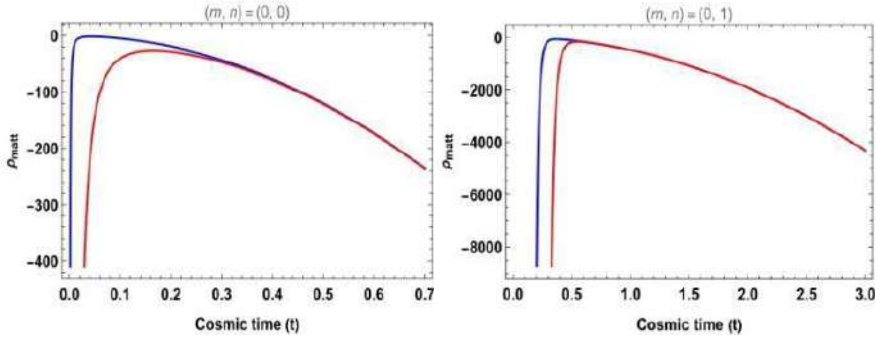

Figure 3 Behavior of matter density of (m,n)-Type HDE versus cosmic time with the appropriate pair respectively as $(m,n)=(0,0),(0,1)$ and choice of constants $f_0=1, \tau=3.2, \gamma=14.2, \xi=2.1$ and $\eta=0.3.$

Calculated pressure of the universe by using the potential functions (3.11) and (3.12) in the field equation (3.2) is:

$$p_{de} = f_0 \left[\begin{array}{l} (\tau-1)\left[\tau\dfrac{\ddot{G}}{G} + \tau(\tau+1)\dfrac{\dot{G}^2}{G^2} + 2\tau(\tau-2)\dfrac{\dot{R}\dot{G}}{RG} - (\tau-2)\left\{\dfrac{\ddot{R}}{R} + (\tau-3)\dfrac{\dot{R}^2}{R}\right\}\right] \\ -\dfrac{1}{\gamma^2(\xi+2)^2(t)^2}\left\langle \begin{array}{l} 2(\tau-1)[9-3\gamma(\xi+2)]\left\{-\tau\dfrac{\dot{G}}{G} + (\tau-1)\dfrac{\dot{R}}{R}\right\} \\ +36\tau\left[\begin{array}{l} (\tau+1)\left\{-\dfrac{\ddot{G}}{G^2} + (\tau+2)\dfrac{\dot{G}^2}{G^3} - 2(\tau-1)\dfrac{\dot{R}\dot{G}}{G^2}\right\} \\ +(\tau+1)\left\{\dfrac{\ddot{R}}{G} + (\tau-1)\dfrac{\dot{R}^2}{RG}\right\} \end{array}\right] \\ -3(\tau-1)\{9-2\gamma(\xi+2)\} \end{array}\right\rangle \\ -\dfrac{24\tau[9-3\gamma(\xi+2)]}{\gamma^3(\xi+2)^3(t)^3}\left\{-(\tau+1)\dfrac{R^3\dot{G}}{G^2} + (\tau-1)\dfrac{\dot{R}}{G}\right\} + R \end{array} \right] \frac{R^{\tau-1}}{G^{\tau}}$$

(4.5)

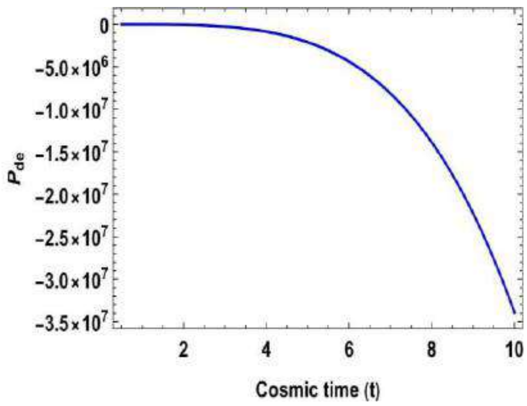

Figure 4 Behavior of pressure of (m,n)-Type HDE versus cosmic time with the appropriate pair respectively as $(m,n)=(0,0),(1,0)$ and choice of constants $f_0 = 1, \tau = 3.2, \gamma = 14.2, \xi = 2.1$ and $\eta = 0.3$.

4.1 Kinematical Properties of the Model

The kinematical properties which are important in cosmology for discussing the geometrical behavior of the universe that are spatial volume, Hubble parameter, expansion scalar, mean parameterized isotropy parameter, shear scalar, deceleration parameter, jerk parameter and overall density parameter which have the following expressions by using the potential functions (3.11) and (3.12) as follows:

The obtained spatial volume of the model is,

$$V = \left[\eta\,(t)^{\gamma}\right] \tag{5.1}$$

The resulting mean Hubble parameter of the model is,

$$H = \left[\frac{\gamma}{3t}\right] \tag{5.2}$$

The obtained expansion scalar for the model is,

$$\theta = \left[\frac{\gamma}{t}\right] \tag{5.3}$$

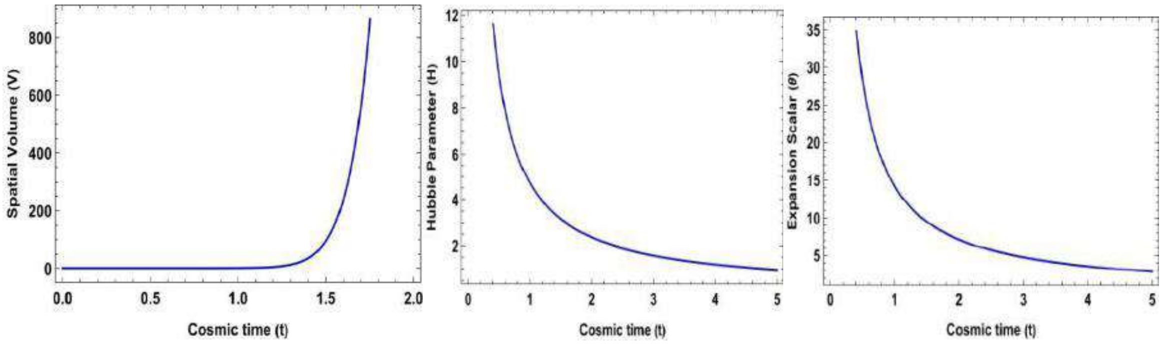

Figure 5 Behavior of V, H & θ versus cosmic time with the appropriate pair of constants $\gamma = 14.2$ and $\eta = 0.3$.

To mentioned whether or not the models either approach isotropy or not, we tend to outline associate anisotropy parameter of the enlargement as,

$$A_m = \Sigma_{i=1}^{3}\left(\frac{H_i - H}{H}\right)^2 = \left[\frac{27\xi^2 - \gamma^4(\xi+2)^2 + 54}{\gamma^4(\xi+2)^2}\right] \tag{5.4}$$

Similarly the founded Shear Scalar of the model is;

$$\sigma^2 = \frac{3}{2}H^2 A_m = \left[\frac{27\xi^2 - \gamma^4(\xi+2)^2 + 54}{6\gamma^2(\xi+2)^2 t^2}\right] \tag{5.5}$$

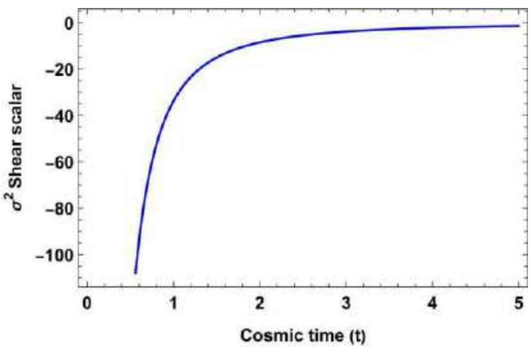

Figure 6 Behavior of σ^2 versus cosmic time with choice of constants $\gamma = 14.2$ and $\xi = 2.1$.

The obtained deceleration parameter of the model is given by,

$$q = \left[\frac{3}{\gamma} - 1\right] \tag{5.6}$$

In the cosmology the jerk parameter can be defined as the third derivative of a scale factor and is written as:

$$j(t) = \frac{\ddot{a}}{aH^3} = H = \frac{e^{\eta t} - \eta}{e^{\eta t}} + \frac{e^{2\eta t} - \eta^2}{e^{2\eta t}} - \frac{\eta^2 t(e^{\eta t} - 1)}{e^{2\eta t}} \tag{5.7}$$

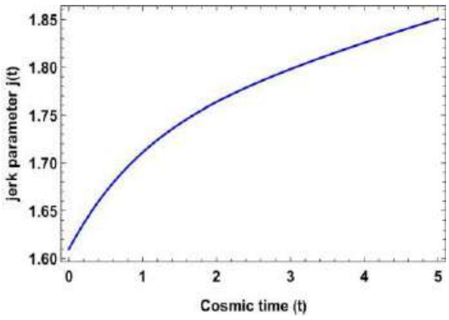

Figure 7 Behavior of $j(t)$ versus cosmic time with the appropriate choice of constant $\eta = 0.3$.

Calculated (m,n)-type energy density parameter of the universe by utilizing (4.3) and the Hubble parameter (5.2) is:

$$\Omega_{de} = \frac{\rho_{de}}{3H^2} = 9b^2t^2\left[\left\{\frac{9\gamma^2}{(\gamma\, n+3)^2}\right\}\eta^{\frac{2}{3}(m-n)}\,(t)^{\frac{2}{3}[\gamma(m-n)-3]}\right]^{-1} \tag{5.8}$$

Also calculated (m,n)-Type matter density parameter of the universe by utilizing (4.4) and the Hubble parameter (5.2) is:

$$\Omega_{matt} = \frac{\rho_{matt}}{3H^2} = \frac{9t^2}{\gamma^2}\left\{\begin{array}{l} f_0\left[\begin{array}{l}\dfrac{3(\tau-1)}{\gamma\, t}\left\{-\tau\dfrac{\dot{G}}{G}+(\tau-2)\dfrac{\dot{R}}{R}\right\} \\ +\dfrac{324\,\tau\,\xi}{\gamma^3(\xi+2)^3(t^3)}\left\{-(\tau+1)\dfrac{R\dot{G}}{G^2}+(\tau-1)\dfrac{\dot{R}}{G}\right\} \\ -R+\left\{\dfrac{(\tau-1)(18\xi+9)}{\gamma^2(\xi+2)^2}\right\}\end{array}\right]\dfrac{R^{\tau-1}}{G^{\tau}} \\ -3b^2\left[\left\{\dfrac{9}{(\gamma\, n+3)^2}\right\}\eta^{\frac{2}{3}(m-n)}\,(t)^{\frac{2}{3}[\gamma(m-n)-3]}\right]^{-1}\end{array}\right\} \tag{5.9}$$

Hence the overall energy density parameter for the (m,n)-type HDE cosmological models is we have

$$\Omega = \left[\begin{array}{l} 9\,f_0\left[\begin{array}{l}\dfrac{3(\tau-1)t}{\gamma^3}\left\{-\tau\dfrac{\dot{G}}{G}+(\tau-2)\dfrac{\dot{R}}{R}\right\} \\ +\dfrac{324\,\tau\,\xi}{\gamma^5(\xi+2)^3(t)}\left\{-(\tau+1)\dfrac{R\dot{G}}{G^2}+(\tau-1)\dfrac{\dot{R}}{G}\right\} \\ -\left(\dfrac{t^2}{\gamma^2}\right)R+\left\{\dfrac{(\tau-1)(18\xi+9)t^2}{\gamma^4(\xi+2)^2}\right\}\end{array}\right]\dfrac{R^{\tau-2}}{G^{\tau}} \\ -\dfrac{2b^2}{\gamma^2(\gamma\, n+3)^2}\left\{\eta^{\frac{2}{3}(m-n)}\,(t)^{\frac{2}{3}[\gamma(m-n)-3]}\right\}\end{array}\right] \tag{5.10}$$

5. State-finder Parameter Diagnosis

Let us try to explain the state finder parameter diagnosis for the scale factor given by (3.10) and for the Hubble parameter (5.2). The parameter r and s for given model is found out as:

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$$r = \frac{\dddot{a}}{aH^3} = \frac{18}{\gamma}, \tag{6.1}$$

$$s = \frac{r-1}{3(q-1/2)} = \frac{18}{s}, \tag{6.2}$$

From (6.1 - 6.2) here we got the relation between r and S as:

$$r = \frac{(6-s)(3-s)}{18}, \tag{6.3}$$

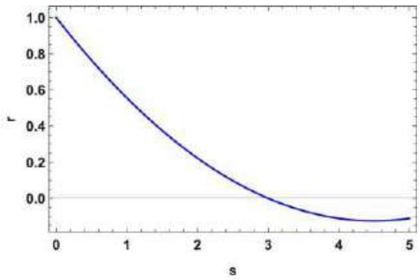

Figure 8 Behavior of state-finder parameter with the appropriate pair of constant $\eta = 0.3$.

6. Conclusion

In fig. 1 Graph of Ricci curvature and Guass- Bonnet with respect to cosmic time t has been plotted for $\gamma = 14.2$ and $\xi = 2.1$. Both exhibit same behavior. For small t there is sharp increase in the values then for large values of t a constant behavior has been observed.

In fig. 2 we have plotted the graph of energy density with cosmic time for various values of (m,n) for $(m,n) = (0,0)$ energy density shows decreasing behavior, for large values of t it became constant, for (m,n)= (0,1) steep decrease in the values has been observed for large values of t it shows a constant behavior for $(m,n) = (0,0),(0,1)$ it shows an increasing behavior for $t > 0$.

In fig.3 graph of matter density has been plotted with cosmic time for $(m,n) = (0,0),(0,1)$ shows an abrupt increase behavior while for large values of t it shows decreasing behavior. $(m,n) = (0,0),(0,1)$ matter density shows a decreasing behavior which is consistent with the observational values.

From fig. 4 we can see when $t = 0$ pressure of (m, n) type of H.D.E. model was zero. It shows a constant behavior for $t > 0$ but for large values of t it shows decreasing behavior.

In fig. 5 Graph of spatial volume has plotted against cosmic time for γ = 14.2 and η = 0.3 we can see for

t =0 and $t > 0$ spatial volume remain same but large values of t it shows an increasing behavior whereas Hubble parameter shows a decreasing behavior but for large t it became constant.

Expansion scalar θ decreases abruptly as t increases but for large t it shows a constant behavior.

In fig. 6 Graph of shear scalar σ^2 against time has plotted with $\gamma = 14.2$ and $\xi = 2.1$ and it is evident that it is an increasing function and for large values of t it increases gradually.

In fig 7. Jerk parameter $j(t)$ has been plotted against cosmic time t with a choice of $\eta = 0.3$ and it shows a gradual increase with the increase in the time.

In fig. 8 State finder parameter has been plotted against Hubble parameter, it can be seen that it shows a decreasing behavior for all values of t, by using state finder approach we can easily comment upon the behavior of the model. For $s = 0, r = 1$ our model approaches ΛCDM fixed point in the future. For r < 1, s >0 our model depicts quintessence model and for $r > 1, s < 0$ it shows chaplyngin Gas (CG) model.

Quintessence and CG follow in $r - s$ plane demonstrate quite strikingly the contrasting behavior of our dark energy model.

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7

Fractional Gabor transform in the Zemanian space

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Abstract:
In this paper some properties of kernel of fractional Gabor transform are proved and fractional Gabor transform is extended in the distributional generalized sense. For that testing function space is defined. Boundedness property and uniqueness theorem for the fractional Gabor transform are proved.
Keywords: Gabor transform, fractional transform, fractional Gabor transform, testing function space.

I. INTRODUCTION

Zang Y. [5] introduced the concept of Gabor transform of fractional order using window function. Relation between Gabor transform and fractional Fourier transform and their application for signal processing was studied in [3]. A generalization of the Fourier transform known as the fractional Fourier transform was proposed by Namias [1].

The fractional Gabor transform of signal $f(x)$ with rotation α is defined as,

$$[G_\alpha f(x)](u) = \mathrm{G}_\alpha(u,t) = \int_{-\infty}^{\infty} f(x) K_\alpha(x,u,t)\,dx \qquad (1.1)$$

Where, $K_\alpha(x,u,t) = \sqrt{\dfrac{1-i\cot\alpha}{2\pi}}\, e^{i\frac{(x^2+u^2)\cot\alpha}{2}}\, e^{-\frac{(x-t)^2\csc\alpha}{2}}\, e^{-iux\csc\alpha}$ (1.2)

The above fractional Gabor transform is the generalization of the conventional Gabor transform which is defined as follows in [5]

$$G(u,t) = \sqrt{\frac{1}{2\pi}} \int_{-\infty}^{\infty} f(x) e^{-\frac{(x-t)^2}{2}} e^{-iux}\,dx \qquad (1.3)$$

Because of its recent application in many fields, including optics and signal processing, the brief account of its application is discussed in [2].

In this paper section II discusses some properties of kernel where as in section III we define testing function space. Section IV gives boundedness property and section V gives uniqueness theorem. Last section VI concludes the paper.

Notation and terminology are as used in [4].

II. Properties of kernel:

We prove the following properties of kernel of fractional Gabor transform.

1. $\lim\limits_{\alpha\to n\pi} K_\alpha(x,u,t) = K_{n\pi}$.
2. $K_{-\alpha}(x,u,t) = K_\alpha^*(x,u,t)$, where "$*$" denotes the conjugation.

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3. $K_\alpha(x,u,t) = \dfrac{e^{\frac{(u-t)^2}{2}\csc\alpha}}{e^{\frac{(x-t)^2}{2}\csc\alpha}} K_\alpha(u,x,t)$

4. $|K_\alpha(x,u,t)| = \sqrt{\dfrac{e^{-(x-t)^2\csc\alpha}}{2\pi\sin\alpha}}$

5. $K_\alpha(x,u,t) = e^{\left[\frac{u\sec\alpha}{2}-x+t\right]u\sec\alpha\csc\alpha - i\frac{u^2}{2}\tan\alpha.} K_\alpha(x-u\sec\alpha,0,t)$

Proof: First four properties are simple to prove, hence we prove last property.

$$K_\alpha(x,u,t) = \sqrt{\frac{1-i\cot\alpha}{2\pi}}e^{i\frac{(x^2+u^2)\cot\alpha}{2}}e^{-\frac{(x-t)^2\csc\alpha}{2}}e^{-iux\csc\alpha}$$

$$= \sqrt{\frac{1-i\cot\alpha}{2\pi}}e^{\left[\frac{ix^2\cot\alpha}{2}+\frac{iu^2}{2}\left(-\tan\alpha+\frac{1}{\sin\alpha\cos\alpha}\right)-iux\csc\alpha\right]}e^{-\frac{(x-t)^2\csc\alpha}{2}}$$

$$= \sqrt{\frac{1-i\cot\alpha}{2\pi}}e^{-\frac{iu^2\tan\alpha}{2}}e^{\frac{i}{2}\left[(x-u\sec\alpha)^2+0^2\right]\cot\alpha}e^{-i(x-u\sec\alpha)0\csc\alpha}e^{-\frac{((x-u\sec\alpha)-t)^2\csc\alpha}{2}}e^{\left[\frac{u^2\sec^2\alpha}{2}-xu\sec\alpha+ut\sec\alpha\right]\csc\alpha}$$

$$K_\alpha(x,u,t) = e^{\left[\frac{u\sec\alpha}{2}-x+t\right]u\sec\alpha\csc\alpha - i\frac{u^2}{2}\tan\alpha.} K_\alpha(x-u\sec\alpha,0,t)$$

III. Testing function space E'

An infinitely differentiable complex valued function ψ on R^n belongs to $E(R^n)$ or E if for each compact set $K \subset S_a$ where,

$S_a = \{x : x \in R^n, |x| \le a, a > 0\}$, $k \in N^n$,

$\gamma_{E,k}(\psi) = \sup_{x\in K}\left|D^k\psi(x)\right| < \infty.$

Clearly E is complete and so a Frechet space, also if f is a member of E' (the dual space of E) then we say that f is a fractional Gabor transformable.

IV. Boundedness property

If the $\sup f \subset S_a$ where $S_a = \{x : x \in R^n, |x| \le a, a > 0\}$ and for each $\in > 0$ there exists a constant C and a positive integer k such that for $0 < \alpha < \pi$,

$$|G_\alpha(\xi)| \le CC_{1\alpha}\cdot\exp\left\{c_{2\alpha}\left[\left(|\operatorname{Im}\xi|^2 + (a+\in)^2\cos\alpha - 2(a+\in)|\operatorname{Im}\xi| - (a+\in-t)^2\right)\right]\right\}\times$$

$$\sum_{j=0}^{k} C_{\alpha,j}\left(i[2(a+\in)\cos\alpha - 2\xi] - 2(a+\in-t)\right)^{k-2j}$$

Proof: By boundedness property of the generalized function, there exist a constant C and a non-negative integer k such that,

$$|G_\alpha(\xi)| = |\langle f(x), K_\alpha(x,\xi,t)\rangle|$$

$$\le C\cdot\max_{|\beta|\le k}\sup_{x\in R^n}\left|D_x^\beta K_\alpha(x,\xi,t)\right|$$

$$\le C\cdot\max_{|\beta|\le k}\sup_{x\in R^n}\left|C_{1\alpha}D_x^\beta\left\{\exp\left(C_{2\alpha}\left[i\left[(x^2+\xi^2)\cos\alpha - 2\xi x\right] - (x-t)^2\right]\right)\right\}\right|$$

$$\leq CC_{1\alpha}\cdot\exp\left\{c_{2\alpha}\left[\left(|\operatorname{Im}\xi|^2+(a+\in)^2\cos\alpha-2(a+\in)|\operatorname{Im}\xi|-(a+\in-t)^2\right)\right]\right\}\times$$
$$\max_{|\beta|\leq k}\sum_{j=0}^{\beta}C_{\alpha,j}\left(i[2(a+\in)\cos\alpha-2\xi]-2(a+\in-t)\right)^{\beta-2j}$$
$$\leq CC_{1\alpha}\cdot\exp\left\{c_{2\alpha}\left[\left(|\operatorname{Im}\xi|^2+(a+\in)^2\cos\alpha-2(a+\in)|\operatorname{Im}\xi|-(a+\in-t)^2\right)\right]\right\}\times$$
$$\sum_{j=0}^{k}C_{\alpha,j}\left(i[2(a+\in)\cos\alpha-2\xi]-2(a+\in-t)\right)^{k-2j}$$

Where C, $C_{1\alpha}$, $C_{2\alpha}$, $C_{\alpha,j}$ are constants depends on α ,k ,j.

V. Uniqueness Theorem:

If $\left[G^{\alpha}f(x)\right](\xi)=\mathrm{F}_{\alpha}(\xi)$ and $\left[G^{\alpha}g(x)\right](\xi)=\mathrm{G}_{\alpha}(\xi)$ for $0<\alpha<\pi$ and $\sup f\subset S_a=\{x:x\in R,|x|\leq a,a>0\}$ and $\sup g\subset S_a$. If $\mathrm{F}_{\alpha}(\xi)=\mathrm{G}_{\alpha}(\xi)$, then $f=g$ in the sense of equality in E'.

Proof: By inversion theorem

$$f-g=\frac{1}{\pi i}\int_{-\infty}^{\infty}\overline{K_{\alpha}(x,u,t)}\left[\mathrm{F}_{\alpha}(\xi)-\mathrm{G}_{\alpha}(\xi)\right]d\xi=0,$$

as $\mathrm{F}_{\alpha}(\xi)=\mathrm{G}_{\alpha}(\xi)$, thus $f=g$ in E'

This proves uniqueness.

VI. Conclusion:

We present some properties of kernel. Boundedness property for the fractional Gabor transform is given. Uniqueness theorem is also given. Further we plan to prove operation transform formulae and some more interesting properties of this transform.

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8

Tsallis Hologrphic Dark Energy in Kaluza Klein Universe

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Abstract
In this work, we investigate an anisotropic, homogeneous and five dimensional Kaluza-Klein Universe filled with Dark Matter (DM) and Dark Energy (DE) in the framework of Einstein's theory of Relativity. We choose an interaction between DM and DE with the interacting term, $Q = 3H\gamma\rho_m$, by considering Tsallis generalized entropy. The exact solutions of the field equations are obtained by using the laws of the Hubble parameter proposed by Berman [21]. The EoS parameter, Anisotropy Parameter and Deceleration parameter are obtained. The results, we obtained are consistent with the observational data.

Keywords: Kaluza Klein Universe, Tsallis Holographic Dark Energy, Dark Matter, Einstein's theory of Relativity, EoS.

1. Introduction

The entire universe is now accelerating, according to experiment data from Supernova Ia Riess et al. [1], Perlmutter et al. [2]. It has also been suggested that "dark energy," an unusual negative pressure, is the main cause behind this. This remains a cosmic puzzle to this day. Two approaches are being actively considered in the literature to explain the accelerated expansion of the universe. One approach is to build dark energy models and study their dynamics. To identify the cosmological models in the modified theories of gravity and then look into their dynamical characteristics, another strategy is to use Einstein's general theory of gravitation. The most obvious hypothesis for dark energy is the cosmological constant. However, it is plagued by coincidence and other issues. As a result, other DE candidates such as quintessence, phantom, k- essence and quintom models have also been considered to explain DE Ratra and Peebles [3], Chiba et al. [4], Elizalde et al. [5], Caldwell [6]. Among the different dynamical DE models, the HDE model, in particular, has been a prominent model for examining the DE mystery in recent years. It was based on the quantum properties of black holes (BH), which have been widely studied in the literature to investigate quantum gravity Li [7], Susskind [8]. Due to the formation of BH in quantum field theory, the holographic principle states that the bound on the vacuum energy of a system with size L should not cross the limit of the BH mass of the same size. Tsallis HDE (THDE) is one of the new HDE models developed and is never stable at the classical level Tavayef et al. [9], Tsallis et al. [10]. Several investigations on THDE models in alternative theories of gravitation have been done by several researchers all over the globe Aditya et al. [11] Ghaffari et al. [12], Maity et al. [13], Iqbal et al. [14], Santhi and Sobhanbabu [15].

In the third decade of the previous century, Kaluza [16] and Klein [17] attempted to unify electro-magnetic force with gravitational force which resulted in the development of Kaluza-Klein (KK) theory. In KK approach, an extra dimension, viz. fifth dimension was introduced for coupling the two forces mentioned earlier. Chodos and Detweiler [18] have shown in their five dimensional model that the extra dimension contracts due to cosmic evolution. According to Guth [19] and Alvarez and Gavela [20], production of huge entropy due to the presence of an extra dimension can solve the flatness and horizon problems without invoking the idea of

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inflation. So, five dimensional model in the framework of KK theory has been successful in addressing some of the problematic issues of Big Bang cosmology. In this study we have investigated Kaluza-Klein cosmological model in Tsallis holographic dark energy in Einstein's theory of gravitation.

The paper organized as follows: section 2 deals with metric and field equations, section 3 deals with solution of field equations and some physical properties, discussions are done in section 4.

2. Metric and Field Equation

The Kaluza-Klein spacetime is characterized by:

$$ds^2 = dt^2 - a^2\left(dx^2 + dy^2 + dz^2\right) - b^2 d\psi^2 \; . \tag{2.1}$$

The cosmic scale factor is represented by a and b and ψ is taken to be space-like.

The equations describing Einstein's field in the natural limit $(8\pi G = c = 1)$ are expressed as follows

$$R_{ij} - \frac{1}{2} R g_{ij} = -(T_{ij} + \bar{T}_{ij}) \quad , \tag{2.2}$$

Where, R_{ij} is the Ricci tensor, R is the Ricci scalar and g_{ij} is the metric tensor. T_{ij} *and* $\bar{T}_{ij}$ are the energy momentum tensors of matter and THDE, respectively.

The expressions for the energy-momentum tensors are provided as follows

$$T_{ij} = \rho_m u_i u_j \quad , \tag{2.3}$$

and

$$\bar{T}_{ij} = \left(\rho_T + p_T\right) u_i u_j - g_{ij} p_T \quad , \tag{2.4}$$

Where, ρ_m , ρ_T and p_T are the energy density of matter, energy density of THDE and pressure of the THDE respectively.

The THDE density with Hubble horizon as the IR cutoff is [20].

$$\rho_T = BH^{-2\delta+4} \quad , \tag{2.5}$$

Where, F is an unknown parameter, H is the Hubble parameter and δ is a free parameter.

In comoving coordinate systems, the Einsteins field equations (2.2) for the metric (2.1), utilizing equations (2.3) - (2.4), can be expressed as

$$3\left(\frac{\dot{a}}{a}\right)^2 + 3\frac{\dot{a}\dot{b}}{ab} = \rho_T + \rho_m \quad , \tag{2.6}$$

$$2\frac{\ddot{a}}{a} + \frac{\ddot{b}}{b} + \left(\frac{\dot{a}}{a}\right)^2 + 2\frac{\dot{a}\dot{b}}{ab} = -p_T \quad , \tag{2.7}$$

$$3\frac{\ddot{a}}{a} + 3\left(\frac{\dot{a}}{a}\right)^2 = -p_T \quad , \tag{2.8}$$

Where, an overhead dot $(\cdot)$ represents derivative with respect to time t.

The Directional Hubble Parameter in the direction of x , y, z *and* ψ , denoted respectively, and the average Hubble parameter are defined as,

$$H_x = H_y = H_z = \frac{\dot{a}}{a} \quad \text{and} \quad H_\psi = \frac{\dot{b}}{b} \quad , \tag{2.9}$$

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$$H = \frac{1}{4}\frac{\dot{V}}{V} = \frac{1}{4}\sum_{i=1}^{4} H_i \quad . \tag{2.10}$$

The special volume, denoted as V and the Average Scale factor, denoted as R are defined as,

$$V = R^4 = a^3 b\,, \qquad R = \left(a^3 b\right)^{1/4} \quad . \tag{2.11}$$

The deceleration parameter, denoted as $q(t)$ is defined by,

$$q = -\frac{a\,\ddot{a}}{\dot{a}^2} \quad . \tag{2.12}$$

The mean anisotropy parameter of expansion, denoted as A_m, the expansion scalar θ, are defined for the metric as,

$$\mathrm{A}_m = \frac{1}{3}\sum_{i=1}^{3}\left(\frac{H_i - H}{H}\right)^2 \quad , \tag{2.13}$$

$$\theta = 3H \quad . \tag{2.14}$$

By utilizing equations (2.6) - (2.8), the cosmic scale factor can be expressed as,

$$a = D_1 V^{1/4} \exp\left(X_1 \int \frac{dt}{V} \right) \quad , \tag{2.15}$$

$$\mathrm{b} = \mathrm{D}_2 \mathrm{V}^{1/4} \exp\left(X_2 \int \frac{dt}{V} \right) \quad , \tag{2.16}$$

Where, the relation $D_1^3 D_2 = 1$ *and* $3X_1 + X_2 = 0$ are satisfied by D_1, D_2, X_1 & X_2, and $D_1 = d^{1/4}, D_2 = d^{-3/4}, X_1 = \frac{1}{4}x$ & $X_2 = \frac{-3}{4}x$.

From above the relation, if one can take $D_1 = D$ then $D_2 = D^{-3}$ and if $X_1 = X$ then $X_2 = -3X$. Then the equation (2.15) and (2.16) can be expressed as,

$$a = D V^{1/4} \exp\left(X \int \frac{dt}{V} \right) \quad , \tag{2.17}$$

$$\mathrm{b} = \mathrm{D}^{-3} \mathrm{V}^{1/4} \exp\left(-3X \int \frac{dt}{V} \right) \quad , \tag{2.18}$$

The energy conservation law $T^{ij}_{;j} = 0$, yields the continuity equation as

$$\dot{\rho}_m + \dot{\rho}_T + 4H\left(\rho_m + \rho_T + p_T\right) = 0 \quad . \tag{2.19}$$

In the interacting model, where DE interacts with DM through an interaction term Q, the continuity equation transforms to:

$$\dot{\rho}_m + 4H\rho_m = Q \quad , \tag{2.20}$$

$$\dot{\rho}_T + 4H\left(\rho_T + p_T\right) = Q \quad . \tag{2.21}$$

In this study, we opt for the interaction term $Q = 4\gamma H \rho_m$, where γ represents coupling parameter between DM and DE, setting $\gamma = 0$ results in the non-interacting model.
By employing Eq. (2.5) in (2.21), the Equation of State (EoS) parameter of THDE can be derived as:

$$\omega_T = \frac{p_T}{\rho_T} = -1 + \frac{(2\delta - 4)\dot{H}}{4H^2} - \gamma\frac{\rho_m}{\rho_T} \quad . \tag{2.22}$$

3. Cosmological Solutions of the model

To derive exact solutions for the field equations (2.6) - (2.8) and the cosmic scale factor a and b, we assume a specific law of variation for the Hubble parameter. This assumption leads to a constant value for the deceleration parameter [35].
According to this law, the variation of the mean Hubble parameter is expressed as,

$$H = k\, a^{-n} \quad , \tag{3.1}$$

Where, $k > 0$ and $n \geq 0$.
Here, we derive two cosmological models: I) A Model for $n = 0$ and II) A Model for $n \neq 0$.
In this paper we consider,

A Model for $n \neq 0$ [Power-law Volumetric Expansion Model]:

For $n \neq 0$, Equation (3.1) yields the volume scale factor as:

$$V = \left(nkt + c_2\right)^{4/n} \quad , \tag{3.2}$$

where $c_2 > 0$ is a constant of integration.
Using equation (3.2) into equations (2.17) - (2.18), we obtain the exact values of the scale factors as:

$$a = D\left(nkt + c_2\right)^{4/n} \exp\left(\frac{X}{k(n-4)}\left(nkt + c_2\right)^{n-4/n}\right) \quad , \tag{3.3}$$

$$b = D^{-3}\left(nkt + c_2\right)^{4/n} \exp\left(\frac{-3X}{k(n-4)}\left(nkt + c_2\right)^{n-4/n}\right) \quad . \tag{3.4}$$

The mean Hubble parameter H, deceleration parameter q, mean anisotropy parameter of expansion A_m and the expansion scalar θ for the model are respectively given as,

$$H = k\left(nkt + c_2\right)^{-1} \quad , \tag{3.5}$$

$$q = n - 1 \quad , \tag{3.6}$$

$$\mathrm{A}_m = \frac{3X^2 (nkt + c_2)^{\frac{2(n-4)}{n}}}{k^2} \quad . \tag{3.7}$$

$$\theta = 3H = 3k(nkt + c_2)^{-1} \quad , \tag{3.8}$$

The energy density of THDE is obtained as,

$$\rho_T = \frac{B\left(nkt + c_2\right)^{2\delta - 4}}{k^{2\delta - 4}} \quad . \tag{3.9}$$

The energy density of DM is obtained as,

$$\rho_m = 6k^2 (nkt + c_2)^{-2} - 6X^2 (nkt + c_2)^{-8/n} - Bk^{4-2\delta}(nkt + c_2)^{2\delta - 4} . \tag{3.10}$$

The Equation of State (EoS) parameter of THDE is given as,

$$\omega_T = -1 - \frac{(2\delta-4)n}{4} - \gamma\left[\frac{6k^2(nkt+c_2)^{-2} - 6X^2(nkt+c_2)^{-8/n}}{Bk^{4-2\delta}\left(nkt+c_2\right)^{2\delta-4}} - 1\right]. \quad (3.11)$$

4. Conclusion

In this work we have studied five dimensional Kaluza-Klein Universe filled with Dark Matter and Dark Energy in the framework of Einstein's theory of Relativity. The concluding remarks of the model are as below:

1. The anisotropic parameter is positive and decreases with respect to time t and approaches to zero after some time t. Thus, the observed isotropy of the universe can be achieved in our derived model at the present epoch.
2. The EoS parameter $-1 < \omega_T > -1/3$ i.e. The EoS parameter of THDE behaves like quintessence.
3. The sign of q indicates whether the model accelerates or not. The positive sign of q (for $n > 1$) corresponds to the deceleration of the universe, whereas the negative sign $-1 \le q < 0$ for $0 \le n < 1$ indicating inflation of the universe and for $n = 1$ gives $q = 0$ corresponds to expansion with constant velocity i.e. Acceleration and deceleration of the model may depend on the value of n.
4. The Anisotropy of expansion dies out very quickly also the special volume V is finite at $t \to 0$ and diverges for $t \to \infty$ thus the universe approaches to isotropy for large cosmic time.
5. The Hubble parameter H and the expansion scalar θ are constant for $t = 0$ and vanish for $t = \infty$.

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Role of Special form of Deceleration Parameter in $f(R,T)$ theory

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Abstract:
We have studied locally rotationally symmetric Bianchi-V Universe in the presence of modified theory for gravitation and for that, we considered perfect fluid with heat conduction as the energy source. We have obtained the solutions of field equations by assuming the special form of deceleration parameter and arrived at values of the scale factor. Also, we have discussed the physical and geometrical properties of the model in detail.
Keywords: $f(R,T)$ gravity, LRS Bianchi type V, perfect fluid, deceleration parameter.

1. Introduction

Modern cosmology achieved a new path because of the idea of accelerated expansion of the Universe. This is the main reason why the modern cosmology is the fastest-growing field in the study of the Universe. It is well known as $f(R,T)$ theory of gravity which was proposed by Harko et al.(2011), where R is the Ricci scalar and T is a trace of the stress-energy tensor. The $f(R,T)$ theory has attracted a lot of attention of the astrophysicist in recent times and hence discussion is going on by many researchers in this modified theory because of its ability to explain mysterious things in cosmology and astrophysics, for more detail one can refer the work by [Barrow and Turner (1981), Sahoo et al. (2016), Gron (1983), Yousaf et al. (2017), Pawar et al. (2016), Pawar and Shahare (2019, 2020), Khade (2022, 2023)]. The most curios mystery of the Universe is Big-Bang singularity and hence it is very obvious that researchers are interested to study the behavior of the Universe near the Big-Bang singularity. We are interested and motivated by one of the alternative theory of gravitation.

From the above work, we got a motivation to study the behavior of the Universe by considering LRS Bianchi-V space-time, filled with perfect fluid with heat conduction in $f(R,T)$ theory. The physical and dynamical behavior of the Universe is also observed. The paper is organized as follows: In section 2 we discussed the $f(R,T)$ gravity. In Section 3, we have studied the metric (Bianchi type-V) and field equations for $f(R,T)$ gravity. In Section 4, we have studied solution of the field equation using special form of deceleration parameter. we have discussed the physical and dynamical parameters in section 5. At the last section 6, we have discussion and conclusion our work.

2. Field equation of $f(R,T)$ theory

Hilbert-Einstein variational principle on which field equation of $f(R,T)$ theory formed, is given by,

$$S = \int \left[\frac{1}{2\kappa} f(R,T) + L_m\right]\sqrt{-g}\, d^4x, \tag{1}$$

The gravitational field equations for $f(R,T)$ gravity are,

$$f_R(R,T)R_{ij} - \frac{1}{2} f(R,T)g_{ij} + \left(g_{ij}\nabla^i\nabla_j - \nabla_i\nabla_j\right)f_R(R,T) = \kappa T_{ij} - f_T(R,T)T_{ij} - f_T(R,T)\Theta_{ij}. \tag{2}$$

where ∇_i being the covariant derivative and

$$f_R = \frac{\partial f(R,T)}{\partial R} \quad \text{and} \quad f_T = \frac{\partial f(R,T)}{\partial T} \quad \Theta_{ij} = g^{\alpha\beta}\frac{\partial T_{\alpha\beta}}{\partial g^{ij}} \tag{3}$$

we choose $\kappa = \frac{8\pi G}{c^4}$.

The energy-momentum tensor for a perfect fluid with heat flow is given by Singh (2008)

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$$T_{ij} = (\rho + p)u_i u_j + p g_{ij} + h_i u_j + h_j u_i \tag{4}$$

Where ρ is the energy density, p is the thermodynamic pressure, u_i is the four-velocity of the fluid, h_i is the heat flow vector satisfying

$$h^i u_i = 0 \qquad h^i u_i > 0 \tag{5}$$

Let us consider that $h^i = \delta_0^i$ .Then the field equation and eq.(5) give that the heat flow is in the x-direction only, and therefore we have

$$h_i = (h_1(t), 0,0,0) \tag{6}$$

In the present work, we have taken particular functional as $f(R,T) = R + 2f(T)$ otherwise functional can be taken in different ways corresponding to viable models. Here $f(T)$ is a function of the trace of the energy-momentum tensor. Also, we have obtained the variation of stress-energy for perfect fluid with heat flow is

$$\Theta_{ij} = -2T_{ij} - p g_{ij} \tag{7}$$

By using this functional and Θ_{ij} field equation can be rewritten as,

$$R_{ij} - \frac{1}{2}R g_{ij} = kT_{ij} - f_T T_{ij} + 2f_T T_{ij} + f_T p g_{ij} \tag{8}$$

where f_T is a partial derivative of f with respect to T.

Assuming $f(T) = \lambda T$, (9)

where λ being constant, we have chosen a system for $\kappa = 1$.

3. Metric and field equations

We consider Locally Rotationally Symmetric (LRS) Bianchi type-V space-time described by the line element

$$ds^2 = A^2 dx^2 + B^2 e^{2x}(dy^2 + dz^2) - dt^2 \tag{10}$$

Here, A and B are functions of cosmic time t only.

Now using a co-moving coordinate system, the field Eqn.(8) with the help of Eqn.(4) and Eqn.(5) for the metric Eqn.(10), can be explicitly written as

$$2\frac{\ddot{B}}{B} + \frac{\dot{B}^2}{B^2} - \frac{1}{A^2} = -p \tag{11}$$

$$\frac{\ddot{A}}{A} + \frac{\ddot{B}}{B} + \frac{\dot{A}\dot{B}}{AB} - \frac{1}{A^2} = -p \tag{12}$$

$$2\frac{\dot{A}\dot{B}}{AB} + \frac{\dot{B}^2}{B^2} - \frac{3}{A^2} = \rho \tag{13}$$

$$2\left(\frac{\dot{B}}{B} - \frac{\dot{A}}{A}\right) = h_1 \tag{14}$$

Here over-headed dot means derivative with respect to t.

The average scale factor is

$$a(t) = (AB^2)^{\frac{1}{3}} \tag{15}$$

The spatial volume is

$$V = a^3 = AB^2 \tag{16}$$

The directional Hubble parameters are

$$H_x = \frac{\dot{A}}{A} \qquad H_y = H_z = \frac{\dot{B}}{B} \tag{17}$$

The average Hubble parameter is

The dynamical scalar expansion θ and shear scalar σ^2 are

$$\theta = 3H = [\frac{\dot{A}}{A} + 2\ \frac{\dot{B}}{B}] \tag{18}$$

$$\sigma^2 = \frac{1}{2}\sigma^{ij}\sigma_{ij} = \frac{1}{2}[\frac{\dot{A}}{A} - \frac{\dot{B}}{B}]^2 \tag{19}$$

The average anisotropic parameter Δ is

$$\Delta = \frac{1}{3}\sum_{i=1}^{3}\left[\frac{H_i - H}{H}\right]^2 \tag{20}$$

Here Hi represents the directional Hubble parameters $(i = 1,2,3)$

The deceleration parameter (DP) is

$$q = -1 + \frac{d}{dt}\left(\frac{1}{h}\right) \tag{21}$$

Now, Eqns.(11)-(14) can be written in terms of H, q, σ^2 as

$$\rho = 3H^2 - \sigma^2 + \frac{1}{A^2} \tag{22}$$

$$p = H^2(2q-1) - \sigma^2 + \frac{1}{A^2} \tag{23}$$

4. Solution of the field equations

In order to solve the system completely, we use a special form of deceleration parameter defined by Debnath et al. (2009) for FRW metric as

$$q = -\left[\frac{a\ddot{a}}{\dot{a}^2}\right] = -1 + \frac{\alpha}{1+a^\alpha} \tag{24}$$

where, $\alpha > 0$ is a constant and a is scale factor of the universe.

After solving equation (24) one can obtain the mean Hubble parameter H as

$$H = \frac{\dot{a}}{a} = k(1 + a^{-\alpha}) \tag{25}$$

where $k > 0$ is a constant of integration.

On integrating equation (25), we obtain the mean scale factor as

$$a = (e^{k\alpha t} - 1)^{\frac{1}{\alpha}} \tag{26}$$

Choose $k = 1$.

$$a = (e^{\alpha t} - 1)^{\frac{1}{\alpha}} \tag{27}$$

To find the determinate solution of the system, we used the law of variation. Now, from Eqn.(11) and Eqn.(12), we get

$$\frac{\ddot{B}}{B} - \frac{\ddot{A}}{A} + \frac{\dot{B}^2}{B^2} - \frac{\dot{A}\dot{B}}{AB} = 0 \tag{28}$$

This, on integration gives,

$$\frac{\dot{B}}{B} - \frac{\dot{A}}{A} = \frac{c_1}{AB^2} \tag{29}$$

Where c_1 is constant of integration.

$$\frac{B}{A} = c_2 \exp\left[\int \frac{c_1}{a^3} dt\right] \tag{30}$$

Using Eqn.(15) in Eqn.(29) and integrating again, the metric functions A and B in terms of average scale factor $a(t)$ are given by

$$A = c_2^{-2/3} a exp\left[\frac{-2c_1}{3}\int a^{-3}\, dt\right] \tag{31}$$

$$B = c_2^{1/3} a exp\left[\frac{c_1}{3}\int a^{-3}\, dt\right] \tag{32}$$

Now using Eqn.(27) in Eqn.(31) and Eqn.(32), we get

$$A = c_2^{-2/3}(e^{\alpha t} - 1)^{\frac{1}{\alpha}} exp\left[\frac{-2c_1}{3}\frac{(e^{\alpha t}-1)^{\frac{\alpha-3}{\alpha}}}{(\alpha-3)e^{\alpha t}}\right] \tag{33}$$

$$B = c_2^{1/3}(e^{\alpha t} - 1)^{\frac{1}{\alpha}} exp\left[\frac{c_1}{3}\frac{(e^{\alpha t}-1)^{\frac{\alpha-3}{\alpha}}}{(\alpha-3)e^{\alpha t}}\right] \tag{34}$$

$$ds^2 = c_2^{-4/3}(e^{\alpha t} - 1)^{\frac{2}{\alpha}} exp\left[\frac{-4c_1}{3}\frac{(e^{\alpha t}-1)^{\frac{\alpha-3}{\alpha}}}{(\alpha-3)e^{\alpha t}}\right] dx^2 + c_2^{2/3}(e^{\alpha t} - 1)^{\frac{2}{\alpha}} exp\left[\frac{2c_1}{3}\frac{(e^{\alpha t}-1)^{\frac{\alpha-3}{\alpha}}}{(\alpha-3)e^{\alpha t}}\right] e^{2x}(dy^2 + dz^2) - dt^2 \tag{35}$$

5. Physical parameters of the model

Dynamical parameters are quite significant in the discussion of the physical properties of the cosmological model and to develop a cosmological theory in $f(R,T)$ theory of gravity. We

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compute the following cosmological parameters for the model given by Eqn.(25). The spatial volume of the metric is

$$V = (e^{\alpha t} - 1)^{\frac{3}{\alpha}} \tag{36}$$

The directional Hubble parameters are

$$H_x = \frac{\dot{A}}{A} = \left\{\frac{-2c_1}{3(e^{\alpha t}-1)^{\frac{3}{\alpha}}} + \frac{e^{\alpha t}}{(e^{\alpha t}-1)}\right\} \tag{37}$$

$$H_y = \frac{\dot{B}}{B} = \left\{\frac{c_1}{3(e^{\alpha t}-1)^{\frac{3}{\alpha}}} + \frac{e^{\alpha t}}{(e^{\alpha t}-1)}\right\} \tag{38}$$

The average Hubble parameter is

$$H = \frac{e^{\alpha t}}{(e^{\alpha t}-1)} \tag{39}$$

The dynamical scalar expansion θ and shear scalar σ^2 are

$$\theta = 3H = \frac{3e^{\alpha t}}{(e^{\alpha t}-1)} \tag{40}$$

$$\sigma^2 = \frac{1}{2}\frac{{c_1}^2}{(e^{\alpha t}-1)^{\frac{6}{\alpha}}} \tag{41}$$

The solution of heat conduction can be obtained as

$$h_1 = \frac{2c_1}{(e^{\alpha t}-1)^{\frac{3}{\alpha}}} \tag{42}$$

The anisotropic parameter Δ is

$$\Delta = \frac{2c_1^2}{9e^{2\alpha t}(e^{\alpha t}-1)^{\frac{2(3-\alpha)}{\alpha}}} \tag{43}$$

Now using the above equations in Eqn.(22) and Eqn.(23), we get energy density and pressure as follows:

$$\rho = 3\frac{e^{2\alpha t}}{(e^{\alpha t}-1)^2} - \frac{1}{2}\frac{{c_1}^2}{(e^{\alpha t}-1)^{\frac{6}{\alpha}}} - \frac{3}{c_2^{\frac{-4}{3}}(e^{\alpha t}-1)^{\frac{2}{\alpha}} exp\left[\frac{-4c_1(e^{\alpha t}-1)^{\frac{\alpha-3}{\alpha}}}{3(\alpha-3)e^{\alpha t}}\right]} \tag{44}$$

$$p = \frac{e^{2\alpha t}}{(e^{\alpha t}-1)^2}\left[-3 + \frac{2\alpha}{e^{\alpha t}}\right] - \frac{1}{4}\frac{{c_1}^4}{(e^{\alpha t}-1)^{\frac{12}{\alpha}}} + \frac{3}{c_2^{\frac{-4}{3}}(e^{\alpha t}-1)^{\frac{2}{\alpha}} exp\left[\frac{-4c_1(e^{\alpha t}-1)^{\frac{\alpha-3}{\alpha}}}{3(\alpha-3)e^{\alpha t}}\right]} \tag{45}$$

6. Discussion and Conclusion:

we have studied locally rotationally symmetric Bianchi-V with perfect fluid and heat conduction as the energy source. The solutions of the field equations are obtained under the assumption of special form of deceleration parameter. So we found solutions in the presence of heat conduction only and we have not discussed the solutions without heat conduction. Here we found some of the dynamical parameters, metric potentials, internal pressure, density and mainly the heat flow for which our work is devoted. We observed that at an initial time, metric potential $A(t)$ and $B(t)$ are zero. Also, it tends to zero as well as infinity depending on the value of α, i.e. for $\alpha < 3$ and $\alpha > 3$ respectively. The average Hubble parameter (H) and shear scalar (σ) are the function of time t and have a singularity at t = 0 and it tends to zero for large t. dynamical expansion scalar (θ) and Heat flow is infinite at initial epoch but it will vanish for large t. The volume of the universe is zero when $t \to 0$ and as time increases volume V increases exponentially. When $t \to 0, \rho \to \infty$ and when $t \to \infty, \rho \to 0$, which indicates that the universe starts with initial (Big-Bang) type of singularity and the models reduces to vacuum at very late time. The anisotropy of expansion is maintained throughout the evolution of the universe. The deceleration parameter q varies from 1 to -1. It shows that the universe accelerates after an epoch of deceleration. The deceleration parameter q is in the range $-1 \leq$

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$q \leq 0.5$ which matches with the observations made by Riess et al. (1998) and Perlmutter et al. (1999) and the present day universe is undergoing accelerated expansion.

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Exploration of Barrow Holographic Dark Energy in Modified Theory of Gravitation

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Abstract:
In this paper, we consider the Bianchi-I Kasner type space-time in the presence of Barrow Holographic Dark Energy in the context of $f(R,T)$ theory of gravitation. It is observed that universe is accelerating through the variation of the equation of state (EoS) parameter. In addition, stability of the BHDE model has been examined by squared sound speed v_s^2.

Keywords: Kasner metric, $f(R,T)$ gravity, Barrow Holographic Dark Energy.

1. Introduction

One of the most straightforward methods for replicating the observed late-time expansion of the Universe is through alternative theories of gravity [1-3]. Furthermore, there are a number of consistency issues with general relativity (GR) [4, 5] that need to be resolved in the end. The question therefore becomes, which gravity theories preserve the positive aspects of General Relativity while addressing some of the unanswered problems? The most logical and natural extension of the Einstein-Hilbert action is to substitute any function f(R) for the Ricci scalar *R*. This is the widely recognized Gravitation hypothesis f (*R*). The late-time cosmic acceleration has been tested to be explained by this modified gravity hypothesis , and it is consistent with the local gravitational tests [6–12]. Harko et al. [13] have recently suggested an additional adjustment that takes the Einstein-Hilbert action into consideration and represents it as f(*R*,*T*) ,where *T* is the trace of the energy-momentum tensor. The incorporation of the matter element in the gravity Lagrangian may have been justified by the quantum effect manifested as conformal anomaly. Nevertheless, because of the interaction between matter and gravity, this gravity model depends on the source term. As a result, test particles lack a geodesic path and a hypothetical force term exists perpendicular to the four velocities. Moreover, the field equations get extremely complex.

The authors are motivated to investigate various cosmological issues because of the crucial role that the Kasner [14, 15] metric has played in clarifying the existence, composition, and singularities of anisotropic cosmological models in general relativity. One of the metrics that is studied the most is the Kasner metric. Its applicability in building of cosmological models and its usefulness for specific investigations of basic particles have made it especially appealing for use. Due to its simplicity, it has been "rediscovered" numerous times and shares a close relationship with measures provided by Weyl, Levi-Civita, and Wilson several years prior. The dynamic form of the synchronous Bianchi I metric has virtually replaced the one in which Kasner first described it. The space-time is invariant under a three-dimensional Abelian translation group, and the Kasner solution generally gives an anisotropic metric in which the space directions are Killing translations. The Kasner metric is a one-parameter family of solutions for a four-dimensional space-time because it contains three parameters, or the Kasner indices, which must fulfil the two so-called Kasner algebraic relations. In particular, the intersection of a three-dimensional sphere with radius unity and a plane in which the total of those parameters equals one defines the values of the parameters on the real number line.

The Holographic Dark Energy (HDE) provides a helpful paradigm. Such a method, which starts from the holographic principle with Bekenstein-Hawking (BH) entropy and the Hubble horizon as its IR cutoff, offers a precise quantitative analysis of DE in its original formulation. However, several hesitant modifications to this model have been inspired by its difficulties in explaining the history of a flat Friedmann-Robertson-Walker (FRW) Universe. For example, HDE has been used in the BD framework to address the DE problem by taking into account various IR cutoffs or appropriate interactions with DM.The holographic dark energy proposed by Barrow [16] has a complex structure that lead to a finite volume but with infinite (or finite) area, which is given by

$S_B = \left(\frac{A}{A_0}\right)^{\frac{2+\nabla}{2}}$,where A represents standard horizon area and A_0 is the Planck area. The new form of the exponent Δ was introduced by Barrow, which lies in the range $0 \le \Delta \le 1$. For $\Delta = 0$, the expression reduces to the standard Bekenstein–Hawking entropy. The standard holographic dark energy is given by the inequality $\rho_B L^4 \le 4$, where L is the horizon length, and imposing the inequalities $S\,\alpha\, A\alpha\, L^2$. We consider here a modified form of density introduced by Barrow to define the entropy caused by quantum-gravitational effects, which yields $\rho_B = C L^{\Delta-2}$. The energy density of Barrow HDE is $\rho_B = C H^{\,2-\Delta}$.

In this paper, we consider the Bianchi-I Kasner type space-time in the presence of Barrow Holographic Dark Energy in the context of $f(R,T)$ theory of gravitation.

2. METRIC AND FIELD EQUATIONS

We consider an anisotropic [Bianchi type-I] metric in Kasner form as

$$ds^2 = dt^2 - t^{2p_1} dx^2 - t^{2p_2} dy^2 - t^{2p_3} dz^2 \tag{1}$$

where p_1, p_2, p_3 are three parameters satisfying $p_1 + p_2 + p_3 = s$, $p_1^{\,2} + p_2^{\,2} + p_3^{\,2} = \theta$.The parameters p_1, p_2, p_3 will require to be constants and if at least two of the three are different, the space is anisotropic.

The action of $f(R,T)$ in the presence of matter with Lagrangian is

$$S = \frac{1}{16\pi}\int f(R,T)\sqrt{-g}\, d^4x + \int L_m\, d^4x \tag{2}$$

The field equations of $f(R,T)$ gravity model discovered by Harko et al. [13]:

$$f_R(R,T) R_{ij} - \frac{1}{2}(R,T) g_{ij} + (g_{ij} \; - \nabla_i \nabla_j) f_R(R,T) = 8\pi T_{ij} - f_T(R,T) T_{ij} - f_R(R,T)\Theta_{ij} \tag{3}$$

where, $T_{ij} = \frac{-2\partial(\sqrt{-g})}{\sqrt{-g}\,\partial g^{ij}} L_m$, $\Theta_{ij} = -2T_{ij} - p\, g_{ij}$, $f_R(R,T) = \frac{\partial f(R,T)}{\partial R}$, $f_T(R,T) = \frac{\partial f(R,T)}{\partial T}$,

As a popular choice , $f(R,T) = R + 2 f(T)$ (4)

where the function $f(T)$ depends only on the trace of the matter field. Using the above equation, the gravitational field equations reduce to:

$$G_{ij} = R_{ij} - \frac{1}{2} R g_{ij} \; = 8\pi T_{ij} + 2 f^{\,l}(T) T_{ij} + [2p f^{\,l}(T) + f(T)]\, g_{ij}, \tag{5}$$

where the prime indicates the differentiation with respect to the argument. We choose the function of matter as: $f(T) = \mu T$, (6)

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where μ is constant. The energy momentum tensor for matter (T_{ij}) and BHDE (Barrow Holographic dark energy $(\overline{T_{ij}})$ is given by :

$$T_{ij} = \rho_m u_i u_j \text{ and } \overline{T}_{ij} = (\rho_B + p_B) u_i u_j - g_{ij} p_B, \tag{7}$$

where ρ_B, ρ_m, p_B are the energy densities of BHDE, dark matter and the BHDE pressure. It satisfies the condition $u^i u_i = 1$. In co-ordinate system $u^1 = u^2 = u^3 = 0, u^4 = 1$ we get, $T_1^1 = T_2^2 = T_3^3 = 0$, $T_4^4 = \rho_m$, $\overline{T}_1^1 = \overline{T}_2^2 = \overline{T}_3^3 = -\omega_B \rho_B$, $\overline{T}_4^4 = \rho_B$. We have the following relation

$$T = -3\omega_B \rho_B + \rho_m + \rho_B. \tag{8}$$

In co-moving coordinate system, from equations (1)-(8), it is easy to write down the expression for the field equation:

$$[p_1(s-1) - K_0]t^{-2} = -(8\pi + 3\mu)\omega_B \rho_B + \mu(\omega_m + \rho_B), \tag{9}$$

$$[p_2(s-1) - K_0]t^{-2} = -(8\pi + 3\mu)\omega_B \rho_B + \mu(\omega_m + \rho_B), \tag{10}$$

$$[p_3(s-1) - K_0]t^{-2} = -(8\pi + 3\mu)\omega_B \rho_B + \mu(\omega_m + \rho_B), \tag{11}$$

$$[\frac{1}{2}(\theta - s^2)]t^{-2} = (8\pi + 3\mu)(\rho_m + \rho_B) + 2p_B \mu - 3\omega_m \rho_B \mu \quad , \tag{12}$$

where, $K_0 = \frac{1}{2}(s^2 - 2s + \theta)$.

Using equations (9), (10) & (11) , we get $p_1 = p_2 = p_3 = p*$ (say).

Hence equations (9)-(11) yield

$$[p^* (s-1) - K_0]t^{-2} = -(8\pi + 3\mu)\omega_B \rho_B + \mu(\omega_m + \rho_B) \tag{13}$$

The energy density of Barrow HDE is:

$$\rho_B = c\left(\frac{p^*}{t}\right)^{2-\Delta} \tag{14}$$

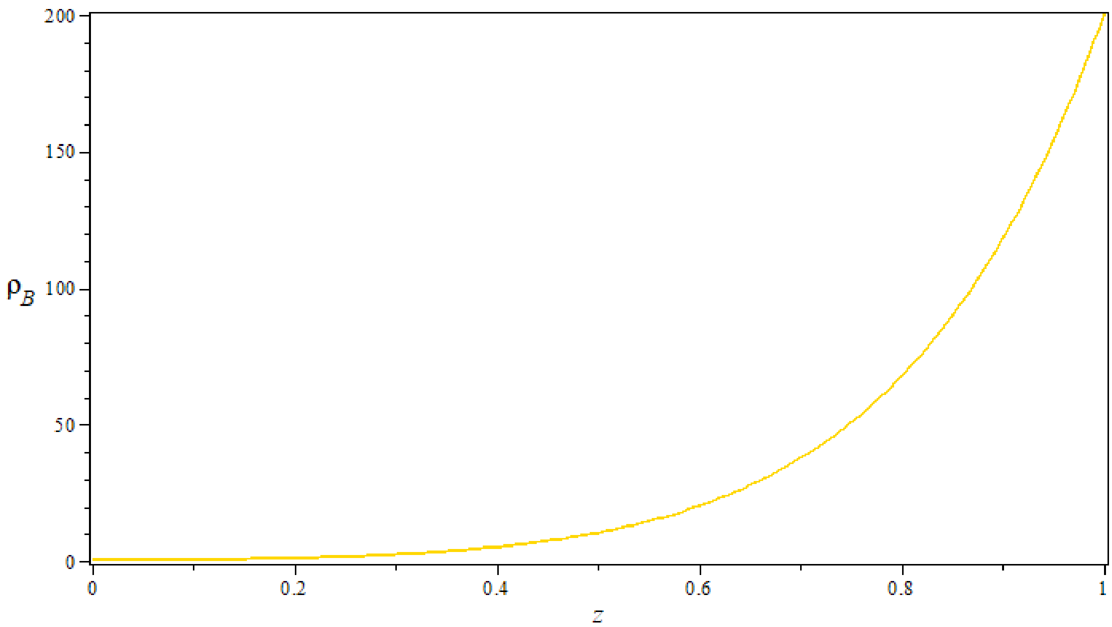

Fig 1. Plot of energy density $\rho_{B,}$ of Barrow holographic dark energy against Red-shift z

The behavior of energy density for our model versus redshift is shown in Fig. 1.From this figure, it is observed that the energy density is positive and is a decreasing function of redshift. Also, when z = 0, the energy density of Universe is positive and increases with the escalation in the value of z.

The EoS parameter, matter density and pressure are expressed as

$$\omega_B = \frac{1}{c\left(p^*/t\right)^{2-\Delta}[(8\pi+3\mu)^2-\mu^2]}\left\{\frac{\mu(\theta-s^2)}{2}-(8\pi+3\mu)[p^*(s-1)-k_0]\right\}t^{-2} \tag{15}$$

$$\rho_m = \left\{\frac{[p^*(s-1)-k_0]}{\mu}-\frac{(8\pi+3\mu)^2}{[(8\pi+3\mu)^2-\mu^2]}\frac{[p^*(s-1)-k_0]}{\mu}+\frac{(8\pi+3\mu)}{[(8\pi+3\mu)^2-\mu^2]}\frac{(\theta-s^2)}{2}\right\}t^{-2}-\rho_B \tag{16}$$

$$p_B = \left\{\frac{[1-16\pi]}{[1-(1-16\pi)^2]}\{2(s-1)-(s^2-2s+\theta)-(1-16\pi)(\theta-s^2)\right\}t^{-2}-(\theta-s^2)t^{-2}. \tag{17}$$

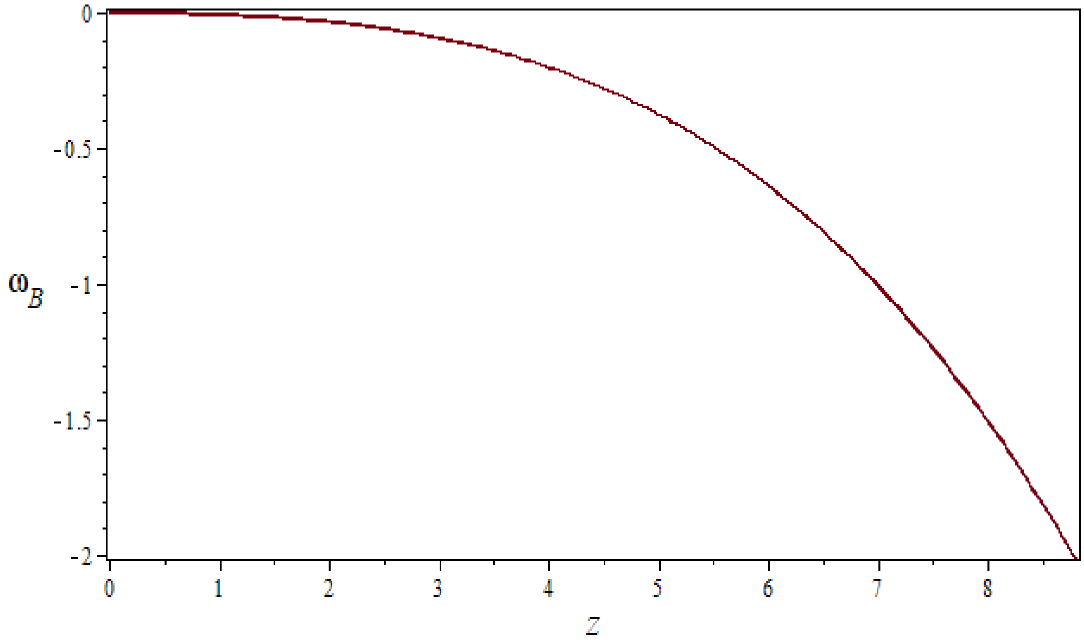

Fig 2. The behaviour of EoS Parameter $\omega_{B,}$ against redshift z .

Figure 2 illustrates the evolution of the equation of state as a function of red-shift z. The outcomes of our model align with the limitations of the equation of state parameter for the Planks Collaboration and WMAP, which provide the parameter ranges: $-0.92 \le \omega \le -1.26$ (Planck+ WP+ Union 2.1), $-0.89 \le \omega \le -1.38$ (Planck +WP+BAO), $-0.983 \le \omega \le -1.162$ (WMAP+eCMB+BAO+H0). Lastly, the behaviour of the developed model agrees well with current SNe-Ia observational data.

We can test the stability of our BHDE model against perturbations by using the squared sound speed $v_s^2 = \frac{dp_B}{d\rho_B}$, which is given

$$V_s^2 = \frac{(1+z)^{\frac{\Delta}{p}}}{c(2-\Delta)\,p^{2-\Delta}}\frac{1}{[(8\pi+3\mu)^2-\mu^2]}\{\mu(\theta-s^2)-(16\pi-6\mu)[p(s-1)-k_0]\}. \tag{18}$$

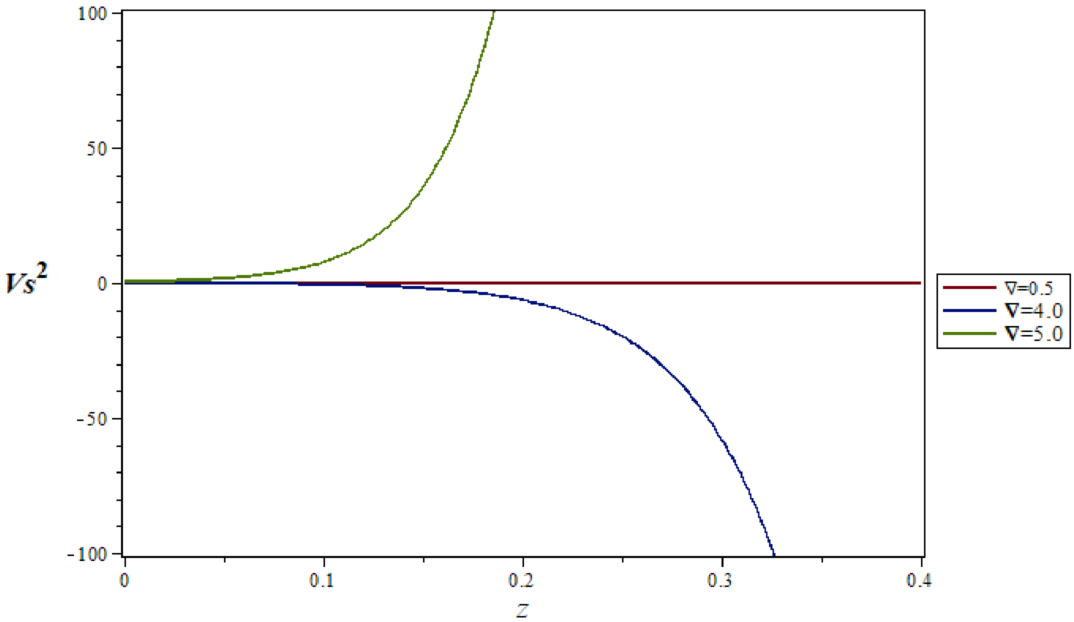

Fig. 3. The behaviour of squared sound speed v_s^2 as a function of redshift z for distinct values of ∇.

The behaviour of squared sound speed v_s^2 given in Eq. (18) is plotted against redshift z show in Fig. 3. We observed that as $z \to -1$ i.e. in the future, stability of our BHDE models occurs for $\Delta = 5.0$, 0.5 (for large scale), while for $\Delta = 4.0$ an instability persists.

3. Conclusions:

In this presented paper, we have explored the Kasner space-time in the presence of Barrow holographic dark energy in the context of modified $f(R,T)$ theory of gravitation. It is observed that the energy density of BHDE is positive and decreases as universe expands. In addition, the equation of state parameter of our model shows the transition from zero to negative value with cosmic evaluation where as the stability parameter in term of squared speed is stable for some values of Δ.

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Dynamical instability of cosmological model in *f(R,T)* theory of gravitation

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Abstract:

In this paper, we have investigated the dynamical instability of Kantowski-Sachs universe in the framework of *f(R,T)* theory of gravitation. In this scenario, we have presented the dynamical equations from the contracted Bianchi identities for the locally anisotropic fluid. Perturbation scheme is applied to the dynamical equations and the physical variables to find the general collapse equation. The dynamical instability is explored in the Newtonian (N) and Post-Newtonian (pN) regimes. It is found that the adiabatic index plays an important role in the stability analysis.

Keywords: Kantowski-Sachs, *f(R,T)* theory, Adiabatic Index

1 Introduction

In modern cosmology the modified theories of gravitation are playing important role to explain the dark energy dominance in the universe. The astronomical observations from several sources of high red shift from Ia supernova, cosmic microwave background, large scale structure indicate that the present universe is undergoing the accelerated expansion (Riess et al. 1998,Perlmutter et al. 1999, Komatsu et al. 2011). It is generally believed that some sort of dark energy is responsible for this mysterious nature of the universe. This is a hypothetical form of energy that tends to increase the rate of expansion of the universe. To explain the actual nature of dark energy, several modified theories have been developed and studied.

The general theory of relativity is well consistent with the observational local tests up to the solar system scale. But to give the correct explanation of evolution of the universe, the modified theories of gravitation have been formulated by modifying the Einstein-Hilbert action on the larger cosmological scales. Therefore, much attention has been paid on the modified theories of gravitation. There are several modified theories of gravitation, i.e., *f(R), f(T), f(G), f(R,T), f(R,G)* etc. These theories lead to an alternative route for dark energy models. The *f(R)* gravity (Nojiri and Odinstov, 2003, De Felice and Tsujikawa, 2010)gives a natural unification of early time inflation and late time acceleration. The *f(T)* gravity is the generalization of teleparallel gravity. *f(G)* and *f(R,G)* are among the other modified theories which are used for the analysis of accelerated expansion of the universe. Recently, Katore and Hatkar (2015a) have investigated two fluid cosmological models in *f(R)* theory of gravitation.

To study the phenomenon of gravitational collapse has been the topic of interest among many researchers. In relativistic physics, the gravitational collapse is useful to explain the formation of structure in the universe. Oppenheimer and Synder (1939) were the first to study the system under gravitational collapse. Thorne (1965) have discussed the gravitational collapse and the death of a star. Joshi et al. (2004) have investigated the influence of shearing effects present within a collapsing matter cloud and outcome of gravitational collapse in terms of formation of either a black hole or a naked singularity as the final end state. Chakraborty and Bandopadhyay (2010) have studied collapse dynamics of a star of dark matter and dark energy. Sharif and Rani (2014) have investigated the dynamical instability of spherical collapse in *f(T)* gravity. Radiating collapse in the presence of anisotropic stresses have been discussed by Govender et al. (2016).

Herko et al. (2011) have presented another expansion of the general theory of relativity called *f(R,T)* theory of gravitation, where the gravitational Lagrangian is given by an arbitrary

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function of Ricci scalar R and trace of stress energy tensor T. Reddy et al. (2012) have investigated Bianchi type-III cosmological model in *f(R,T)* theory of gravity. Shriram et al. (2013) have studied anisotropic cosmological models in *f(R,T)* theory of gravitation. Singh and Singh (2014) have discussed reconstruction of modified *f(R,T)* gravity with perfect fluid cosmological models. They have concluded that it is possible to explain dark energy model through the reconstructed form of *f(R,T)* with perfect fluid in flat Friedmann-Robertson-Walker (FRW) model with the suitable choice of the form $f(R,T) = R + 2f(T)$, where R is considered as a variable.

The stability analysis against fluctuations plays a key role to study the existence of stellar structures. It should be noted that different instability ranges of the stellar structures leadto the various patterns of evolution. The dynamical instability with the use of adiabatic index was first explored by Chandrasekhar (1964). Chan et al. (1989) examined the heat flow and dynamical instability in spherical collapse. Later on, Herrera et al. (2012) have analysed dynamical instability and the expansion free condition. Sharif and Azam (2013) have studied the stability of anisotropic cylinder with zero expansion. But they have concluded that stability of cylinder depends upon physical properties of the fluid, not on the stiffness,i.e., adiabatic index of the fluid.

Recently, many authors have extended this work in modified theories of gravitation. Sharif and Yousaf (2014a) have studied electromagnetic field and dynamical instability of collapse with CDTT model. They found that *f(R)* solutions rely completely on the properties of matter variables such as radial and tangential pressure, energy density, higher curvature terms and electric charge occupied by the sphere. Sharif and Rani (2014) have investigated dynamical instability of expansion-free collapse in *f(T)* gravity. Noureen and Zubair (2015) have analysed dynamical instability of spherical star in *f(R,T)* theory of gravitation.

Motivated by the above work, we have studied dynamical instability of Kantowski-Sachs universe in *f(R,T)* theory of gravitation. The paper is organised as follows. Sect. 2 deals with field equations and dynamical equations. Sect. 3 contains the perturbation scheme. In Sect. 4, we have studied the Newtonian (N) and Post-Newtonian (pN) regimes of the system under consideration. Sect. 5 covers the conclusion followed by appendix.

2 Field equations and dynamical equations

The *f(R,T)* action is given by (Herko et al. 2011)

$$\int dx^4 \sqrt{-g}\left[\frac{f(R,T)}{16\pi G} + L_M\right], \tag{1}$$

where L_M is the matter Lagrangian. The stress energy tensor for fluid configuration is given by (Landau and Lifshitz, 2002)

$$T^m_{\mu\nu} = g_{\mu\nu}L_M - \frac{2\partial L_M}{\partial g^{\mu\nu}}. \tag{2}$$

Varying the action (1) with respect to $g_{\mu\nu}$, we obtain the field equations in *f(R,T)*gravity

$$\begin{aligned} &R_{\mu\nu} f_R(R,T) - \frac{1}{2} g_{\mu\nu} f(R,T) + \left(g_{\mu\nu}\nabla^{\alpha}\nabla_{\alpha} - \nabla_{\mu}\nabla_{\nu}\right) f_R(R,T) \\ &\quad = 8\pi G T^m_{\mu\nu} - f_T(R,T) T^m_{\mu\nu} - f_T(R,T)\Theta_{\mu\nu}, \end{aligned} \tag{3}$$

where $f_R(R,T)$ and $f_T(R,T)$ denote derivatives of $f(R,T)$ with respect to R and T respectively. ∇_{α} is the covariant derivative associated with the Levi-Civita connection of the metric tensor and $\Theta_{\mu\nu}$ is given by

$$\Theta_{\mu\nu} = -2T^{m}_{\mu\nu} + g_{\mu\nu}L_M - 2g^{\alpha\beta}\frac{\partial^2 L_M}{\partial g^{\mu\nu}\partial g^{\alpha\beta}}. \qquad (4)$$

Here we choose $L_M = \rho$. Hence

$$\Theta_{\mu\nu} = -2T^{m}_{\mu\nu} + g_{\mu\nu}L_M. \qquad (5)$$

Therefore equation (3) takes the form

$$G_{\mu\nu} = \frac{1}{f_R}\left[(f_T + 1)T^{m}_{\mu\nu} - \rho g_{\mu\nu} f_T + \frac{f - Rf_R}{2} g_{\mu\nu} + \left(\nabla_\mu \nabla_\nu - g_{\mu\nu}\nabla^\alpha \nabla_\alpha\right) f_R\right]. \qquad (6)$$

The "Kantowski-Sachs" cosmological models admit a four-parameter continuous isometry group which acts on spacelike hypersurfaces, which possesses a three-parameter subgroup whose orbits are 2-surfaces of constant curvature, i.e. the models possess spherical symmetry, combined with a translational symmetry, and can thus be regarded as nonempty analogs of part of the extended Schwarzschild manifold (Collins 1977). Kantowski-Sachs space-time are homogeneous but anisotropic expanding (contracting) cosmologies. They also gives models where the effects of anisotropy can be estimated and compared with FRW cosmologies (Thorne 1967).Also these space-times play an important role in understanding the realistic picture of the universe immediately after the big bang (Naidu et al. 2015).Rahaman et al. (2002) have obtained the solutions of homogeneous Kantowski–Sachs model in lyra geometry. Rao and Neelima (2013) have investigated Kantowski-Sachs String Cosmological Model with Bulk Viscosity in General Scalar Tensor Theory of Gravitation. Ravishankar et al. (2013) have studied Kantowski–Sachs cosmological model with wet dark fluid in the general theory of relativity. Rao and Suryanarayana (2015) have discussed Kantowski-Sachs Cosmological Model in *f(R,T)* Theory of Gravity. Kantowski-Sachs Viscous Fluid Model in Bimetric Relativity has been studied by Sahu et al (2015).

The Kantowski-Sachs space-time is given by

$$ds^2 = dt^2 - A^2 dr^2 - B^2\left(d\theta^2 + \sin^2\theta\, d\phi^2\right), \qquad (7)$$

where A and B are the functions of r and t only.

It is worth mentioning that the local isotropy is frequently assumed in the study of self-gravitating systems, whenever the fluid approximation is used to examine the matter distribution of the object. The large observational evidences support this Pascalian character of fluids which points towards the equality of principal stresses under a variety of circumstances. However, strong theoretical evidences suggest that for certain density ranges, different kinds of physical phenomena may take place, giving rise to local anisotropy (Herrera and Santos 1997). In recent years, the increasing attention has been paid to study the locally anisotropy of the system. The energy momentum tensor for a locally anisotropic fluid is given by (Sharif and Kausar, 2011)

$$T^{m}_{\mu\nu} = (\rho + P_\perp)u_\mu u_\nu - P_\perp g_{\mu\nu} + (P_r - P_\perp)\chi_\mu \chi_\nu, \qquad (8)$$

where ρ is energy density, u_μ is the four velocity of the fluid, χ_μ is the radial four vector, P_r and $P_\perp$ denote radial and tangential pressure respectively satisfying following identities

$$\chi^\alpha = A^{-1}\delta^\alpha_1 \text{ and } u_\alpha = \delta^\alpha_4,$$

$$u_\alpha u^\alpha = 1,\ \chi_\alpha \chi^\alpha = -1. \qquad (9)$$

The Ricci scalar for equation (7) is

$$R = 2\left[\frac{\ddot{A}}{A} + \frac{2\ddot{B}}{B} + \frac{2\dot{A}\dot{B}}{AB} + \frac{\dot{B}^2}{B^2} + \frac{1}{B^2} - \frac{2B''}{A^2B} + \frac{2A'B'}{A^3B} - \frac{B'^2}{B^2A^2}\right]. \quad (10)$$

From equation (6) and (8), the components of field equations for (7) are

$$G_{11} = \frac{A^2}{f_R}\left[P_r + (P_r + \rho) f_T - \frac{f - Rf_R}{2} - \frac{2 f_R' B'}{A^2 B} + \ddot{f}_R + \frac{2\dot{f}_R \dot{B}}{B}\right], \quad (11)$$

$$G_{14} = \frac{1}{f_R}\left[\dot{f}_R' - \frac{\dot{A}}{A} f_R'\right], \quad (12)$$

$$G_{22} = \frac{B^2}{f_R}\left[P_\perp + (P_\perp + \rho) f_T - \frac{f - Rf_R}{2} - \frac{f_R''}{A^2} + \frac{f_R'}{A^2}\left(\frac{A'}{A} - \frac{B'}{B}\right) + \ddot{f}_R + \dot{f}_R\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B}\right)\right], \quad (13)$$

$$G_{44} = \frac{1}{f_R}\left[\rho + \frac{f - Rf_R}{2} + \frac{f_R''}{A^2} - \frac{f_R'}{A^2}\left(\frac{A'}{A} - \frac{2B'}{B}\right) - \dot{f}_R\left(\frac{\dot{A}}{A} + \frac{2\dot{B}}{B}\right)\right], \quad (14)$$

where prime and dot denote the derivatives with respect to r and t respectively.

The dynamical equations help to determine many useful physical properties of collapsing bodies such as energy variation of matter with time and adjacent surfaces during collapse.For dynamical equations we consider the conservation of the field equations, i.e., the contracted Bianchi identities (Noureen and Zubair, 2015). These conservation equations provide the description of variation from equilibrium position leading to collapse process.

$$G^{\mu\nu}_{;\nu} u_\mu = 0 \quad \text{and} \quad G^{\mu\nu}_{;\nu} \chi_\mu = 0. \quad (15)$$

Equation (15) gives two dynamical equations, given by

$$\dot{\rho} + \rho\left\{(1 + f_T)\left(\frac{\dot{A}}{A} + \frac{2\dot{B}}{B}\right) - \frac{\dot{f}_R}{f_R}\right\} + (1 + f_T)\left(\frac{\dot{A}}{A}P_r + \frac{2\dot{B}}{B}P_\perp\right) + K_1 = 0, \quad (16)$$

$$(\rho + P_r) f_T' + (1 + f_T)\left\{P_r' + P_r\left(\frac{2A'}{A} + \frac{2B'}{B} - \frac{f_R'}{f_R}\right) - 2\frac{B'}{B}P_\perp\right\}$$
$$+ f_T\left(\rho' + \frac{2A'}{A}\rho - \frac{f_R'}{f_R}\right) + K_2 = 0, \quad (17)$$

where K_1 and K_2 are given in appendix.

3 Perturbation scheme

In modified theories of gravitation, the application of perturbation theory has been a subject of growing interest in relativistic astrophysics. This scheme generally reduces non-linear relations through perturbation parameter and provides information about system time evolution as well as its number of independent degrees of freedom. In the present work, we use perturbation approach to get collapse equation which will further be helpful to obtain instability constraints through stiffness parameter. The basic idea of the perturbative expansion is that this refines our expressions by using correction terms. For this purpose, we take the initial data for the metric coefficients and matter variables in such a way that they are r dependent only. In other words, the system is in complete static equilibrium. We have considered following *f(R,T)* model

$f(R,T) = R + \alpha R^2 + \lambda T,$

where α is any real number, λ is a coupling parameter and λT is a correction to *f (R)* gravity. Here we have assumed $0 < \epsilon << 1$, $0 < \xi << 1$ and $0 < \eta << 1$. The perturbation scheme is defined as follows (Chan et al. 1993, Sharif and Yousaf, 2014b)

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$$A(r,t)=A_0(r)+\in D(t)a(r), \tag{18}$$

$$B(r,t)=B_0(r)+\in D(t)b(r), \tag{19}$$

$$\rho(r,t)=\rho_0(r)+\in \bar{\rho}(r,t), \tag{20}$$

$$p_r(r,t)=p_{r0}(r)+\in \bar{p}_r(r,t), \tag{21}$$

$$p_\perp(r,t)=p_{\perp 0}(r)+\in \bar{p}_\perp(r,t). \tag{22}$$

$$R(r,t)=R_0(r)+\xi D(t)e(r), \tag{23}$$

$$T(r,t)=T_0(r)+\eta D(t)e(r), \tag{24}$$

$$f=\left[R_0+\alpha R_0^2+\lambda T_0\right]+\xi D(t)e(r)\left[1+2\alpha R_0\right]+\eta D(t)e(r), \tag{25}$$

$$f_R=(1+2\alpha R_0)+2\xi\alpha D(t)e(r), \tag{26}$$

$$f_T=\lambda\,. \tag{27}$$

Applying perturbations given in equations (18) - (27), the static part of the Ricci scalar is given by

$$R_0=2\left[\frac{1}{B_0^2}-\frac{2B_0''}{B_0A_0^2}-\frac{B_0'^2}{A_0^2B_0^2}+\frac{2A_0'B_0'}{A_0^3B_0}\right]. \tag{28}$$

The perturbed part of Ricci Scalar is obtained as

$$De=2\ddot{D}\left(\frac{a}{A_0}+\frac{b}{B_0}\right)-\frac{4D}{A_0B_0}\left[a'B_0'+b'A_0'+\frac{b''}{A_0}-\frac{aB_0''}{A_0^2}-\frac{aA_0'B_0'}{A_0}-\frac{b'B_0'}{A_0B_0}+\frac{b'B_0'}{A_0^2B_0}-\frac{bB_0'^2}{4B_0}+\frac{b}{2}R_0\right] \tag{29}$$

Applying perturbation to the dynamical equations (16) and (17), we obtain the perturbed parts as follows

$$\dot{\bar{\rho}}+\left[\frac{2e\alpha\rho_0}{Y}+\lambda_1\left\{\frac{a}{A_0}(\rho_0+P_{r0})+\frac{2b}{B_0}(\rho_0+P_{\perp 0})\right\}+K_{1p}\right]\dot{D}=0\,, \tag{30}$$

$$\bar{P}_r'+2P_{r0}D\left\{\left(\frac{a}{A_0}\right)'+\left(\frac{b}{B_0}\right)'-\frac{2\alpha^2eR_0}{Y}+\frac{\alpha e'}{Y}\right\}+\bar{P}_r\left(\frac{A_0'}{A_0}+\frac{B_0'}{B_0}+\frac{\alpha R_0}{Y}\right)$$

$$-2\frac{b}{B_0}DP_{\perp 0}-2\frac{B_0'}{B_0}\bar{P}_\perp+\frac{\lambda}{\lambda_1}\left[\bar{\rho}'+\left\{2\left(\frac{a}{A_0}\right)'+\frac{2\alpha}{Y}(\alpha R_0-e')\right\}D\rho_0+\left(\frac{2A_0'}{A_0}-\frac{2\alpha R_0}{Y}\right)\bar{\rho}\right]$$

$$+\frac{Y}{\lambda_1}K_{2p}=0, \tag{31}$$

where $Y=1+2\alpha R_0$ and K_{1p} and K_{2p} are given in appendix

Integrating equation (30) with respect to time t provides $\bar{\rho}$ as

$$\bar{\rho}=-\left[\frac{2e\alpha\rho_0}{Y}+\lambda_1\left\{\frac{a}{A_0}(\rho_0+P_{r0})+\frac{2b}{B_0}(\rho_0+P_{\perp 0})\right\}+K_{1p}\right]D\,. \tag{32}$$

Equation (29) implies

$$2\ddot{D}\left(\frac{a}{A_0}+\frac{b}{B_0}\right)-\frac{4D}{A_0B_0}\left[a'B_0'+b'A_0'+\frac{b''}{A_0}-\frac{aB_0''}{A_0^2}-\frac{aA_0'B_0'}{A_0}-\frac{b'B_0'}{A_0B_0}+\frac{b'B_0'}{A_0^2B_0}-\frac{bB_0'^2}{4B_0}+\frac{b}{2}R_0-\frac{A_0B_0e}{4}\right]=0\ . \tag{33}$$

Equation (33) takes the form

$$\ddot{D}(t)-\omega^2(r)D(t)=0, \tag{34}$$

where $\omega^2(r)$ is given in appendix.

The solution of equation (34) takes the form

$$D(t)=-e^{\omega t}\ . \tag{35}$$

The stars have a life cycle. They are born in gigantic clouds of dust and galactic material; they evolve and shine for millions of years, and eventually enter the phase of dissolution and extinction. Stars shine by burning their nuclear fuel. The nuclear processes mainly include hydrogen fusing to helium and later into other heavier elements. When all matter is converted to iron, no more nuclear processes capable of producing energy are possible and no new internal energy is produced within the star (Joshi and Malafarina 2012). The time required for a star to consume its nuclear fuel is many billions of years. It is important to decide the fate of the star when it has consumed all its fuel and can no longer maintain the nuclear reactions which have sustained it since from its birth (Thorne 1965).This final state of a star is known as the gravitational collapse. This occurs when there is an imbalance between internal pressure of a massive astronomical body and the inward pull of gravity. It is now known that when a massive star collapses, the final fate of such a gravitational collapse will be either a black hole or a naked singularity under a wide variety of physically reasonable circumstances within the framework of general theory of relativity. This is the most fascinating and interesting issue of relativistic astrophysics. Here we intend to examine the instability of the system, hence, we assume that the system starts the collapsing with $T(-\infty)=0$ at $t=-\infty$, keeping it in static position.

The final states of the stars are elaborated by the equation of state for matter at the end of thermonuclear point of evolution. The equation of state for such matter was formulated by Harrison and Wheeler (1958) from the nuclear physics. There are two known classes of compact stars, white dwarfs and neutron stars. Distinct classes of compact degenerate stars originate in properties of gravity; the distinction is made rigorous by the theorem of Wheeler and collaborators (Harrison et al. 1965). The theorem concerns solutions of the stellar structure equations whenever the mass reaches a maximum or minimum as a function of central density (Glendenning and Kettner 2000).We formulate the collapse with the help of an equation of state of Harrison–Wheeler type in the scenario of second law of thermodynamics. This equation of state is actually the ratio of specific heat. The Harrison-wheeler equation of state is given by (Harrison et al. 1965)

$$\bar{P}_i=\Gamma\frac{P_{i0}}{\rho_0+P_{i0}}\bar{\rho}\ , \tag{36}$$

where Γ is the adiabatic index which is taken as a constant.

Equations (32) and (36) imply

$$\bar{P}_r=-\Gamma\frac{P_{r0}}{\rho_0+P_{r0}}\left[\frac{2e\alpha\rho_0}{Y}+\lambda_1\frac{2b}{B_0}(\rho_0+P_{\perp 0})+K_{1p}\right]D-\Gamma\lambda_1\frac{aP_{r0}}{A_0}D\ , \tag{37}$$

$$\bar{P}_\perp=-\Gamma\frac{P_{\perp 0}}{\rho_0+P_{\perp 0}}\left[\frac{2e\alpha\rho_0}{Y}+\lambda_1\frac{a}{A_0}(\rho_0+P_{r0})+K_{1p}\right]D-2\Gamma\lambda_1\frac{bP_{\perp 0}}{B_0}D. \tag{38}$$

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Substituting equations (32), (37) and (38) in equation (31), we obtain

$$-\Gamma\left[\frac{P_{r0}}{\rho_0+P_{r0}}\left\{\frac{2e\alpha\rho_0}{Y}+\lambda_1\left(\frac{2b}{B_0}(\rho_0+P_{\perp0})-\frac{a}{A_0}P_{r0}\right)+K_{1p}\right\}\right]' D$$

$$+2P_{r0}D\left\{\left(\frac{a}{A_0}\right)'+\left(\frac{b}{B_0}\right)'-\frac{2\alpha^2 eR_0}{Y}+\frac{\alpha e'}{Y}\right\}$$

$$-2\Gamma\left[\frac{P_{r0}}{\rho_0+P_{r0}}\left\{\frac{2e\alpha\rho_0}{Y}+\lambda_1\left(\frac{2b}{B_0}(\rho_0+P_{\perp0})-\frac{a}{A_0}P_{r0}\right)+K_{1p}\right\}\right]\left\{\frac{A_0'}{A_0}+\frac{B_0'}{B_0}+\frac{\alpha R_0}{Y}\right\}D$$

$$-2\frac{b}{B_0}DP_{\perp0}+\frac{2B_0'}{B_0}\Gamma\left[\frac{P_{\perp0}}{\rho_0+P_{\perp0}}\left\{\frac{2e\alpha\rho_0}{Y}+\lambda_1\frac{a}{A_0}(\rho_0+P_{r0})-2\lambda_1\frac{bP_{\perp0}}{B_0}\right\}+K_{1p}\right]D$$

$$-\frac{\lambda}{\lambda_1}\left[\begin{array}{l}-\left\{\frac{2e\alpha\rho_0}{Y}+\lambda_1\left(\frac{a}{A_0}(\rho_0+P_{r0})+\frac{2b}{B_0}(\rho_0+P_{\perp0})\right)+K_{1p}\right\}'+2\rho_0\left\{\left(\frac{a}{A_0}\right)'+\frac{\alpha}{Y}(\alpha R_0-e')\right\}\\ -\left(\frac{2A_0'}{A_0}-\frac{2\alpha R_0}{Y}\right)\left\{\frac{2e\alpha\rho_0}{Y}+\lambda_1\left(\frac{a}{A_0}(\rho_0+P_{r0})+\frac{2b}{B_0}(\rho_0+P_{\perp0})\right)+K_{1p}\right\}\end{array}\right]D$$

$$+\frac{1}{\lambda_1}K_{2p}D=0. \tag{39}$$

Equation (39) is known as the general collapse equation.

4 Instability regions in the Newtonian (N) and Post-Newtonian (pN) regimes

Here, we discuss the ranges of instability atboth Newtonian (N) and Post-Newtonian (pN) regimes.

4.1 Newtonian regime

To study the astrophysical phenomenon of a particular system, it would be a great waste of time to use Einstein's theory of gravitation if Newtonian theory would give the same results. So, it is important to examine those results under which Newtonian theory is a good approximation to general relativity. In this approximation, we take $\rho_0 >> P_{r0}$, $\rho_0 >> P_{\perp0}$ and $A_0=1, B_0=1$. Inserting these assumptions in (39), we get

$$\Gamma<\frac{2P_{r0}K_3+\frac{\lambda}{\lambda_1}[K_4+2\rho_0+K_5]+2bP_{\perp0}-\frac{K_{2p(N)}}{\lambda_1}}{K_6+P_{r0}K_7}, \tag{40}$$

where

$$K_3=\left(a'+b'+\frac{2\alpha}{Y}(\alpha eR_0+e')\right),$$

$$K_4=-\left\{\frac{2e\alpha\rho_0}{Y}+\lambda_1(2b(\rho_0+P_{\perp0})+a(P_{r0}+\rho_0))+K_{1p}\right\}',$$

$$K_5=\frac{2\alpha R_0}{Y}\left\{\frac{2e\alpha R_0}{Y}+\lambda_1(2b(\rho_0+P_{\perp0})+a(P_{r0}+\rho_0))+K_{1p}\right\},$$

$$K_6 = P_{r0}\left\{\frac{2e\alpha\rho_0}{Y} + \lambda_1\left(2b\left(\rho_0 + P_{\perp 0}\right) - aP_{r0}\right) + K_{1p}\right\}',$$

$$K_7 = \left(\frac{2e\alpha\rho_0}{Y} + \lambda_1\left(2b\left(\rho_0 + P_{\perp 0}\right) - aP_{r0}\right) + K_{1p}\right)\frac{2\alpha R_0}{Y},$$

and $K_{2p(N)}$ is the perturbed part of K_2 with terms in Newtonian Regime.

4.2 Post-Newtonian regime

In this regime, we take $A_0 = 1 - \frac{m_0}{r}$, $B_0 = 1 + \frac{m_0}{r}$ implying

$$\Gamma < \frac{2P_{r0}K_8 + \frac{\lambda}{\lambda_1}\left[K_9 + 2\rho_0 K_{10} + K_{11}\right] - 2\frac{b}{1 + \frac{m_0}{r}}P_{\perp 0} - K_{2p(pN)}}{K_{12} + K_{13} + K_{14}}, \tag{41}$$

where

$$K_8 = \left[\frac{a'}{1 - \frac{m_0}{r}} + \frac{b'}{1 + \frac{m_0}{r}} - a - b\right] - \frac{2\alpha^2 eR_0}{Y} + \frac{\alpha e'}{Y},$$

$$K_9 = -\left\{\frac{2e\alpha\rho_0}{Y} + \lambda_1\left(2\frac{b}{1 + \frac{m_0}{r}}\left(\rho_0 + P_{\perp 0}\right) + \frac{a}{1 - \frac{m_0}{r}}\left(P_{r0} + \rho_0\right)\right) + K_{1p}\right\}',$$

$$K_{10} = \frac{a'}{1 - \frac{m_0}{r}} - a + \frac{\alpha}{Y}\left(\alpha R_0 - e'\right),$$

$$K_{11} = -\left(\frac{2}{1 - \frac{m_0}{r}} - \frac{2\alpha R_0}{Y}\right)\left\{\frac{2e\alpha\rho_0}{Y} + \lambda_1\left(2\frac{b}{1 + \frac{m_0}{r}}\left(\rho_0 + P_{\perp 0}\right) + \frac{a}{1 - \frac{m_0}{r}}\left(P_{r0} + \rho_0\right)\right) + K_{1p}\right\},$$

$$K_{12} = \frac{P_{\perp 0}}{\rho_0 + P_{\perp 0}}\left\{\frac{2e\alpha\rho_0}{Y} + \lambda_1\left(\frac{a}{1 - \frac{m_0}{r}}\left(\rho_0 + P_{\perp 0}\right) - 2\frac{b}{1 + \frac{m_0}{r}}P_{\perp 0}\right) + K_{1p}\right\}',$$

$$K_{13} = \frac{P_{r0}}{\rho_0 + P_{r0}}\left\{\frac{2e\alpha\rho_0}{Y} + \lambda_1\left(2\frac{b}{1 + \frac{m_0}{r}}\left(\rho_0 + P_{\perp 0}\right) - \frac{a}{1 - \frac{m_0}{r}}P_{r0}\right) + K_{1p}\right\}\left(\frac{2\alpha R_0}{Y}\right),$$

$$K_{14} = \frac{2}{1 + \frac{m_0}{r}}\left[\frac{P_{\perp 0}}{\rho_0 + P_{\perp 0}}\left\{\frac{2e\alpha\rho_0}{Y} + \lambda_1\left(\frac{a}{1 - \frac{m_0}{r}}\left(\rho_0 + P_{\perp 0}\right) - 2\frac{b}{1 + \frac{m_0}{r}}P_{\perp 0}\right) + K_{1p}\right\}\right],$$

$K_{2p(pN)}$ corresponds to the perturbed part of K_2 in post Newtonian regime.

5 Conclusions

This paper is devoted to study the dynamical instability of Kantowski- Sachs universe in the framework of *f(R,T)* theory of gravity. We have considered the locally anisotropic fluid distribution. The dynamical equations are formulated with the conservation of the field equations, i.e., the conservation of the Einstein tensors. In this regard, we have obtained two dynamical equations. The perturbation approach is employed on the dynamical equations and the physical quantities which lead to the general collapse equation. The instability ranges are found for Newtonian (N) and Post-Newtonian approximations.

The adiabatic index or the stiffness parameter provides the measurement for the variation of pressure; its value defines the range of instability. Our results shows that the adiabatic index plays an important role to define the instability ranges of the system, which is well consistent with the results obtained by (Sharif and Yousaf, 2014c and Noureen and Zubair, 2015). We have concluded that our system would be unstable if it satisfies equations (40) and (41), otherwise it will move towards the stable configuration.

Appendix:

$$K_1=\left\{\frac{f-Rf_R}{2}+\frac{f_R''}{A^2}-\frac{f_R'}{A^2}\left(\frac{A'}{A}-\frac{2B'}{B}\right)-\dot{f}_R\left(\frac{\dot{A}}{A}+\frac{2\dot{B}}{B}\right)\right\}_{;4}$$
$$-\frac{1}{AB^2\sin^2\theta}\left\{AB^2\sin^2\theta\left(\frac{1}{A^2}\left(\dot{f}_R'-\frac{\dot{A}}{A}f_R'\right)\right)\right\}_{;1}$$
$$+\left(\frac{\dot{A}}{A}+\frac{2\dot{B}}{B}\right)\left\{\frac{f-Rf_R}{2}+\frac{f_R''}{A^2}-\frac{f_R'}{A^2}\left(\frac{A'}{A}-\frac{2B'}{B}\right)-\dot{f}_R\left(\frac{\dot{A}}{A}+\frac{2\dot{B}}{B}\right)\right\}$$
$$+\left(\frac{\dot{A}}{A}+\frac{2\dot{B}}{B}\right)\left\{\frac{f-Rf_R}{2}+\frac{f_R'}{A^2}\left(\frac{A'}{A}-\frac{2B'}{B}\right)+\dot{f}_R\left(\frac{\dot{A}}{A}+\frac{2\dot{B}}{B}\right)-\frac{f_R''}{A^2}+\ddot{f}_R\right\}$$

$$K_2=\left\{-\frac{f-Rf_R}{2}-\frac{2f_R'B'}{A^2B}+\ddot{f}_R+\frac{2\dot{f}_R\dot{B}}{B}\right\}_{;1}$$
$$-\frac{1}{AB^2\sin^2\theta}\left\{AB^2\sin^2\theta\left(\frac{1}{A^2}\left(\dot{f}_R'-\frac{\dot{A}}{A}f_R'\right)\right)\right\}_{;4}$$
$$+\left(\frac{A'}{A}+\frac{2B'}{B}\right)\left\{-\frac{f-Rf_R}{2}-\frac{2f_R'B'}{A^2B}+\ddot{f}_R+\frac{2\dot{f}_R\dot{B}}{B}\right\}$$
$$-\frac{2B'}{B}\left\{-\frac{f-Rf_R}{2}+\frac{f_R'}{A^2}\left(\frac{A'}{A}-\frac{2B'}{B}\right)+\dot{f}_R\left(\frac{\dot{A}}{A}+\frac{\dot{B}}{B}\right)-\frac{f_R''}{A^2}+\ddot{f}_R\right\}$$
$$-\frac{\dot{A}}{A}\left(\dot{f}_R'-\frac{\dot{A}}{A}f_R'\right)$$

$$K_{1p} = \left[2\alpha R_0' \left\{ -e'' - \frac{2aR_0''}{A_0} - \left(\frac{a}{A_0} \right)' - 2 \left(\frac{b}{B_0} \right)' - 2\alpha (2aR_0' + e') \left(\frac{A_0'}{A_0} - \frac{2B_0'}{B_0} \right) \right\} \right]_{;4}$$

$$- 2\alpha (e' + aR_0') \left(\frac{A_0'}{A_0} - \frac{2B_0'}{B_0} \right) + \left(\frac{a}{A_0} + \frac{b}{B_0} \right) \left\{ 2\alpha R_0' \left(\frac{2A_0'}{A_0} - \frac{3B_0'}{B_0} \right) \right\} \dot{D}$$

$$- \left(\frac{1}{A_0 B_0^2} \right) \left\{ A_0 B_0^2 \left(2\alpha e' - \frac{2\alpha a R_0'}{A_0} \right) \right\}_{;1} \dot{D}$$

$$K_{2p} = \left\{ -\frac{1}{2}(e - 2\alpha e R_0) - \frac{4\alpha}{A_0^2 B_0} \left(e'B_0' + b'\alpha R_0' - \frac{bR_0'B_0'}{B_0} - \frac{aR_0'B_0'}{A_0} \right) \right\}_{;1}$$

$$+ \left(\frac{A_0'}{A_0} + \frac{2B_0'}{B_0} \right) \left\{ -\frac{1}{2}(e - 2\alpha e R_0) - \frac{4\alpha}{A_0^2 B_0} \left(e'B_0' + b'\alpha R_0' - \frac{bR_0'B_0'}{B_0} - \frac{aR_0'B_0'}{A_0} \right) \right\}$$

$$+ \left(2 \left(\frac{a}{A_0} \right)' + 2 \left(\frac{b}{B_0} \right)' \right) \left\{ -\frac{1}{2} \left(-\alpha R_0^2 + \lambda T_0 - \frac{4\alpha R_0' B'}{A_0^2 B_0} \right) \right\}$$

$$+ \frac{A_0'}{A_0} \left\{ -\frac{1}{2}(e - 2\alpha e R_0) - \frac{4\alpha}{A_0^2 B_0} \left(e'B_0' + b'\alpha R_0' - \frac{bR_0'B_0'}{B_0} - \frac{aR_0'B_0'}{A_0} \right) \right\}$$

$$+ \frac{B_0'}{B_0}(e - 2\alpha e R_0) - 2 \left(\frac{b}{B_0} \right)' \left\{ -\frac{1}{2}(-\alpha R_0^2 + \lambda T_0) + \frac{2\alpha R_0'}{A_0^2} \left(\frac{A_0'}{A_0} - \frac{B_0'}{B_0} \right) \right\}$$

$$+ 2(\alpha e' + 2\alpha e)\ddot{D} - \left(\frac{1}{A_0 B_0^2} \right) \left\{ A_0 B_0^2 \left(2\alpha e' - \frac{2\alpha a R_0'}{A_0} \right) \right\}_{;1} \dot{D}$$

$$\omega^2(r) = \frac{2T}{A_0 B_0} \left(\frac{a}{A_0} + \frac{2b}{B_0} \right)^{-1}$$

$$\times \left[a'B_0' + b'A_0' + \frac{b''}{A_0} - \frac{aB_0''}{A_0^2} - \frac{aA_0'B_0'}{A_0} - \frac{b'B_0'}{A_0 B_0} + \frac{b'B_0'}{A_0^2 B_0} - \frac{bB_0'^2}{4B_0} + \frac{b}{2} R_0 - \frac{A_0 B_0 e}{4} \right]$$

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Integral Transform and its Applications in Science and Engineering

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Abstract:
Researchers are especially fond of integral transforms. The various forms of integral transforms are the Fourier, Hankel, Laplace, and Mellin transforms. As transform methods offer a quick and efficient way to solve many engineering issues, the Laplace Transform has recently become a crucial component of the mathematical foundation needed for scientists and engineers. This paper focus on a brief discussion of the Laplace type integral transform and its applications in Science and Engineering that has been created recently in this study.
Keywords: Integral transform, Laplace integral transform, Inverse Laplace Transform, Differential Equation.

Introduction:

Integral transforms are now a necessary tool for solving the majority of engineering and scientific challenges. By developing mathematical models in terms of various equation types and their systems, such as ordinary differential equations and their systems, partial differential equations and their systems, integral equations and their systems, many fascinating real-world problems in science and technology can be readily solved using integral transforms.

The integral transform is the mathematical operation that converts a differential equation into an algebraic equation. It converts a complex problem to a simpler one that can be solved mathematically. By integrating the product of a function and another function known as the integral transform kernel, the integral transform mathematical operator can generate a result function. The integral transform's general form can be expressed as follows:

$$F(s)=\int k(x,s)f(x)dx.$$

Where, $F(s)$ is the function resulting from the integral transform and $k(x,s)$ is the kernel function.

Integral transforms functions from one domain, where certain mathematical operations are rather complex, to another, where they become more flexible and easier to process mathematically. Typically, the resultant function is converted back into its original domain using an inverse version of the integral transform that was applied [2,3].

Euler initially presented the integral transformation to the world in 1763 [1]. Since then, mathematicians have been keen to put in the time and energy necessary to research, suggest, and evaluate the applicability of both new and current integral transforms in various spheres of life [4–7].

Numerous integral transforms have been proposed over the years, and the majority of these transforms bear the names of the mathematicians who first proposed them.

In this paper we study the integral transform of Laplace type.

Pierre-Simon Laplace pioneered the Laplace transform which is very useful and effective technique for solving the ordinary Differential equation with constant coefficient.

Laplace transform [8]: This transform is defined as

$$L\{f(t)\}=\int_0^\infty e^{-st} f(t)dt = \bar{f}(s)$$

Where $f(t)$ is a function defined for all values of $t \geq 0$ and s is the parameter (real or complex).

Existence of Laplace Transform: Laplace Transforms of $f(t)$ exists only if

i) $f(t)$ must be piecewise continuous.
ii) $f(t)$ must be of exponential order of m i.e. there must exists numbers m and $\propto$ such that $|f(t)| \leq \propto e^{mt}$

Laplace transform of some standard functions are stated below:

(1)	$L\{t^n\} = \frac{n!}{s^{n+1}}$	(3)	$L\{e^{at}\} = \frac{1}{s-a}$	(5)	$L\{\sin at\} = \frac{a}{s^2+a^2}$	(7)	$L\{\sinh at\} = \frac{a}{s^2-a^2}$
(2)	$L\{1\} = \frac{1}{s}$	(4)	$L\{e^{-at}\} = \frac{1}{s+a}$	(6)	$L\{\cos at\} = \frac{s}{s^2+a^2}$	(8)	$L\{\cosh at\} = \frac{s}{s^2-a^2}$

Properties of Laplace Transforms:

P-(1): Linearity Property: L {a f (t) + b g(t)} = a L {f (t)} + bL {g(t)} where a and b are constants.

P-(2): Change of Scale Property: If $L\{f(t)\} = \bar{f}(s)$ then $L\{f(ta)\} = \bar{f}\left(\frac{s}{a}\right)$

P-(3): First Shifting Property: If $L\{f(t)\} = \bar{f}(s)$ then $L\{e^{-at}f(t)\} = \bar{f}(s+a)$ and $L\{e^{at}f(t)\} = \bar{f}(s-a)$

P-(4): Laplace Transform of Integral: If $L\{f(t)\} = \bar{f}(s)$, then $L\left\{\int_0^t f(u)du\right\} = \frac{\bar{f}(s)}{s}$

P-(5): Multiplication by t: If $L\{f(t)\} = \bar{f}(s)$, then $L\{tf(t)\} = -\frac{d}{ds}\bar{f}(s)$ and $L\{t^n f(t)\} = (-1)^n \frac{d^n}{ds^n}\bar{f}(s)$

P-(6): Division by t: If $L\{f(t)\} = \bar{f}(s)$, then $L\{tf(t)\} = \int_s^\infty \bar{f}(s)\, ds$

Inverse Laplace Transforms:

The inverse Laplace Transform is the transformation of a Laplace transform into a function of time. If $L\{f(t)\} = \bar{f}(s)$, then $L^{-1}\{\bar{f}(s)\}$ = f(t), i.e. $f(t)$ is called Inverse Laplace Transform of $\bar{f}(s)$

APPLICATION OF LAPLACE TRANSFORM IN SCIENCE AND ENGINEERING FIELDS:

The uses of Laplace transform in science and engineering are covered in this section. The Laplace Transform is frequently utilized in subsequent scientific and engineering domain.

1. **Analysis of electronic circuits:** Laplace Transform is widely used by electrical and electronic engineers to solve differential equations occurring in the analysis of electronic circuits.
2. **Digital signal processing**: The digital signal processing problems are also solved by using Laplace Transform.

APPLICATION OF LAPLACE TRANSFORM TO DIFFERENTIAL EQUATION WITH CONSTANT COFFICIENT: -

Laplace Transform is used in various engineering fields to obtain the solution of linear non homogeneous ordinary differential equations with constant coefficients when the initial (or the boundary) conditions are given.

E.g: $(D^2+1)y = 0, t > 0, D = \frac{d}{dt}$ with $y = 1, Dy = 2$ when $t = 0$ ………… (1)

Step 1- Apply L.T. on both sides of the given differential equation (1) resulting in subsidiary equation.

Step 2- Solve the equation algebraically for Y(s), usually by partial fraction fraction.

Step 3-Apply Inverse L.T. to Y(s) obtained in step 2. This gives the solution of O.D.E. (1) satisfying the initial condition which is the solution of the given differential Equation.

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Thus, the Laplace transform method changes a differential equation with initial values to an algebraic equation (the subsidiary equation) from which Y(s), is known and its Inverse Laplace Transform Y(t) is the solution of the given differential equation.

Conclusion: Throughout this paper, we discuss about the definition, properties of Laplace and Inverse Laplace Transform. Besides this we present the applications of Laplace transforms in various Engineering fields areas. Also, it is widely used in control systems, circuit analysis and electric systems for analysis of transient behaviour and stability.

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Quadratic equation of State With Variable Deceleration Parameter In $f(R)$ Gravity

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Abstract:
In this paper we have studied the plane symmetric cosmological model with perfect fluid in the $f(R)$ theory of gravity. The exact solution of the field equations is obtained under a variation law of the Hubble parameter (H) which yields a time dependent deceleration parameter. The model presents a cosmological scenario which describes early deceleration and late time acceleration. The physical parameters of the model have been analyzed.

1.Introduction:

The general theory of relativity successfully explains the origin and evolution of the universe but late time acceleration of the universe and the existence of dark matter challenged general relativity. To explain the observational results of the cosmological model recently many different approaches have been proposed. Different types of modified theories of gravity have been formulated to explain the nature of dark energy which is responsible for the accelerated expansion of the universe. $(G), f(R,G), f(R), f(T)$and $f(R,T)$ gravity theory are some generalization of GR theory. In (R) modified theory of gravity, the Ricci scalar R in the Einstein-Hilbert action is replaced by an arbitrary function of R belongs to the well-known. Nojiri and Odintsov studied late time acceleration of universe by using f(R) gravity model [1]. Furthermore, it is believed that the early universe may not have been exactly uniform. Therefore, inhomogeneous and anisotropic models of universe plays important role in theoretical cosmology. This prediction encourages us to explore the initial phases of the universe using models with an anisotropic background. Among which, Bianchi type models are the simplest models with anisotropic background. Numerous researchers have explored Bianchi type spacetimes in various contexts [2][3][4][5]. Kumar and Singh solved the field equations using a Bianchi type I spacetime in the presence of a perfect fluid [6].

To explore in cosmological models, Quadratic equation of state is needed . The general form of the quadratic equation of state is given by $= p_0 + \alpha\rho + \beta\rho^2$, where $p_0, \alpha, and\ \beta$, are the parameters. In our work, we have consider the quadratic equation of state of the form $p = \varepsilon\rho^2 - \rho$, where ε is constant and strictly $\varepsilon \neq 0$. Several researchers have explored the quadratic equation of state in various contexts using cosmological models [7-12]. Camera investigated The effective equation of state in Palatini in $f(R)$ cosmology [13]. Chirde et al. had investigated Quadratic Equation of State with Constant Deceleration Parameter in $f(R)$ Gravity [14].

Inspiring from above discussion, w€ have examined Bianchi Type I cosmological model with quadratic EoS in the metric version of $f(R)$ gravity by using variable deceleration parameter. The organisation of the paper is as follows: In Sect. 2, Some Basics of $f(R)$ gravity is given, whereas in Sect. 3, we present the Metric and Fiel Equation. The solution of the field equations has been explored in Sect. 4. Section 5 gives the physical and geometrical properties of the field equations, and in the last Sect. 6, we cover the discussion and conclusion.

2. Some Basics of $f(R)$ gravity

$f(R)$ theory of gravity is generalization of GR, The action of $f(R)$ gravity is given by

$$S = \frac{1}{2k^2}\int d^4 \sqrt{-g}f(R) + \int d^4\, xL_m(g_{ij}, \Psi_m) \qquad (1)$$

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Where $k^2 = 8\pi G = 1$ and $f(R)$ is some function of the Ricci scalar.
$g = det\, g_{ij}$ is the determinant of the metric tensor. and L_m is the metric Lagrangian that depends on g_{ij} and the matter field ψ_m .
The corresponding $f(R)$ gravity field equations is obtained by varying the action with respect to the metric g_{ij}

$$F(R)R_{ij} - \frac{1}{2}f(R)g_{ij} - \nabla_i\nabla_j F(R) + g_{ij}\Box F(R) = T_{ij} \tag{2}$$

Where, $\Box = \nabla^i\nabla_j$, $F(R) = \frac{d}{dR}f(R)$ (3)

∇_i is the covariant derivative and T_{ij} is the standard matter energy-momentum tensor derived from the Lagrangian L_m.

3. The Metric and Field Equation

We consider a Bianchi type-I space-time of the form

$$ds^2 = dt^2 - A^2dx^2 - B^2(dy^2 + dz^2) \tag{4}$$

where ,A and B are the functions of t only.
Let us consider that the matter content is a perfect fluid such that the Energy momentum tensor T_{ij} is taken as

$$T_{ij} = (p + \rho)u_i v_j - pg_{ij} \tag{5}$$

Let p and ρ be the pressure and energy density of the fluid respectively which satisfy the general form of the quadratic equation of state (EoS) [15].

$$p = \varepsilon\rho^2 - \rho \tag{6}$$

where ε is constant and strictly $\varepsilon \neq 0$.

The field equations in Eqn. (2) corresponding to the metric in Eqn. (4) gives the following set of linearly independent differential equations

$$\left[\frac{\ddot{A}}{A} + 2\frac{\dot{A}}{A}\frac{\dot{B}}{B}\right]F - \frac{1}{2}f(R) + 2\frac{\dot{B}}{B}\dot{F} + \ddot{F} = \rho - \varepsilon\rho^2 \tag{7}$$

$$\left[\frac{\ddot{B}}{B} + \frac{\dot{A}\dot{B}}{AB} + \frac{\dot{B}^2}{B^2}\right]F - \frac{1}{2}f(R) + \left[\frac{\dot{A}}{A} + \frac{\dot{B}}{B}\right]\dot{F} + \ddot{F} = \rho - \varepsilon\rho^2 \tag{8}$$

$$\left[\frac{\ddot{A}}{A} + 2\frac{\ddot{B}}{B}\right]F - \frac{1}{2}f(R) + \left[\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right]\dot{F} = \rho \tag{9}$$

Here an overhead dot indicates differentiation with respect to cosmic time t.
From equations (7) and (8), We get

$$\left(\frac{\ddot{A}}{A} - \frac{\ddot{B}}{B}\right) + \left(\frac{\dot{A}^2}{A^2} - \frac{\dot{B}^2}{B^2}\right) + \left(\frac{\dot{A}}{A} - \frac{\dot{B}}{B}\right)\left(\frac{\dot{B}}{B} - \frac{\dot{F}}{F}\right) = 0 \tag{10}$$

Integrating Eqn. (!0),

$$\frac{A}{B} = exp\left[\int \frac{cF}{AB^2}dt\right] \tag{11}$$

Kotub Uddin et al. have established a power law relation between $F$and a in the context of $f(R)$ gravity, where $a(t)$ is the average scale factor [16].

$$F \propto a^m$$

$$F = \alpha a^m$$

$$F = a^m, \qquad \alpha = 1$$

$$F = (AB^2)^{\frac{m}{3}} \tag{12}$$

The spatial volume of the metric is given as

$$V = AB^2 = a^3$$

$$F = V^{\frac{m}{3}} \tag{13}$$

Eqn. (11) implies,

$$\frac{A}{B} = exp\left[c\int V^{\frac{m-3}{3}}dt\right] \tag{14}$$

4. Solution of the field equations

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To get a solution, we do no assume an equation of state, but we take the special type of Hubble parameter proposed by Benerjee and Das [22] as follows

$$H = \beta(a^{-n} + 1) \tag{15}$$

Where β is an arbitory constant and n is constant, β is taken to be positive which ensure positivity of Hubble parameter irrespective of constant n.

Integrating Eqn. (14),

$$a^n = e^{n\beta t} - 1 \tag{16}$$

The deceleration parameter is given by,

$$q = -1 + \frac{n}{e^{n\beta t}} \tag{17}$$

The directional Hubble parameters is given as,

$$\frac{\dot{A}}{A} = H_1 = \frac{\beta e^{n\beta t}}{(e^{n\beta t}-1)} + \frac{2K_1}{3(e^{n\beta t}-1)^{\frac{3}{n}}} \tag{18}$$

$$\frac{\dot{B}}{B} = H_2 = H_3 = \frac{\beta e^{n\beta t}}{(e^{n\beta t}-1)} - \frac{K_1}{3(e^{n\beta t}-1)^{\frac{3}{n}}} \tag{19}$$

And the mean Hubble parameter is given as,

$$H = \frac{\beta e^{n\beta t}}{(e^{n\beta t}-1)} \tag{20}$$

The spatial volume of the metric is given as

$$V = (e^{n\beta t} - 1)^{\frac{3}{n}} \tag{21}$$

The anisotropy parameter is given by,

$$A_m = \frac{2{K_1}^2}{3\beta^2 e^{2\beta t}(e^{n\beta t}-1)^{\frac{6-2n}{n}}} \tag{22}$$

The dynamical scalar expansion θ and shear scalar σ are

$$\theta = \frac{3\beta e^{n\beta t}}{(e^{n\beta t}-1)}$$

(23)

$$\sigma = \frac{K_1}{\sqrt{3}(e^{n\beta t}-1)^{\frac{3}{n}}} \tag{24}$$

The metric functions A and B are given by

$$A = (e^{n\beta t} - 1)^{\frac{1}{n}}\ exp\left[\frac{2c(e^{n\beta t}-1)^{\frac{(m+n-3)}{n}}}{3\beta(m+n-3)e^{n\beta t}}\right] \tag{25}$$

$$B = (e^{n\beta t} - 1)^{\frac{1}{n}}\ exp\left[\frac{-1c(e^{n\beta t}-1)^{\frac{(m+n-3)}{n}}}{3\beta(m+n-3)e^{n\beta t}} -\right] \tag{26}$$

5. Physical and geometrical properties of the model

Now, The corresponding Ricci scalar is given by [17],

$$R = (2-n)6\beta^2 \frac{e^{2n\beta t}}{(e^{n\beta t}-1)^2} + \frac{6{K_1}^2}{9(e^{n\beta t}-1)^{\frac{6}{n}}} \tag{27}$$

$$f(R) = 12n\beta^3(n-2)\frac{(e^{n\beta t}-1)^{\frac{m}{n}-2}[(m-2n)e^{n\beta t}+n]}{\beta(m-2n)(m-n)} - \frac{4{K_1}^2\beta(e^{n\beta t}-1)^{\frac{m-6}{n}}}{\beta(m-6)} \tag{28}$$

Energy density and Pressure is given as follows

$$\rho = \left\{\frac{(m+1-n)3\beta^2 e^{2n\beta t}}{(e^{n\beta t}-1)^2} + \left(\frac{1}{3} + \frac{1}{m-6}\right)\frac{2{K_1}^2}{(e^{n\beta t}-1)^{\frac{6}{n}}} - \frac{6n\beta^2(n-2)[(m-2n)e^{n\beta t}+n]}{(m-2n)(m-n)(e^{n\beta t}-1)^2} + \frac{2\beta K_1 e^{n\beta t}}{3(e^{n\beta t}-1)^{\frac{3}{n}+1}}\right\}(e^{n\beta t}-1)^{\frac{m}{n}}$$

(29)

$$p = \varepsilon\left\{\frac{(m+1-n)3\beta^2 e^{2n\beta t}}{(e^{n\beta t}-1)^2} + \left(\frac{1}{3}+\frac{1}{m-6}\right)\frac{2{K_1}^2}{(e^{n\beta t}-1)^{\frac{6}{n}}} - \frac{6n\beta^2(n-2)\left[(m-2n)e^{n\beta t}+n\right]}{(m-2n)(m-n)(e^{n\beta t}-1)^2} + \frac{2\beta K_1 e^{n\beta t}}{3(e^{n\beta t}-1)^{\frac{3}{n}+1}}\right\}^2 \left(e^{n\beta t}-1\right)^{\frac{2m}{n}} - \left\{\frac{(m+1-n)3\beta^2 e^{2n\beta t}}{(e^{n\beta t}-1)^2} + \left(\frac{1}{3}+\frac{1}{m-6}\right)\frac{2{K_1}^2}{(e^{n\beta t}-1)^{\frac{6}{n}}} - \frac{6n\beta^2(n-2)\left[(m-2n)e^{n\beta t}+n\right]}{(m-2n)(m-n)(e^{n\beta t}-1)^2} + \frac{2\beta K_1 e^{n\beta t}}{3(e^{n\beta t}-1)^{\frac{3}{n}+1}}\right\}\left(e^{n\beta t}-1\right)^{\frac{m}{n}} \tag{30}$$

6. Discussion and Conclusion

In this paper, we have investigated Bianchi I Cosmological Model with quadratic EoS in the metric version of $f(R)$ gravity has been investigated. For obtaining a solution to the field equations, we do not assume an equation of state, but rather we take a variation law for the Hubble parameter H (Banerjee and Das 2005) that yields a deceleration parameter q. We have evaluated some important cosmological physical and kinematical quantities for this model. We observe that the spatial volume V of the model is zero at $t = 0$. Hence the model starts evolving at $t = 0$ and expands continuously. The expansion scalar θ and shear scalar σ diverge at $t = 0$. For the deceleration parameter, we have $q \rightarrow n - 1\ (> 0\ for\ n > 1)$. Hence the expansion in the model initially decelerates. Since the deceleration parameter is -1 for large t, The universe beings with a decelerating expansion, and it changes to accelerating later on. In the derived model, It is observed that energy density is a function of time I and always decrease positively with the expansion. At the initial stage $t \rightarrow 0$, pressure p , energy density ρ diverges and vanishes for large value of t. The anisotropy parameter A_m tends to zero for large t. Therefore the model approaches isotropy at late times.

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14

Accelerated Expansion of FRW Cosmological Model in Linear $f(T)$ Gravity

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Abstract:

In present work, we have investigated the spatially homogeneous and isotropic flat Friedman-Robertson-Walker (FRW) cosmological model with perfect fluid in the framework of $f(T)$ gravity. We have taken into account of linear model of $f(T)$ gravity, which is $f(T)=T$ and considered power law to get the exact solution of field equations. We have investigated some physical parameters of the model such as energy density, equation of state parameter and squared velocity of sound. Furthermore, some kinematical parameters of the model have been discussed.

Keywords:

FRW metric, Perfect Fluid, Power law, $f(T)$ gravity, cosmology.

1. Introduction

Observational data coming from the cosmic microwave background (CMB) anisotropy spectrum, type Ia supernovae (SNeIa) surveys and large-scale structure (LSS) indicate that the expansion of our present universe is accelerating [1 - 4]. The proposals that have been put forward to explain this observed phenomenon can basically be classified into two categories. One is to assume that in the framework of Einstein's general relativity (GR), an exotic component with negative pressure called dark energy (DE) is necessary to explain this observed phenomenon. Another alternative to account for the current accelerating cosmic expansion is to modify GR theory.

The well-known modified gravity theories are: $f(R)$ gravity, $f(R,T)$ gravity, $f(T)$ gravity, etc. In modified $f(R)$ gravity, one replaces the Ricci scalar R in the Einstein-Hilbert action by an arbitrary function of R. Recently Shaikh and Katore [5 - 6] have investigated Bianchi type-VI_0 and Bianchi type-III cosmological model with bulk viscosity in the framework of $f(R)$ gravity. Wankhade et al. [7] have worked on interacting two fluid dark energy Bianchi type-I cosmological model in the same gravity. Chirde and Shekh have investigated interaction between barotropic fluid and dark energy with zero-mass scalar field for the spatially homogeneous and isotropic flat FRW universe in the framework of $f(R)$ gravity [8]. In $f(R,T)$ gravity, the gravitational action includes an arbitrary function of the Ricci scalar R and trace of the stress energy momentum tensor T. Chirde and Shekh [9], Yadav et al. [10], Pawar et al. [11], Shaikh and Wankhade [12], Sahoo et al. [13], Sharif and

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Zubair [14], Ahmed and Pradhan [15], Dagwal et al. [16] have worked on different aspects of $f(R,T)$ gravity.

Among the various modifications of Einstein's theory, another one way to look at the theory beyond the Einstein equation is the Teleparallel Gravity (TG) which uses the Weitzenbock connection in place of the Levi–Civita connection and so it has no curvature but has torsion which is responsible for the acceleration of the Universe. In recent past, a number of authors, Shekh and Chirde [17], Bhoyar et al. [18], Cai et al. [19], Bamba et al. [20], Godonou et al. [21], Rezazadeh et al. [22], Zubair and Waheed [23], Bhatti et al. [24], Dagwal and Pawar [25], Myrzakulov [26], Sharif and Rani [27], Mandal and Sahoo [28], Pradhan et al. [29], Shaikh et al. [30] have investigated $f(T)$ gravity in so many different aspects.

2. $f(T)$ Gravity Formalism

Here we give a brief description of the $f(T)$ gravity and thorough derivation of its field equations. From here onwards, let us define the notations of the Latin subscripts or superscripts as related to the tetrad field, whereas Greek one is related to the space-time coordinates. For a general space-time metric, we can define the line element as

$$ds^2 = g_{\mu\nu} dx^\mu dx^\nu \tag{1}$$

This line element can be converted to the Minkowski's description of the transformation called tetrad, as follows

$$ds^2 = g_{\mu\nu} dx^\mu dx^\nu = \eta_{ij} \theta^i \theta^j \tag{2}$$

$$dx^\mu = e_i^\mu \theta^i, \qquad \theta^i = e_\mu^i dx^\mu \tag{3}$$

where η_{ij} is a metric on Minkowski space-time and $\eta_{ij} = diag[1,-1,-1,-1]$ and $e_i^\mu e_\nu^i = \delta_\nu^\mu$ or $e_i^\mu e_\mu^j = \delta_i^j$.

The root of the metric determinant is given by $\sqrt{-g} = \det\left[e_\mu^i\right] = e$. For a manifold in which the Riemann tensor part without the torsion terms is null (contribution of the Levi-Civita connection) and only the non-zero torsion terms exist, the Weitzenbocks connection components are defined as

$$\Gamma_{\mu\nu}^\alpha = e_i^\alpha \partial_\nu e_\mu^i = -e_\mu^i \partial_\nu e_i^\alpha \tag{4}$$

This has a zero curvature but nonzero torsion. Through the connection, we can define various components of the torsion tensors as

$$T_{\mu\nu}^\alpha = \Gamma_{\mu\nu}^\alpha - \Gamma_{\nu\mu}^\alpha = e_i^\alpha \left(\partial_\mu e_\nu^i - \partial_\mu e_\mu^i\right) \tag{5}$$

The difference between the Levi-Civita and Weitzenbock connections is a space-time tensor and is known as con-torsion tensor:

$$K_\alpha^{\mu\nu} = \left(-\frac{1}{2}\right)\left(T^{\mu\nu}{}_\alpha + T^{\nu\mu}{}_\alpha - T_\alpha^{\mu\nu}\right) \tag{6}$$

For facilitating the description of the Lagrangian and the equation of motion, we can define another tensor $S_\alpha^{\mu\nu}$ from the components of the torsion and con-torsion tensors as

$$S_\alpha^{\mu\nu} = \left(\frac{1}{2}\right)\left(K^{\mu\nu}{}_\alpha + \delta_\alpha^\mu T^{\beta\nu}{}_\beta - \delta_\alpha^\nu T_\beta^{\beta\mu}\right) \tag{7}$$

The torsion scalar T is

$$T = T_{\mu\nu}^\alpha S_\alpha^{\mu\nu} \tag{8}$$

Now we define action by generalizing the Tele-parallel Theory i.e. $f(T)$ theory as

$$S = \int \left[T + f(T) + L_{matter} \right] e \, d^4x \tag{9}$$

Here $f(T)$ denotes an algebraic function of the torsion scalar T. Making the functional variation of the action in equation (9) with respect to the tetrads, we get the following equations of motion

$$S_{\mu}^{\nu\rho} \partial_{\rho} T f_{TT} + \left[e^{-1} e_{\mu}^{i} \partial_{\rho} \left(e e_{i}^{\alpha} S_{\alpha}^{\nu\rho} \right) + T^{\alpha}{}_{\lambda\mu} S_{\alpha}^{\nu\lambda} \right] (f_T) + \frac{1}{4} \delta_{\mu}^{\nu} (f) = 4\pi T_{\mu}^{\nu} \tag{10}$$

where T_{μ}^{ν} is the energy momentum tensor and $f_T = df(T)/dT$. The field equation (11) is written in terms of tetrads and their partial derivatives and appears very different from Einstein's equation. But by setting $f(T) = a_0 = \text{constant}$, this is dynamically equivalent to the GR.

3. Metric, components of field equations and Kinematical parameters

In our work, we consider the spatially homogeneous and isotropic Friedman-Robertson-Walker (FRW) line element of the form

$$ds^2 = dt^2 - a^2(t) \left[\frac{dr^2}{1-kr^2} + r^2 \left(d\theta^2 + \sin^2\theta \, d\phi^2 \right) \right], \tag{11}$$

where $a(t)$ is the scale factor, θ and ϕ are the usual azimuthal and polar angels of the spherical co-ordinate system, the curvature constant k represents closed, flat and open models of the universe for $k=+1$, $k=0$ and $k=-1$ respectively. In view of above universe in this work, we deliberate on the flat universe so take $k=0$ with infinite radius.

The energy momentum tensor for perfect fluid is taken as

$$T_{\mu}^{\nu} = (p+\rho) u^{\nu} u_{\mu} - p g_{\mu}^{\nu} \tag{12}$$

with commoving coordinates $u^{\nu} = (0,0,0,1)$ and $u^{\nu} u_{\nu} = 1$,

where u^{ν} is the four-velocity vector of the fluid, p and ρ are pressure and energy density of the fluid respectively, and are functions of time t. The universe is filled with perfect fluid which leads to $\omega = p/\rho$, (13)

where ω is equation of state (EoS) parameter.

The corresponding Torsion scalar is obtained as

$$T = -6H^2 \tag{14}$$

where $H = \frac{\dot{a}}{a}$ is the Hubble parameter and overhead dot (.) represents derivative with respect to time t.

From the equation of motion (10), Friedman equation for stress energy tensors (12) can be written as

$$(T+f) + 4(1+f_T) \left\{ \frac{\ddot{a}}{a} + \frac{2\dot{a}^2}{a^2} \right\} + 4\frac{\dot{a}}{a} \dot{T} f_{TT} = -16\pi p \tag{15}$$

$$(T+f) + 12(1+f_T) \frac{\dot{a}^2}{a^2} = 16\pi\rho \tag{16}$$

We are having two differential equations with five unknowns as T, f, a, p and ρ.

Now we define some kinematical quantities for the FRW cosmological model which are important in cosmological observations.

The spatial volume is given by

$$V = a^3 \tag{17}$$

The mean Hubble parameter, which expresses the volumetric expansion rate of the Universe,

$$H = \frac{\dot{a}}{a} \tag{18}$$

The mean anisotropy parameter, for discussing whether universe approach isotropy or not, is defined as

$$A_m = \frac{1}{3}\sum_{i=1}^{3}\left(\frac{H_i - H}{H}\right)^2 \tag{19}$$

The expansion scalar and shear scalar are respectively defined as

$$\theta = 3\frac{\dot{A}}{A} = 3H \tag{20}$$

$$\sigma^2 = \frac{3}{2}H^2 A_m \tag{21}$$

4. Solution of field equations

In order to solve the system of non-linear differential equations and to obtain the exact solution of field equations in (15) and (16), one can assume a state equivalent to some physical circumstances or an arbitrary mathematical hypothesis. Let us consider the scale factor of the form [31 - 32],

$$a = t^n, \tag{22}$$

where $n > 0$ is constant.

Using equation (22), the mean Hubble parameter is found to be

$$H = \frac{n}{t}. \tag{23}$$

Also, we consider linear model of $f(T)$ gravity, which is $f(T) = T$, where T is the torsion scalar.

Using equation (15), the isotropic pressure of the model is obtained as

$$p = -\frac{n(3n-2)}{4\pi t^2}. \tag{24}$$

Using equation (16), the energy density of the model is obtained as

$$\rho = \frac{3n^2}{4\pi t^2}. \tag{25}$$

From equation (25), it is observed that the energy density of the derived model is always positive. At an initial stage $(t = 0)$ when universe start to expand, the energy density $\rho \to \infty$ and as time increases, i.e. at the expansion of the universe, it approaches to very small positive value.

Using equations (24) and (25), the equation of state parameter (EoS) is found to be

$$\omega = -1 + \frac{2}{3n}. \tag{26}$$

Some of the limits of equation of state parameter (EoS), obtained from observational results that came from SNe-Ia data and a combination of SNe-Ia data with CMB anisotropy and Galaxy clustering statistics, are $-1.66 < \omega < -0.62$ and $-1.33 < \omega < -0.79$ respectively. In the derived model, from equation (26), it is observed that the equation of state (EoS) parameter is constant throughout the expansion of the universe and for proper choice of constant i.e. for $n = 2, 3, 4, 5...$, the EoS parameter ranges from $-0.67 < \omega < -1$, which is in complete agreement

with the observational data. Hence the derived model represents quintessence region throughout the expansion.
The squared velocity of sound is obtained as

$$\upsilon^2 = -\left(\frac{3n-2}{3n}\right). \tag{27}$$

It is required that the velocity of sound should be less than the velocity of light, i.e. within the range $0 < \vartheta_s^2$. From equation (27), it is observed that the stability factor for the present model is negative throughout the expansion of the Universe i.e. $\vartheta_s^2 < 0$ and hence the model is unstable throughout the expansion.

5. Kinematical parameters

Using equations (17) and (22), the spatial volume is found to be

$$V = t^{3n}. \tag{28}$$

It is observed that, $V \to \infty$ as $t \to \infty$ and hence the universe is expanding.
The scalar expansion is obtained as

$$\theta = \frac{3n}{t}. \tag{29}$$

From above equation, it is clear that the expansion scalar is decreasing function of time. As time increases, rate of expansion decreases. Hence the universe is expanding with increase of time but the rate of expansion is decreasing.
The deceleration parameter is obtained as

$$q = -1 + \frac{d}{dt}\left(\frac{1}{H}\right) = -1 + \frac{1}{n}. \tag{30}$$

From above equation, it is observed that the deceleration parameter is constant throughout the expansion of the Universe.

6. Conclusions

In this work, we have considered spatially homogeneous and isotropic flat Friedman Robertson Walker
(FRW) cosmological model with perfect fluid in the framework of $f(T)$ gravity by taking linear model $f(T) = T$. We obtained the solution of the field equations using volumetric power law and found following results.

- The energy density of the derived model is always positive and decreases as a function of time.
- From EoS parameter, for proper choice of constant, it is observed that model represents quintessence region throughout the expansion [33 - 34].
- The spatial volume increases with the increase of time.
- The expansion scalar is decreasing function of time i.e. the universe expands rapidly in the starting and then slows down when time increases.
- The deceleration parameter is negative and constant throughout the expansion of the universe [35 - 36].
- The stability factor is negative which indicates that the model is unstable throughout the expansion.

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String Cosmological Model in a Modified theory of Gravitation with Bulk Viscous Fluid

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Abstract:
In this paper, we have studied Bianchi Type-V cosmological model in $f(R,T)$ theory of gravitation with bulk viscous fluid, where R is the Ricci scalar and T is the trace of the stress energy momentum tensor. To get the solution of model, we suppose that the barotropic equation of state for bulk viscous pressure and $\bar{p} \propto \rho$ where $\bar{p}$ is pressure density and $\rho$is the energy density. In the given model string carry on. We also find the kinematical equation of cosmological model.
Keyword: Bianchi Type-V, string cosmological model, bulk viscous fluid, $f(R,T)$gravity.

1. Introduction:

A cosmological model is a mathematical description of the universe, which tries to explain the reason of current aspect, and to describe its evolution during time. We discuss the characteristic of isotropic and homogeneous Bianchi Type-V cosmological model. The expansion of universe is accreting [1-3]. The cause of this observed accretion is still unknown, and 'dark energy' problem is commonly used to describe it. To solve this problem, introduced two methods first is to develop several dark energy condition, and second method is to modify Einstein's theory of gravitation. Modified theories are $f(R)$ gravity [4-6], $f(G)$ gravity [7], $f(T)$ gravity [8], and $f(R,T)$ gravity [9]. Here we study the $f(R,T)$ theory of gravity, where R is the Ricci scalar and T is the trace of the stress energy momentum tensor. We consider the first case i.e. $f(R,T) = R + 2f(T)$to solve the field equation.

We investigate the string cosmological model in modified $f(R,T)$ theory of gravity with bulk viscous fluid. In this paper we derived explicit equation of field equation with reference to Bianchi type-V bulk viscous string cosmological model.

Bulk viscos cosmological model in modified theory of gravity investigated by Debath [10]. $f(R,T)$ Gravity for Bianchi type-V metric in Lyra geometry investigates by Brahma and Dewri [11]. Bianchi Type-V cosmological model with bulk viscous fluid in Lyra's geometry within the frame work of $f(R,T)$gravity investigates by Brahma and Dewri [12]. Study of Bianchi type-III and VI_0 cosmological models with string fluid source in $f(R,T)$ gravity investigates by Sahoo et al. [13]. A spatially homogenous and anisotropic Bianchi type-V cosmological model in a scalar – tensor theory investigates by Naidu, Reddy, Ramprasad and Ramana [14]. Bianchi type-V cosmological model in modified theory and consider the cosmological constant as a function of the trace of the stress energy momentum tensor investigates by Ahmed and Pradhan [15]. By using the hybrid expansion law for the average scale factor Ram and Chandel study the spatially homogenous and anisotropic Bianchi type-V cosmological solution of massive string in the presence of magnetic field within the frame work of $f(R,T)$ gravity theory [16]. Ram et al. study the non-singular Bianchi type-I and V cosmological model in the presence of bulk viscous fluid within the frame work of $f(R,T)$ gravity theory [17]. Anisotropic Bianchi type-V cosmological model filled with perfect fluid in the frame work of $f(R,T)$ gravity theory investigates by Pawar and Katre [18]. The spatially homogenous and anisotropic Bianchi type- III, V and VI_0 cosmological models in $f(R,T)$ theory of gravity investigates by Vinutha and Kavya [19]. Bhardwaj and Yadav investigate the physical behavior of Bianchi type-V cosmological models in $f(R,T)$ theory of gravity [20]. Viability of Bianchi type-V in $f(R,T)$ theory of gravitation investigates by Sharma el al. [21]. Bianchi type-V cosmological model in the presence of bulk viscous fluid and within the framework of $f(R,T)$ theory of gravity investigates by Khade [22]. Explore the exact solutions of Bianchi type- V space time in $f(R,T)$ theory of gravity, two exact solutions are investigated using assumptions of the variation law of Hubble parameter and constant deceleration parameter investigates by Samir [23].

From the above investigation we have inspired to investigate the string Bianchi type-V cosmological model in $f(R,T)$ theory of gravity in the presence of bulk viscous fluid. In section 2 disuses about the modified $f(R,T)$ theory of gravity. In section 3 we discuss about metric and line elements. In section 4 we find the solution of field equation. In section 5 we found the kinematics equation of model, and in last section we conclude the conclusion of the model.

2. Modified $f(R,T)$ Gravity:

The action of $f(R,T)$ gravity,

$$S=\frac{1}{16\pi}\int f(R,T)\sqrt{-g}d^4x+\int L_m\sqrt{-g}d^4x \tag{1}$$

Where $f(R,T)$ an arbitrary functions of Ricci scalar R and T is the trace of stress-energy tensor. g is the determinant of the metric tensor g_{ij}, and L_m is the matter Lagrangian density. For the matter source, the stress energy tensor T_{ij} is given by,

$$T_{ij}=\frac{-2}{\sqrt{-g}}\frac{\delta\sqrt{-g L_m}}{\delta g^{ij}} \tag{2}$$

And its trace is

$$T=g^{ij}T_{ij} \tag{3}$$

Here, we have assumed that the matter Lagrangian L_m is depends only on the metric tensor component g_{ij} rather than its derivatives. Hence, we obtain

$$T_{ij}=g_{ij}L_m-\frac{\partial L_m}{\partial g^{ij}} \tag{4}$$

The $f(R,T)$ gravity field equations are obtained by using the equation (1)

$$f_R(R,T)R_{ij}-\frac{1}{2}f(R,T)g_{ij}+\left(g_{ij}\,\Box-\nabla_i\nabla_j\right)f_R(R,T)=-\frac{8\pi G}{c^2}T_{ij}-f_T(R,T)\theta_{ij}-f_T(R,T)T_{ij} \tag{5}$$

where

$$\theta_{ij}=-2T_{ij}+g_{ij}L_m-2g^{lm}\frac{\partial^2 L_m}{\partial g^{ij}\delta g^{lm}} \tag{6}$$

Here,

The covariant derivative is $f_R(R,T)=\frac{\partial f(R,T)}{\partial R}$, $f_T(R,T)=\frac{\partial f(R,T)}{\partial T}$ and ∇_i denotes the covariant derivative, $\Box=\nabla^u\nabla_u$ the standard stress energy tensor for matter Lagrangian is given by

$$T_{ij}=(p+\rho)u_iu_j-pg_{ij} \tag{7}$$

Where ρ is the energy density and p is the pressure of the fluid. Here $u^i=(0,0,0,1)$ is the four-velocity vector in the co-moving coordinate system satisfying

$u_iu^i=-1$ and $u^i\nabla_j u_i=0$.

By using equation number (6) the variation of stress-energy of perfect fluid is expressed as

$$\theta_{ij}=-2T_{ij}-pg_{ij} \tag{8}$$

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Normally, the field equation depends on θ_{ij}, i.e. on the physical behavior of the matter field. Hence the $f(R,T)$ gravity theory depends on the properties of the matter source. Harko [9] constructed three types of frames of $f(R,T)$ gravity as follows

$$f(R,T) = \begin{cases} R + 2f_1(T) \\ f_1(R) + f_2(T) \\ f_1(R) + f_2(R)f_3(T) \end{cases} \tag{9}$$

We consider first case as

$$f(R,T) = R + 2f_1(T) \tag{10}$$

Here, $f(T)$ is arbitrary function of matter of the trace of stress-energy tensor.
We obtain the field equation of $f(R,T)$ gravity from the equation (5), as

$$R_{ij} - \frac{1}{2}Rg_{ij} = 8\pi T_{ij} - 2f'(T)T_{ij} - 2f'(T)\theta_{ij} + f(T)g_{ij} \tag{11}$$

Here, differentiation along with respect to the case is denoted by the prime. Uncertainty a matter source is a perfect fluid,

$$\theta_{ij} = -2T_{ij} - pg_{ij} \tag{12}$$

Then the field equation takes the form

$$R_{ij} - \frac{1}{2}Rg_{ij} = 8\pi T_{ij} + 2f'(T)T_{ij} + [2pf'(T) + f(T)]g_{ij} \tag{13}$$

The energy momentum tensor which contained one dimensional cosmic string for a bulk viscos fluid is taken as

$$T_{ij} = (\rho + \bar{p})u_i u_j + \bar{p}g_{ij} - \lambda x_i x_j \tag{14}$$

Where,

$$\bar{p} = p - 3\xi H \tag{15}$$

Here, ρ is the energy density, $\xi[t]$ is the coefficient of bulk viscosity, H is the Hubble's parameter which is the four velocity of the fluid is u^i, the direction of the string is represented by x^i and string tension density is represented by λ.
Here four velocity vectors is $u^i = \delta_4^i$ which satisfy the equation given below

$$g_{ij}u^i u_j = -x^i x_j = -1, \quad u^i x_j = 0 \tag{16}$$

Here $\rho, \bar{p}$ and λ are function of time t only.
As mention in equation number (10) we consider $f(R,T) = R + 2f_1(T)$ and we choose

$$f(T) = uT \tag{17}$$

where u is constant.

3. Field equation and metric:

We consider the Bianchi type-V space time described by the line elements.

$$ds^2 = -dt^2 + A^2dx^2 + e^{-2mx}(B^2dy^2 + C^2dz^2) \tag{18}$$

Here A, B, and C are function of time t only, m is treated as constant.
For the metric (18), the Einstein field equation (13) reduced to the form as

$$\frac{\ddot{B}}{B} + \frac{\ddot{C}}{C} + \frac{\dot{B}\dot{C}}{BC} - \frac{m^2}{A^2} = -\bar{p}(8\pi + 7\mu) + \lambda(8\pi + 3\mu) + \rho\mu \tag{19}$$

$$\frac{\ddot{A}}{A} + \frac{\ddot{C}}{C} + \frac{\dot{A}\dot{C}}{AC} - \frac{m^2}{A^2} = -\bar{p}(8\pi + 7\mu) + \lambda\mu + \rho\mu \tag{20}$$

$$\frac{\ddot{A}}{A} + \frac{\ddot{B}}{B} + \frac{\dot{A}\dot{B}}{AB} - \frac{m^2}{A^2} = -\bar{p}(8\pi + 7\mu) + \lambda\mu + \rho\mu \tag{21}$$

$$\frac{\dot{A}\dot{B}}{AB} + \frac{\dot{B}\dot{C}}{BC} + \frac{\dot{A}\dot{C}}{AC} - \frac{3m^2}{A^2} = \rho(8\pi + 3\mu) + \lambda\mu - 5\bar{p} \tag{22}$$

$$\frac{\dot{B}}{B}+\frac{\dot{C}}{C}-2\frac{\dot{A}}{A}=0 \tag{23}$$

where, the overhead dot denotes derivative with respect to the cosmic time t.

The spatial volume (V) and the scale factor $a(t)$are given by

$$v=(a)^3=ABC \tag{24}$$

$$a(t)=(ABC)^{\frac{1}{3}} \tag{25}$$

Hubble's parameter (H) is defined as

$$H=\frac{\dot{a}}{a}=(H_1+H_2+H_3) \tag{26}$$

Where, $,H_1=\frac{\dot{A}}{A},\ \ H_2=\frac{\dot{B}}{B}$ and $H_3=\frac{\dot{C}}{C}$ are the directional Hubble parameters in the direction of x, y, and z respectively.

The scalar expansion (θ) are defined as

$$\theta=3H=\left(\frac{\dot{A}}{A}+\frac{\dot{B}}{B}+\frac{\dot{C}}{C}\right) \tag{27}$$

The average anisotropic parameter A_h is defined as

$$3A_h=\sum_{i=1}^{3}\left(\frac{H_i-H}{H}\right)^2;\, i=1,2,3 \tag{28}$$

The shear expansion (σ^2) is defined as

$$\sigma^2=\frac{1}{2}\sigma^{ij}\sigma_{ij}=\sum_{i=1}^{3}{H_i}^2-3H^2$$
$$\Longrightarrow 2\sigma^2=3A_h-H^2 \tag{29}$$

The declaration parameter is

$$q=-1+\frac{d}{dt}\left(\frac{1}{H}\right) \tag{30}$$

4. Solution of field equation:

Integrating equation number (23), we get

$$A^2=kBC \tag{31}$$

Where k is integrating constant, we choose k as unity

$$A^2=BC \tag{32}$$

By observing equation number (19) to (23), we found that there are six unknown from five equations. To solve the field equation we need some other condition.

- We consider the shear scalar σ is proportional to the expansion scalar θ [24]

$$B=C^2 \tag{33}$$

where n is a non-zero constant.

- Here we consider the combined effect of the proper pressure and the bulk viscous pressure, for a barotropic fluid as,

$$\bar{p}=p-3\xi H=\varepsilon\rho,\ \ p=\varepsilon_0\rho \tag{34}$$

Such that $\varepsilon=\varepsilon_0-\eta(0\le\varepsilon_0\le 1)$ and $\varepsilon,\varepsilon_0$, and η are constant.

The symbol ξ is known as the coefficient of bulk viscosity and p is known as the proper pressure of the model.

We consider a time dependent displacement field scale factor as given by [25],

$$a(t)=\alpha e^{\alpha_1 t} \tag{35}$$

where α and α_1 are constants.

By using the equation numbers (32), (33) and (35), we have

$$A=\alpha e^{\alpha_1 t},\ \ B=(\alpha e^{\alpha_1 t})^{\frac{2n}{n+1}},\ \ \ C=(\alpha e^{\alpha_1 t})^{\frac{2}{n+1}} \tag{36}$$

Then equation (18) can be transformed into

$$ds^2=-dt^2+(\alpha e^{\alpha_1 t})^2+e^{-2mx}\left[(\alpha e^{\alpha_1 t})^{\frac{4n}{n+1}}dy^2+(\alpha e^{\alpha_1 t})^{\frac{4}{n+1}}dz^2\right] \tag{37}$$

5. Kinematical property of the model:

The Physical parameters of the model are obtained as follows

Spatial volume (V)

$$V = a^3(t) = \alpha e^{\alpha_1 t} \tag{38}$$

The Hubble's parameter is obtained from equations (26) and (36)

$$\mathrm{H} = 3\alpha_1 \tag{39}$$

The expansion scalar $\theta$is given by

$$\theta = 9\alpha_1 \tag{40}$$

The average anisotropic parameter A_h is obtained as

$$A_h = \frac{2(7n^2+10n+7)}{9(n+1)^2} \tag{41}$$

The shear scalar is given by

$$\sigma^2 = \frac{-\alpha_1{}^2(n-1)(n+3)}{2(n+1)^2} \tag{42}$$

The deceleration parameter is given by

$$q = -1 \tag{43}$$

The string tension density is given by

$$\lambda = \frac{3\alpha_1{}^2(n-1)}{2(n+1)(4\pi+\mu)} \tag{44}$$

The energy density is obtained from adding equations (19)-(21) and applying equation (22) as,

$$\rho = \frac{\frac{2\alpha_1{}^2(n-1)}{n+1}\left\{\frac{1}{(n+1)}\left[\frac{(n-1)(5n+1)}{(\alpha e^{\alpha_1 t})^{\frac{2}{n+1}}}+4\right]-3\frac{(2\pi+\mu)}{(4\pi+\mu)}\right\}}{\varepsilon[5-3(8\pi-7\mu)]-8\pi} \tag{45}$$

Also we find the total pressure and proper pressure as,

$$\bar{p} = \varepsilon\left\{\frac{\frac{2\alpha_1{}^2(n-1)}{n+1}\left\{\frac{1}{(n+1)}\left[\frac{(n-1)(5n+1)}{(\alpha e^{\alpha_1 t})^{\frac{2}{n+1}}}+4\right]-3\frac{(2\pi+\mu)}{(4\pi+\mu)}\right\}}{\varepsilon[5-3(8\pi-7\mu)]-8\pi}\right\} \tag{46}$$

$$p = \varepsilon_0\left\{\frac{\frac{2\alpha_1{}^2(n-1)}{n+1}\left\{\frac{1}{(n+1)}\left[\frac{(n-1)(5n+1)}{(\alpha e^{\alpha_1 t})^{\frac{2}{n+1}}}+4\right]-3\frac{(2\pi+\mu)}{(4\pi+\mu)}\right\}}{\varepsilon[5-3(8\pi-7\mu)]-8\pi}\right\} \tag{47}$$

The coefficient of bulk viscosity is given by

$$\xi = \frac{\varepsilon_0-\varepsilon}{9\alpha_1}\left\{\frac{\frac{2\alpha_1{}^2(n-1)}{n+1}\left\{\frac{1}{(n+1)}\left[\frac{(n-1)(5n+1)}{(\alpha e^{\alpha_1 t})^{\frac{2}{n+1}}}+4\right]-3\frac{(2\pi+\mu)}{(4\pi+\mu)}\right\}}{\varepsilon[5-3(8\pi-7\mu)]-8\pi}\right\} \tag{48}$$

The Einstein field equation (37) is useful to describe $f(R,T)$ gravity, we shows expanding mode with time t.

6. Conclusion:

In this paper we have study the Bianchi Type-V string cosmological model in $f(R,T)$ theory of gravity. In this model we have obtained anisotropy parameter $A_h \neq 0$ it means that model is isotropic and homogeneous in a scalar tensor theory of gravitation. In this paper we consider bulk viscous fluid containing one dimensional cosmic string. We get $\lambda \neq 0$ that is string does not vanished. The model does not shear free because in this model $\sigma \neq 0$. As $t \to \infty$ we get bulk viscosity decreases with time increases.

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Exact Analytic Solutions of Bulk Viscous Cosmological Model In F(R) Gravity

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Abstract: In this article, we examine the Bianchi type-I space-time in the metric version of $f(R)$ gravity in the presence of bulk viscous fluid as a source of gravitation. The exact solution of field equation has been obtained by using volumetric power law and exponential law of expansion proposed by Berman [29], corresponds to the model of the universe. The physical and kinematic behavior of the universe has been discussed by using some physical and geometrical properties. Also, we can find the function of the Ricci scalar $f(R)$ for each model.

Keywords: Bianchi type -I space-time, $f(R)$ Gravity, deceleration parameter, cosmic time.

1. INTRODUCTION

It's far believed that universe starts from infinitesimally small point called as singularity and it is in development to grow majestically massive. One of the most significant discovery of the human is the expansion of the universe. Also, the question arises regarding the expansion of the universe and its expansion rate. The revolutionized cosmic ideas on this expansion and the beginning of this universe as a result of the big bang was presented by Guth [1]. The study of modern cosmology gives the past history, the present state and future evolution of the universe. One of the milestone in the study of the Universe is Supernova Ia project [2], [3] in which they have observed Universe is expanding as well as accelerating. Due to the presence of energy known as dark energy (DE), the expansion of the universe is not slowing down, rather it is actually speeding up. There are many experiments and projects that have worked out for the human curiosity about the study of the Universe like CMBR, WMAP, BAO etc. [4], [5]. The CMBR experiment shows that the unseen energy of the universe dubbed as a dark energy causes expansion and covers about 73% area of space. After many years, James Peebles [6] revived the cosmological constant and found that it is one of the candidates to observe nature and evolution of the dark energy. For the help of humanity and curiosity regarding the discovery of the universe many cosmologists worked on the same idea of the start of the universe and its rate of expansion but there is no idea about what present before singularity? when we look back in time. To overcome this issue, a very inventive theory was presented known as bouncing cosmology or the big bounce [7], [8], [9]. In the past, to address various cosmological concerns, several theories have been proposed by making some modification in Einstein theory of gravity.

The $f(R)$ gravity is the most prominent and simplest of the modified gravity. It provides an alternative to dark energy. The $f(R)$ theory of gravity was first proposed by Buchdahl in 1970.It suggest that by replacing the Einstein-Hilbert action of General relativity with the function of Ricci scalar the cosmic acceleration can be achieved. Chiba et al. [10] has been studied that $f(R)$ gravity theories have been shown to be equivalent to scalar-tensor theories of gravity that are incompatible with Solar System tests of general relativity, as long as the scalar field propagates over Solar System scales. Sharif et al. [11], [12] studied the vacuum and non-vacuum solution of various Bianchi type spacetimes in $f(R)$ theory of gravity. To investigate the early-time and late-time acceleration of the Universe, the mimetic $f(R)$ gravity

[13] has been proposed. It revealed the consistency of mimetic $f(R)$ gravity with Planck and BICEP2/Keck array observations. The dynamical behavior of the anisotropic universe has been investigated by Mishra et al [14] in modified theory of gravity. Vijaya Santhi et al. [15] investigated the Bianchi Type-I bulk viscous model and bulk viscous string cosmological model in $f(R)$ theory of gravity. Recently [16-18] studied the black hole in $f(R)$ gravity. In $f(R)$ modified gravity framework, Odintsov and Oikonomou [19] have investigated a bouncing cosmology with a Type IV singularity at the bouncing point.[20], [21] investigated the various bouncing cosmological models in modified gravity framework. Oikonomou [22] worked on exponential inflation and Sharma et al. [23] investigated the power law inflation in $f(R)$ gravity. Recently Patil et al. [24] studied the Cosmological Power law model and exponential model in $f(R)$ gravity.

Bianchi type I space-time plays an important role in the study of universe. Hasmani et al. [25] studied the exact solution of Bianchi Type – I cosmological models in $f(R)$ theory of gravity. Bhardwaj and Dixit [26] investigated LRS Bianchi type -I bouncing cosmological model in $f(R,T)$ gravity. Bianchi type- I space-time with bulk viscosity in $f(R,T)$ gravity was investigated by Koussour and Bennai [27]. Patil et al. [28] discuss the energy condition and state-finder diagnostic of cosmological model with special law of Hubble parameter in $f(R,T)$ gravity. Berman [29] introduced a different method to solve the field equation by using the variation law of Hubble Parameter. The main feature of variation law is that it gives a constant value of deceleration parameter.

In this paper, we have emphasized to investigate the exact solution of Bianchi type – I space-time in $f(R)$ theory of gravity using Power law in presence of viscous fluid. The article is organized as follows. Gravitational field equation and detail review of modified $f(R)$ theory of gravity and its field equation are given in section **2** and **3**. Section **4** is used to find the exact solution of Bianchi type- I space-time. Finally, the conclusion is summarized in section **5.**

2. GRAVITATIONAL FIELD EQUATIONS OF *F (R) MODIFIED* GRAVITY

The $f(R)$ theory of gravity is the modification of the general theory of relativity. The field equations are derived from the modification of Hilbert-Einstein action in variational principal. The action for $f(R)$ gravity is given as,

$$S=\int\sqrt{-g}\left(\frac{f(R)}{16\pi G}+L_m\right)d^4x\ , \tag{1}$$

Where $f(R)$ is a general function of the Ricci scalar and L_m is the usual matter Lagrangian. The action (1) is obtained by replacing R by $f(R)$ in standard Einstein–Hilbert.

The corresponding field equations are obtained by varying the action for metric $g_{\mu\nu}$ as,

$$F(R)R_{\mu\nu}-\frac{1}{2}f(R)g_{\mu\nu}-\nabla_\mu\nabla_\nu F(R)+g_{\mu\nu}\Box F(R)F(R)=kT_{\mu\nu} \tag{2}$$

where, $F(R)\equiv\frac{df(R)}{dR}$, $\Box=\nabla^\mu\nabla_\mu$, ∇_μ denotes covariant differentiation, $T_{\mu\nu}$ is the standard matter energy-momentum tensor derived from the Lagrangian L_m .

When we contract the field equations, it follows that

$$F(R)R-2f(R)+3\Box F(R)=kT \tag{3}$$

$$f(R)=\frac{F(R)R+3\Box F(R)-kT}{2} \tag{4}$$

Equation (4) is an important relationship between $f(R)$ and $F(R)$ which will be used to simplify the field equation and to evaluate $f(R)$.

Using equation (4) in equation (2), the field equation takes the form.

$$F(R)R_{\mu\nu} - \nabla_\mu \nabla_\nu F(R) - kT_{\mu\nu} = \left(\frac{F(R)R - \Box F(R) - kT}{4} \right) g_{\mu\nu} \tag{5}$$

Thus, we have eliminated $f(R)$ from the field equation which helps us to solve the field equations.

3. METRIC AND ENERGY MOMENTUM TENSOR

The line element of Bianchi type I is given by

$$ds^2 = dt^2 - L^2 dx^2 - M^2\ dy^2 - N^2 dz^2, \tag{6}$$

where L, M and N are cosmic scales factors.

Here we consider the source of gravitational as the bulk viscous fluid. Therefore, the energy momentum tensor is given by

$$T_{\mu\nu} = (\bar{p} + \rho) u_\mu u_\nu - \bar{p} g_{\mu\nu} \tag{7}$$

and $\quad \bar{p} = p - \eta u^i_{;i} = p - 3\eta H \qquad (8)$

where $\bar{p}$ is the effective pressure, η is the coefficient of bulk viscosity, p is the isotropic pressure, ρ is the energy density, H is the Hubble's parameter and u^μ is the fluid four velocity vector satisfying $u_\mu u^\mu = 1$. Thus, the dynamics of cosmic evolution does not change fundamentally by the inclusion of viscous terms in the energy momentum tensor.

Now, we define some geometrical parameter related to the cosmic scale factor for the space-time (6) such as average scale factor (a), spatial volume (V), mean Hubble parameter (H) mean anisotropy parameter (A_m), expansion scalar (θ), shear scalar (σ^2), deceleration parameter (q) as,

$$a = \sqrt[3]{LMN} \tag{9}$$

$$V = a^3 = LMN \tag{10}$$

$$H = \frac{1}{3}(H_1 + H_2 + H_3) = \frac{1}{3}\frac{\dot{V}}{V} = \frac{\dot{a}}{a} \tag{11}$$

where $H_1 = \frac{\dot{L}}{L}$, $H_2 = \frac{\dot{M}}{M}$, $H_3 = \frac{\dot{N}}{N}$ are the directional Hubble parameters in the direction of x, y and z axis respectively.

$$A_m = \frac{1}{3}\sum_{i=1}^{3}\left(\frac{H_i - H}{H} \right)^2 \tag{12}$$

$$\theta = u^\mu_{;\mu} = 3H = \frac{\dot{L}}{L} + \frac{\dot{M}}{M} + \frac{\dot{N}}{N} \tag{13}$$

$$\sigma^2 = \frac{3}{2} A_m H^2 = \frac{1}{2}\left[\left(\frac{\dot{L}}{L}\right)^2 + \left(\frac{\dot{M}}{M}\right)^2 + \left(\frac{\dot{N}}{N}\right)^2 \right] - \frac{1}{6}\theta^2, \tag{14}$$

$$q = \frac{d}{dt}\left(\frac{1}{H} \right) - 1 = -\frac{a\ddot{a}}{\dot{a}^2}, \tag{15}$$

4. FIELD EQUATION AND ITS EXACT SOLUTIONS

The corresponding Ricci scalar for the space-time (6) is

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$$R=-2\left[\frac{\ddot{L}}{L}+\frac{\ddot{M}}{M}+\frac{\ddot{N}}{N}+\frac{\dot{L}\dot{M}}{LM}+\frac{\dot{M}\dot{N}}{MN}+\frac{\dot{L}\dot{N}}{LN}\right], \tag{16}$$

where dot means derivative with respect to t. Since the metric (6) depends on t and χ, Equation (5) yields a set of linearly independent differential equations for $F(t), L, M$ and N in the presence of bulk viscous fluid as a source of gravitational

$$\left(\frac{\ddot{L}}{L}+\frac{\dot{L}\dot{M}}{LM}+\frac{\dot{L}\dot{N}}{LN}\right)F+\frac{1}{2}f(R)-\left(\frac{\dot{M}}{M}+\frac{\dot{N}}{N}\right)\dot{F}-\ddot{F}=k\overline{p}, \tag{17}$$

$$\left(\frac{\ddot{M}}{M}+\frac{\dot{L}\dot{M}}{LM}+\frac{\dot{M}\dot{N}}{MN}\right)F+\frac{1}{2}f(R)-\left(\frac{\dot{L}}{L}+\frac{\dot{N}}{N}\right)\dot{F}-\ddot{F}=k\overline{p}, \tag{18}$$

$$\left(\frac{\ddot{N}}{N}+\frac{\dot{M}\dot{N}}{MN}+\frac{\dot{L}\dot{N}}{LN}\right)F+\frac{1}{2}f(R)-\left(\frac{\dot{L}}{L}+\frac{\dot{M}}{M}\right)\dot{F}-\ddot{F}=k\overline{p}, \tag{19}$$

$$\left(\frac{\ddot{L}}{L}+\frac{\ddot{M}}{M}+\frac{\ddot{N}}{N}\right)F+\frac{1}{2}f(R)-\left(\frac{\dot{L}}{L}+\frac{\dot{M}}{M}+\frac{\dot{N}}{N}\right)\dot{F}=-k\rho, \tag{20}$$

From equations (17) - (18), (18) - (19) and (17) - (19) we obtain,

$$\frac{L}{M}=l_1\exp\left[k_1\int\frac{dt}{a^3F}\right], \tag{21}$$

$$\frac{M}{N}=l_2\exp\left[k_2\int\frac{dt}{a^3F}\right], \tag{22}$$

$$\frac{L}{N}=l_3\exp\left[k_3\int\frac{dt}{a^3F}\right] \tag{23}$$

Using equations (21), (22) and (23) we can write the metric function explicitly as

$$L=a\,m_1\exp\left[n_1\int\frac{dt}{a^3F}\right], \tag{24}$$

$$M=a\,m_2\exp\left[n_2\int\frac{dt}{a^3F}\right], \tag{25}$$

$$N=a\,m_3\exp\left[n_3\int\frac{dt}{a^3F}\right], \tag{26}$$

Where, $m_1=\left(l_1^2\,l_2\right)^{\frac{1}{3}}$, $m_2=\left(l_1^{-1}\,l_2\right)^{\frac{1}{3}}$, $m_3=\left(l_1^{-1}\,l_2^{-2}\right)^{\frac{1}{3}}$ (27)

and $n_1=\dfrac{2k_1+k_2}{3}$, $n_2=\dfrac{-k_1+k_2}{3}$, $n_3=\dfrac{-(k_1+2k_2)}{3}$ (28)

k_i and l_i are the constants of integration and $m_1m_2m_3=1$, $n_1+n_2+n_3=0$.

$f(R)$ theory of gravity has been shown to be equivalent to scalar tensor theory of gravity that is incompatible with solar system test of general relativity, as long as the scalar field propagates over system scales.

We also assume that the result established by M. Vijaya Santhi et al. [15] in $f(R)$ theory of gravity which shown that $F(R)\ \alpha\ (a(t))^m$,

Using the power law relation between F and a, we have $F=F_0\left(a(t)\right)^m$, (29)

where F_0 is the proportionality constant, m is any integer (here use as -2)

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The mean Hubble's parameter (H) proposed by Berman defined as $H = \beta\left(a(t)\right)^{-\alpha}$ (30)

where $\beta > 0, \alpha \geq 0$ are constant and $a(t)$ is average scale factor. This equation gives constant value of deceleration parameter. By solving equation (30), we obtain

$$a(t) = (\alpha\beta t + c_1)^{\frac{1}{\alpha}},\ \alpha \neq 0$$
$$a(t) = c_2 \exp(\beta t),\quad \alpha = 0 \tag{31}$$

c_1 and c_2 are constants of integration. Thus, we obtained two values of the average scale factor corresponding to two different models of the universe.

4.1 MODEL OF THE UNIVERSE WHEN $\alpha \neq 0$

In this model, F becomes, $F = F_0(\alpha\beta t + c_1)^{\frac{-2}{\alpha}}$ and the corresponding metric coefficient L, M and N turn out to be

$$L = m_1(\alpha\beta t + c_1)^{\frac{1}{\alpha}} \exp\left[\frac{n_1(\alpha\beta t + c_1)^{\frac{\alpha-1}{\alpha}}}{F_0\,\beta(\alpha-1)}\right], \alpha \neq 1 \tag{32}$$

$$M = m_2(\alpha\beta t + c_1)^{\frac{1}{\alpha}} \exp\left[\frac{n_2(\alpha\beta t + c_1)^{\frac{\alpha-1}{\alpha}}}{F_0\,\beta(\alpha-1)}\right], \alpha \neq 1 \tag{33}$$

$$N = m_3(\alpha\beta t + c_1)^{\frac{1}{\alpha}} \exp\left[\frac{n_3(\alpha\beta t + c_1)^{\frac{\alpha-1}{\alpha}}}{F_0\,\beta(\alpha-1)}\right], \alpha \neq 1 \tag{34}$$

The Ricci scalar of the model is found to be

$$R = \frac{6\beta^2(\alpha-2)}{(\alpha\beta t + c_1)^2} - \frac{6\beta(n_1+n_2+n_3)}{F_0}(\alpha\beta t + c_1)^{\frac{-(1+\alpha)}{\alpha}} + \frac{2}{F_0^{\,2}}\left[(n_1n_2+n_1n_3+n_2n_3) - (n_1+n_2+n_3)^2\right](\alpha\beta t + c_1)^{\frac{-2}{\alpha}} \tag{35}$$

The function of Ricci scalar $f(R)$ of the model is obtained as

$$f(R) = \frac{6\alpha(\alpha-2)F_0\beta^2}{(\alpha+1)}(\alpha\beta t + c_1)^{\frac{-2\alpha-2}{\alpha}} - \frac{6\beta(\alpha+1)(n_1+n_2+n_3)}{(\alpha+3)}(\alpha\beta t + c_1)^{\frac{-(\alpha+3)}{\alpha}} + \frac{\left[(n_1n_2+n_1n_3+n_2n_3) - (n_1+n_2+n_3)^2\right]}{F_0}(\alpha\beta t + c_1)^{\frac{-4}{\alpha}} \tag{36}$$

Equation (36) represents the function of Ricci scalar for the model, it is clear that the function of Ricci scalar is positive and decreases with time.

Using the value of metric potential, the model of universe (6) becomes,

$$ds^2 = dt^2 - m_1^2(\alpha\beta t + c_1)^{\frac{2}{\alpha}} \exp\left[\frac{2n_1(\alpha\beta t + c_1)^{\frac{\alpha-1}{\alpha}}}{F_0\,\beta(\alpha-1)}\right]dx^2 - m_2^2(\alpha\beta t + c_1)^{\frac{2}{\alpha}} \exp\left[\frac{2n_2(\alpha\beta t + c_1)^{\frac{\alpha-1}{\alpha}}}{F_0\,\beta(\alpha-1)}\right]dy^2 - m_3^2(\alpha\beta t + c_1)^{\frac{2}{\alpha}} \exp\left[\frac{2n_3(\alpha\beta t + c_1)^{\frac{\alpha-1}{\alpha}}}{F_0\,\beta(\alpha-1)}\right]dz^2 \tag{37}$$

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The metric (37) represents the Bianchi type-I Bulk-viscous cosmological model in the $f(R)$ theory of gravity.

In the model of universe (37), it is observed that metric potential L, M, N are the product of both exponential and power term. Initially at the point $t=0$, all the metric potential are constant and hence the model has no singularity. But, at the point $t=\frac{-c_1}{\alpha\beta}$ it represents the singular model. Also, at $t\to\infty$, L, M, N becomes infinite.

The mean generalized Hubble parameter and the volume scale factor becomes,

$$H=\frac{\beta}{\alpha\beta t+c_1}\ ;\ V=(\alpha\beta t+c_1)^{\frac{3}{\alpha}} \tag{38}$$

The mean anisotropy parameter A_m turns out to be

$$A_m=\frac{(n_1^2+n_2^2+n_3^2)}{3\beta^2 {F_0}^2}(\alpha\beta t+c_1)^{\frac{2(\alpha-1)}{\alpha}}+\frac{2(n_1+n_2+n_3)}{3\beta F_0}(\alpha\beta t+c_1)^{\frac{(\alpha-1)}{\alpha}} \tag{39}$$

The expansion scalar θ and shear scalar σ^2 are given by

$$\theta=\frac{3\beta}{\alpha\beta t+c_1} \tag{40}$$

$$\sigma^2=\frac{(n_1^2+n_2^2+n_3^2)}{2{F_0}^2}(\alpha\beta t+c_1)^{\frac{-2}{\alpha}}+\frac{\beta(n_1+n_2+n_3)}{F_0}(\alpha\beta t+c_1)^{\frac{-(1+\alpha)}{\alpha}} \tag{41}$$

The deceleration parameter is given by

$$q=\alpha-1 \tag{42}$$

With the help of equation (20), (32), (33) and (34) we get energy density

$$\rho=\frac{(\alpha\beta t+c_1)^{\frac{-2}{\alpha}}}{k}\left\{\begin{array}{l}\frac{1}{2F_0}\left[\left(n_1n_2+n_1n_3+n_2n_3\right)-\left(n_1^2+n_2^2+n_3^2\right)\right](\alpha\beta t+c_1)^{\frac{-2}{\alpha}}\\ -\frac{6\beta(\alpha+2)}{(\alpha+3)}\left(n_1+n_2+n_3\right)(\alpha\beta t+c_1)^{\frac{-(1+\alpha)}{\alpha}}-\frac{3F_0\beta^2(1+2\alpha)}{(\alpha+1)(\alpha\beta t+c_1)^2}\end{array}\right\} \tag{43}$$

we obtained the total pressure as

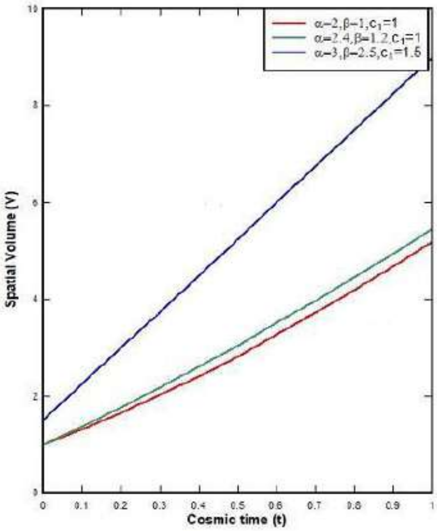


Figure 1: Cosmic Time vs spatial volume

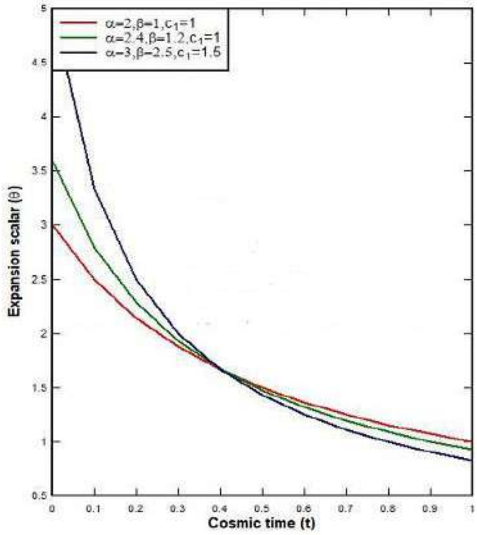
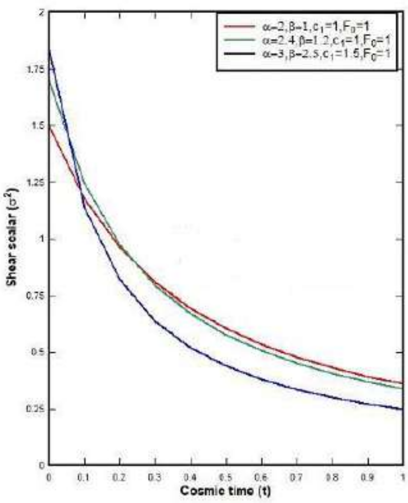
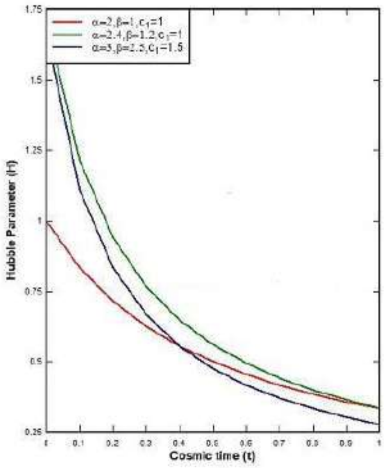


Figure 2: Cosmic Time vs Expansion scalar





$$\bar{p}=\frac{(\alpha\beta t+c_1)^{\frac{-2}{\alpha}}}{k}\left\{\begin{array}{l}\frac{3F_0\beta^2(1-2\alpha)}{(\alpha+1)(\alpha\beta t+c_1)^2}+\frac{6\beta}{(\alpha+3)}\left(n_1+n_2+n_3\right)(\alpha\beta t+c_1)^{\frac{-(1+\alpha)}{\alpha}}\\ +\frac{1}{2F_0}\left(n_1^2-n_2^2-n_3^2+n_1n_2+n_1n_3-n_2n_3\right)(\alpha\beta t+c_1)^{\frac{-2}{\alpha}}\end{array}\right\} \quad (44)$$

It is observed that the energy density is the function of time t and always decreases positively with the expansion in power law model. Initially as $t \to 0$, the energy density of the universe is infinitely large i.e., $\rho \to \infty$ but with the expansion of universe it declines.

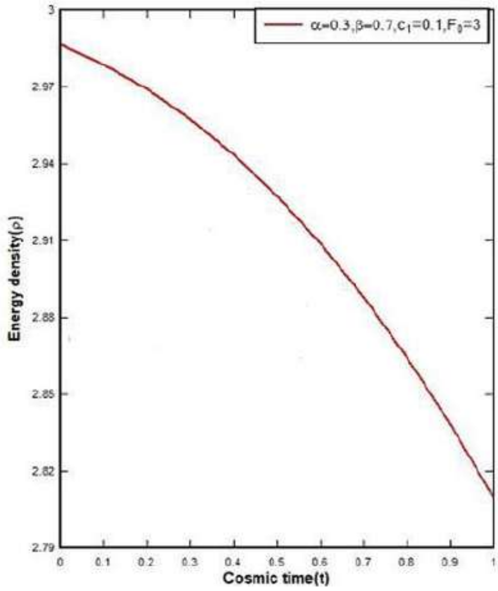


Figure 5: Cosmic Time vs Energy density

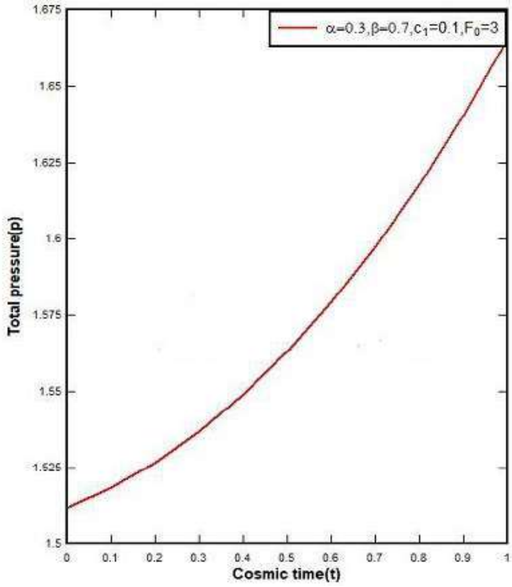


Figure 6:Cosmic Time vs Total pressure

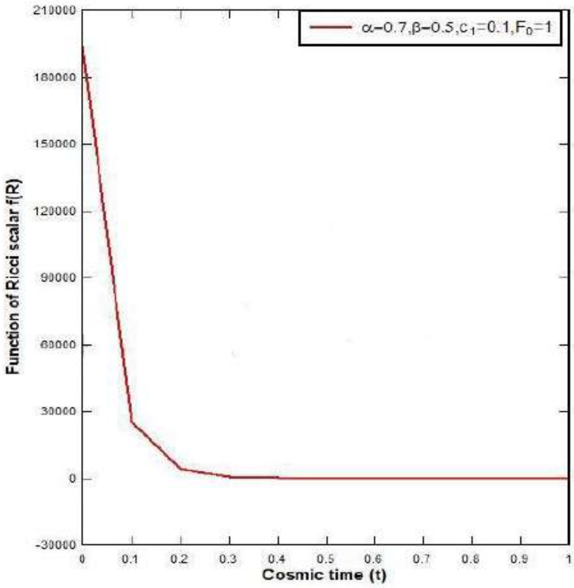


Figure 7: Cosmic Time vs f(R)

4.2 MODEL OF THE UNIVERSE WHEN $\alpha = 0$

For this model, F becomes, $F = \frac{F_0}{c_2^{\,2}} \exp(-2\beta t)$ and the corresponding metric coefficient L, M and N turn out to be

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$$L = m_1 c_2 \exp(\beta t) \exp\left[\frac{-n_1 \exp(-\beta t)}{F_0 c_2 \beta}\right], \tag{45}$$

$$M = m_2 c_2 \exp(\beta t) \exp\left[\frac{-n_2 \exp(-\beta t)}{F_0 c_2 \beta}\right], \tag{46}$$

$$N = m_3 c_2 \exp(\beta t) \exp\left[\frac{-n_3 \exp(-\beta t)}{F_0 c_2 \beta}\right], \tag{47}$$

The Ricci scalar of the model is found to be

$$R = \frac{2}{F_0^2 c_2^2}\left[(n_1 n_2 + n_2 n_3 + n_1 n_3) - (n_1 + n_2 + n_3)^2\right]\exp(-2\beta t) - \frac{6\beta}{F_0 c_2}(n_1 + n_2 + n_3)\exp(-\beta t) - 12\beta^2 \tag{48}$$

The function of Ricci scalar $f(R)$ of the model is obtained as

$$f(R) = \frac{1}{F_0 c_2^4}\left[(n_1 n_2 + n_2 n_3 + n_1 n_3) - (n_1 + n_2 + n_3)^2\right]\exp(-4\beta t) - \frac{2\beta}{c_2^{\,3}}(n_1 + n_2 + n_3)\exp(-3\beta t) \tag{49}$$

Using the value of metric potential, the model of universe (6) becomes,

$$\begin{aligned} ds^2 &= dt^2 - m_1^2 c_2^2 \exp(2\beta t) \exp\left[\frac{-2n_1 \exp(-\beta t)}{F_0 c_2 \beta}\right] dx^2 \\ &\quad - c_2^2 \exp(2\beta t)\left[m_2^2 \exp\left(\frac{-2n_2 \exp(-\beta t)}{F_0 c_2 \beta}\right) dy^2 + m_3^2 \exp\left(\frac{-2n_3 \exp(-\beta t)}{F_0 c_2 \beta}\right) dz^2\right] \end{aligned} \tag{50}$$

In the model of universe (50), it is observed that metric potential L, M, N are the product of exponential term. Initially at the point $t=0$, all the metric potential are constant and hence the model is free from singularity.

The mean generalized Hubble parameter and the volume scale factor becomes,

$$H = \beta, \quad V = c_2^{\,3} \exp(3\beta t) \tag{51}$$

The mean anisotropy parameter A_m turns out to be

$$A_m = \frac{n_1^{\,2} + n_2^{\,2} + n_3^{\,2}}{3\beta^2 F_0^{\,2} c_2^{\,2}} \exp(-2\beta t) + \frac{2(n_1 + n_2 + n_3)}{3\beta F_0 c_2} \exp(-\beta t) \tag{52}$$

The expansion θ and shear scalar σ^2 are given by

$$\theta = 3\beta, \quad \sigma^2 = \frac{n_1^{\,2} + n_2^{\,2} + n_3^{\,2}}{2F_0^{\,2} c_2^{\,2}} \exp(-2\beta t) + \frac{\beta(n_1 + n_2 + n_3)}{F_0 c_2} \exp(-\beta t) \tag{53}$$

The deceleration parameter is given by

$$q = -1 \tag{54}$$

With the help of equation (20), (45), (46) and (47) we get energy density

$$\begin{aligned} \rho &= \frac{\left[(n_1 n_2 + n_1 n_3 + n_2 n_3) - (n_1^2 + n_2^2 + n_3^2)\right]}{2kF_0 c_2^4} \exp(-4\beta t) \\ &\quad - \frac{2\beta}{kc_2^3}(n_1 + n_2 + n_3)\exp(-3\beta t) - \frac{9F_0 \beta^2}{kc_2^2}\exp(-2\beta t) \end{aligned} \tag{55}$$

we obtained the total pressure as

$$\bar{p}=\frac{\left(n_1^2-n_2^2-n_3^2 n_1 n_2+n_1 n_2+n_1 n_3-n_2 n_3\right)}{2kF_0 c_2^4}\exp(-4\beta t)$$
$$+\frac{2\beta}{kc_2^3}\left(n_1+n_2+n_3\right)\exp(-3\beta t)+\frac{3F_0\beta^2}{c_2^2}\exp(-2\beta t) \quad (56)$$

5. SUMMARY AND CONCLUSION

In this paper we have studied the behavior of the Bianchi type- I space-time in framework of $f(R)$ gravity with bulk viscous fluid as a source of gravitation in relation to volumetric power law and exponential law expansion. Also, we have obtained some important cosmological physical quantities for these models such as Hubble's parameter (H), volume scale factor (V), expansion scalar (θ), shear scalar (σ^2), deceleration parameter (q) and the mean anisotropy parameter (A_m). The function of the Ricci scalar $f(R)$ is also evaluated for the model.

Power-law model of the universe has point type singularity at $t=\frac{-c_1}{\alpha\beta}$. The physical parameter H,θ and σ^2 all are infinite at this point for $\alpha>0$ while the volume scale factor vanishes. The mean anisotropy parameter A_m is also infinite at this point for $0<\alpha<1$ and it will also vanish for $\alpha>1$.The function of Ricci scalar also infinite while metric potential vanishes at the point of singularity. It also shown that the expansion and shear scalar decreases for $\alpha>0$ with the passage of time and the mean anisotropic parameter decreases for $\alpha>1$ with the increase in time. As the Hubble parameter (H) and scalar expansion (θ) are inversely proportional to time (t) and initially at $t\to 0$ they attain infinitely large value and decreases with expansion and approaches to zero for large expansion. Therefore, our power law model represents both decelerating model as well as accelerating model of the universe.

For the exponential model of the universe the physical parameter H,θ and σ^2 all are finite for all finite values of t. The mean generalized Hubble parameter H and the expansion scalar θ is finite and constant. The metric functions do not vanish for this model. In this case the value of deceleration parameter is $q=-1$ and hence, we have accelerating model of the universe. The volume scale factor increases exponentially with time which indicates that universe starts its expansion with zero volume from infinite past. The function of Ricci scalar $f(R)$ is inversely proportional to time (t)

5. Abbreviations

CMBR, cosmic microwave background radiation; WMAP, Wilkinson Microwave Anisotropy Probe; BAO, baryon acoustic oscillations; DE, Dark energy.

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Anisotropic Exploration of the Polytropic Equation of State in the Bianchi Type - III cosmological Model

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Abstract:
In this research paper, we investigate the dynamics of the Bianchi Type–III cosmological model with a polytropic equation of state. The Bianchi Type-III model is an anisotropic cosmological solution to Einstein’s field equations, and we consider a cosmic fluid whose pressure and energy density are related through the polytropic equation of state. We explore the implications of this polytropic fluid on the anisotropic evaluation of the Universe and study how the anisotropy influences the behavior of the cosmic fluid. Numerical simulation and analytical approximations are used to analyze the model’s evaluation and exact insights into the anisotropic cosmological scenarios.
Key words: Bianchi Type-III, Polytropic equation of state, Anisotropy.

Introduction:
The FLRW metric serves as the foundation of the standard cosmological model, effectively explaining numerous observed phenomena in the Universe. Nevertheless, this model assumes the uniformity of space and isotropy, which may not be universally valid across all scales and cosmic epochs. To address this limitations, Bianchi cosmological models offer an alternative frame work, introducing the possibility of special anisotropy. Among these models, the Bianchi Type -III cosmological model stands out with its distractive rotational symmetry around a single axis, rendering it a captivating subject of exploration.

By incorporating the polytropic equation of state, a versatile tool for modeling cosmic fluid behavior, researchers gain the means to investigate diverse cosmological scenarios. This equation connects the pressure and energy density of the cosmic fluid through a power-law relationship. The interplay between the polytropic equation of state and the anisotropic Bianchi Type-III model provides valuable insights into the universe’s dynamics evolution.

In this research paper, we investigate the complexities of the Bianchi Type-III cosmological model with a polytropic equation of state. Utilizing numerical simulations and analytical approximations, we explore the anisotropic expansion of the universe, where different special expansion of the FLRW model shows attractive implication for the cosmic structure formation and early universe cosmology. Our results disclose the complex dynamics of the polytropic fluid under the influence of anisotropy. The evolution of the cosmic fluid’s pressure and energy density showcases diverse behaviors, uncovering a rich tapestry of the possibilities for the early universe’s evolution.

By discussing the stability of the anisotropic model with polytropic fluid, we deepen our understanding of the cosmic inflation. The rapid expansion believed to have occurred shortly after the Big Bang. Examining the Model’s strength against perturbations sheds light on the universe’s early moments and the fundamental principles governing its developments.

Overall, this research bridges the gap between anisotropic cosmological models and polytropic equations of state. In broadens our understanding of cosmic evaluation, paving the way for further investigations into the vast cosmic landscape and providing a potential avenue for reconciling observed phenomena with theoretical predictions. Further research may extend this work to other Bianchi models and explore additional tests to discern between anisotropic and isotropic cosmological scenarios. The Bianchi Type-III cosmological model with a polytropic equation state presents an exciting and promising avenue for unraveling the complexities of our universe's journey.

Literature Review:

The literature on Bianchi cosmological models and polytropic equation of state spans several decades, encompassing both theoretical and observational studies. The anisotropic nature of Bianchi models has been a subject of interest in various cosmological contexts, leading to significant advancements in our understanding of the universe's evolution. This literature review aims to provide a comprehensive overview of the existing research and identify the gaps that motivate our investigation into the Bianchi Type-III cosmological model with a polytropic equation of state.

Early studies on Bianchi cosmological model date back to the 1960s, with pioneering works by Karlhede, Collins, and others, who investigated the mathematical properties of these anisotropic solutions to Einstein's field equations. These early efforts laid the groundwork for subsequent research, highlighting the rich and complex dynamics that anisotropy introduces into the evolution of the universe.

In the context of early universe cosmology, the significance of anisotropic models emerged during the inflationary epoch. Guth's proposal of cosmic inflation, followed by developments by Linde, Albrecht, and Steinhardt, provided a compelling explanation for the universes large-scale isotropic modes that might have left imprints on the cosmic microwave background radiation. Several studies explored these imprints, leading to constraints on anisotropic components during inflation and their potential consequences for structure formation.

The Bianchi Type-III model characterized by its rotationally symmetric anisotropy, attracted attention due to its distinct properties. Researchers such as Ellis, MacCallum, and Wainwright delved into the geometrical and dynamical aspects of this model, offering insights into its unique features and its relevance to understanding the early universe.

Furthermore, cosmological structure formation within anisotropic models has been extensively investigated. Numerical simulations by Maartens, Barrow, and Dunsbyexplored the effects of anisotropy on the growth of cosmic structures, reveling the impact on large scale structure formation and galaxy clustering. The behavior of dark matter and baryonic matter in anisotropic universes, as studied by Coley and Lim, demonstrated the complexities that anisotropy introduces into the formation and evolution of cosmic structure.

In the realm of dark energy scenarios, the presence of anisotropic stress and its implications on cosmic acceleration have been explored. The nature of dark energy is one of the most significant enigmas in modern cosmology, and incorporating anisotropy adds an additional layer of complexity to the puzzle. Several studies have investigated the effect of anisotropic dark energy on cosmic expansion and its potential observational signatures

While these studies have significantly advanced our knowledge of anisotropic cosmological models and behavior of cosmic fluids, limited attention has been devoted to the specific combination of the Bianchi Type-III model with a polytropic equation of state. This research paper aims to bridge this gap and contribute new insights into the interplay between anisotropy and the dynamics of the cosmic fluid. The polytropic equation of state offers a promising avenue for modeling the behavior of cosmic fluids in anisotropic universes opening up exciting possibilities for exploring different cosmological scenarios.

In conclusion, the literature on Bianchi cosmological models and polytropic equations of state is vast and diverse, covering a wide range of theoretical and observational studies. The anisotropic nature of Bianchi models has been studied in various cosmological contexts, providing valuable insights into the dynamics of the early universe, cosmic structure formation and dark energy scenarios. However, the specific combination of the Bianchi Type-III models with a polytropic equation of state remains relatively unexplored. This research paper aims to fill this gap and contribute to the growing body of knowledge on anisotropic cosmological scenarios, shedding light on the interplay between anisotropy and cosmic fluid behavior.

Methodology:

The combination of numerical simulation and analytical approximations constitutes a powerful and complementary approach to explore the dynamics of the Bianchi Type-III cosmological model with a polytropic equation of state. Numerical simulation provides a robust and accurate method to solve the Einstein's field equations, allowing us to capture the complex evolution of the anisotropic universe over cosmic time. By employing advanced computational techniques, we can numerically integrate the differential equations and obtain numerical solutions for the evolution of the scale factors.

The numerical simulations tell the complex patterns of the anisotropic expansion, showing how the cosmic fluids behavior is influenced by the polytropic equation of state. These simulations allow to observe how the anisotropy affects the expansion rates along different spatial dimensions, cracking light on the cosmic evolution's deviations from isotropic scenarios. Moreover, numerical simulations offer the advantage of exploring various initial conditions and parameters, providing a comprehensive understanding of the mode's behavior under different cosmic settings. In parallel we utilize analytical approximations to gain a deeper theoretical understanding into the anisotropic cosmological model. Perturbation theory applied to the coupled Einstein field equations and polytropic equation of state, allow us to study the system stability under pure conditions.

Through perturbation theory, we examine the growth of small fluctuations and the stability of the cosmic fluid in the presence of anisotropy. The stability analysis provides essential information about the model's strength against perturbations and potential instabilities. It also enhances our understanding of how anisotropic perturbations can influence the cosmic fluids behavior, impacting the cosmic structure formation and large-scale geometry.

By integrating numerical simulations and analytical approximations, our research achieves a comprehensive and multi-faceted investigation of the Bianchi Type-III cosmological model with a polytropic equation of state. This integrated approach allows us to cross validate our results and ensure the reliability of our findings. It also provides deeper understanding of the complex interaction between anisotropy and cosmic fluid behavior, unlocking new paths of exploration within anisotropic cosmological scenarios.

In conclusion, the combination of numerical simulations and analytical approximations is fundamental to advancing our understanding of the Bianchi Type-III cosmological model with polytropic equation of state. The synthesis of these two powerful methods allow to explore the evolution of models, unveil the effects of anisotropy on cosmic fluid behavior, and investigate the system stability. This integrative approach covers the way for further investigations into the details of anisotropic universes and provides valuable understandings into the fundamental principles shaping our cosmic evolution.

Results:

The numerical simulations and analytical approximation divulge the complex patterns of the anisotropic evolution in the Bianchi Type-III cosmological model with a polytropic equation of state. Our findings indicate that anisotropy significantly affects the expansion rates of the different spatial dimensions. This leads to varying cosmic expansion rates along different axes, presenting a stark departure from the uniform expansion seen the FLRW model. Additionally, we observe how the polytropic equation of state influences the pressure and energy density of the cosmic fluid. The model exhibits rich dynamical behavior, allowing us to draw valuable insights into the evolution of anisotropic universes.

Discussion:

Our findings carry significant implications for the cosmology of the early universe. Anisotropic cosmological models challenge conventional models, offering new opportunities

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for exploring the cosmic evolution complexities. We discuss the potential consequences of anisotropy for the formation and growth of cosmic structures, such as galaxies and galaxy clusters. The presence of anisotropy in the early universe can imprint observable signatures on the cosmic microwave background radiation, potentially providing a unique opportunity to test these models against observational data.

Furthermore, we explore the stability of the anisotropic model with the polytropic fluid. instabilities and perturbations in anisotropic cosmology have implications for cosmic inflation, an essential ingredient in our understanding of the universe's early moments. Our investigations sheds light on the stability conditions and the strength of the model's predictions against perturbations, enhancing our understanding of the universe's early evolutions.

Conclusion:

Our research contributes to a deeper understanding of the Bianchi Type-III cosmological model with a polytropic equation of state, highlighting the significance of considering anisotropy in cosmological scenarios. The anisotropic nature of the Bianchi Type-III model leads to the deviations from the standard FLRW predictions, providing crucial understanding the early dynamics of the universe. The polytropic equation of state offers a flexible approach to model the cosmic fluid, allowing the exploration of various cosmic scenarios. By merging the study of anisotropy and the polytropic equation of state, this research uncovers the complex interplay between cosmic expansion and the properties of the cosmic fluid. Future research could extend this work to consider other Bianchi models and investigate further observational tests to distinguish between anisotropic and isotropic cosmological models. Overall, the Bianchi Type-III cosmological model with polytropic equation of state presents an exciting path for exploring the vast cosmic landscape and introducing the essential principles that indicate the evolution of the universe.

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18

Theory of Relativity and its Applications

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ABSTRACT

Present paper gives the study of Special relativity and General relativity for mathematical applications. Albert Einstein presented his theory of relativity to the world in the early 20th century, he was proposing just that and what's more? He's been proven correct. Einstein's theory has two parts 1) Special relativity and 2) General relativity

A surface level study of the theory and its consequences followed by a look at some of its applications will provide an introduction to one of the most influential scientific discoveries of the last century.

The strange consequences of special relativity aren't limited to time. In two different inertial reference frames, the length of an object will be different depending on the relative velocity between the frames. The Doppler Effect in light waves is another result of special relativity. General relativity was published in 1915. Instead of inertial reference frames, it deals with acceleration and gravity. From the equivalence principal it follows that we can expect phenomena that occur in reference frames experiencing gravity to match those that occur in accelerating reference frames

This energy melts or vaporizes the work piece material creating the desired cut. Electron beam machining has allowed for the fast, high precision machining of a variety of parts for the medical, automotive, aerospace and other industries.

Keywords: Relativity, acceleration, light waves, aerospace,

Introduction:

According to the theory of general relativity, matter causes space to curve. It is posited that gravitation is not a force, as understood by Newtonian physics, but a curved field (an area of space under the influence of a force) in the space-time continuum that is actually created by the presence of mass. No experiment done on the earth will detect the absolute motion of the earth. This statement is so profoundly true that there is, therefore, no meaning to the notion of absolute motion. All motion is relative to other bodies, and this is why we call it the "theory of relativity." When Albert Einstein presented his theory of relativity to the world in the early 20th century, he was proposing just that. And what's more? He's been proven correct. Einstein's theory has two parts:–

1) Special relativity, which deals with inertial reference frames and
2) General relativity, which deals with the curvature of space time.

A surface level study of the theory and its consequences followed by a look at some of its applications will provide an introduction to one of the most influential scientific discoveries of the last century [1-3].

Special Relativity:

Special relativity was published in 1905 and has two overarching ideas:

1. The laws of physics are valid in all inertial reference frames (frames that aren't accelerating) and there is no preferred reference frame.
2. The speed of light is constant for all reference frames (c = 299,792,458 m/s).

These ideas come with several bizarre consequences. The first is that time doesn't move at the same rate for two observers that are moving relative to each other. To a person standing still looking at a car speeding past, time would appear to be moving slower for the driver. This effect is referred to as time dilation and can be modeled by: $\Delta t' = \gamma \Delta t$ where γ is called the Lorenz factor. The Lorenz factor is approximately one for speeds much less than the speed of light and increases as the relative speed approaches light speed (Walker, 2012).

Since time can be altered by speed, you're probably wondering about time travel. In a sense, special relativity allows for time travel to the future. Let's say a person leaves Earth on a spaceship that travels at a speed close to the speed of light. Time on the spaceship would be moving slower than time on Earth due to time dilation (Walker, 2012). So the traveler could return to Earth say 100 earth- years after he left, but may have only aged 10 years. The bad news is, to travel back to the past the traveler would need to travel faster than the speed of light. As a person's speed approaches the speed of light, their Lorenz factor becomes infinitely large, therefore the energy ($E = \gamma mc$ 2) required to propel them becomes infinitely large. For this reason, traveling to the past is possible only in science fiction movies [4-6].

The strange consequences of special relativity aren't limited to time. In two different inertial reference frames, the length of an object will be different depending on the relative velocity between the frames. For example, a meter stick From the 1985 film "Back to the Future" 1 Rea: The Theory of Relativity and Applications Published by EngagedScholarship@CSU, 2018 traveling directly toward you will appear to be shorter than one meter. This can be modeled as: $L' = L/\gamma$ where γ is the same Lorentz factor as before. This phenomenon is referred to as length contraction (Walker, 2012).

The Doppler Effect in light waves is another result of special relativity. In sound waves, the Doppler Effect changes the frequency of sound emitted from a source based on that source's motion relative to the detector. That is the reason why police sirens sound high pitched when they are approaching you and low pitched when they are driving away. In light waves, the Doppler Effect also alters the frequency, and therefore the wavelength, of sources. Light sources moving away from the detector will have longer wavelengths (called red shifting) and sources moving closer to the detector will have shorter wavelengths (called blue shifting). The greater the relative velocity, the greater the shift in wavelength (Walker, 2012). Scientists have used the detection of red shifted electromagnetic waves to determine how fast the universe is expanding [7-10].

At this point you're likely thinking that special relativity is weird and would like some evidence to back up these wild claims. In 1971, Joseph C. Hafele and Richard E. Keating performed an experiment that did just that. They flew two cesium atomic clocks around the world twice and then compared them with clocks that had remained stationary. The clocks disagreed and their difference was exactly predicted by the theory of relativity (Radeska, 2016). In 2017, another experiment was done using strontium clocks, whose accuracy is three times that of cesium clocks, and the theory of relativity was once again upheld (Ananthaswamy, 2017).

General Relativity:

General relativity was published in 1915. Instead of inertial reference frames, it deals with acceleration and gravity. General relativity starts with the equivalence principal, which states that the effects of gravity are always equivalent to the effects of acceleration (Hainline, n.d.). So, if we put a person in a box without windows, they wouldn't be able to tell if they were on Earth feeling Earth's gravity or accelerating in space. From the equivalence principal it follows that we can expect phenomena that occur in reference frames experiencing gravity to match those that occur in accelerating reference frames. One result of this is that light bends around massive objects as a result of gravity. Hafele and Keating with their atomic clocks. 2 The Downtown Review, Vol. 5, Iss. 1 [2018], Art. 3

https://engagedscholarship.csuohio.edu/tdr/vol5/iss1/3 This observation contradicts Newtonian gravity ($Fg = G\ Mm\ r\ 2$) because photons (light) are massless and therefore, in a Newtonian physics world, would be unaffected by gravity [11-12].

The general theory of relativity redefines gravity as an effect due to the curvature of space-time. Space-time is the entanglement of three-dimensional space and time. It is warped and bent by energy in a way that is described by the Einstein field equations (Pe'er, n.d.). Note here: Einstein’s equation: $E = mc\ 2$ (from special relativity) defines mass as a type of energy, so saying energy warps space-time includes mass energy. There are six independent field equations all of the form: $R\mu\nu - 1\ 2\ Rg\mu\nu + \Lambda g\mu\nu = 8\pi GT\mu\nu$

The left side of the equation deals with the geometry of space-time and the right side deals with the effects of energy (mass). The more massive an object, the more it bends space-time. One way to visualize the warping of space-time around a massive object, like Earth, is to think of a bowling ball on a trampoline. The bowling ball will deform the surface of the trampoline and when you place a marble on the trampoline it will roll toward the bowling ball. In a similar way, the warping of space-time around the Earth results in a pulling of less massive objects (like people) towards the Earth. This is gravity.

One effect of space-time’s curvature is gravitational time dilation. Time slows down near massive objects due to the bending of space-time. More massive objects slow time more, because they produce curvier space-time (Hainline, n.d.). There are actually infinite points in space-time within some extremely massive objects, like black holes, where time, from the point of view of an outside observer, slows to a stop (“A black hole is a one-way”, 2009).

Einstein’s general theory of relativity also predicts the existence of gravitational waves. These are produced by events such as: the explosion of a supernova, the merging of two black holes or when two massive stars orbit each other. Much like ripples in a pond, gravitational waves travel radially outward from the source through space-time losing intensity with distance. These waves move at light speed. They compress and stretch space-time as they travel (“What is a gravitational wave”, 2017). In 2015, scientists at the Laser Interferometer Gravitational-Wave Observatory (LIGO) physically sensed the space-time distortion from gravitational waves for the first time. The waves were produced by the collision of two black holes 1.3 billion years ago (“What is a gravitational wave”, 2017).

Einstein’s general theory of relativity has allowed for several advances in science. For instance, scientists couldn’t accurately predict the orbit of Mercury until they considered that Mercury goes deeper into curvy space-time when it gets closer to the sun. Also, the bending of light around massive objects, described by general relativity, allows for gravitational lensing. Astronomers use gravitational lensing to view distant stars that are behind other massive celestial bodies (Hainline, n.d.).

Applications:

Einstein’s theory of relativity has made many new technologies possible. A world without relativity would be a world without cathode ray televisions, radar guns, the global positioning system and more [13-16].

Cathode ray tube (CRT) televisions create pictures by shooting electrons at a phosphorous screen. These electrons are accelerated to high velocities, near 20- 30% of the speed of light. Remember from special relativity that as a particle approaches speeds near light speed, the energy required to propel the particle is increased. Magnets in the television are responsible for placing the electrons in the correct configuration on the screen. They must account for the relativistic effects on these electrons or the picture created will be out of focus (Akpan, 2015). So, we have Einstein to thank for making CRT televisions, the precursor to plasma and LCD televisions, possible.

Another modern technology with a tie to Einstein’s theory of relativity is the radar gun. Radar guns are used in the military, professional sports, and, yes, to give out speeding tickets.

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A radar gun consists of a radio wave emitter and a detector. A police officer points his radar gun at a speeding car. The radar gun emits radio waves. These waves reflect off of the speeding car and travel back to the detector (Akpan, 2015). Based on the amount of wavelength shift, due to the Doppler effect discussed in special relativity, the radar gun is able to calculate the speed of the passing car. So, remember to thank Einstein for making your next speeding ticket possible

The theory of relativity plays a crucial role in the accuracy of the global positioning system (GPS). The GPS consists of 24 satellites that orbit the Earth. These satellites are about 20,000 km above Earth's surface and are traveling at about 4 km/s (just shy of 9,000 mph). GPS receivers, like the one in your car's navigation system, receive four signals emitted by four satellites. They use these signals to solve four independent linear equations that triangulate your location. These equations can be summarized as: the distance traveled by the light wave (the distance from the satellite to you) is equivalent to the speed of the wave (the speed of light) multiplied by the time it took the wave to get to you.

In order for these equations to work correctly, the GPS satellites must keep very accurate time. They use atomic clocks that are routinely adjusted for the effects of both special and general relativity. The relative speed between the satellites and the Earth will cause a time dilation that slows the GPS clocks. Opposing this effect, a gravitational time dilation is caused because the satellite clocks are further from the Earth and are therefore in less curvy space-time than those on Earth's surface. If these effects weren't accounted for, the errors would be significant; as much as 11 km in only one day (Ashby, 2002).

Einstein's discovery also had a hand in electron beam machining (EBM). EBM is a non traditional machining process, invented in 1952, that utilizes a beam of high velocity electrons to perform cutting operations. The electrons are produced in the electron beam gun and are accelerated to 50- 80% the speed of light by an anode (Kalpakjian, 2014). With speeds close to the speed of light, the electron's kinetic energy must be calculated using equations that come from special relativity. When these high- energy electrons hit the work piece, their kinetic energies are transferred to thermal energy. This energy melts or vaporizes the work piece material creating the desired cut ("Electron Beam", n.d.). Electron beam machining has allowed for the fast, high precision machining of a variety of parts for the medical, automotive, aerospace and other industries.

Walking through the basics of Einstein's special and general theory of relativity has provided a basic understanding of one of the most important Illustration of four satellites in the GPS triangulating a location Mixer Disc: 2,340 holes of 0.9 mm diameter drilled by EBM 5 Rea: The Theory of Relativity and Applications Published by EngagedScholarship@CSU, 2018 scientific advances of the last century. The theory of relativity explained previously unexplained scientific observations, led the way for new scientific advances and made many common technologies possible.

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Review of domination in hypergraph theory

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Abstract:-
This paper provide comprehensive review of the notion of an isolate domination in hypergraphs. The review encompasses a wide range of research articles and presents key findings related to domination in hypergraph theory such as isolate domination, isolate domination number. In conclusion, this review paper not only consolidates the wealth of information available but also identifies gaps in knowledge, paving the way for future investigations in the domination of hypergraph theory with studying some new domination parameters in connection with other hypergraph theoretic parameters.
Keywords: Hypergraphs, domination number, isolate domination

Introduction:-
Graph Theory is an important area of contemporary mathematics with many applications in computer science, genetics, chemistry, engineering, industry, business and in social sciences. It is a young science invented and developing for solving challenging problems of "computerized" society for which traditional areas of mathematics such as algebra or calculus are powerless. The first mathematicians to work in graph theory (in particular the thriving Hungarian school with D. Konig, P. Erdos, P. Turin, T. Gallai, G. Hajos, etc.) considered mainly undirected graphs, and this could lead students to believe that there are two theories one for directed graphs and one for undirected graphs. The results for a directed graph can be interpreted for an undirected graph by replacing each edge of the undirected graph with two oppositely directed arcs with the same endpoints.
One of the pioneering works in hypergraph theory was done by Claude Berge [3], a French mathematician, in the 1950s. He introduced the concept of hypergraphs and established fundamental definitions and properties.
The concept of domination in graphs was introduced by de Jaenisch [2] in 1862 and The domination in hypergraph was introduced by Acharya[1] in 2007. Several variants of domination have been introduced and well-studied in the present literature such as edge domination, total domination, connected domination, global domination, equitable domination etc. and many others are being studied.
We recall some basic definitions

Definition1: A hypergraph $\mathcal{H}$ is a pair $\mathcal{H}(V, E)$ where V is a finite nonempty set and E is a collection of subsets of V. The elements of V are called vertices and the elements of E are called edges or hyperedges and $\bigcup_{e_i \in E} e_i = V$ and $e_i \neq \emptyset$ are required, for all $e_i \in E$.
The number of vertices in $\mathcal{H}$ is called the order of the hypergraph and is denoted by $|V|$.
The number of edges in $\mathcal{H}$ is called the size of $\mathcal{H}$ and is denoted by $|E|$.
A hypergraph of order n and size m is called a (n, m) hypergraph.
Concept of the domination in hypergraph was introduced by Acharya[1] in 2007.

Definition 2: For a hypergraph $\mathcal{H}(V, E)$, a set $D \subseteq V$ is called a dominating set of $\mathcal{H}$ if for every $v \in V \setminus D$, there exists $u \in D$ such that u and v are adjacent in $\mathcal{H}$, that is there exists $e \in E$ such that u and v are adjacent in $\mathcal{H}$, that is there exist e$\in E$ such that u, v $\in$ e.
Jadhav[4] defined concept of isolate domination in hypergraph.

Definition 3: For any vertex v in a hypergraph $\mathcal{H}(V, E)$ the set

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$N[v]$ = $\{u \in V : u$ is adjacent to $v\} \cup \{v\}$ is called the closed neighborhood of v in $\mathcal{H}$ and each vertex in the set $N[v] - \{v\}$ is called a neighbor of v. The open neighborhood of the vertex v is the set $N[v] - \{v\}$.

Definition 4: A dominating set I of a hypergraph $\mathcal{H}(V,E)$ is called an isolate dominating set of $\mathcal{H}(V,E)$ if it contains at least one vertex $v \in I$ such that v is not adjacent to any vertex of I i.e. $N(v) \cap I = \emptyset$, for at least one vertex $v \in I$.

Definition 5: An isolate dominating set I of a hypergraph $\mathcal{H}(V,E)$ is called a minimal isolate dominating set if no proper subset of I is an isolate dominating set of $\mathcal{H}(V,E)$.

Definition 6: The minimum (maximum) cardinality of a minimal isolate dominating set in a hypergraph $\mathcal{H}(V,E)$ is called the isolate (upper isolate) domination number of H and is denoted by $\gamma_0(\mathcal{H})(\Gamma_0(\mathcal{H}))$.

An isolate dominating set of cardinality γ_0 (Γ_0) is called a γ_0 -set(Γ_0-set).

Example :- Consider the hypergraph $\mathcal{H}(V,E)$ where $V = \{v_1, v_2, \dots . v_{14}\}$ and $E = \{ e_1, e_2 \dots , e_5\}$. In which the edges of $\mathcal{H}$ are defined as follows:

$e_1 = \{v_1, v_2, v_3, v_4, v_5, v_6\}$
$e_2 = \{v_5, v_6, v_7, v_8\}$
$e_3 = \{v_6, v_9\}$
$e_4 = \{ v_2, v_3, v_{10}, v_{11}\}$
$e_5 = \{v_1, v_2, v_{12}, v_{13}, v_{14}\}$

Then the sets $I_1 = \{v_2, v_7, v_9\}$, $I_2 = \{v_4, v_6, v_{10}, v_{12}\}$ and $I_3 = \{v_4, v_7, v_9, v_{10}, v_{12}\}$ are the isolate dominating sets of $\mathcal{H}$. But among these only I_1 and I_3 are minimal isolate dominating sets but not I_2. In fact, I_1 is a minimal dominating set of $\mathcal{H}$ with minimum cardinality and$I_3$is that of maximum cardinality. Hence $\gamma_0(\mathcal{H}) = 3$ and $\Gamma_0(\mathcal{H}) = 5$.

Observation: If I is a minimal isolate dominating set of $\mathcal{H}$ then V/I is a dominating set of $\mathcal{H}$.

In view of the above observation, complement of a minimal isolate dominating set is dominating but need not be an isolate dominating. But following theorem proves that like domination number of $\mathcal{H}$, the isolate domination number $\gamma_0(\mathcal{H})$ does not exceed half of the order of $\mathcal{H}$.

Theorem: For a connected hypergraph $\mathcal{H}$, $\gamma_0(\mathcal{H}) \leq \frac{n}{2}$, where n is the number of vertices of $\mathcal{H}$. Moreover, if p and q are positive integers such that $q \geq 2p$ then there exists a hypergraph $\mathcal{H}$ of order q with $\gamma_0(\mathcal{H}) = p$.

Conclusion:

In conclusion, this research has delved into the intricate realm of dominating sets within the context of hypergraph theory, shedding light on the fundamental concepts in domination in hypergraph. The study has provided a handful of insight on hypergraph and some properties of domination and several results on it.

We plan to extend the concept of domination in graph to hypergraph. We will try to find related parameters in domination and study these parameters for certain types of hypergraph

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Two-Fluid Dark Energy Models in LRS Bianchi Type-I Model in $f(R,T)$ Theory of Gravity

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Abstract
In the present paper we have investigated a LRS Bianchi type I cosmological model using the $f(R,T)$ theory of gravity, where the source of gravity is a combination of barotropic fluid and dark energy (DE), with a time-varying deceleration parameter (DP). By examining the state finder parameters (r,s), we observe that our model transitions from the Einstein static era to the ΛCDM era. The equation of state parameter (ω_d) for dark energy shifts from a phantom phase $(\omega < -1)$ to a quintessence phase $(\omega > -1)$, aligning with observational findings. Our model successfully replicates the current accelerated expansion phase of the universe.

1. INTRODUCTION

In recent times, scientists have become increasingly intrigued by cosmological models that incorporate dark energy within the framework of general relativity and in alternative theories of gravity. The most remarkable observational discoveries have shown that our universe is currently undergoing an accelerated expansion. The latest cosmological observation detects the expansion of the universe as an accelerating rate [1, 2]. On the basis of these astronomical observations cosmologists have accepted the existence of dark energy which is a fluid with negative pressure which account more than 70% of the total energetic content of the universe to be mostly responsible for the accelerated expansion of the universe due to repulsive gravitations [3,4]. DE is a scalar field of negative pressure with positive energy which serves as a means for reverse gravitational action [5, 6]. This explains the shift from early time inflation to late time acceleration. Dark energy (DE) can be understood in two different manners. The first approach involves considering exotic types of matter such as quintessence [7–9], phantom [10], k- essence [11–13]. While the cosmological constant is the simplest and most widely used method to explain the acceleration, it faces challenges related to cosmic coincidence and fine-tuning [14-16]. However, these options alone are not adequate to fully elucidate the enigma of dark energy. A model for DE can be constructed using the Equation of State (EoS) parameter ω which defined as in terms of pressure and energy density such that; $\omega(t) = p/\rho$. This parameter need not be a constant. It can be parametrized as in terms of time or scale factor (a) or redshift (z). The second way to interpret DE is by making modifications to the theory of gravity. These modified theories offer natural gravitational alternatives to dark energy and seek to provide an explanation for the current acceleration. Some of these modified theories include $f(R), f(G), f(T)$ and $f(R,T)$.

In the Einstein-Hilbert action, the usual term involving the Ricci scalar R is replaced with a more general function $f(R)$ in the Lagrangian. This modification gives rise to the f(R) theory of gravity. This theory is designed to encompass both early universe inflation and the current late-time acceleration. It deals with higher-order curvature invariants expressed as a function of R. Expanding on this, the $f(R)$ gravity theory can be further extended to the $f(R,T)$ theory, which was first proposed by Harko et al. [17]. This new theory introduces a dependence not only on R but also on the trace of the energy-momentum tensor T. This model, contrast to other theories, discuss matter and geometry coupling. This results in source term independence, where source term is the matter stress energy tensor variant. They claim that cosmic

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acceleration is also a result of matter content besides geometrical input. In [18] FLRW cosmological model has been studied in the framework of $f(R,T)$ gravity through phase space analysis. Recently, V. Fayaz et al. [19] studied Bianchi-I space-time in this theory where they regenerated $f(R,T)$ function using holographic dark energy. They reproved that the rate of evolution of the anisotropic universe is greater than that of FRW and ΛCDM model. The EoS parameter ω is established as a time dependent factor in the respective case. Singh et al. [20] examined Bianchi type II model for a perfect fluid source in $f(R,T)$ gravity. The solutions were obtained using the power law relation between mean Hubble parameter $(H(t))$ and average scale factor $(a(t))$. Singh and Sharma [21] constructed Bianchi Type-II Dark Energy Model in f(R, T) Gravity. By considering constant DP they obtained two models of the universe, namely, power law model and exponential model. Yadav et al. [22] obtained dark energy dominated universe in $f(R,T)$ gravity with hybrid law expansion. Bishi [23] studied Bianchi type-III dark energy model in $f(R,T)$ gravity with variable DP. Chaubey et al. [24] considered general class of Bianchi cosmological models in $f(R,T)$gravity with the dark energy in the form of standard and modified Chaplygin gas. In earlier, Saha et al. [25] studied Two-fluid scenario for dark energy models in an FRW universe-revisited. Reddy et al. [26] considered Two fluid scenario for dark energy model in a scalar-tensor theory of gravitation. Recently, several authors [27-40] have examined and discussed the DE models in different context of use.

Incited by above discussions, in this paper, we use both the approach concurrently. That is we considered the source of gravitational matter as a mixture of perfect fluid and dark fluid in a modified theory called $f(R,T)$ theory. The work being organized in the following manner: In Section-I, Introduction and motivations from the literature are briefly elaborated. Section-II contains the basic formalism of $f(R,T)$gravity general field equations. The solution of the field equation for LRS Bianchi type-I metric by employing time varying DP are presented in Section-III. At last the Physical behavior of the model and conclusions are outlined in Section-IV and Section-V respectively.

2. THE $f(R,T) = R + 2f(T)$ GRAVITY

The $f(R,T)$ theory of gravity is the generalization or modification of General Relativity (GR). In this theory, the modified gravity action is given

$$S = \frac{1}{16\pi G}\left[\int f(R,T)\sqrt{-g}d^4x + \int L_m\sqrt{-g}d^4x\right], \qquad (1)$$

where $f(R,T)$is an arbitrary function of the Ricci scalar R, T is the stress energy tensor T_{ij} of matter andL_m is the matter Lagrangian density. It would be worthwhile to mention that if we replace $f(R,T)$ with $f(R)$, we get the action for $f(R)$ gravity and the displacement of $f(R,T)$with R leads to the action of GR. g is the determinant of the metric tensor g_{ij}.

The energy-momentum tensor T_{ij} is defined as

$$T_{ij} = -\frac{2}{\sqrt{-g}}\frac{\delta(\sqrt{-g}L_m)}{\delta g^{ij}} \qquad (2)$$

Here, Instead of considering the derivative of matter Lagrangian, we have assumed that the matter Lagrangian Lm depends only on the metric components. Such as

$$T_{ij} = g_{ij}L_m - \frac{\partial L_m}{\partial g^{ij}} \qquad (3)$$

The $f(R,T)$ gravity field equations are obtained by varying the action S in equation (1) with respect to the metric tensor. It is given as

$$f_R(R,T)R_{ij} - \frac{1}{2}f(R,T)g_{ij} + (g_{ij}\Box - \nabla_i\nabla_j)f_R(R,T) = 8\pi T_{ij} - f_T(R,T)T_{ij} - f_T(R,T)\Theta_{ij}, \quad (4)$$

where ∇_i being the covariant derivative and

$\Box = \nabla^i\nabla_i$, $f_R = \frac{\partial f(R,T)}{\partial R}$ and $f_T = \frac{\partial f(R,T)}{\partial T}$,

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$$\Theta_{ij} = -2T_{ij} + g_{ij}L_m - 2g^{lm}\frac{\partial^2 L_m}{\partial g^{ij}\partial g^{lm}}. \quad (5)$$

The field equations in $f(R,T)$ modified gravity model we assume that the particular functional $f(R,T)$ as

$$f(R,T) = R + 2f(T) \quad . \quad (6)$$

Otherwise functional can be taken in different ways corresponding to viable models. Here $f(T)$ is an arbitrary function of the trace of the stress-energy tensor of matter.
By using this functional, field equation can be rewritten as

$$R_{ij} - \frac{1}{2}Rg_{ij} = 8\pi T_{ij} - 2f'(T)T_{ij} - 2f'(T)\theta_{ij} + f(T)g_{ij}, \quad (7)$$

where the prime denotes a derivative with respect to the argument.
The average scale factor a and the spatial volume V of the LRS Bianchi type I are defined by the relation

$$V = a^3 = A^2B \quad (8)$$

The mean generalized Hubble parameter H for the metric (8) is defined by

$$3H = \frac{\dot{a}}{a} = 2\frac{\dot{A}}{A} + \frac{\dot{B}}{B}. \quad (9)$$

The shear scalar σ and anisotropy parameter Am are defined as follows

$$\sigma^2 = \frac{1}{2}\left[2\left(\frac{\dot{A}}{A}\right)^2 + \left(\frac{\dot{B}}{B}\right)^2\right] - \frac{1}{6}\theta^2. \quad (10)$$

The mean generalized anisotropy parameter Am is defined as

$$Am = \frac{1}{3}\sum_{i=1}^{3}\left(\frac{\triangle H_i}{H}\right)^2. \quad (11)$$

where $\triangle H_i = H_i - H, (i = 1,2,3)$ and $H_1 = \frac{\dot{A}}{A} = H_3 = \frac{\dot{B}}{B}$ are the directional Hubble parameters.

3. FIELD EQUATIONS AND SOLUTIONS

We consider the spatially homogeneous LRS Bianchi type-I metric as

$$ds^2 = dt^2 - A^2(dx^2 + dy^2) + B^2dz^2. \quad (12)$$

where A, B are functions of cosmic time t only.
The stress-energy momentum tensor is in the form

$$T^i_j = T^i_{(m)j} + T^i_{(de)j}, \quad (13)$$

where $T^i_{(m)j}$and$T^i_{(de)j}$ are energy momentum tensor of perfect fluid and dark energy respectively. These are given by

$$T^i_{(m)j} = diag[\rho_m, -p_m, -p_m, -p_m] \quad (14)$$

$$T^i_{(de)j} = diag[\rho_d, -p_d, -p_d, -p_d] \quad (15)$$

where $p_m, \rho_m$are pressure and energy density for perfect fluid and p_d, ρ_d are pressure and the energy density for dark energy components respectively. The field eqn. (7) with $f(T) = \alpha T$, where α is an arbitrary constant, becomes

$$R_{ij} - \frac{1}{2}Rg_{ij} = (8\pi + 2\alpha)T_{ij} + (2\alpha p + \alpha T)g_{ij}, \quad (16)$$

In the framework of $f(R,T)$ gravity, in the term $(2\alpha p + \alpha T)$, p is the isotropic pressure and T is the trace of energy momentum tensor. The trace of energy momentum tensor is of isotropic pressure and energy density i.e. $T = \rho - 3p$.
The field eqn. (16) for the line element (12) is given as

$$\dot{H}_1 + H_1^2 + \dot{H}_2 + H_2^2 + H_1H_2 = -(8\pi + 2\alpha)(p_m + p_d) + \alpha(\rho_m - p_m) \quad (17)$$

$$2\dot{H}_1 + 3H_1^2 = -(8\pi + 2\alpha)(p_m + p_d) + \alpha(\rho_m - p_m) \quad (18)$$

$$2H_1H_2 + H_1^2 = (8\pi + 2\alpha)(\rho_m + \rho_d) + \alpha(\rho_m - p_m) \quad (19)$$

Here $H_1 = \frac{\dot{A}}{A}$, $H_2 = \frac{\dot{B}}{B}$ and the over dot represent derivatives with respect to cosmic time t. We have six unknowns $H_1, H_2, p_m, \rho_m, p_d$ & ρ_d and three equations. In order to obtain the exact solution, we have assumed in first step the Bianchi identity $G_{ij;j} = 0$ as it is followed from the definition of the Einstein tensor G_{ij} and R_{ij}. From which we have obtained the following relation.

$$\dot{\rho_m} + 3(1 + \omega_m)\rho_m H = 0 \tag{20}$$

EoS parameter of perfect fluid is defined by

$$p_m = \omega_m \rho_m \tag{21}$$

$$\rho_m = c_1 a^{-3(1+\omega_m)} \tag{22}$$

where c_1 is an integration constant.

According to this new special law the two prominent candidates q and H are related by the relation

$$q = -1 + \frac{d}{dt}\left(\frac{1}{H}\right) \tag{23}$$

Integrating Eq. (23) to get the value of average scale factor $a(t)$ as

$$a(t) = e^{\eta} exp\left\{\int \frac{dt}{\int (1+q)dt + l_1}\right\} \tag{24}$$

For an explicit determination of factor $a(t)$ we have to integrate the Eq. (23). There are two different ways to integrate depending on the choice for the values of deceleration parameter q.

(i) According to Berman q is taken to be a constant either positive or negative which provides an explicit function of $a\ (t)$ and

(ii) according to new law q is taken to vary with cosmic time for an explicit determination of $a\ (t)$ which leads to a possible choice of q as

$$q = -\frac{l_2}{t^2} + (l_3 - 1) \tag{25}$$

where $l_2 > 0$ is a parameter having the dimension of square of time and $l_3 > 1$ is a dimensionless constant. Here it is to be noted that for different values of l_2 and l_3 we are getting the different models.

Thus from Eqs. (24) and (25) we get the time variation scale factor as

$$a(t) = e^{\eta} exp \int \frac{t}{l_3 t^2 + l_1 t + l_2} dt \tag{26}$$

Here η & l_1 are the constant of integration, without loss of generality we can choose $\eta = 0.$ $l_1 = 0.$

Equation (26) gives

$$a = (l_3 t^2 + l_2)^{\frac{1}{2l_3}} \tag{27}$$

The second condition we have to assume that

$$A = B^n \tag{28}$$

This gives value of scale factor as

$$B = (l_3 t^2 + l_2)^{\frac{\lambda}{l_3}}, \tag{29}$$

$$A = (l_3 t^2 + l_2)^{\frac{\lambda n}{l_3}}, \tag{30}$$

Where

$$\lambda = \frac{3}{2(2n+1)}$$

Thus the metric LRS Bianchi type I given by Eq. (12) wih the help of equations (29) and (30) takes the form

$$ds^2 = dt^2 - (l_3 t^2 + l_2)^{\frac{2\lambda n}{l_3}}(dx^2 + dy^2) + (l_3 t^2 + l_2)^{\frac{2\lambda}{l_3}} dz^2. \tag{31}$$

Integrating (20), the energy density of perfect fluid leads to

$$\rho_m = c_1(l_3t^2 + l_2)^{\frac{-3(1+\omega_m)}{2l_3}} \tag{32}$$

From equations (18) and (19), the values of p_d, ρ_d *and* ω_d are obtained as

$$\rho_d = \frac{1}{(8\pi+2\alpha)}\left[\frac{4t^2\lambda^2 n(2+n)}{(l_3t^2+l_2)^2} - \frac{(8\pi+3\alpha-\alpha\omega_m)}{(l_3t^2+l_2)^{\frac{3(1+\omega_m)}{2l_3}}}\right] \tag{33}$$

$$p_d = \frac{1}{(8\pi+2\alpha)}\left[\frac{(\alpha-8\pi\omega_m-3\alpha\omega_m)c_1}{(l_3t^2+l_2)^{\frac{3(1+\omega_m)}{2l_3}}} - \frac{\left[2\left(l_2-l_3t^2\right)+12t^2\lambda^2n^2\right]}{(l_3t^2+l_2)^2}\right] \tag{34}$$

$$\omega_d = \left[\frac{(\alpha-(8\pi+3\alpha)\omega_m)c_1\left(l_3t^2+l_2\right)^2-\left[2l_2+(6\lambda^2n^2-l_3)2t^2\right]\left(l_3t^2+l_2\right)^{\frac{3(1+\omega_m)}{2l_3}}}{4t^2\lambda^2n(2+n)(l_3t^2+l_2)^{\frac{3(1+\omega_m)}{2l_3}}-[8\pi+(3-\omega_m)\alpha](l_3t^2+l_2)^2}\right] \tag{35}$$

The deceleration parameter q is

$$q = -1 + 2tl_3 \tag{36}$$

The mean generalized Hubble parameter defined by Eq. (9) is

$$H = \frac{t}{(l_3t^2+l_2)} \tag{37}$$

The scalar expansion (θ) and shear scalar σ^2 are respectively given by

$$\theta = \frac{3t}{(l_3t^2+l_2)} \tag{38}$$

$$\sigma^2 = \frac{4t^2\lambda^2(2n^2+1)-3t}{2(l_3t^2+l_2)^2} \tag{39}$$

The anisotropy parameter A_m is given by

$$A_m = \frac{t^2}{3}[4\lambda^2(2n^2+1) - 4\lambda(2n+1) + 3] \tag{40}$$

One of the important quantities for the dynamical description of the universe is known as state finder pair or $r - s$ parameter. It helps to study the coincidence between obtained model with ΛCDM model. For flat ΛCDM model, the value of state finder pair yields as $\{r, s\} = \{1, 0\}$. The values of the $r - s$ parameter of our model becomes

$$r = \frac{(1-2l_3)[(1-l_3)t^2+2tl_3+l_2]}{t^3} \tag{41}$$

$$s = \frac{2(1-2l_3)[(1-l_3)t^2+2tl_3+l_2]-t^3}{3t^3(4tl_3-3)} \tag{42}$$

The matter energy density Ω_m and dark energy density Ω_d are obtained as

$$\Omega_m = \frac{c_1\left(l_3t^2+l_2\right)^2}{3t^2(l_3t^2+l_2)^{\frac{3(1+\omega_m)}{2l_3}}} \tag{43}$$

$$\Omega_d = \frac{\left(l_3t^2+l_2\right)^2}{(8\pi+2\alpha)3t^2}\left[\frac{4t^2\lambda^2n(2+n)}{(l_3t^2+l_2)^2} - \frac{(8\pi+3\alpha-\alpha\omega_m)}{(l_3t^2+l_2)^{\frac{3(1+\omega_m)}{2l_3}}}\right] \tag{44}$$

Adding eqns. (43) and (44) we get the total energy Ω as

$$\Omega = \frac{\left(l_3t^2+l_2\right)^2}{3t^2}\left\{\frac{c_1}{(l_3t^2+l_2)^{\frac{3(1+\omega_m)}{2l_3}}} + \frac{1}{(8\pi+2\alpha)}\left[\frac{4t^2\lambda^2n(2+n)}{(l_3t^2+l_2)^2} - \frac{(8\pi+3\alpha-\alpha\omega_m)}{(l_3t^2+l_2)^{\frac{3(1+\omega_m)}{2l_3}}}\right]\right\}. \tag{45}$$

5.CONCLUSION

In the present paper we have investigated Two Fluid Dark Energy Models in LRS Bianchi Type I space-time in $f(R,T)$ gravity. In order to determine the exact solution of the required space-time we have used a new special law for the deceleration parameter proposed by Akarsu and Dereli. The mean generalized Hubble's parameters are the function of the cosmic time t and these parameters vanishes for infinitely large value of time t where as these parameters have the finite value when cosmic time is zero. The same behaviours happen for scalar expansion θ and shear scalar σ with respect to cosmic time t. The spatial volume of the model is finite at

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the initial epoch and increases with increase in cosmic time. the energy density ρ_d is a positive decreasing function of time and tends to zero at t tends to ∞. The graphics for pressure p, which is a negative increasing function of time and tends to zero at t tends to ∞. As per the observation, the negative pressure is due to DE in the context of accelerated expansion of the universe. Hence, the behavior of pressure in our model agrees with this observation. The EoS parameter lies in the accelerated phase dominated by DE era. One can observe that the EoS parameter shows a transitional behaviour. It is clear from equation (41) that, s is negative when r is greater than one. As $r \to \infty, s \to -\infty$ and when $r = 1$ we have $s = 0$. Hence the universe starts from the Einstein static era and goes to ΛCDM era. It can be observed that the universe is dominated by dark energy which may be the strongest evidence for present cosmic expansion. All of the solutions obtained are consistent with the observational results.

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Hilbert Inequalities and Their Integral Extensions A Comprehensive Review with Advanced Perspectives of some Analytical inequalities.

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ABSTRACT
This paper talk about a journey of Hilbert inequalities evolved over time. We'll focus on integral inequalities which are like special tools used to understand Hilbert inequalities better. Paper talk about two mathematicians, G. H. Hardy and Chen-Ning Yang, and how they teamed up to make important contributions to this field. The paper breaks down the history of Hilbert inequalities, explains integral analogy of Hilbert inequalities.

KEY WORDS
Hilbert inequalities, Hilbert-Hardy inequality, Yang-Hilbert inequality, Integral Inequality, Cusa-Hygen inequality, integral analogies, measurable functions etc.

INTRODUCTION

In 1908 a German Mathematician David Hilbert introduce one of the results in analytical inequality as

For any real sequence x_m , y_n

If $0 < \sum_{m=0}^{\infty} x^2{}_m < \infty$ and $0 < \sum_{n=0}^{\infty} y^2{}_n < \infty$ Then

$$\sum_n^{\infty} \sum_m^{\infty} \frac{x_m y_n}{m+n} < \pi \left(\sum_{n=1}^{\infty} x^2{}_m \sum_n^{\infty} y^2{}_n\right)^{1/2} \qquad (1)$$

Where π best possible constant.

An integral analogy for Hilbert inequality is a generalization of the classical Hilbert inequality that involves integrals instead of sums. For example, one of the simplest integral analogies for Hilbert inequality is:

$0 < \int_0^{\infty} f^2(x)\, dx < \infty$, $0 < \int_0^{\infty} g^2(y)\, dy < \infty$ then we have

$$\int_0^{\infty}\int_0^{\infty} \frac{f(x)g(y)}{x+y}\, dxdy < \pi \sqrt{\int_0^{\infty} f^2(x)\, dx \int_0^{\infty} g^2(y)\, dy} \qquad (2)$$

Where $f(x)$ and $g(y)$ are measurable functions.

Where π is again the best possible constant. We called (1) Hilbert's integral inequality, which still does not contain any parameter. Inequalities (1) and (2) are important in analysis and its applications. We can find a number of improvements and extensions in the vast mathematics literature.

Some relevant Results in Hilbert type inequalities

In further there is improvement in (2) by Issai Schur[10]

[3] Hardy-Hilbert type inequality introduce (2) in new form with best possible constant.

$$\int_0^{\infty}\int_0^{\infty} \frac{f(x)g(y)}{x+y}\, dxdy < \frac{\pi}{\sin(\frac{\pi}{p})} \sqrt[p]{\int_0^{\infty} f^p(x)\, dx} \sqrt[q]{\int_0^{\infty} g^q(y)\, dy} \qquad (3)$$

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$$\int_0^\infty \left(\int_0^\infty \frac{f(x)g(y)}{x+y} dx \right)^p dy < \left(\frac{\pi}{\sin(\frac{\pi}{p})} \right)^p \int_0^\infty f^p(x)\, dx \quad (4)$$

In 2002 Zhang Using operator theory improve Hilbert integral inequality

$$\int_0^\infty \int_0^\infty \frac{f(x)g(y)}{x+y} dxdy \le \frac{\pi}{2}\sqrt{[\int_0^\infty f^2(x)\, dx \int_0^\infty g^2(y)\, dy + (\int_0^\infty f.g.dx)^2} \quad (5)$$

In 2006 Yang [5] gave the following simple Hilbert-type integral inequality

$$\int_0^\infty \int_0^\infty \frac{\left|\ln(\frac{x}{y})\right| f(x)g(y)}{max[x+y]} dxdy < 8\sqrt{\int_0^\infty f^2(x)\, dx \int_0^\infty g^2(y)\, dy} \quad (6)$$

Again, improvement in Hilbert type integral inequality comes in picture

In 2008, Yang [23] and [157] gave the following simple Hilbert-type integral inequalities

$$\iint_0^\infty \frac{\left|\ln(\frac{x}{y})\right| f(x)g(y)}{max[x+y]} dxdy < k_0 \sqrt{\int_0^\infty f^2\, dx \int_0^\infty g^2\, dy} \quad (7)$$

Best value for $k_0 = 8\sum_0^\infty \frac{(-1)^n}{(2n-1)^2} = 7.3277 +$

Improve in following way

$$\iint_0^\infty \frac{arctan\sqrt{x/y}}{x+y} f.g\, dxdy < \frac{\pi^2}{4}\sqrt{\int_0^\infty f^2\, dx \int_0^\infty g^2\, dy} \quad (8)$$

Some Remarkable Note: [9,10,11,12,13]with these references we can contribute to develop new results with Hilbert type inequality theory for new researcher like us we can find some interesting results in future related Hilbert type integral inequality by extend its domain with Trigonometric *sinc* , Hyperbolic *sinhc* functions.[14] Also using Hilbert Types Inequality and its integral inequality we can define some quotients of *sinc* & *sinhc* functions and find closet sharper bounds withs different domain.

Open Problems Find best possible fractional value of k any (constant) which is closest to π, π^2, e, e^2 *where e is euler constant* such that

- $\int_0^\infty \int_0^\infty \frac{f(x)g(y)\sin(x-y)}{\sinh(x+y)(x-y)} dxdy \le k\sqrt{[\int_0^\infty f^2(x)\, dx \int_0^\infty g^2(y)}$
- $\int_0^\infty \sum_1^\infty \frac{a_n}{x+n} f(x).dx < k\sqrt{\int_0^\infty f^2\, dx \sum_1^\infty {a_n}^2}$

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22

LRS Bianchi Type-I String Cosmological Model in $f(R)$ Gravity

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Abstract:
The current study explores the cosmological model of LRS Bianchi type-I within the context of $f(R)$ theory of gravity, focusing on the specific scenario involving cosmic strings. The investigation involves solving field equations by employing volumetric exponential law, the power law association between $f(R)$ and the average scale factor a, as well as the volumetric expansion law. The objective of the study is to identify and visually represent the physical parameters.

Keywords: LRS Bianchi type-I metric; $f(R)$ gravity; modified gravity; Nambu strings.

1. INTRODUCTION

The initial phases of the universe's development remain a topic of ongoing investigation. Following the occurrence of the big bang, the universe potentially experienced various phase transitions as its temperature decreased. Within these transitions, the breaking of symmetry in elementary particle physics led to the emergence of topological defects such as domain walls, strings, and monopoles. [1]. Among the three topological defects mentioned, only cosmic strings have the potential to result in highly intriguing cosmological outcomes [2].

In recent years, many researchers have been inspired by the study of cosmological models with cosmic strings within the framework of general relativity and in alternative theories of gravitation. Katore and Hatkar [3] investigated both interacting and non-interacting situations involving two fluids within the framework of FRW space-time in the f(R) theory of gravity. Capozziello *et al.* [4] examined the gravitational action at the tree level in bosonic string theory, incorporating interaction with the dilaton field. Myung and Kim [5] studied Hoˇrava-Lifshitz black hole solutions and its thermodynamic properties. Mann found a class of black hole solutions to a (3 + 1) dimensional theory gravity coupled to abelian gauge fields with negative cosmological constant that has been proposed as a dual theory to a Lifshitz theory describing critical phenomena in $(2 + 1)$ dimensions [6]. Santosh *et al.* [7] obtained exact solutions for isotropic homogeneous cosmological model with bulk viscosity. Yadav *et al.* [8] have studied some Bianchi type – I Viscous fluid string cosmological models with magnetic field. Pradhan and Rai [9] have found the integrality of cosmic string in Bianchi type – III space time in presence of bulk viscous fluid. Wang [10] discussed Kantowski – Sachs string cosmological model with Bulk Viscosity in General Relativity.

Given the recent identification of the universe's accelerated expansion [11, 12], cosmologists are increasingly focusing on modified gravity theories. These theories are gaining attention due to their potential to explain the universe's acceleration. Notable examples include the $f(R,T)$ gravity theory [13] and $f(R)$ gravity [14, 15].

Bianchi-type models, characterized by homogeneity but not necessarily isotropy, appear to offer the most promising explanation for potential effects of anisotropy in the early universe. Jaffe *et al.* [16] investigated that by eliminating a Bianchi component from the data of the Wilkinson Microwave Anisotropy Probe (WMAP), it is possible to explain several anomalies observed at large angles, resulting in the conclusion that the universe is isotropic. Consequently, models featuring an anisotropic background are deemed the most appropriate for depicting the early phases of the universe. Among the straightforward models with an anisotropic background, Bianchi type-I models stand out. In the realm of $f(R)$ theory of

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gravity, numerous researchers have explored diverse cosmological models characterized by anisotropic Bianchi types in recent years. Shamir [17] examined specific vacuum solutions for Bianchi type-I, III, and Kantowski–Sachs space-times within the metric formulation of $f(R)$ gravity. Several researchers devote their efforts towards the work in this context [18-20].

With the reference of above discussion, here we explored, LRS Bianchi type-I Nambu string cosmological model in the framework of $f(R)$ theory of gravity. The paper is organized as follows: In Sec. 2, we discussed the formation of $f(R)$ field equations for the LRS Bianchi type-I space-time. In section 3 the solution of field equation is given. In section 4 properties of model are discussed with graphical representation and in the last section 4 discussion and conclusions are given.

2. BASIC FORMATION.

The field equations of $f(R)$ gravity are obtained from the action

$$S = \int \sqrt{-g}\,\left(\frac{1}{16\pi G} f(R) + L_m\right) d^4x, \tag{1}$$

where $f(R)$ is a general function of the Ricci scalar and L_m is the matter Lagrangian. Variation of action (1) with respect to metric gives the following field equations:

$$F(R)R_{ij} - \frac{1}{2} f(R) g_{ij} - \nabla_i \nabla_j\, F(R) + g_{ij}\delta F(R) = \, kT_{ij} \tag{2}$$

Where $F(R) = \frac{df}{dR}$ and $\delta \; = \nabla^i \nabla_i$, ∇_i is the covariant derivative. Contracting the filed equation (2), we get

$$F(R)R - 2f(R) + 3\delta F(R) = kT\ , \tag{3}$$

Using above equation in Eq. (2), the field equations take the form

$$F(R)R_{ij} - \nabla_i \nabla_j\, F(R) - \, kT_{ij} = \, g_{ij}\,\left(\frac{F(R)R - \delta F(R) - kT}{4}\right), \tag{4}$$

Equation (3) is an important relationship between $f(R)$ and $F(R)$ which will be used to simplify the field equations and to evaluate $f(R)$.

We consider the anisotropic LRS Bianchi type-I metric in the form

$$ds^2 = \, dt^2 - A^2 dx^2 - \, B^2(dy^2 + dz^2), \tag{5}$$

where A and B are functions of cosmic time t only.

The energy–momentum tensor for cosmic string source is given by

$$T_{ij} = \, \rho u_i u_j - \, \lambda a_i a_j, \tag{6}$$

Where λ is the string tension density, ρ is the rest energy density of the system and functions of time t only. Also, u_i is the four velocity vector, a_i is a space-like vector which represents the anisotropic directions of the string and they satisfy

$$g^{ij} u_i u_j = \, -a^i a_j = \ , \qquad u^i a_i = 0\ \ , \tag{7}$$

We assume the string to be lying along the x-axis. The one-dimensional strings are assumed to be loaded with particle and energy density is $\rho_p = \, \rho - \, \lambda$ Latelier [18] has pointed out that λ may be positive or negative.

By adopting comoving coordinates, the field equations (4) for the metric (5) yield the following equations:

$$\frac{\ddot{A}}{A} + 2\frac{\dot{A}\dot{B}}{AB} + 2\frac{\dot{F}\dot{B}}{FB} + \frac{\ddot{F}}{F} - \frac{f(R)}{2F} = \, \frac{k\,\lambda}{F} \tag{8}$$

$$\frac{\ddot{A}}{A} + 2\frac{\ddot{B}}{B} + \frac{\dot{F}}{F}\left(\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right) - \frac{f(R)}{2F} = \, \frac{k\rho}{F} \tag{9}$$

$$\frac{\ddot{B}}{B} + \frac{\dot{A}\dot{B}}{AB} + \frac{\dot{B}^2}{B^2} + \frac{\dot{F}}{F}\left(\frac{\dot{A}}{A} + \frac{\dot{B}}{B}\right) + \frac{\ddot{F}}{F} - \frac{f(R)}{2F} = 0$$

(10)

Where overhead dot stands for ordinary differentiation with respect to cosmic time t.

We define the following some important physical and kinematical parameters for the model (5).

Hubble’s parameter of the model

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$$H = \frac{\dot{r}}{r} = \frac{1}{3}\left(\frac{\dot{A}}{A} + 2\frac{\dot{B}}{B}\right), \tag{11}$$

Where $r = (AB^2)^{\frac{1}{3}}$ is average scale factor.
The volume of model is defined as

$$V = (AB^2)^3 \quad , \tag{12}$$

Expansion scalar and shear scalar are defined

$$\theta = u^i_{;i} = \frac{2\dot{A}}{A} + \frac{\dot{B}}{B} \quad , \tag{13}$$

$$\sigma^2 = \frac{1}{2}\sigma^{ij} = \frac{1}{3}\left(\frac{\dot{A}}{A} - \frac{\dot{B}}{B}\right)^2 \tag{14}$$

Where σ_{ij} is shear tensor.
Anisotropic parameter Δ is given by

$$\Delta = \frac{1}{3}\sum_{i=1}^{3}\left(\frac{H_i - H}{H}\right)^2 \quad , \tag{15}$$

Where $H_1 = \frac{\dot{A}}{A}, H_2 = H_3 = \frac{\dot{B}}{B}$ are directional Hubble's parameter, which express the expansion rates of the universe in the directions of x, y and z respectively.
Deceleration parameter is given by

$$q = -\frac{\ddot{r}r}{\dot{r}^2} \quad , \tag{16}$$

The behavior of the universe models is determined by the sign of the q. The positive value of q suggests deceleration model while the negative value indicates inflation.
The scalar curvature for the metric (5) is given by

$$R = 2\left(\frac{\ddot{A}}{A} + 2\frac{\ddot{B}}{B} + \frac{\dot{B}^2}{B^2} + 2\frac{\dot{A}\dot{B}}{AB}\right), \tag{17}$$

3. SOLUTION OF FILED EQUATIONS

Now the field equations (8) - (10) reduces to the following independent equations

$$\frac{\ddot{A}}{A} - \frac{\ddot{B}}{B} - \frac{\dot{B}^2}{B^2} + \frac{\dot{A}\dot{B}}{AB} + \frac{\dot{F}}{F}\left(\frac{\dot{B}}{B} - \frac{\dot{A}}{A}\right) = \frac{k\,\lambda}{F} , \tag{18}$$

$$\frac{\ddot{A}}{A} + \frac{\ddot{B}}{B} - \frac{\dot{B}^2}{B^2} - \frac{\dot{A}\dot{B}}{AB} + \frac{\dot{F}}{F}\frac{\dot{B}}{B} - \frac{\ddot{F}}{F} = \frac{k\rho}{F} , \tag{19}$$

The equations (18) and (19) are two independent equations with five unknown $A, B, f(R), \rho$ and λ. Hence to find a determinate solution we use the following physically possible conditions:

(I) We Consider the volumetric exponential law given by

$$V = p_1 e^{3tn} , \tag{20}$$

Here p_1 and n are constants.

(II) The power law relation between F and average scale factor $a(t)$ is [20]

$$f(R) = F_0 a^n , \tag{21}$$

Here we take $F_0 = 1$ is proportionally constant and n is any integer.

(III) The equation of state for string model is [21]

$$\rho = \varpi\lambda \quad , \tag{22}$$

Where the constant $\varpi = 1$ defines Nambu string.

4. The properties of Nambu String cosmological model ($\lambda = \rho$).

Using equations (18) - (21), we get the metric potentials as

$$A = p_1 e^{\frac{3tn^2 + 2e^{2tn}p_1{}^2Q_1}{3n}} , \tag{23}$$

$$B = p_1^{1/3} e^{tn - \frac{e^{3tn}p_1Q_1}{9n}} , \tag{24}$$

The equation (5) can be written as

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$$ds^2 = dt^2 - \left[p_1 e^{\frac{3tn^2+2e^{2tn}p_1{}^2Q_1}{3n}} \right]^2 dx^2 - \left[p_1^{\frac{1}{3}} e^{tn-\frac{e^{3tn}p_1Q_1}{9n}} \right]^2 (dy^2+dz^2), \quad (25)$$

Where P_1 and Q_1 are constant of integration.
The volume of the model is given by

$$V = p_1 e^{3nt}, \quad (26)$$

Here p_1 and n are constants.
The directional Hubble parameters are given by

$$H_x = \frac{n+2e^{tn}}{3} p_1 Q_1 , \quad (27)$$

$$H_y = \frac{n-e^{tn}}{3} p_1 Q_1, \quad (28)$$

The mean Hubble parameter is given by

$$H = \frac{n}{3}, \quad (29)$$

The anisotropic parameter is given by

$$\Delta = \frac{2e^{2nt}p_1^2Q_1^2}{3n^{2^2}}, \quad (30)$$

The expansion scalar is given by

$$\theta = n , \quad (31)$$

The shear scalar is given by

$$\sigma^2 = \frac{2ne^{2nt}p_1^2Q_1^2}{9n^{2^2}} , \quad (32)$$

The Ricci scalar R is given by

$$R = \frac{2}{3}(2n^2 + e^{2nt}p_1^2Q_1^2) , \quad (33)$$

The function f(R) is

$$f(R) = \frac{4n^2p_1^2Q_1^2\, e^{t\left(\frac{k}{n}+2n\right)}}{3(k+2n^2)}, \quad (34)$$

The energy density is given by

$$\rho = \lambda = \frac{e^{\frac{tk}{n}}(-9k^2+3kn^2-2n^4+np_1Q_1e^{nt}(-3k+10n^2+np_1Q_1e^{nt}))}{9n^2\kappa}$$

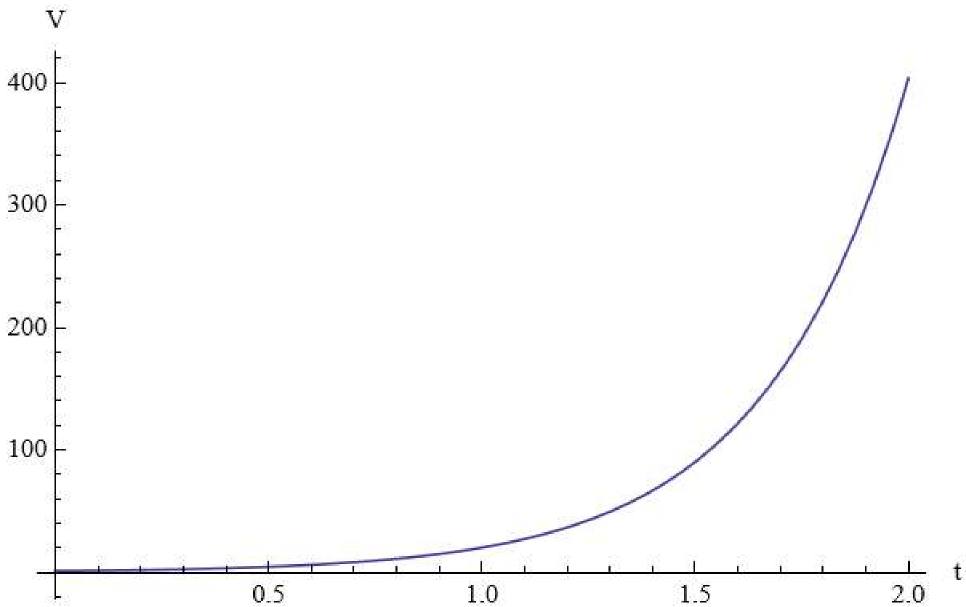

Fig-1: Volume verses time plotted for $n = -2, k = 5, Q_1 = 1, p_1 = 1$, $\kappa = 0.1$

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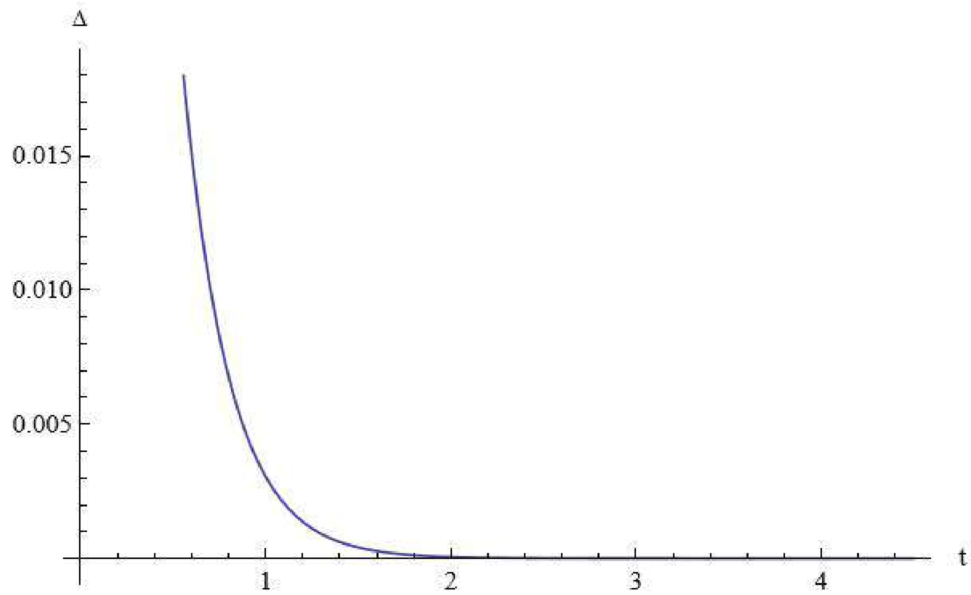

Fig-2: Anisotropic parameter verses time plotted for $n = -2, k = 5, Q_1 = 1, p_1 = 1$, $\kappa = 0.1$

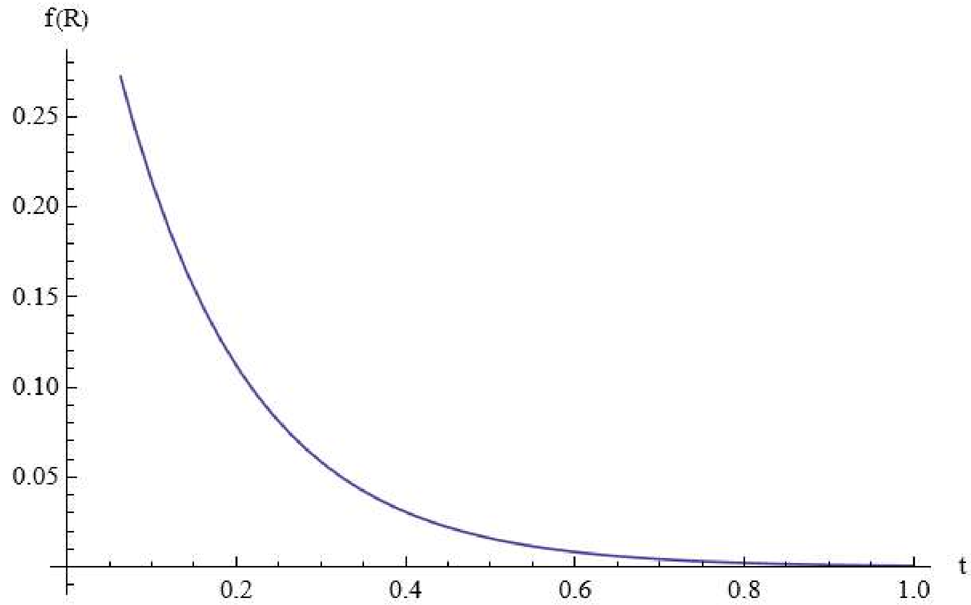

Fig-3: $f(R)$ verses time plotted for $n = -2, k = 5, Q_1 = 1, p_1 = 1$, $\kappa = 0.1$

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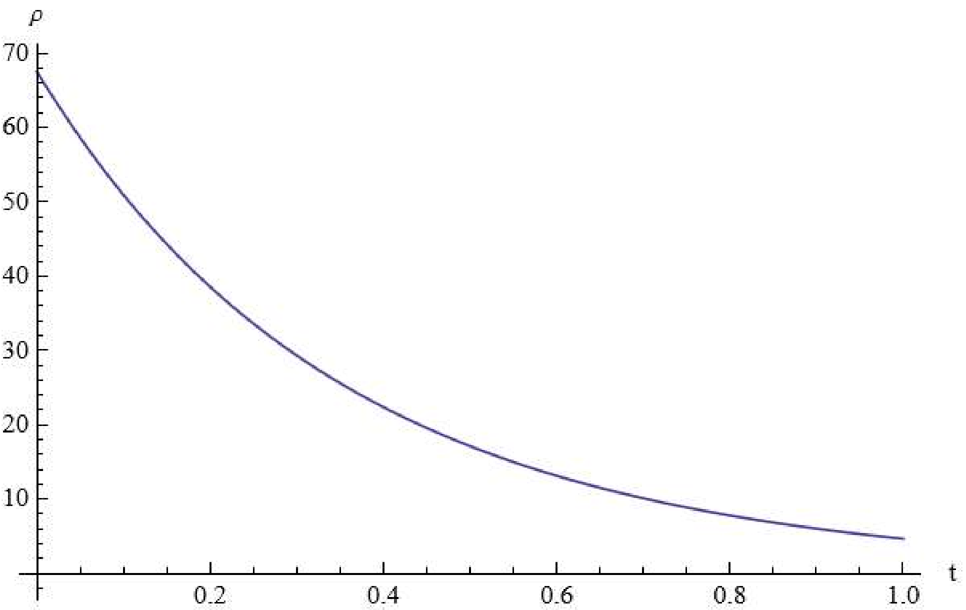

Fig-4: Energy density verses time plotted for $n = -2, k = 5, Q_1 = 1, p_1 = 1$, $\kappa = 0.1$

5. DISCUSSION AND CONCLUSION

In this paper, we have discussed LRS Bianchi type-I string cosmological models in $f(R)$ theory of gravitation. The physical behavior of this model can be summarized as follows.
Form the figure -1 it is clear that the volume of the universe is increasing exponentially. From figure-2, it is clear that the anisotropic parameter is decreasing with respective the cosmic time t and become zero after some stage. Hence it shows anthropic nature after some finite time. Figure-3, gives the graph of function of Ricci scalar which depicts the decreasing nature and lastly in figure-4, the energy density of the universe is decreasing with respective the time t. This shows that the universe shows accelerating expansion. Hence all the observations are allied with the recent observations of the universe.

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Explanation of Techniques for the Complex Analysis and Hyperbolic Function

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Abstract
This work is intended to introduce the problem of complex numbere and hyperbolic function generalized complex analysis. The algebraic properties of these numbers are taken into consideration. Besides complex and hyperbolic generalized complex valued functions are defined and different equational representations of these numbers are examined. Moreover, the relationship between hyperbolic and circular function are also explained.

Keywords **:–** Complex Number, Hyperbolic Function, Circular Function.

I. INTRODUCTION

2 The solution of the Hyperbolic and Inverse Hyperbolic Function of the Complex number has been given in the S.V. Thakare book of Engineering Mathematics-1, In which they have used various trigonometric formulas and it is quite hard to learn. The same problem has been solved with less amount of trigonometrically and hyperbolic formulas, In a way which can be easily understood.

II. BRIEF EXPLANATION

The inverse hyperbolic function provides the hyperbolic angles corresponding to the given value of the hyperbolic function. Those functions are denoted by $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, csch^{-1}, sech^{-1}, and $\coth^{-1}$.

The formulae are explained for solving the below solution in proper way:

Properties of Hyperbolic Functions:-

The properties of hyperbolic functions are analogous to the trigonometric functions.

Some of them are:

1. Sinh (-x) = -sinh x 3. Sinh 2x = 2 sinh x cosh x
2. Cosh (-x) = cosh x 4. Cosh 2x = $\cosh^2$x + $\sinh^2$x

The derivatives of hyperbolic functions are:

1. d/dx sinh (x) = cosh x 2. d/dx cosh (x) = sinh x

Some relations of hyperbolic function to the trigonometric function are as follows:

1. Sinh x = – i sin(ix) 2. Cosh x = cos (ix) 3. Tanh x = -i tan(ix)

Hyperbolic Function Identities

The hyperbolic function identities are similar to the trigonometric functions. Some identities are:

Pythagorean Trigonometric Identities

1. $\cosh^2 (x) - \sinh^2 (x) = 1$ 2. $\tanh^2 (x) + \mathrm{sech}^2 (x) = 1$ 3. $\coth^2 (x) - \mathrm{cosech}^2 (x) = 1$

Sum to Product

- sinh x + sinh y = 2 sinh((x+y)/2) cosh((x-y)/2)
- sinh x – sinh y = 2 cosh((x+y)/2) sinh((x-y)/2)
- cosh x + cosh y = 2 cosh((x+y)/2) cosh((x-y)/2)
- cosh x – cosh y = 2 sinh((x+y)/2) sinh((x-y)/2)

Product to Sum

- 2 sinh x cosh y = sinh(x + y) + sinh(x -y)

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- 2 cosh x sinh y = sinh(x + y) – sinh(x – y)
- 2 sinh x sinh y = cosh(x + y) – cosh(x – y)
- 2 cosh x cosh y = cosh(x + y) + cosh(x – y).

Sum and Difference Identities

- sinh(x ± y) = sinh x cosh x ± coshx sinh y
- cosh(x ±y) = cosh x cosh y ± sinh x sinh y
- tanh(x ±y) = (tanh x ± tanh y) / (1± tanh x tanh y)
- coth(x ±y) = (coth x coth y ± 1) / (coth y ±coth x)

2.1 ***Inverse Hyperbolic Functions***

The inverse function of hyperbolic functions is known as inverse hyperbolic functions. It is also known as area hyperbolic function. The inverse hyperbolic function provides the hyperbolic angles corresponding to the given value of the hyperbolic function. Those functions are denoted by $\sinh^{-1}$, $\cosh^{-1}$, $\tanh^{-1}$, csch^{-1}, sech^{-1}, and $\coth^{-1}$. The inverse hyperbolic function in complex plane is defined as follows:

- $\operatorname{Sinh}^{-1} x = \ln(x + \sqrt{[1+x^2]})$
- $\operatorname{Cosh}^{-1} x = \ln(x + \sqrt{[x^2-1]})$
- $\operatorname{Tanh}^{-1} x = (½)[\ln(1+x) – \ln(1-x)$

The Relationship between Hyperbolic and Circular Function:

The hyperbolic functions are analogs of the circular function or the trigonometric functions. The hyperbolic function occurs in the solutions of linear differential equations, calculation of distance and angles in the hyperbolic geometry, Laplace's equations in the cartesian coordinates.

III. PROBLEM STATEMNET:

If $\tan\frac{x}{2} = \tanh\frac{u}{2}$ then show that $u = \log\left[\tan\left(\frac{x}{2}+\frac{\pi}{4}\right)\right]$

Solution: - RHS=

$$= \log\left[\tan\left(\frac{x}{2}+\frac{\pi}{4}\right)\right] \qquad \text{using } \tan(A+B) = \frac{\tan A+\tan B}{1-\tan A * \tan B}$$

$$= \log\left[\frac{\tan\frac{x}{2}+\tan\frac{\pi}{4}}{1-\tan\frac{x}{2}*\tan\frac{\pi}{4}}\right]$$

$$= \log\left[\frac{\tan\frac{x}{2}+1}{1-\tan\frac{x}{2}}\right]$$

$$= \log\left[\frac{1+\tan\frac{x}{2}}{1-\tan\frac{x}{2}}\right]$$

$$= \log\left[\frac{1+\tanh\frac{u}{2}}{1-\tanh\frac{u}{2}}\right] \qquad \text{by using given equation } \tan\frac{x}{2} = \tanh\frac{u}{2}$$

$$= \log\left[\frac{1+\frac{e^{\frac{u}{2}}-e^{-\frac{u}{2}}}{e^{\frac{u}{2}}+e^{-\frac{u}{2}}}}{1-\frac{e^{\frac{u}{2}}-e^{-\frac{u}{2}}}{e^{\frac{u}{2}}+e^{-\frac{u}{2}}}}\right]$$

$$= \log\left[\frac{e^{\frac{u}{2}}+e^{-\frac{u}{2}}+e^{\frac{u}{2}}-e^{-\frac{u}{2}}}{e^{\frac{u}{2}}+e^{-\frac{u}{2}}-(e^{\frac{u}{2}}-e^{-\frac{u}{2}})}\right]$$

$$= \log\left[\frac{e^{\frac{u}{2}}+e^{-\frac{u}{2}}+e^{\frac{u}{2}}-e^{-\frac{u}{2}}}{e^{\frac{u}{2}}+e^{-\frac{u}{2}}-e^{\frac{u}{2}}+e^{-\frac{u}{2}}}\right]$$

$$= \log\left[\frac{2e^{\frac{u}{2}}}{2\,e^{-\frac{u}{2}}}\right]$$

$$= \log\left[\frac{e^{\frac{u}{2}}}{e^{-\frac{u}{2}}}\right]$$

$$= \log e^{u}$$

$$= u$$

$$= \text{L.H.S}$$

Hence Prove

IV. Conclusions

This method explains the hyperbolic function in easiest way. I have used only one trigonometric formula in the whole problem statement. I have also used hyperbolic formula and logarithmic formulae to prove the solution.

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Dynamics of Bianchi type-I Space-Time in Brans-Dicke Theory of Gravitation

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ABSTRACT

In the framework of the Brans-Dicke theory of gravitation, this paper addresses anisotropic homogeneous Bianchi Type I cosmological models in the presence of two fluids. One of the two fluid models represents the universe's matter content, while the other fluid is selected to represent the CMB radiation. The solution of the field equations are obtained by using constant deceleration parameter. The behavior of physical and kinematical properties of the investigated models is discussed.

Keywords :- Bianchi Type-I Space-Time, Two-Fluids, Brans-Dicke Theory.

1. Introduction

Cosmology is the study of the universe as a whole. General theory of relativity provides basic tools for constructing cosmological models of the universe. It is generally acclaimed as a mathematically precise and physically sound theory of gravitation . However, in recent years, there has been lot of interest in several alternative theories of gravitation. Brans-Dicke (BD) theory [1] is one of the noteworthy among the various modification of general relativity. BD theory introduces a dynamical scalar field to account for variable gravitational constant G. Nordtvedt [2] proposed a general class of scalar tensor theories in which the parameter w of the BD theory is allowed to be an arbitrary function of the scalar field. In Saez Ballester theory [3] metric is coupled with dimensionless scalar filed. Like BD theory there is another viable alternative to general relativity which admits a variable G proposed by Canuto *et al.*[4]. The cosmological constant appears as variable parameter in the frame work of scale covariant theory. In the scale covariant theory, Einsteins field equations are valid in gravitational units whereas physical quantities are measured in atomic unit. The metric tensors in the two systems of units are related by a conformal transformations.

$$\bar{g}_{ij} = \phi^2\left(x^k\right) g_{ij}, \tag{1}$$

where a bar denotes gravitational units and unbarred denotes atomic units. An important feature of this theory is that no independent equation for ϕ exists. Beesham [5], Venkateswarlu [6], Reddy *et al.*[7], Ram *et al.* [8], Zeyanddin and Saha [9], Katore *et al.* [10] are some of the authors who have investigated several aspects of the scale covariant theory of gravitation.

Two fluids models including radiation and matter are cosmologically important. Cosmological observations suggest that the radiation frame and the matter frame of the universe may not coincide [11]. Recently, the researchers are taking keen interest in two fluids cosmological models. Amirhashchi *et al.* [12] have been evaluated interacting two fluid dark energy models in non flat universe. Khalatnikov *et al.* [13] have been studied the quasi isotropic expansion for a simple two fluid cosmological models, including radiation and string gas. Coley and Dunn [14] have been investigated the two fluids source of Bianchi type VI_0 models. Pant and Oli [15] have been examined the Bianchi type II space time with a two fluid cosmological models.

2. Metric and Field equations

Bianchi type space times play a vital role in understanding and description of the early stages of evolution of the universe. We consider the Bianchi type I model in the form

$$ds^2 = -dt^2 + A^2dx^2 + B^2dy^2 + C^2dz^2. \tag{2}$$

Recently, two fluid scenario for dark energy model in Brans Dicke theory of gravitation has been evaluated by Reddy *et al.* [16]. Vishwakarma [17] has been investigated Bianchi type I model with varying G and Λ . Bianchi type I two fluid models in the presence and absence of variable G and Λ is studied by Oli [18]. This motivates to consider Bianchi type I cosmological model in Scale covariant theory of gravitation. The field equations given by Brans-Dicke (1961) for the combined Scalar and tensor fields are

$$R_{ij} - \frac{1}{2}Rg_{ij} - \omega\phi^{-2}\left(\phi_{,i}\phi_{,j} - \frac{1}{2}g_{ij}\phi_{,k}\phi^{,k}\right) - \phi^{-1}\left(\phi_{,ij} - g_{ij}\phi_{,\alpha}^{;\alpha}\right) = 8\pi\phi^{-1}T_{ij}, \tag{3}$$

$$\phi_{,\alpha}^{;\alpha} = 8\pi\phi^{-1}(3+2\omega)^{-1}T, \tag{4}$$

where ϕ is an arbitrary constant, ω is a dimensionless coupling, T_{ij} is energy-momentum tensor and other symbols have their usual meaning.

Also the energy conservation equation

$$T_{;j}^{ij} = 0 \tag{5}$$

is a consequence of the field equations (3) and (4), here comma (,) and semicolon (;) denote partial and covariant differentiation respectively. Also the axial symmetry assumed implies that the scalar field ϕ shares the same symmetry is α and β as a consequence of which we note that

$$\phi_1 = \phi_2 = \phi_3 = 0. \tag{6}$$

The energy momentum tensor for two fluid given by Letelier [19] and Bayin [20] is as follows

$$T_{ij} = \left(T^m\right)_{ij} + \left(T^r\right)_{ij}, \tag{7}$$

where $\left(T^m\right)_{ij}$ is the energy momentum of matter field and $\left(T^r\right)_{ij}$ is the energy momentum tensor of the radiation field.

So, the separate conservation equation of energy momentum tensor are

$$\left(T^m\right)_{ij} = \left(P_m + \rho_m\right)u_i^m u_j^m - P_m g_{ij}, \tag{8}$$

$$\left(T^r\right)_{ij} = \frac{4}{3}\rho_r u_i^r u_j^r - \frac{1}{3}\rho_r g_{ij}, \tag{9}$$

where ρ_m is the energy density of matter, P_m the pressure of the matter and ρ_r the energy density of radiation with $g^{ij}u_i^m u_j^m = 1, g^{ij}u_i^r u_j^r = 1$ and $u_i^m = (0,0,0,1), u_i^r = (0,0,0,1)$ then,

$$T_1^1 = T_2^2 = T_3^3 = -\left(P_m + \frac{1}{3}\rho_r\right), T_4^4 = \rho_m + \rho_r. \tag{10}$$

Using equations (10), for the line element (2), the field equations (4)takes the form as

$$\frac{\ddot{B}}{B} + \frac{\ddot{C}}{C} + \frac{\dot{B}\dot{C}}{BC} + \frac{\omega}{2}\left(\frac{\dot{\phi}}{\phi}\right)^2 + \frac{\dot{\phi}}{\phi}\left(\frac{\dot{B}}{B} + \frac{\dot{C}}{C}\right) + \left(\frac{\ddot{\phi}}{\phi}\right) = \frac{-8\pi}{\phi}\left(P_m + \frac{1}{3}\rho_r\right), \tag{11}$$

$$\frac{\ddot{A}}{A} + \frac{\ddot{C}}{C} + \frac{\dot{A}\dot{C}}{AC} + \frac{\omega}{2}\left(\frac{\dot{\phi}}{\phi}\right)^2 + \frac{\dot{\phi}}{\phi}\left(\frac{\dot{A}}{A} + \frac{\dot{C}}{C}\right) + \left(\frac{\ddot{\phi}}{\phi}\right) = \frac{-8\pi}{\phi}\left(P_m + \frac{1}{3}\rho_r\right), \tag{12}$$

$$\frac{\ddot{B}}{B}+\frac{\ddot{A}}{A}+\frac{\dot{A}\dot{B}}{AB}+\frac{\omega}{2}\left(\frac{\dot{\phi}}{\phi}\right)^{2}+\frac{\dot{\phi}}{\phi}\left(\frac{\dot{A}}{A}+\frac{\dot{B}}{B}\right)+\left(\frac{\ddot{\phi}}{\phi}\right)=\frac{-8\pi}{\phi}\left(P_{m}+\frac{1}{3}\rho_{r}\right), \tag{13}$$

$$\frac{\dot{A}\dot{B}}{AB}+\frac{\dot{A}\dot{C}}{AC}+\frac{\dot{B}\dot{C}}{BC}-\frac{\omega}{2}\left(\frac{\dot{\phi}}{\phi}\right)^{2}+\frac{\dot{\phi}}{\phi}\left(\frac{\dot{A}}{A}+\frac{\dot{B}}{B}+\frac{\dot{C}}{C}\right)=\frac{8\pi}{\phi}\left(\rho_{m}+\rho_{r}\right), \tag{14}$$

where over head dot denote differentiation with respect to t.
Using equations (11) and (12) we obtain

$$\frac{\ddot{A}}{A}-\frac{\ddot{B}}{B}+\left(\frac{\dot{A}}{A}-\frac{\dot{B}}{B}\right)\frac{\dot{C}}{C}+\left(\frac{\dot{A}}{A}-\frac{\dot{B}}{B}\right)\frac{\dot{\phi}}{\phi}=0\,. \tag{15}$$

Equation further reduces to

$$\frac{d}{dt}\left(\frac{\dot{A}}{A}-\frac{\dot{B}}{B}\right)+\left(\frac{\dot{A}}{A}-\frac{\dot{B}}{B}\right)\left(\frac{\dot{A}}{A}+\frac{\dot{B}}{B}+\frac{\dot{C}}{C}\right)+\left(\frac{\dot{A}}{A}-\frac{\dot{B}}{B}\right)\frac{\dot{\phi}}{\phi}=0. \tag{16}$$

Let $V=ABC$. (17)

Making the use of equation (17) in equation (18), we yields

$$\frac{d}{dt}\left(\frac{\dot{A}}{A}-\frac{\dot{B}}{B}\right)=\left(\frac{\dot{A}}{A}-\frac{\dot{B}}{B}\right)\left(\frac{\dot{V}}{V}\right)+\left(\frac{\dot{A}}{A}-\frac{\dot{B}}{B}\right)\frac{\dot{\phi}}{\phi}=0. \tag{18}$$

Integrating equation (18) we get

$$\left(\frac{\dot{A}}{A}-\frac{\dot{B}}{B}\right)=\frac{x_{1}}{V}. \tag{19}$$

Equation (19) further reduces to

$$\frac{A}{B}=d_{1}\exp\left(x_{1}\int\frac{1}{\phi V}dt\right). \tag{20}$$

Similarly using equations (11) and (13) and equations (12) and (13) we obtain

$$\frac{A}{C}=d_{2}\exp\left(x_{2}\int\frac{1}{\phi V}dt\right), \tag{21}$$

$$\frac{B}{C}=d_{3}\exp\left(x_{3}\int\frac{1}{\phi V}dt\right), \tag{22}$$

where d_1,d_2,d_3,x_1,x_2,x_3 are integration constant which satisfy the condition $d_2=d_1d_3, x_2=x_1+x_3$ of constant. From equations (20), (21) and (22), we obtain

$$A=D_{1}V^{\frac{1}{3}}\exp\left(X_{1}\int\frac{1}{\phi V}dt\right), \tag{23}$$

$$B=D_{2}V^{\frac{1}{3}}\exp\left(X_{2}\int\frac{1}{\phi V}dt\right), \tag{24}$$

$$C=D_{3}V^{\frac{1}{3}}\exp\left(X_{3}\int\frac{1}{\phi V}dt\right), \tag{25}$$

where D_1,D_2,D_3,X_1,X_2,X_3 are integration constant which satisfy the condition $D_1D_2D_3=1, X_1+X_2+X_3=0$ of constant.

The Hubble parameter is given by

$H = \frac{1}{3}(H_1 + H_2 + H_3)$

where $H_1 = \frac{\dot{A}}{A}, H_2 = \frac{\dot{B}}{B}, H_3 = \frac{\dot{C}}{C}$ are directional Hubble parameter in the direction of X ,Y ,Z axes respectively.

$$\therefore \ H = \frac{1}{3}\frac{\dot{V}}{V} = \frac{\dot{R}}{R}, \tag{26}$$

where R is the average scale factor.
We assume the relation

$$H = lR^{-n}, \tag{27}$$

where $l > 0, n \geq 0$ are constants.
The equation (26) and (27) becomes

$$\dot{R} = lR^{-n+1}. \tag{28}$$

Case I) when $n = 0$
Equation (28) leads to

$$R = c_1 \exp(lt). \tag{29}$$

The volume of the universe is found to be

$$V = \exp(3lt). \tag{30}$$

Now $\phi \propto a^n$ (M. Shamir et. al)

$$\phi = ba^n \text{ and } a^3 = V = c_1 \exp(3lt).$$

$$a = c^{\frac{1}{3}}{}_1 \exp(lt)$$

$$a^n = c^{\frac{n}{3}}{}_1 \exp(nlt)$$

$$\phi = bc^{\frac{n}{3}}{}_1 \exp(nlt)$$

The solutions of the field equations are obtained as

$$A = D_1 \exp\left(lt - \frac{X_1}{bc_1^{\frac{n}{3}} l(n+3)} \exp\left(-l(n+3)t\right) \right), \tag{31}$$

$$B = D_2 \exp\left(lt - \frac{X_2}{bc_1^{\frac{n}{3}} l(n+3)} \exp\left(-l(n+3)t\right) \right), \tag{32}$$

$$C = D_3 \exp\left(lt - \frac{X_3}{bc_1^{\frac{n}{3}} l(n+3)} \exp\left(-l(n+3)t\right) \right). \tag{33}$$

Metric potentials *A, B, C* are exponential functions of time. At *t=0, A, B, C* are non zero. Therefore, the model is free from singularity. They diverges to infinity as $t \to \infty$.

These are the solutions of the field equations subjected to the condition $X_1 = X_2 = X_3 = 0$

The density of the matter

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$$\rho_m = \frac{\omega n^2 l^2 b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)} + \frac{3n^2 l^2 b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)} + \frac{9nl^2 b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)} + \frac{12 l^2 b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)}, \quad (34)$$

The density of the radiation

$$\rho_r = \frac{(-15\gamma+18)\omega n^2 l^2 b c_1^{\frac{n}{3}} \exp(nlt)}{16\pi(4-3\gamma)} - \frac{3n^2 l^2 b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)} - \frac{(18\gamma-15)nl^2 b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)} + \frac{(27\gamma-72)l^2 b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)}, \quad (35)$$

Matter density parameter

$$\Omega_m = \frac{\rho_m}{3H^2} = \frac{\omega n^2 b c_1^{\frac{n}{3}} \exp(nlt)}{24\pi(4-3\gamma)} + \frac{n^2 b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)} + \frac{3nb c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)} + \frac{4b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)}, \quad (36)$$

Radiatiion density parameter

$$\Omega_r = \frac{\rho_r}{3H^2} = \frac{(-5\gamma+6)\omega n^2 b c_1^{\frac{n}{3}} \exp(nlt)}{16\pi(4-3\gamma)} - \frac{n^2 b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)} - \frac{(6\gamma-5)nb c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)} + \frac{(9\gamma-24)b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)}, \quad (37)$$

Energy density parameter

$$\Omega = \Omega_m + \Omega_r = \frac{(-15\gamma+11)\omega n^2 b c_1^{\frac{n}{3}} \exp(nlt)}{16\pi(4-3\gamma)} - \frac{(6\gamma+8)nb c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)} + \frac{(9\gamma-20)b c_1^{\frac{n}{3}} \exp(nlt)}{8\pi(4-3\gamma)}, \quad (38)$$

where ρ_m, ρ_r are increasing functions of time. $\rho_m, \rho_r \to 0$, as $t \to \infty$ and as $t \to 0$, $\rho_m, \rho_r \to \infty$. $\Omega_m, \Omega_r, \Omega \to 0$ at large time. Thus the universe may be collapse in the far future.

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4. Conclusion:-

In this paper, we have investigated the behavior of LRS Bianchi type-I cosmological model for non-interacting two fluid. It is found that in case the model is free from singularity. The universe may be collapse in the far future. The behavior of the density of the matter, the density of the radiation, matter density parameter, radiation density parameter, energy density parameter fluid parameters are also discussed.

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Library Science

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1

Blockchain Empowered: A Comprehensive Study on the Role of Libraries in Safeguarding and Managing Electronic Theses

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ABSTRACT

The academic landscape transitions towards digitization, the secure management of electronic theses has become a critical concern for academic institutions and libraries. This research explores the transformative potential of blockchain technology in fortifying the role of libraries as custodians of electronic theses. The study delves into the challenges faced by libraries in ensuring the integrity, authentication, and accessibility of electronic theses, and investigates how blockchain can serve as a robust solution.

The research methodology encompasses a thorough review of existing literature, case studies of libraries implementing blockchain for thesis management. Through these investigations, the study aims to elucidate the mechanisms by which blockchain technology enhances the security, transparency, and efficiency of electronic thesis management.

Keywords: blockchain, Role of Libraries, Mazement, Theses, Safeguarding

INTRODUCTION

Blockchain technology empowers libraries in several ways, transforming traditional library practices in the digital age. Blockchain can empower libraries, particularly in managing electronic theses. Blockchain provides a decentralized and immutable ledger, making it highly resistant to tampering or unauthorized alterations. Libraries can leverage this feature to secure electronic theses, ensuring the integrity of the documents over time. Blockchain employs cryptographic techniques to uniquely identify authors and theses. This enhances authentication processes, allowing libraries to verify the authorship of electronic theses with a high degree of certainty.

Instead of relying on a central server, blockchain enables decentralized storage of electronic theses across a network of nodes. This enhances resilience, as the information is distributed, reducing the risk of data loss or system failures. Blockchain's smart contract functionality automates access control to electronic theses. Libraries can enforce digital rights management through programmable contracts, ensuring that only authorized users have access based on predefined criteria.

Blockchain's timestamping capabilities help libraries establish the existence of a thesis at a specific point in time. This can be crucial for proving the originality and priority of the work, which is valuable in academic and legal contexts. Blockchain operates on a public ledger accessible to all participants. This transparency fosters accountability, as stakeholders can independently verify the information recorded on the blockchain, promoting trust in the management of electronic theses.

Libraries can collaborate to establish common standards for using blockchain in electronic thesis management. This promotes interoperability between different library systems, ensuring consistency and reliability across the academic landscape.

CHALLENGES OF BLOCKCHAIN TECHNOLOGY

Implementing blockchain technology can be complex and may require specialized knowledge. Libraries may face challenges in terms of technical expertise and the initial learning curve.

Scalability can be an issue for certain blockchain networks. As the volume of transactions and data increases, some blockchains may experience limitations, affecting performance. Proof-of-work consensus mechanisms, used in some blockchains like Bitcoin, can be energy-intensive. This environmental impact is a concern for institutions seeking sustainable technology solutions.

The regulatory environment surrounding blockchain is still evolving. Libraries may encounter legal and compliance challenges as they navigate the integration of blockchain technology. Users, including students and researchers, may not be familiar with blockchain technology. Libraries might need to invest in user education and training to ensure smooth adoption and understanding.

Initial setup costs and ongoing maintenance expenses associated with blockchain implementation can be significant. Libraries need to assess the budgetary implications before adopting blockchain solutions. While blockchain ensures data integrity, the transparency of the ledger means that certain information is visible to all participants. Libraries must carefully consider privacy implications and handle sensitive data appropriately.

ADOPTION OF BLOCKCHAIN TECHNOLOGY

The adoption of blockchain technology in Indian libraries was in its early stages, with some interest and experimentation. The level of awareness and understanding of blockchain technology among library professionals and decision-makers is crucial. Training programs, workshops, and awareness campaigns may be necessary to familiarize library staff with the benefits and challenges of blockchain. Collaboration among libraries and standardization of blockchain applications can facilitate smoother adoption. Establishing common standards ensures interoperability and consistency across different library systems.

The regulatory environment in India plays a significant role in technology adoption. Clear guidelines and regulatory support for the use of blockchain in libraries would provide a more favorable environment for implementation. Libraries need to assess their resources, both in terms of budget and technical expertise, before adopting blockchain technology. The costs associated with implementation, training, and ongoing maintenance should be considered.

CONCLUSION

Key aspects under examination include the establishment of a tamper-resistant and decentralized ledger for recording theses, cryptographic techniques for authorship verification, and the implementation of smart contracts for digital rights management. The research also evaluates the potential impact of blockchain on user experience, interoperability, and standardization within the library ecosystem.

The findings of this study are anticipated to contribute to the body of knowledge in Library and Information Science, providing insights into the practical applications of blockchain for safeguarding electronic theses. Additionally, the research offers recommendations for libraries seeking to adopt blockchain technology, addressing potential challenges and outlining best practices for successful implementation.

By addressing the intersection of blockchain technology and library practices, this research seeks to empower libraries to play a pivotal role in ensuring the security and authenticity of electronic theses in the digital age.

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2

Importance of Social Media for Librarians: A Study

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Abstract

The library professionals are creating a virtual platform using Social media to interact with their users and social media is also helping to reach out to the targeted audiences and customers. Social media is using by librarians to make their library users and also use social media for the marketing of their sources and services. Several factors are influencing the use of social media in the libraries because the library professionals think that social media is the best choice to bring library users nearer. Besides these facts there are massive numbers of challenges and issues are facing by the library professional while using social media in their respective libraries. These hurdles and issues should be resolved for better and reliable use of social media in the libraries. Library professionals use social media to share information with their potential users. This paper has highlighted some of the aspects of social media e.g. usage, factors and issues, challenges in the use of libraries.

Keywords: Librarians**,** Social media, Library, Digital, ICT

1. Introduction

The rapid growth of ICTs and its associated aids has changed the living standard of human beings. ICTs made several revaluations in term of social media and others same media of communications. At the beginning of computer and internet the people thought that this is biggest things to use for their lifelong working but at the inception of social media, the people saw a massive change in the mode of communication. Social media makes things easy to connect, share and receive information from one end to another end of the world. Even though this media of communication has changed attitude, thinking and perception of service providers throughout the globe.

The social media has finished the discrimination of communication from the community and it provides the way to access the learned society and make them aware of the access to the library sources and services from their home. Moreover, social media is providing the techniques to the librarians to make things easy to market their sources and services to their targeted audiences. These social media are, LinkedIn, My Space, web.2.0, Blogs, WhatsApps, QQ, and We chat and LIS professionals are using these social media to interact with their users at remote locations and marketing their products addressed that twitter is the type of social media that allows the library professionals to create a platform to access library resources and services. Additionally, the Library Professionals are trying to use a suitable and convenient means of communication to fulfill the needs and wants of library users.

The number of libraries in the world is using different social media to bring library users to nearer library sources and services found that Librarians are using social media for professional development in their respected areas of interest. Moreover, the present age social networking sites are meeting the need of library professionals to prepare themselves for upcoming challenges in their fields. Library professionals should learn skills and knowledge to develop them to meet the needs and wants of the library users in the future. Added that social networking technologies are creating a virtual environment changing the method of communication among library users and library professionals. Furthermore, in the current age of social media usage, library professionals are getting familiar with the demand of library users. On the other hand, the utilization and adoption of social media in the libraries are making a big difference to cope up with the issues and challenges shortly. Facebook is the most popular network amongst librarians, followed by Twitter and blogs

(Figure 1. 

Figure 1: Source: https://www.smartinsights.com/social-media-marketing/social-media-strategy/new-global-social-media-research.

2. Social Networks Sites

The present age of information explosion has encountered the mindset and thinking of human beings. Everyone is running behind the information, but they have no idea how to collect the information and shared the information from one to one and one to many at one time. Besides these facts, the present age of information ICTs and its related aids has changed the role of information professionals. Furthermore, ICTs has made tremendous achievement in the shape of generating the social networks sites for exchanging the information one end to another end. According to Wikipedia (2019) “Social media may have roots in the 1840s introduction of the telegraph, which connected the United States”. Social media has created an environment where everyone can access the information, share the information and disseminate the information. Additionally, there is a number of social networks has been launched and some of them are very much popular throughout the globe like Facebook, Twitter, YouTube, WeChat, Instagram, QQ, QZone, Weibo, Twitter, Tumblr, Telegram, Baidu Tieba, LinkedIn, LINE, Snapchat, Pinterest, Viber etc. social media creates an effective platform to make people access and share their information with other people with far distance. Social media helps the library professionals to make things easy for them and for their readers to increase their capacity to build good relationships among library staff and library users. Social media like Facebook helps the library professionals to create an account to promote their library sources and services. Facebook provides platforms to market their source s and service effectively and efficiently.

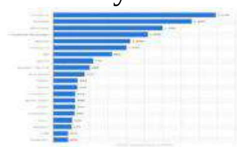

Figure 2: Source: https://www.smartinsights.com/social-media-marketing/social-media-strategy/new-global-social-media-research.

Likewise, Twitter is playing a vital role in the promotion of library sources and services. Today in the modern age of ICTs the social media is the cheapest source for marketing the library sources and services. Additionally, Social media have a different aspect to share news and views about the library, communicate different events and create an environment for effective service to their library users addressed Facebook is the best tool to promote library sources and services and provides a platform to market library sources and services with low expenditures. Furthermore, Facebook helps the library staff to advertise their product and maximize the use of their sources and services to the potential users .

2.1. Definition of social media

1. Social media is a collection of Internet-based communities that allow users to interact with each other online. This includes web forums, wikis, and user-generated content (UGC) websites.

2. Websites and computer programs that allow people to communicate and share information on the internet using a computer or mobile phone

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2.2. Definition of facebook

1. Facebook is a popular free social networking website that allows registered users to create profiles, upload photos, and video, send messages and keep in touch with friends, family, and colleagues.
2. An online community that allows individual users to create personal profiles, share photos and videos, and post on each other's profile pages, or "Timelines."

2.3. Definition of twitter

3. An Internet service that allows people to publish quick updates and see posts or "tweets" of other users they are following in real-time. of LinkedIn
4. A professional networking website that allows users to create profiles, post resumes, and communicate with other professionals and job-seekers of Pinterest.
5. An online community that allows users to share ideas and photos with others by "pinning" items and describing them on their profile pages.

2.4. Definition of MySpace

6. My Space is an online community that allows friends to keep in touch and meet new people as well. It started as a website that bands could use to promote their music but has since grown into a more general community of friends.

2.5. Definition of Instagram

1. Instagram is an online photo-sharing service. It allows you to apply different types of photo filters to your pictures with a single click, and then share them with others.

2.6.Definition of Blog

1. Short for "Web Log," this term refers to a list of journal entries posted on a Web page. Anybody who knows how to create and publish a Web page can publish their blog.

2.7.Definition of Wikis

1. A wiki is a Web site that allows users to add and update content on the site using their Web browser.

2.8.Definition of Web 2.0

1. Web 2.0 is a term that was introduced in 2004 and refers to the second generation of the World Wide Web.

2.9.Definition of Twitter

1. Twitter is a micro blogging and social networking service on which users post and interacts with messages known as "tweets". Tweets.

3. Role of Social Librarian related works

Librarians' awareness of social media usage for informal scientific communication in university libraries in south-south, Nigeria. The author used the survey method and questionnaire to collect the data and descriptive research method. He has collected data from 284 librarians. The response ratio of the research was 71% because out of 284 respondents 202 were retrieved with proper responses. The result of this study has revealed that the majority of the librarians were fully aware of the use of social media. On the bases of these findings, the author has suggested that the library administrator should provide the social media tools for better communication and librarians should be well aware of the importance of social media while in communicating.

investigated the influence of social networking sites on library and information centers. They focused on the latest development in the library and information centers in terms of information transformation. They find out that the present age every library is connected with a different type of social media to maximize the gape among libraries and users. They mentioned some of the most popular social media like Facebook and twitter etc. examined the social networking technologies in the digital environment: its possible implications on libraries. He investigated that social networking sites are making things easy for library users to interact with other library users to get connected to the world using the web. He examined different social software and their usage in the libraries but finally, the author has found out the web 2.0 is suitable social software for the libraries to interact with their users.

Studied how libraries use social networking sites to interact with users. They probed that the adoption of social networking sites is increasing day by day at a great pace. They further added that besides these facts the participation of the library users to the social networking sites is very little. They investigated some major social network sites Facebook, Twitter and Weibo about the sharing, dissemination, communication, and gathering of knowledge and information. They used mix methods to complete this research.

4. Factors of Usage of Social Media in the Libraries

The social media is playing a pivotal role to reach out the potential customer and users. The massive number of information has been transferred from the last four to five decades from one pole to the other pole of the world. The social media is the biggest change of the 21st century and it is growing rapidly. Millions of information are being shared one to one, one to many at the same time on the same channels. The libraries are looking forward to using social media to fulfill the requirement of their users. Social media gained several factors of usage in the libraries to disseminate the information within a quick time. [20] some of the purposes that meet the library user's needs and this will help to reach out to the new customers. Furthermore, he discussed that social media build library image and modernize the library.

Mentioned that social media is the technique or tool to make things easy and it is the vital source to share and receive the information. Facebook is the best tool to accommodate strong positive impact SMEs and positive relations with the non-financial performance of SMEs Social media is providing the best tool to reach library users where they can share and receive their information without any trouble. Additionally, social media is putting a great impact on libraries. LIS professionals are getting familiar with social media to create a flexible environment to reach potential library users. social media is putting a massive impact on libraries and information centers to promote library services and sources. Several social media bring all the library users community together on one spot to share their ideas and views about their relevant and specific information. Furthermore, social media is providing massive space to the library professionals to create a virtual environment to enhance the library service providing capacity. [24] addressed that the use of social media is making things easy for library professionals to reduce the gap between library users and library resources and services. Moreover, social media is expanding their use in the libraries because of the library uses approach have given remarks about the social media that this will facilitate the library professionals to achieve their library goals and objectives.

Likewise, social media will help library professionals to make their services effective and efficient. Social media will establish a bridge between library users and library resources. Similarly, the fourth law of library sciences told about the saving of time of library users. So, the present age of ICTs social media is a powerful tool to engage the library users from remote locations to the library resources and services. It can be said the there are number of factors of using social media in the libraries and information centers. so, those factors can be interaction with potential library users, marketing of library sources and services, sharing and receiving the information, searching for new library users, save the time of library users, achieve the library goals and objectives, create an effective environment, improve the library images, etc (Figure 3).

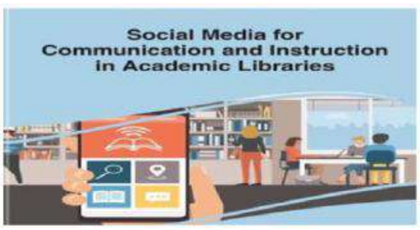

Figure 3: Sources: https://www.kobo.com/gr/en/ebook/social-media-for-communication-and-instruction-in-academic-libraries.

5. Issues and Challenges use of Social Media in Libraries

Investigated the challenges at the usage of social media in the Nigerian university libraries. They indicated some of the major issues and challenges that are creating problems with the use of social media in the said study population. They mentioned some of them as follows lack of financial support, lack of authority support, lack of cooperation among the library staff, no knowledge of social media and its tools and lack of expertise of ICTs and lack of getting feedback from library users. Furthermore, it can be said that these challenges are genuine that encountering the use of social media in libraries throughout the globe. Today, the world has become a global village and everyone is access to the internet connecting to other people via social media. The librarians and LIS professionals are trying to make a bridge between the library sources, services and library users via social networks. addressed the challenges of the use of social networking sites in the libraries. They identified some of the challenges and issues of lack of training of library staff, lack of government or authority supports copyright issues. Furthermore more, these issues should be resolved until the librarians cannot use social media for the promotion of library sources and services.

Conclusion

The recent past social media growth comes at the peak. Social media is the most promising tool to interact with other remote located peoples. Besides these facts, social media are providing a new and excellent platform to the library professionals to reach out to their potential library customers to fulfill their needs, wants and demands. Social media is the point of access where every individual library users can get their demand within a click addressed social networking sites are the technologies that are offering new methods of access to latent customers. Likewise, social media helps the librarians to make their services effective and convenient. The most popular social media like Facebook, Twitter, LinkedIn, and Wechat are the best tools for library staff to promote their library services and sources make their opinion about web 2.0 that the majority of the libraries are applying this social media tool to share and provide information services to their online clients. Furthermore, librarians are personally taking an interest in using social media to bring people to know about their sources and services. [30] searched the marketing library services through Facebook groups. Library staff is using social media for the marketing of library sources and services. Social media can be a better choice for the library to adopt these tools and make them accessible through the globe. Social media would play an important role to change the role and responsibilities of the librarians what we called today cyprian.it would be suggested that every librarian is to apply social media to promote their sources and services.

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3

Digital Literacy skills and ability with special reference to The Scope of Digital Libraries in Indian Academic Libraries

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Abstract:
In today's scenario, digital libraries are facing many challenges. The main challenge today is physical contact with the students and faculties. The application of information technology has provided wider opportunities in archiving and accessing data in digitized form besides conservation and preservation of traditional data. This Digitization of materials helps students and researchers to access the contents irrespective of time and space boundaries. The researcher has tried to highlight the need of today and explain the difficulties and opportunities available for the researchers. The article is written with the aim to describe the importance of digital libraries in colleges, as well as the challenges that will be faced in the implementation of digital libraries as learning resources to support education. This paper also discusses various reasons for Digitalization, processes, and selection criteria for digitalization.

Keywords: Digital Library, Opportunities, Challenges.

1. Introduction:

Digitization of materials is the process of converting analogue information to a digital format.With the emergence of information and communication Technology and the internet facilities the traditional function of the library has changed dramatically.It refers to the process of translating a piece of information such as books, sound recording, picture or video into bits. Modern libraries are increasingly being redefined as places to get unlimited access to information in many formats and from many sources. The trend to procure and maintain e-resources has increases exponentially among the libraries. This is due to the change in the information seeking behavior of students, researchers, and faculty members.This paper explains about digital library, its importance, what are the opportunities and what are the challenges in the current scenario for developing the digital libraries.

2. Definition of Digital Library:

"Digital library may be a library that maintains all, or a considerable half, of its assortment in computer-processible type as an alternate, supplement, or complement to the traditional written and microfilm materials that presently dominate library collections" (William Saffady)

"Digital libraries area unit organizations that give the resources, together with the specialised employees, to select, structure, supply intellectual access to, distribute, preserve the integrity of, and make sure the persistence over time of collections of digital works so they're pronto and economically on the market to be used by an outlined community or set of communities" (Don Waters).

3. Evolution of Digital Libraries:

The history of digital libraries that is currently or so twenty years long, is that the history of a spread of various kinds of info systems that have be referred to as "Digital Libraries". the primary system delivering information artifacts in digital kind will basically be seen as archives of digital texts accessible through a pursuit service and enforced by a centralized data catalogue. a very important example of a system formed to reply to concrete wants went on-

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line beginning in Aug 1991. this technique, originally named e-print archive and currently worldwide called arXiv.

Besides aeXiv, important samples of such early systems were archives of assorted sorts like Electronic Thesis & Dissertations repositories. (ETD's), whose pilot program started in 1996; and archives of psychological feature sciences papers. Cogprints, (n.d.) each launched in 1997. In 2000, it had been created compliant with the protocol outlined by the open archives initiatives and so its computer code was regenerate into the e-prints digital repository computer code E-prints, a versatile platform supporting straightforward and quick originated of repositories of open access analysis outputs. owing to its simplicity, e-prints is presently wide used, over 250 repositories declared to admit it.

4. Benefits of digitization of Library Resources:

Digitization improves access to library resources. Through digitisation of library collections, data are accessible to all or any rather than a bunch of researchers. Digital comes enable users to look for collections quickly and comprehensively from anyplace at any time. digitisation makes the invisible to be visible. Following are some edges of Digitization:

4.1 No physical boundary: The consumer of a processed library need to not attend the library physically; people from everyplace throughout the planet will access the same knowledge, as long as an online association is accessible.

4.2 Round the clock accessibility: a stimulating most popular position of advanced libraries is that people will get entrance day in and trip to the information.

4.3 Digital Library will offer wider access: We are able to produce multiple copies of requested document by library users. By this manner library will meet data want of the many folks simply.

4.4 Preservation of rare assortment of library: Through digitisation library will preserve resources that are rare in assortment. digitisation improves the potency of data search mechanisms and enhances access to library resources.

4.5 Space: Though' standard libraries are restricted by room, processed libraries will presumably store considerably additional knowledge, primarily on the grounds that advanced knowledge needs nearly no physical house to contain them and media storage innovations are additional moderate than any time in recent memory.

4.6 Improved data sharing: Through the suitable information and knowledge exchange protocols, the digital libraries will simply share data with different similar digital libraries and supply increased access to users.

5. Digital Library Opportunities and challenges:

5.1 Advantages of Digital Library:

The advantages of digital libraries as a method of simply and chop-chop accessing books, archives and pictures of varied varieties square measure currently widely known by industrial interests and public bodies alike.

5.1.1 No physical boundary: The user of a digital library needn't to travel to the library physically; folks from everywhere the globe may gain access to identical info, as long as an online affiliation is offered.

5.1.2 Around the clock availability: A digital library is accessed at any time, twenty four hours on a daily basis and one year of the year

5.1.3 Multiple accesses: An identical resource is used at identical time by variety of users.

5.1.4 Structured approach: Digital library provides access to abundant richer content in an exceedingly additional structured manner i.e. we are able to simply move from the catalog to the actual book then to a specific chapter then on.

5.1.5Retrieval: The user is in a position to use any search term call to the word or phrase of the whole assortment. Digital library can offer terribly user friendly interfaces, giving click ready access to its resources.

5.1.6 Preservation and conservation: a definite copy of the initial is created any range of times with none degradation in quality.
5.1.7 Space: Whereas ancient libraries square measure restricted by cupboard space, digital libraries have the potential to store rather more info, just because digital info needs little physical area to contain them. once the library had no area for extension digitisation is that the solely resolution.
5.1.8 Networking: a specific digital library will offer the link to alternative the other} resources of other digital library terribly simply so a seamlessly integrated resource sharing is achieved.
5.1.9 Cost: The value of maintaining a digital library is way below that of a standard library. a standard library should pay massive sums of cash paying for workers, book maintains, rent, and extra books. Digital libraries do away with these fees.

6. Challenges of Digital Library:

6.1 info Accuracy: "Most of the digital library comes implement Optical Character Recognition (O C R), that is merely ninety fifth accurate"-5 and it's true that close to regarding five and mistake might stay, raising the matter of data accuracy. Repeating while not distorting or losing info is troublesome.
6.2. Compatibility of Hardware/Software: Use of digital assortment for accessing and retrieving info can create compatibility drawback. Breath-taking innovations within the field of element and software's, creates the matter of compatibility within the implementation of contemporary technology with the ICT infrastructure accessible within the library, though backward compatibility is ensured by producing firm.
6.3. Authenticity of Information: It is ascertained that several times the data uploaded on varied internet sites, and social medias like blogs, twits, wikis, face book etc isn't authentic , that is additionally accessible in digital formats.
6.4. IPR Issues: Protection of holding rights isn't totally possible in digital media. Difficulties area unit still uninterrupted concerning the copyright protection of the authors and publishers etc. of e-resources.
6.5. Data Security: Data security is regarding keeping information safe .There are a unit key threats to information hold on in digital media, like system crash, faulty disks, equipment failure, accidently deleting or over writing the files, worm, hacking, natural disasters, cash creating, revenge etc.
6.6. Fair Use: The extent of 'fair use' concerning digital resources isn't enclosed in any law. it's troublesome to see what quantity one will copy beneath enjoyment.
6.7. Convenience of usage: Reading the data hold on within the digital type isn't as comfy, quick and effective as reading a written book, periodicals etc. It additionally puts a lot of strain on the eyes.
6.8. Demand Technology: In order to retrieve the data hold on in digital media, use of the devices like Computers, CD players, compact disk players, Disk drives etc become the half and parcel of the data retrieval systems.
6.9. Costly: To retrieve and browse the data hold on in digital type, would like bound devices, that area unit expensive and one ought to knowledge to work these devices.
6.10. Storage life/Shelf life: The storage lifetime of the electronic media is way a lot of but the medium. Storage lifetime of the laborious disks, floppy disks, pc tapes, CDs, compact disk etc is of few years.
6.11. Digital reading and storage devices ought to be ubiquitous: - A large variety of users visit the library often to satisfy their info wants, therefore, so as to avoid wasting the time of the users, the devices helpful for reading and storage of digital info, ought to be ubiquitous.
6.12. Conversion of standard written material into digital type is tedious and really expensive: In several libraries, substantial a part of their assortment is in the standard print

type and thence, it's difficult, tedious, time overwhelming still as terribly high-ticket, to convert these print resources into the digital type.

6.13. Need of Hardware and Software: Software in consistence with the accessible hardware is required for the conversion of the print resources.

Conclusion:

Libraries round the world are performing on this intimidating set of challenges for many years currently. The library/information center must overcome the inhibitions and appearance ahead for the betterment of data services to the user community by with success adopting the digital technology-the want of the hour and keep up with world. It appears that the times might not so much once the entire world would have digital libraries interconnecting all libraries to satisfy the tutorial and analysis desires among the short time. However, before digital libraries took over the library and knowledge network, the country’s archives laws must be modified to satisfy this challenge within the areas of copyright protection of information and interference of corruption of information.

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Turning Pages, Changing Lives: Use of Bibliotherapy as a Therapeutic Tool

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Abstracts:
Bibliotherapy explores the therapeutic efficacy of Books Therapy, a method utilizing literature for emotional and psychological healing. The paper explores into its diverse applications, ranging from addressing mental health challenges to fostering personal growth. Analysing various theoretical foundations, mechanisms of change, and population-specific considerations, the review highlights bibliotherapy adaptability across different age groups and cultural contexts. Despite challenges, including the need for personalized approaches, bibliotherapy emerges as a valuable and accessible tool, offering insights into its potential to enhance mental well-being through literature-based interventions.

Keywords: Therapy, Bibliotherapy, Books, Biblio, Health, Books Therapy, Mental Health.

Definitions:

1) The use of reading materials for help in solving personal problems or for psychiatric therapy….by https://www.merriam-webster.com/dictionary/bibliotherapy.

2) Bibliotherapy is a form of therapy in which structured readings are used as an adjunct to **psychotherapy.** Such readings can be used to reinforce learning or insights gained in the therapeutic session or to give individuals additional professional resources to help in personal growth and development……by https://www.encyclopedia.com/medicine/encyclopedias-almanacs-transcripts-and-maps/Bibliotherapy#A

INTRODUCTION TO BIBLIOTHERAPY:-

The name "bibliotherapy," which comes from the Greek terms "biblion" (book) and "therapeia" (healing), refers to a therapeutic technique in which people use books to help them deal with a range of emotional, psychological, and interpersonal issues. At its core, bibliotherapy recognizes the enormous impact that reading can have on the human mind and harnesses this potential to encourage personal growth and well-being.

The idea that literature can offer readers comfort, understanding, and a sense of community is the foundation of the bibliotherapy practice. The stories, characters, and themes found in books—whether they are works of non-fiction or fiction—may strike a chord with readers, providing them with insights and coping strategies that they can use in their own lives.

A flexible intervention, bibliotherapy is used in self-help, education, and clinical therapy, among other contexts. It recognizes that reading, thinking about, and conversing about literary works can help people achieve emotional catharsis, become more self-aware, and create coping mechanisms.

Bibliotherapy is not limited to treating mental health issues; it also includes personal growth, stress management, and improving general wellbeing. Literature selection may be customized to meet the needs of the individual, which makes it an extremely flexible and approachable therapeutic tool.

TYPES OF BIBLIOTHERAPY:-

1. Individual Bibliotherapy:

A person participates in autonomous reading in individual bibliotherapy, either on the advice of their therapist or on their own volition. The person considers the information and how applicable it is to their own struggles. This kind enables a more individualized and private investigation.

2. Group Bibliotherapy:

In group bibliotherapy, participants read and discuss chosen texts in a supervised environment. A sense of community is fostered by the supportive atmosphere that the group dynamic offers for exchanging ideas and perspectives. With a variety of viewpoints, group conversations can improve the therapeutic experience.

3. Prescriptive Bibliotherapy:

In prescriptive bibliotherapy, a mental health specialist makes book or literary resource recommendations based on each patient's unique therapeutic objectives. The recommended reading list is tailored to the individual's needs, encouraging introspection and understanding.

4. Interactive Bibliotherapy:

In order to enhance engagement with the information, interactive bibliotherapy incorporates interactive exercises, debates, or other activities with reading. This kind promotes involvement and the application of knowledge learned from the literature.

5. Creative Bibliotherapy:

In creative bibliotherapy, reading is combined with creative expression exercises like writing, sketching, or other artistic pursuits. Taking up artistic pursuits can facilitate emotional processing, improve self-expression, and open up new vistas for inquiry.

6. Educational Bibliotherapy:

The goal of educational bibliotherapy is to convey knowledge or teach certain skills through the use of literature. This method is frequently used in educational settings to meet learning objectives related to social, emotional, or educational aspects.

7. Expressive Bibliotherapy:

Encouragement to write or use other artistic mediums to convey feelings and ideas is a key component of expressive bibliotherapy, which is centred around the literature that the patient is reading. This method places a strong emphasis on the healing benefits of artistic expression.

8. Clinical Bibliotherapy:

Clinical bibliotherapy is used in formal therapeutic contexts like psychotherapy and counselling. In a clinical setting, mental health practitioners employ particular texts as therapeutic tools to treat the emotional and psychological difficulties of their clients.

9. Legacy Bibliotherapy:

In legacy bibliotherapy, books that represent a person's cultural background, beliefs, or customs are studied. It strives to create a sense of identity and belonging by fortifying ties to one's heritage.

10. Biographical Bibliotherapy:

Reading the autobiographical works of others who have experienced comparable struggles is known as biographical bibliotherapy. It can support people on their particular paths of self-discovery and resilience by offering them inspiration, role models, and a sense of shared humanity.

APPLICATION OF BIBLIOTHERAPY IN MENTAL HEALTH:-

1. Depression and Anxiety:

Bibliotherapy can be used to supplement traditional treatments for depression and anxiety. Reading literature that explores characters dealing with similar struggles can provide insights, foster a sense of connection, and offer coping strategies.

2. Stress Reduction:

Engaging in literature as a form of escapism or relaxation can help individuals manage stress. Reading materials that transport readers to different worlds or provide a break from daily pressures can contribute to stress reduction.

3. Trauma and PTSD:

Bibliotherapy is utilized to assist individuals in processing and coping with trauma, including post-traumatic stress disorder (PTSD). Reading narratives that address trauma-related themes can facilitate understanding, expression, and emotional healing.

4. Self-Esteem and Identity Issues:

Bibliotherapy can be applied to address self-esteem and identity challenges. Reading stories featuring characters who overcome similar issues can inspire self-reflection and empower individuals to explore and affirm their own identities.

5. Grief and Loss:

Individuals experiencing grief and loss can benefit from bibliotherapy that addresses themes of mourning, acceptance, and resilience. Reading about characters navigating similar experiences can provide comfort and perspective.

6. Relationship Issues:

Bibliotherapy is used to explore and navigate relationship challenges. Reading materials that depict various relationship dynamics can offer insights into communication, empathy, and conflict resolution.

7. Eating Disorders:

In the treatment of eating disorders, bibliotherapy can play a supportive role by addressing body image concerns, self-acceptance, and the emotional aspects of recovery. Reading about characters who undergo similar struggles can foster empathy and understanding.

8. Addiction and Substance Abuse:

Bibliotherapy can be integrated into addiction treatment programs by addressing underlying emotional issues and providing tools for recovery. Reading materials that depict the challenges of addiction and recovery can offer hope and motivation.

9. Parenting and Family Issues:

Bibliotherapy can assist individuals in navigating parenting challenges and family dynamics. Reading materials that explore diverse family structures and relationships can provide guidance and promote understanding.

10. Coping with Chronic Illness:

Individuals dealing with chronic illnesses may find solace and coping strategies through bibliotherapy. Reading materials that address the emotional and psychological aspects of living with illness can provide comfort and support.

11. Anger Management:

Bibliotherapy can contribute to anger management by offering literature that explores the roots of anger, effective communication, and healthy ways to express and cope with intense emotions.

12. Social Isolation and Loneliness:

Reading materials that explore themes of connection, friendship, and community can be beneficial for individuals experiencing social isolation and loneliness. Bibliotherapy can facilitate a sense of belonging and understanding.

EFFICACY AND EFFECTIVENESS OF BIBLIOTHERAPY:-

1. Empirical Support:

Numerous studies have provided empirical support for the efficacy of bibliotherapy in addressing various mental health concerns. Research has explored its effectiveness in treating conditions such as depression, anxiety, and stress.

2. Comparable to Traditional Therapies:

Some research indicates that the outcomes of bibliotherapy can be comparable to traditional therapeutic approaches. It has been suggested that guided self-help interventions, including bibliotherapy, can yield positive results similar to those achieved through face-to-face therapy.

3. Cost-Effective Intervention:

Bibliotherapy is often considered a cost-effective intervention. It may be more accessible to individuals who face barriers to traditional therapeutic services, making it a valuable option for reaching a broader population.

4. Flexibility and Accessibility:

One of the strengths of bibliotherapy lies in its flexibility and accessibility. Individuals can engage in reading at their own pace, in a comfortable setting, and at a convenient time. This flexibility can enhance the acceptability and adherence to the intervention.

5. Personalization and Tailoring:

The effectiveness of bibliotherapy can be influenced by the degree of personalization and tailoring to the individual's needs. Prescribing or recommending specific books that resonate with the person's experiences can enhance engagement and therapeutic outcomes.

6. Population-Specific Benefits:

Research suggests that bibliotherapy can be beneficial across different age groups and populations. It has been applied successfully with children, adolescents, adults, and older adults, addressing a variety of mental health issues.

7. Cultural Considerations:

Cultural factors may influence the effectiveness of bibliotherapy. The selection of literature that is culturally relevant and sensitive to diverse perspectives can enhance its impact on individuals from various cultural backgrounds.

8. Long-Term Effects:

While some studies demonstrate positive short-term effects, the long-term sustainability of the benefits of bibliotherapy may depend on factors such as ongoing engagement with reading and the integration of learned strategies into daily life.

POPULATION-SPECIFIC CONSIDERATIONS IN BIBLIOTHERAPY: -

1. **Children and Adolescents:-**

- **Book Selection**: Choose age-appropriate literature that addresses the developmental needs and concerns of children and adolescents.
- **Interactive Elements:** Incorporate activities, discussions, or creative expressions to enhance engagement and understanding.
- **Parental Involvement**: Involve parents or caregivers to support and reinforce the bibliotherapeutic process.

2. **College Students:-**

- **Academic and Stress-Related Themes**: Select literature that addresses the academic pressures and stressors commonly experienced by college students.
- **Transition Periods**: Address challenges related to transitions, such as adjusting to college life, academic demands, and interpersonal relationships.

3. **Adults:-**

- **Workplace Stress**: Choose literature that explores themes relevant to the workplace, career transitions, and work-life balance.
- **Relationship Dynamics**: Address adult-specific issues such as marriage, parenting, and midlife challenges.
- **Diversity of Experiences**: Offer a diverse range of literature that reflects the varied experiences of adults.

4. **Cultural Considerations:-**

- **Diverse Representation**: Ensure that the literature selected is culturally diverse and resonates with the backgrounds of the target population.

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- **Language Sensitivity**: Consider language preferences and literacy levels, providing materials in languages accessible to the population.

5. **Individuals with Mental Health Conditions:-**

- **Specific Conditions**: Tailor bibliotherapy interventions to address the unique challenges associated with specific mental health conditions (e.g., depression, anxiety, PTSD).
- **Collaboration with Therapists**: Integrate bibliotherapy as part of a comprehensive treatment plan, collaborating with mental health professionals.

6. **Diverse Sexual Orientations and Gender Identities:-**

- **Inclusive Literature:** Select literature that is inclusive and representative of diverse sexual orientations and gender identities.
- **Identity Exploration**: Address themes related to identity exploration, acceptance, and coping with societal challenges.

7. **Individuals in Correctional Settings:-**

- **Rehabilitative Themes**: Choose literature that supports rehabilitation, personal growth, and self-reflection.
- **Empowerment:** Utilize literature that empowers individuals to envision positive futures and alternatives.

CHALLENGES AND LIMITATION IN BIBLIOTHERAPY:-

A) Challenges in Bibliotherapy:

1. Lack of Personalization:

Finding literature that resonates with an individual's unique experiences and challenges can be challenging. Personalization is crucial for the effectiveness of bibliotherapy, and a one-size-fits-all approach may not address individual needs.

2. Resistance to Reading:

Some individuals may not have a natural inclination for reading or may face barriers such as literacy challenges. Resistance to engaging with written materials can limit the accessibility and acceptance of bibliotherapy.

3. Ethical Concerns:

Recommending specific books or materials raises ethical considerations. The content of literature and its potential impact on individuals should be carefully considered to avoid causing harm or discomfort.

4. Effectiveness Variation:

The effectiveness of bibliotherapy can vary among individuals. Factors such as reading preferences, engagement levels, and the nature of the condition being addressed contribute to the variability in outcomes.

5. Lack of Therapeutic Relationship:

Bibliotherapy typically lacks the interpersonal dynamic present in traditional therapeutic relationships. Some individuals may benefit from the personal connection and guidance provided by face-to-face interactions with a therapist.

B) Limitations in Bibliotherapy:

1. Not a Stand-Alone Treatment:

Bibliotherapy is often considered as a supplement to traditional therapeutic interventions rather than a stand-alone treatment. It may not be sufficient for addressing complex mental health conditions on its own.

2. Resistance to Self-Help Approaches:

Some individuals may be sceptical of self-help approaches, viewing them as simplistic or insufficient for addressing complex emotional and psychological challenges.

3. Cultural Sensitivity Challenges:

The selection of literature must be culturally sensitive and inclusive. The availability of culturally relevant materials may be limited, posing challenges in ensuring that bibliotherapy is applicable to diverse populations.

4. Dropout Rates:

Individuals may discontinue bibliotherapy due to lack of interest, perceived ineffectiveness, or other external factors. High dropout rates can impact the overall success of bibliotherapeutic interventions.

5. Limited Interactivity:

Bibliotherapy, particularly when undertaken individually, may lack the interactive elements present in traditional therapeutic settings. Interaction with a book or written material is a one-way process, limiting opportunities for immediate feedback or clarification.

CONCLUSION:-

It becomes clear as we explore the vast field of bibliotherapy that stories have the power to heal in addition to amuse, providing people with a therapeutic experience that goes beyond traditional procedures. In order to promote resilience, empathy, and personal development, this paper calls on practitioners, educators, and researchers to embrace the transforming power of literature.

The results highlight bibliotherapy's adaptability and demonstrate how well it works for a variety of age groups, ethnic origins, and mental health issues. It has been demonstrated that the power of stories and narratives, whether employed in individual or group settings, may develop empathy, a sense of connection, and personal development. Additionally, bibliotherapy is a useful addition to conventional therapeutic procedures because of its accessibility and non-intrusive character.

By seeing literature as a therapeutic tool, we embrace a well-rounded approach to wellbeing and accept its ability to treat mental health difficulties. As we get to the end of our investigation, it is evident that bibliotherapy possesses the transforming ability to encourage self-reflection, build resilience, and eventually improve lives.

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5

Emergence of Digital Libraries due to Re-Engineering

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Abstract:
This research paper describes the term like 'Re-engineering, 'Digital libraries’, Technology facilitates seamless access and distribution of information across borders. 'Institutional Repositories', 'Electronic Theses and Dissertations' and the further understand the examples of IRs and ETDs in the Indian scenario, what are the issues and solutions for the implementation of good digital environment for the better services to end users by the libraries have been explained.

Keywords: Re-engineering, Digital libraries, Institutional Repositories

Introduction:

The adoption of technical services and functional styles has changed the way libraries dress. Retrieving information from the library can be faster and more accurate. Information technology has brought great changes to the library. This era requires the application of reengineering in libraries. Reengineering is the concurrent redesign of processes, organizations, and their supporting information systems to achieve radical improvement in time, cost, quality, and customers" regard for the company's products and services. Therefore, this paper highlights how digital libraries are having more significance in changing environment of library activities and services. Every institute should have institutional repositories and it has to be used electronic dissertations and theses for enhancement of research culture, it is so important for the socio-economic development of every citizen of India. A digital library promises a one-step, equitable and timely access to vast number of diverse resources in a shared mode in a given specialty lifting traditional barriers of time and space. www is an unorganized collection of documents, many of them ephemeral information which does not have any durability or lasting value. Defines digital libraries as "managed collection of information, with associated services, where the information is stored in digital formats and accessible over a network".

Literature Review

(Oladokun, 2006) Describes an example of the University of Botswana (UB). It was running a research project on e-learning pilots since 2003. Already there was a clear institutional strategy for online teaching of students, combined with interactive video conferencing, e-learning and other educational technologies, to create virtual classroom. The teaching of information literacy skills by the librarians (discussed below) was part of the agenda. The library has its own University of Botswana electronic leaming (UBel) team, which has been working to put some of the course contents in WebCT (Web Course Tools) for online delivery. ln the meantime the library database was accessible via Internet. Accessibility to several thousands of articles from electronic journals was ensured through the University of Botswana Library (UBL) web page. The library systems also have self-help and self-service functions, whereby individual borrowers could carry out book renewal from any computer with an Internet connection, anywhere within or outside the university campus.

(Wright, 2004) Observed that academic libraries have the opportunity through their Web pages to present to the university community recommended sites and appropriate techniques for searching the Internet. But in the design and organization of home pages, academic libraries often provide inadequate navigational paths to sites that provide search engine selection and evaluation criteria. He noted that libraries are increasingly using the Web to direct users to resources beyond their own licensed collections, but there is a striking and disturbing inconsistency among libraries in the presentation of these Internet-searching resources. This research found that 67 percent of the sites studied have dedicated Internet-searching pages that include search engines, guides. and tutorials. Moreover, libraries that do not offer high-quality Internet search engine links, user guides, and instruction lose a great opportunity to attract students and to position themselves as the primary gateway for information.

(Roxanne Missingham, 2010) "Re-engineering a national resource discovery service: MODS down" describes that Australian libraries have shared resources and records for over 20 years through Kinetics, a service provided by the National Library of Australia. While this service has broadly met the needs of its users, comprising over 1,000 Australian libraries, the Library is Reengineering the service, using MODS (Metadata Object Description Schema) to improve coverage of online publications and records from specialist collections. This article describes the use of MODS to transform records for digital resources into MARC records for resource discovery.

Meaning of Re-Engineering:

The pressures to lower costs, reduce cycle times, raise quality and in general, make workplace processes more productive & intensive. As a result, re-engineering which "burst upon the Management scene in 1990" has been much in vogue. (Davenport) However the term Re-engineering was first introduced by Michael Hammer in 1990 at a Harward Business review article, "Re-engineering work: Don't Automate obliterate". (Gaur,Ramesh C.) Howeven Hammer & champy (1933) says "Re-engineering is the fundamental rethinking & radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance such as cost, quality, service & speed."According to Davenport (1933) "Re-engineering is only the part of what is necessary in the radical change of processes it refers explicitly to the design of new process. The term process innovation encompasses the envisioning of new work strategies, the actual process design activity & the implementation of the change in all its compels Technological, human & Organizational dimensions. The above definitions mostly stresses on rethinking & radical redesign of processes & also on destroying the old ways.

Why Digital Library for Re-engineering?

The unprecedented surge of activities and interest in digital library can generally be attributed to the following three factors:

(i) Emergence of Internet and web technologies as a media of information allows rapid access to a wide variety of networked information resources extending a uniform interface to a vast number of multimedia resources the web, being a hypermedia-based system, allow linking amongst elec- tronic resources;

(ii) Availability of highly evolved, extraordinarily simple and intuitive user interface, i.e., Internet Explorer and Netscape Navigator for all prevalent platforms; and

(iii) Advances in online storage technologies enabling storage of large amounts of contents at increasingly affordable cost. The digital library offers significant and unparalleled improvement and value addition to library services while providing workable solutions to problems traditionally associated with the management of print-based collections in traditional libraries. Improved information retrieval and enhanced document delivery capabilities are widely acclaimed strength of digital libraries. Moreover, the cost of creating, storing, manipulating and transmitting digital information has decreased considerably providing necessary impetus to the digital library initiatives worldwide. Rising acquisition and subscription fees have forced the libraries to find other means to make information available to their users and content aggregators and electronic publishers are providing means to do so. Several large-scale digitization projects are aimed at conserving and preserving old, fragile and

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deteriorating documents of high scholarly value not only for preserving them but also for providing increased access and search possibilities that become possible once the documents are available main computer-processible form. Digital libraries enable greater access to digital contents, can be managed from remote locations and provide a way to enrich the teaching and learning environment. Since information in digital library is electronically stored and accessed, it is not bound to space and time. Digital library systems can be accessed simultaneously by multiple users guaranteeing continuous availability of documents. Digital library implementation can dramatically reduce floor space requirements as compare to conventional shelf-type storage of books and journals.

Important Technologies for Digital Libraries:

The development and growth of hypertext, image technology, the World Wide Web, and other related technology are explored using a variety of terminologies. Some of the top technologists in this sector define and enunciate the fundamental qualities of digital libraries. The section discusses the idea of a "hybrid library," which captures the challenges libraries confront in attempting to combine electronic materials purchased on CD ROM or other media or electronic access with internally created digital collections. The hybrid library sits on a spectrum between the traditional and digital libraries, combining the usage of electronic and paper-based knowledge sources. The necessity for digital libraries is discussed, and the Web, traditional libraries, and conventional information storage are contrasted.

Institutional Repositories (IRS) In Indian Scenario:

There are 99 institutional and subject wise repositories in India that are registered in Registry of Open Access Repository (ROAR). Institutional repositories initiated in India can be viewed at http://roar. eprints.org/.

- Digital Repository of IIT Bombay
- National Institute of Oceanography, India (DRS@ino)
- National Institute of Technology, Rourkela (DSpace@NITR)
- Management Development Institute, Gurgaon (DSpace@MDI)
- DSpace at Indian Institute of Management Kozhikode
- DSpace at National Chemical Laboratory, Pune
- INFLIBNET Centre, Ahmedabad (DSpace@INFLIBNET)

Electronic Theses & Dissertation:

ShodhGanga: Indian ETD Repository (http://shodhganga.inflibnet.ac.in/) it is established in 2010 and implemented by INFLIBNET Centre, more than 160 Universities are participating It is supported by University Grants Commission. Shodhganga is a digital repository set-up for submission of electronic version of theses and dissertations by research scholars in universities in India and make them available in open access to the world-wide academic community in response to the UGC Notification (Minimum Standards & Procedure for Award of M.Phil. / Ph.D. Degree, Regulation, 2009). ShodhGanga is set-up using Dspace that uses internationally recognized protocols and interoperability standards. 160 Universities have signed MoU with INFLIBNET Centre to join in ShodhGanga project and deposit their theses. INFLIBNET Centre also maintain a repository of approved synopsis submitted by research scholars to the universities for registering themselves for the Ph.D. program called ShodhGangotri (http://shodhgangotri. inflibnet.ac.in/) with an aim to measure trends and directions of research being conducted in Indian universities and to avoid duplication of research.

Vidyanidhi Digital Library: (http://www.vidyanidhi.org.in/) It is established in 2000 and implemented by Department of Library Science, University of Mysore. It is supported by NISSAT, DSIR, Government of India, Ford Foundation and Microsoft India. Vidyanidhi is a portal of doctoral research in India. It began as a pilot project in 2000 with support from government, the Ford Foundation and Microsoft India archive of dissertations, as well as a set of resources for doctoral research in India. The Vidyanidhi Digital Library has two layers: a

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metadata database and the full text of theses. Current Status is more than 5000 full text and 50,000 bibliographic records of theses submitted to the universities in India were hosted in Vidyanidhi.The Vidyanidhi website was not functional in March 2014.

Conclusion:

The decrease information and traditional libraries implies that readers today prefer to get information and read materials online rather than physically today library: The digitization process has already begun in many large university and libraries in order to make the content available to users inside adversities of the institution. Library re-engineering is required in terms of digital library for the further necessary benefits like make a wide variety of Content Access, latest and updated resources can be served to users, allow readers to access materials on demand, make readers find resources instantly, no opening or closing hours or 24/7 open access multiple and simultaneous access, library management automation, real-time interactions, eliminate deterioration of resources, preserve knowledge for the future generation. Every institution has to prepare institutional repository and cater the services. Use of ETDs enhances research environment and its quality. So successful implementation of digital libraries is inevitable.

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6

Work Pressures and management of Stress for Library Professionals

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Abstract :

Stress management issue received more attention at global level. In current scenario stress management issue is immerged as burning issue in from of world population. Many researchers have focused on stress management at work place specifically at libraries, because of their specific reasons. They are paid their attention to understand basic causes for stress at working places and their solutions to reduce stress. Library professionals face many problems due to stress and it affects on work quality in libraries. Researcher highlighted the concepts regarding to Stress at work place, possibilities, help to the burn out stages of employees, causes, management of stress including HSE standards approach and Techno-stress.

Keywords- Library Professional , stress ,Pressures

Introduction-

Pressures and Stress are the changes which our bodies experience as we adjust to our continuous changing environment. The rapid adoption of information and communication technologies and their extensive use in learning institutions and system administration has introduced new library and information services. Introduction of different learning modes and expansion of academic programs have also resulted in the librarian, facing more challenges as compared to his predecessors. Some type of stress considers being a person's psychological and physiological response to perception of a demand or challenge. Nature and intensity of this response depends on meaning, one gives to demand or challenge and on one's assessment of resources that are available for meeting it. This conception of stress has a number of important elements. First, stress is not something "out there" or inherent in "stressful" things or situations. Rather, stress is within person, it can be seen through response by person to challenge. Source of demand or challenge is referred to as a "stressor." A stressor with negative meaning (Source of undesirable stress) for one person may cause a completely different response in another. Another element in this definition of stress is importance for person's perception or way of thinking about situation/circumstances. Surely, few normal persons would wish to be without demands or challenges; these can be part of joy and verve of life

Definitions:

Stress:

Stress is a general term applied to various psychological (mental) and Physiological (body) pressures or felt by people throughout their lives.

Stress is defined as "a state of psychological and physiological imbalance resulting from the disparity between situational demand and the individual's ability and motivation to meet those needs."

Stress Management:

Stress Management means to make changes to our life, if someone is in constant stress situation and the person can prevent stress by practicing self care, relaxation and to manage or response to the stressful situations when its occurs.

Stress management is said to reduce the blood pressure, heart, disease, digestive troubles and many more physical ailments. The experts comment that it helps to improve sleep and mental health.

Sources of Stress in the Library work place:

McGrath 1976 discusses about the conception of stress and burnout that it may be functional or dysfunctional at workplace. He also discusses about performance and productivity improvement with increasing stress to a certain level, after which increased stress will cause lowered performance. Discussion further proceeds with the interactions among individuals, organizations and jobs that produce stress and distress at workplace are very complex. Each employee is unique with regard to meanings one attaches to stressors, perceptions of available resources and coping strategies and skills one can and will use. Each organization is, likewise, unique with regard to the stressors, it contains or produces and its approaches to helping employees manage and cope with stress.

Workplace Stress:

The authors discusses about the stress in workplace and the solution. The authors look at historical, sociological and cultural resources for an objective perspective of the topic. The authors examines two societal responses to work stress, concludes that it is very important to locate the origins of work stress in the structure and organisation of the modern workplace and to see the solution in terms of job redesign and the second approach they mentioned to locate the work stress in the responses of the individual and get the solution in terms of therapeutic intervention. (David, 2002).

Working Environment:

The stress relates to the work environment where he or she works. The library professionals expressed the work environment stress they perceived in their work place, they also declared that they do not have enough and adequate working tools in their institute. The librarian also expressed that the library staff gets tired by carrying books from first floor to fourth floor of the library, without usage of the lift system, which has not been repaired or out of service from many days. Librarians also expressed that they have inadequate number of staff in the library to deal with the users. Most of the staff is shifted to the office or any other work. This situation makes them stressful and leads to work overload for them. Other stressful situation also faced by the Librarian to take work from other professionals or subordinate who are very lazy or avoid working in time, few are workaholic. Some library professionals face health issues like eye problem due to constantly facing the computer screen, neck pain due to carrying continuous books from ground floor to upper floor by the circulation staff. They even don’t get the incentives or rewards for their non-stop work. Some librarians face the problem of the staff quarrelling among each other’s for work and all the situations has to be handled by the librarian.

Psychological Stress:

The stress is generally categorised in different criteria and generally was groped as physical or psychological. It was explained that physical stress irritates or brings immediate negative effects on the physical health.

The psychological stress brings immediate or long term irritation or negative effect on psychological or mental state. This may not affect on body immediately, but these two types of stress may be interactive and physical state can affect psychological state or vice versa

Occupational Stress:

Stressor Appraisal Reaction model is an interactional or transactional, which helps to cope the resources, which have strong influence on the future appraisal of the event or situation as stressful. The model allows to understand stress as the combination of persona issues and responses that a person can fell upon in times of stress. The balance of demands and resources defines stress if the demands are greater than the resources, then the stress occurs, if the resources are available to meet the demand, then the secondary appraisal might be one of challenges rather than harm or threat and it would be stressful to the individual. This can be applied to the library and information work place stress.

Management of Stress:

Individuals make various attempts to reduce discomfort associated with stress. Aldwin (2007) quoting Frend (1996) defined coping as the way in which the ego wards off anxiety and exercises control over impulsive behaviour, conflicts and instincts. Considering effects of stress on both employee and employer, there is need for its reduction to barest minimum. Onwushi and Meggison(2001) observed that stable social relations help people and so advocate open communication and participatory management between librarians and other allied staff.

Telework

Telework is defined as "an alternative work arrangement in which employees perform tasks elsewhere that are normally done in a primary or central workplace, for at least some portion of their work schedule, using electronic media to interact with others inside and outside the organization (Gajendran and Harrison, 2007, p. 1525). Although organizations are increasingly providing employees with telework opportunities, which effects on workers' job satisfaction are inconsistent. Some researchers have argued that telework positively influences workers job satisfaction by providing enhanced flexibility in work schedules and facilitating cross-functional collaboration and extensive knowledge sharing across organizational boundaries

Management Standards Approach:

Management standard and associated STBA for the psychosocial risk factor of demands is shown below as an example. Management standards for all six psychosocial risk factors share same format.

Management Standard for demands:

The standard is that:

*Employees indicate that they are able to cope with their job demands.

* Systems are in place locally to respond to any individual concerns.

States to be achieved are:

* Organisation provides employees with adequate and achievable demands in relation to agreed hours of work;

* People's skills and abilities are matched to job demands;

* Jobs are designed to be within capabilities of employees and;

* Employees' concerns about their work environment are addressed.

Conclusion

Stress is a part of our working lives and is not likely to decrease in tomorrow's workplace. A difficult economy, downsizing, taking on additional responsibilities without assistance or additional pay, all are taking their toll on physical, mental and emotional well being. College librarians often feel isolated as the only professional in the field serving the college campus. The librarian also face difficulty in coping with new technologies, staff support, insufficient staff or manpower and busy workloads in academic structure in limited time frames. The librarian has to find time to do activities which helps to reduce workplace stress.

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7

Application of Bradford's Law of Scattering to Agricultural Botany Literature: A Study of Doctoral Theses Citations

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Abstract

Bradford's law of scattering is based on the principle that every scientific field is related, however remotely, to every other field. 19 Ph. D. theses submitted in the field of Agricultural Botany in Mahatma Phule Krishi Vidyapeeh, Rahuri during 2006-2010 for the award of doctoral degrees were analysed to identify the Bradford's zones and productivity of journals cited in the theses. The journal distribution as per the Bradford's law reveals the ratio as 10:41:334 in Agricultural Botany, dispersion of journal titles in Agricultural Botany does not satisfy the Bradford's Law of Scattering.

Keywords: Bradford's Law, Bradford's Zones, Bradford's Law of Scattering, Doctoral theses, Agricultural Botany, Bradford distribution, Leimkuhler Model.

Introduction

The proliferation of journals and the consequent exponential growth of journal literature have laterally jeopardized their capacity to transmit information effectively and rapidly (Subramanyam, 1979). In 1934 Bradford was the first to provide a mathematical expression to the scattering of citations from the journals (Bradford S. C., 1948). The law is based on the principle that every scientific field is related, however remotely, to every other field.

In 1948 Bradford in his first paper entitled 'Sources of information on specific subjects' (Bradford S. C., 1934). He observed and examined two bibliographies prepared in the Science Library (Britain) on Applied Geophysics (1928-1931) and Lubrication (1932-1937). He prepared a list of journals arranged in decreasing order of source items contributed by the journals of bibliographies. Bradford noticed that in each subject there were a few productive sources, large number of sources which were moderately productive and still a large number of sources of constantly diminishing productivity.

Bradford identified three groups of periodicals in the list of periodicals ranked by diminishing productivity that produced approximately the same number of articles on the subject, but the number of periodicals in these three equi-productive zones increased by a constant factor.

If scientific periodicals are arranged in the order of decreasing productivity of articles on a given subject, that may be divided into a nucleus of periodicals, more particularly devoted to the subject, and several groups or zones containing the same number of articles as the nucleus, where the number of periodicals in the nucleus and succeeding zones will be as $1:n:n^2$ ….

Bradford also plotted graph of the cumulative number of source items R(n) versus the logarithm of the cumulative number of journals (log n). This graph came to be known as 'Bradford Bibliograph'.

There have been several studies based on different datasets to assess the Bradford's Law of Scattering.

Scope and Limitations of the study

The Present study is confined to the Ph. D. theses in Agricultural Botany submitted to Mahatma Phule Krishi Vidyapeeth (MPKV), Rahuri during 2006 to 2010. The form of documents covers books, journals and other literature referred by the authors of the theses in

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their foot-notes and bibliographies appended to their thesis. At MPKV, Rahuri during study period 19 theses submitted in Agricultural Botany.

Objectives of the study

- To compile rank list of journals based on frequency of citations.
- To ascertain whether the distribution of citations among the journals confirm to the Bradford's law of Scattering.

Data Collection and Analysis of Data:

The source of the data for the present study is the Ph. D. theses in Agricultural Botany submitted to Mahatma Phule Krishi Vidyapeeth, Rahuri (MPKV, Rahuri) during 2006-2010. During the study period 19 Ph. D. theses submitted in MPKV, Rahuri. The present study is based primarily on the analysis of bibliographic units which is available in the form of footnotes, references and bibliographies in the thesis. The bibliographic details of cited documents in thesis have been collected. The collected details has been recorded using excel sheet for the purpose of analysis. Several fields such as title of the documents, name of author, type of document, year of publication, country of publication etc. have been created to fill in the data so as to analyze it.

After data collection these work sheets were sort out according to the objectives of the study and in this process collected data presented in tabular and graphical form and on the basis of analysis, conclusion are drawn.

Ranking of Journals

Journals are very useful for researchers for scientific communication, but their increasing cost puts the librarian to study the quality, usefulness and suitability to a particular group of users. Core journal ranking studies are usually made to help in the selection of journals and in assessing the importance of one or more journals in a particular subject field. Frequency of citations or uses of a journal is governed by many factors such as availability, language and country of publications, size and frequency of publication, coverage in secondary journals, the reputation of the authors and so on.

In the present study ranking of the journals in the subject Agricultural Botany has been prepared on the basis of total citation frequency received by each journal. The titles have been arranged in decreasing order of the number of citations. List is given in the table no. 1 with their rank and percentage of citations of contribution.

Table No. 1: Ranking of Cited Journals

Sr. No.	Rank	Name of Journal	Country	No. of Citations	Percentage	Cumulative Citation	Cumulative Percentage
1	1	The Indian Journal of Genetics and Plant Breeding	India	210	8.31	210	8.31
2	2	Crop Science	USA	113	4.47	323	12.78
3	3	Journal of Maharashtra Agricultural Universities	India	110	4.35	433	17.13
4	4	Theoretical and Applied Genetics	Germany	84	3.32	517	20.45
5	5	The Madras Agricultural Journal	India	76	3.01	593	23.46
6	6	The Indian Journal of Agricultural Sciences	India	64	2.53	657	25.99
7	7	Journal of the Indian Society for Cotton Improvement	India	55	2.18	712	28.16
8	8	Genetics	USA	46	1.82	758	29.98
9	9	Agronomy Journal	USA	45	1.78	803	31.76
10	10	Journal of Cotton Research and Development	India	41	1.62	844	33.39

11	11	Crop Improvement	India	40	1.58	884	34.97
12	12	Sorghum Newsletter	India	38	1.50	922	36.47
13	13	Euphytica : Netherlands Journal of Plant Breeding	Netherlands	37	1.46	959	37.94
14	14	Annals of Plant Physiology	India	36	1.42	995	39.36
15	15	Journal of Genetics	India	35	1.38	1030	40.74
16	16	The Indian Cotton Growing Review	India	32	1.27	1062	42.01
17	16	The Mysore Journal of Agricultural Sciences	India	32	1.27	1094	43.28
18	17	Current Science	India	29	1.15	1123	44.42
19	18	Genome	Canada	27	1.07	1150	45.49
20	19	Annals of Agricultural Research	India	26	1.03	1176	46.52
21	19	Gujarat Agricultural Universities Research Journal	India	26	1.03	1202	47.55
22	20	Coton et Fibres Tropicales	France	24	0.95	1226	48.50
23	20	Crop Research	India	24	0.95	1250	49.45
24	20	Indian Journal of Agricultural Research	India	24	0.95	1274	50.40
25	20	Legume Research An International Journal	India	24	0.95	1298	51.34
26	21	Indian Journal of Pulses Research	India	23	0.91	1321	52.25
27	22	Forage Research	India	22	0.87	1343	53.13
28	23	Indian Journal of Entomology	India	21	0.83	1364	53.96
29	23	Journal of Heredity	USA	21	0.83	1385	54.79
30	24	Indian Phytopathology	India	20	0.79	1405	55.58
31	24	Nucleic Acids Research	UK	20	0.79	1425	56.37
32	25	Heredity	UK	19	0.75	1444	57.12
33	26	Referativny Zhurnal	Russia	17	0.67	1461	57.79
34	27	Phytopathology	USA	16	0.63	1477	58.43
35	28	American Journal of Botany	USA	15	0.59	1492	59.02
36	28	Karnataka Journal of Agricultural Sciences	India	15	0.59	1507	59.61
37	28	Plant Breeding	Germany	15	0.59	1522	60.21
38	28	Plant Physiology	USA	15	0.59	1537	60.80
39	29	Cotton Development	India	14	0.55	1551	61.35
40	30	Evolution: International Journal of Organic Evolution	USA	13	0.51	1564	61.87
41	30	PKV Research Journal	India	13	0.51	1577	62.38
42	30	Plant Breeding Abstracts	UK	13	0.51	1590	62.90
43	31	Biotechnologie, agronomie,société et environment	Belgium	12	0.47	1602	63.37
44	31	Economic Botany	USA	12	0.47	1614	63.84
45	31	International Sorghum and Millets Newsletter	India	12	0.47	1626	64.32
46	32	Advances in Genetics	USA	11	0.44	1637	64.75
47	32	International Chickpea and Pigeonpea Newsletter	India	11	0.44	1648	65.19
48	32	The Journal of Agricultural Science	UK	11	0.44	1659	65.63
49	33	Advances in Plant Sciences	India	10	0.40	1669	66.02
50	33	Australian Journal of Agricultural Research	Australia	10	0.40	1679	66.42
51	33	Empire Cotton Growing Review	UK	10	0.40	1689	66.81
52	33	Haryana Agricultural University Journal of Research	India	10	0.40	1699	67.21
53	33	Journal of Cotton Science	USA	10	0.40	1709	67.60
54	33	Nature	UK	10	0.40	1719	68.00
55	33	The Journal of Research ANGRAU	India	10	0.40	1729	68.39
56	33	Biometrics	USA	10	0.40	1739	68.79
57	34	China Cotton	China	9	0.36	1748	69.15
58	34	Cytologia	Japan	9	0.36	1757	69.50
59	34	Journal of Economic Entomology	UK	9	0.36	1766	69.86
60	34	Proceedings of the National Academy of Sciences	USA	9	0.36	1775	70.21

61	34	SABRAO Journal of Breeding and Genetics	Japan	9	0.36	1784	70.57
62	34	The Pakistan Cotton	Pakistan	9	0.36	1793	70.93
63	35	Botanical Gazette	USA	8	0.32	1801	71.24
64	35	Indian Journal of Biotechnology	India	8	0.32	1809	71.56
65	35	Indian Journal of Plant Physiology	India	8	0.32	1817	71.88
66	35	Journal of Plant Biochemistry and Biotechnology	India	8	0.32	1825	72.19
67	35	Journal of Plant Biology	South Korea	8	0.32	1833	72.51
68	35	Textile Research Journal	USA	8	0.32	1841	72.82
69	36	Agronomy Abstracts	USA	7	0.28	1848	73.10
70	36	Genetic Resources and Crop Evolution	Netherlands	7	0.28	1855	73.38
71	36	Indian Journal of Heredity	India	7	0.28	1862	73.66
72	36	Iranian Journal of Agricultural Sciences	Iran	7	0.28	1869	73.93
73	36	Journal of Agricultural Research	Pakistan	7	0.28	1876	74.21
74	36	The Journal of the Australian Institute of Agricultural Science	Australia	7	0.28	1883	74.49
75	36	Tr. VNII Selektsii i semenovodkhlopchatnika	Russia	7	0.28	1890	74.76
76	37	Agricultural Science Digest-A Research Journal	India	6	0.24	1896	75.00
77	37	Annual Review of Phytopathology	USA	6	0.24	1902	75.24
78	37	Annual Review of Plant Physiology and Plant Molecular Biology	USA	6	0.24	1908	75.47
79	37	Australian Journal of Biological Sciences	Australia	6	0.24	1914	75.71
80	37	Indian Journal of Agricultural Sciences	India	6	0.24	1920	75.95
81	37	International Journal of Tropical Insect Science	UK	6	0.24	1926	76.19
82	37	Jiangsu Journal of Agricultural Sciences	China	6	0.24	1932	76.42
83	37	Journal of Soils and Crops	India	6	0.24	1938	76.66
84	37	Maydica	Italy	6	0.24	1944	76.90
85	37	Plant Molecular Biology Reporter	USA	6	0.24	1950	77.14
86	37	Soybean Genetics Newsletter	USA	6	0.24	1956	77.37
87	37	The Andhra Agricultural Journal	India	6	0.24	1962	77.61
88	36	Acta Agronomica Sinica	China	5	0.20	1967	77.81
89	36	Agricultural Research Journal	India	5	0.20	1972	78.01
90	36	Australian Journal of Plant Physiology	Australia	5	0.20	1977	78.20
91	36	Dissertation Abstracts International	USA	5	0.20	1982	78.40
92	36	Journal of Entomological Research	India	5	0.20	1987	78.60
93	36	Journal of Food Science	USA	5	0.20	1992	78.80
94	36	Journal of Genetics and Breeding	Italy	5	0.20	1997	79.00
95	36	Journal of Phytopathology :Phytopathologische Zeitschrift	Germany	5	0.20	2002	79.19
96	36	Journal of Southwest Agricultural University	China	5	0.20	2007	79.39
97	36	Journal of the American Oil Chemists' Society	USA	5	0.20	2012	79.59
98	36	Molecular Breeding	Netherlands	5	0.20	2017	79.79
99	36	Physiological and Molecular Plant Pathology	UK	5	0.20	2022	79.98
100	36	Phytoparasitica: Israel Journal of Plant Protection Sciences	Israel	5	0.20	2027	80.18
101	36	Plant Molecular Biology	Netherlands	5	0.20	2032	80.38
102	36	Science and Culture	India	5	0.20	2037	80.58
103	36	Scientia Agricultura Sinica	China	5	0.20	2042	80.78
104	36	Trends in Plant Science	UK	5	0.20	2047	80.97
105	37	Advances in Agronomy	USA	4	0.16	2051	81.13
106	37	Agricultural Research Journal of Kerala	India	4	0.16	2055	81.29
107	37	Agricultural Water Management	Netherlands	4	0.16	2059	81.45

108	37	Bragantia : boletim técnico doInstituto Agronômico do Estado de São Paulo	Brazil	4	0.16	2063	81.61
109	37	Bulletin of The Lenin Academy of Agricultural Sciences	Russia	4	0.16	2067	81.76
110	37	Current Research Reporter, Mahatma Phule Agricultural University	India	4	0.16	2071	81.92
111	37	Egyptian Journal of Genetics and Cytology	Egypt	4	0.16	2075	82.08
112	37	Genetica Agraria	Italy	4	0.16	2079	82.24
113	37	Indian Journal of Mycology and Plant Pathology	India	4	0.16	2083	82.40
114	37	Indian Journal of Plant Protection	India	4	0.16	2087	82.56
115	37	Information Bulletin, ICRISAT	India	4	0.16	2091	82.71
116	37	Plant Archives	India	4	0.16	2095	82.87
117	37	Plant Disease	USA	4	0.16	2099	83.03
118	37	Plant Foods For Human Nutrition	Netherlands	4	0.16	2103	83.19
119	37	Plant Systematics and Evolution	Austria	4	0.16	2107	83.35
120	37	Plant, Cell and Environment	UK	4	0.16	2111	83.50
121	37	Rheedea: Official Journal of Indian Association for Angiosperm Taxonomy	India	4	0.16	2115	83.66
122	37	Scientific American	USA	4	0.16	2119	83.82
123	37	Soybean Science	China	4	0.16	2123	83.98
124	37	Stain Technology	USA	4	0.16	2127	84.14
125	37	The Annals of Applied Biology	UK	4	0.16	2131	84.30
126	37	Thesis Abstracts	India	4	0.16	2135	84.45
127	37	Tropical Agriculture	Trinidad and Tobago	4	0.16	2139	84.61
128	38	38 Journals having three citations each		114	4.51	2253	89.12
129	39	55 Journals having two citations each		110	4.35	2363	93.47
130	40	165 Journals having one citation each		165	6.53	2528	100.00
			Total	**2528**	**100.00**	**2528**	**100.00**

Rank list of journals, presented in the table no. 1. From the study it is revealed that total 385 journals have been cited by the researchers during their study.

From the analysis of above table it is found that "The Indian Journal of Genetics and Plant Breeding" (India) is a highly cited journal with 210 (8.31%) citations. "Crop Science" (USA) ranked second in the table with 113 (4.47%) citations while "Journal of Maharashtra Agricultural Universities" (India) occupied third rank with 110 (4.35%) citations.

On the basis of ranked list of cited journals, core journals are identified. From the above table it is found that first 10 ranked journals contribute 844 (33.39%) citations. The first 10 journals satisfying 1/3rd needs of the users. Hence, these journals can be considered as core journals in the subject Agricultural Botany.

Application of Bradford's Law of Scattering

Bradford's law of scattering states that "If scientific periodicals are arranged in the order of decreasing productivity of articles on a given subject, they may be divided into the nucleus of periodicals most particularly devoted to the subject and several groups or zones containing the same number of articles as the nucleus where the number of periodicals in the nucleus and succeeding zones will be as 1: n: n^2. (Bradford S. C., 1934)

Where 1 represents the number of journals in the nucleus and 'n' is multiplier.

The data obtained in the study has been presented in table no. 1 A to test the verbal formulation of Bradford's law of scattering; citations have been divided into three zones of almost equal number.

Table No. 1 A: Scattering of Journals and Citations over Bradford's Zone

Sr. No.	Zones	No. of Journals	No. of Citations
1	Core Zone	10 (2.60%)	844 (33.39%)
2	Zone 1	41 (10.65%)	845 (33.43%)

3	Zone 2	334 (86.75%)	839 (33.19%)
	Total	**385 (100%)**	**2528 (100%)**

According to Bradford's Law, in a descending series of journals relevant to a given topic three zones can be marked of such that each zone produces 1/3rd of total citations and the number of periodicals in each zone should be in 1: n: $n^{2.}$

In the present study, there are 2528 citations, one-third of which is 842.67 in each zone. First 844 citations are produced by 10 journals; next 41 journals have 845 citations and in the last zone 334 journals cover 839 citations.

Hence, the journal distribution as per Bradford's Law reveals the ratio as

10: 41: 334:: 1: n: n2

Here 10 represent the number of journals in the nucleus and n=4.1 is a Bradford's multiplier. The Bradford's multiplier factor was arrived at by dividing journal of a zone by its preceding zone. Bradford multiplier is expressed as the ratio of a number of journals in any group to the number of journals in any immediately preceding group.

Therefore

$1 \times 10: 4.1 \times 10: (4.1)^2 \times 10 \times 1.99$

$10: 41: 168.1 \times 1.99$

10: 41: 334.52

Bradford's Law of Scattering should be $1: 4.1: (4.1)^2 = 1: n: n^2$

But in the present analysis, Bradford's law is in the following form

$1: 4.1: (4.1)^2 \times 1.99$ is not equal to $1: n: n^2$.

Table no. 1A and mathematical analysis shows that there are 10 (2.6%) journals in nucleus zone. The first zone is represented by 46 (10.65%) journals and last zone is represented by 334 (86.75%) journals.

It is evident from the above ratio that the number of journals titles in each zone is not increasing geometrically. Hence it is concluded that the dispersion of journals titles in Agricultural Botany does not satisfy the verbal formulation of Bradford's Law of Scattering. For more confirmation of this law we can apply one more law i.e., Leimkuhler Model.

Application of Leimkuhler Model

For the application of Bradford's Law, the citation distribution is divided into three or more equal zones (p) since Bradford assumes that there should be minimum three zones, here also p is assumed to be 3. Then by using the mathematical formula.

$k = (e^y \times y_m)^{1/p}$

Where: $e^y = (1.781)$ Euler Number

$y_m = 1^{st}$ rank journal citations = 210

p = p is number of zones i.e. 3

$k = (1.781 \times 210)^{1/3}$

$= (374.01)^{1/3}$

= 7.20

$y_o = \frac{A}{p}$

Where: y_o = No. of citations in each zone.

A = No. of Citations

p = No. of Zones

$y_o = \frac{A}{p} = \frac{2528}{3} = 842.67$

Using k we can calculate different Bradford's groups. Number of journals in the core/ nucleus zone can be calculated with the help of following formula

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$$r_o = \frac{T\,(k-1)}{(k^p-1)}$$

Where: r_o = No. of Journals

T = Total number of journals

$$\therefore r_o = \frac{385\,(7.20-1)}{(7.20^3-1)}$$

= 6.41

Different Bradford's zone can be obtained using the value of k and r_o

Nucleus Zone = $r_o = r_o \times 1 = 6.41 \times 1 = 6.41$

First Zone = $r_1 = r_o \times k = 6.41 \times 7.20 = 46.15$

Second Zone = $r_2 = r_o \times k^2 = 6.41 \times (7.20)^2 = 332.29$

$6.41 \times 1 : 6.41 \times 7.20 : 6.41 \times (7.20)^2$

6.41: 46.15: 332.29 = 384.85

The Bradford groups thus were shown in following table.

Table No. 1 B: Using Leimkuhler Model, Bradford's Zone and Number of Journals

Sr. No.	Zones	No. of Journals	No. of Citations
1	Core Zone	7 (1.82%)	712 (28.16%)
2	Zone 1	46 (11.95%)	997 (39.44%)
3	Zone 2	332 (86.23%)	819 (32.40%)
	Total	**385 (100%)**	**2528 (100%)**

Above table indicates that the number of journals in the core zone is 7 with 712 citations, which falls short by 130 citations with a deviation of -15.51%. In the Zone 1, the number of citations crosses the limit by 155 citations indicating a deviation of +18.4%. Only the Zone 2 comes close to the expected number. With such a deviation ranging from -15% to +18% we cannot say the present data set follows the Bradford's Law even with Leimkuhler formulation. Bradford's Law straightforwardly underlines the fact that each zone should have same number of articles. A slight variation in the number of articles, say up to four or five per cent may be acceptable.

Hence, it is concluded that the present data set does not fit into Bradford's Law of Scattering.

Graphical Formulation

Bradford's Bibliograph for present study have been plotted taking the cumulative number of citations on the Y- axis and cumulative number of journal titles on the X- axis. From the figure no. 1 it is found that data in the present study have an initial raising curve and followed by linearity.

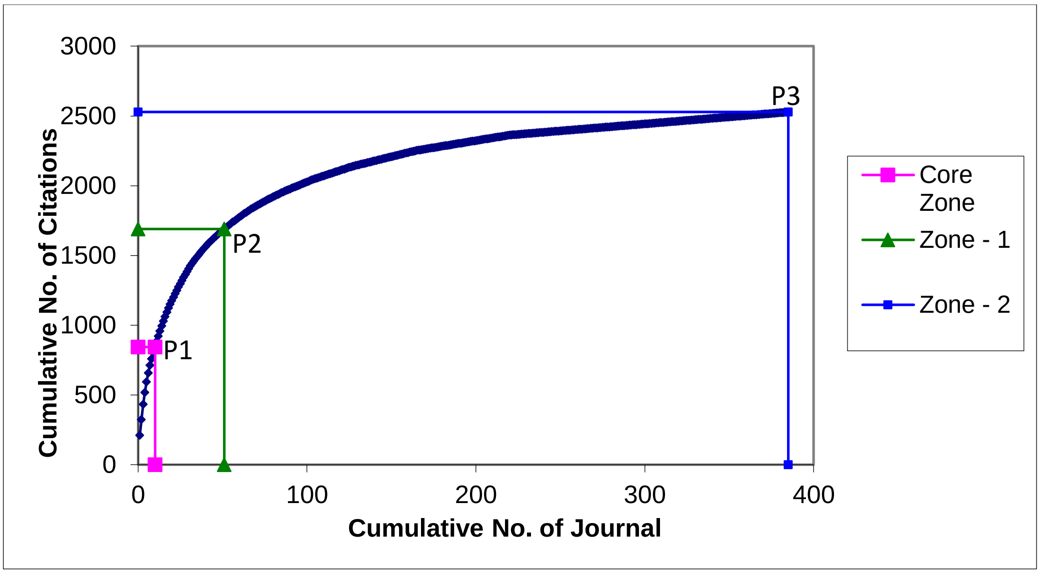

Figure No. 1: Bradford's Bibliograph

Conclusion

Bradford's law is not only about quantitative issues but also about qualitative issues. The most productive journals on a subject are also the best journals and thus the journals that should be selected by libraries and users. Bradford's law is not claiming that scattering is the same from one subject to another. Bradford's law has been regarded as identical with other bibliometric laws and also with laws in quite different domains. The journal usage pattern as reflected through neither doctoral dissertations in Agricultural Botany does not satisfy verbal nor the graphical formulation of the Bradford's Law of scattering. This may be due to the heavy concentration of citations in a few journals. The productivity of journals in Agricultural Botany shows the concentration of more number of citations in a few journals.

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Latest Trends in Library and Information Science

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Abstract :

Technology has become the integral part of our lives today. Our day to day routine are governed by the need to stay connected to the world through technology. Now-a-days younger generation no longer want to visit the library personally for a few hours of quiet reading. Instead, they want a quick and technology-based solution to everything. In this digital and virtual era, information seeking behaviour is constantly changing and the younger generations need to be drawn in through newer, more interesting means. This applies equally to the use of the library. The field of library and information science (LIS) is constantly changing with new trends and technological innovations. Latest trends in library and information science includes the use of ICT for library resources and services, the use of e-resources, use of library blogs, use of social media(Social Networking), cloud computing, RFID Implementation, Internet of Things, Artificial Intelligence, Mobile-Based Library Services and Intelligent Library Search & Federated Search. Earlier, the libraries were offers manual information resources and services to its users but now the libraries have had to force to shift from the traditional library operations to the automated operations with latest state-of-art infrastructure. The impacts of emerging technologies have been felt by the libraries in every aspect of its resources and services. Technology has made wide impact on collection building, technical activities, budgetary provisions, manpower development and the way of providing important library services. These latest trends in LIS demonstrate the field's continued evolution in response to changing user needs and technological advancements. The paper discusses various latest trends and their uses in Library and Information science.

Introduction :

Libraries have been an important part of societies for centuries, serving as repositories of knowledge and providing access to information and resources. Historically, fundamental aim of libraries was to formulate a philosophy of intellectual freedom and to provide access to print information. Today’s Libraries attempt to meet the need of diverse and complex group of user, who have wide-ranging interest and complex set of demands. With the advent of computer and Internet based technology, libraries have undergone significant changes in the way they operate and provide services. One of the most significant impacts of internet and technology on libraries is that they have adopted the digitalization of their resources. This has given access to information and resources, allowing users to access materials from anywhere in the world at any time. In addition, digital collections can be easily searched and organized, making it easier for users to find the information they need. Libraries now offer a range of online services, such as online catalogues, e-book lending, and online reference services. These services provide users with greater flexibility and convenience, allowing them to access library resources from their homes or workplaces.

Technology enabled libraries manage their collections and resources in a better way. Libraries can now use sophisticated library management systems to track and organize their collections, making it easier to manage and retrieve information. In addition, libraries can use data analytics to understand how their resources are being used and to make informed decisions about resource allocation and collection development. Hence we can say that libraries are adopting

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changes with the transformation in the outer world and try to reach and satisfy its users in all possible ways. The paper discusses the latest trends in Library and Information services.

Some new innovations used in libraries and information services:

1. ICT-based resources and services:

Internet Access:

The library provides free or controlled internet and email. Depending on availability, the time during which the user can use the network area may be provided. Libraries often require visitors to access the Internet and send e-mails, etc.

Sharing Resources:

The "giving" and "using" of resources means that libraries should be prepared to allow other libraries to use your resources, and therefore you should use them too.

Inquiry Services:

Asynchronous tools such as email, topic gateways, FAQs, and e-libraries, as well as interactive tools such as chat rooms, virtual help desks, and Ask Me, are replacing traditional mail, phone, or online methods . User questions.

Bibliographic Services:

The compilation of bibliographies, reading lists and current reports is an important part of the LIS' work, especially in research and academic libraries. Searching for guides and definitions is difficult and time-consuming and does not necessarily produce new results. CDROM or online files are provided in electronic format, enabling easy, efficient and cost-effective data retrieval. Electronic databases also have special search capabilities, such as searching by various criteria (keyword, subject, author, location, classification number, ad year, messages, etc.) and different images and types.

Web OPAC:

OPAC (Online Public Access Catalog) should be placed on library pages. This should be a live book and available on web/mobile/tab etc. It should be accessible via . This page will contain new books displayed on the screen (must have pictures of the books). Users can easily search and find out whether a particular book is available in the library. In this case, if the book is already published, people need to pre-order it online. The system itself can send SMS/e-mail alerts if documents are returned to the library. An online demonstration can be embedded on the website to assist users in searching the library catalogue. Online research can be added to the display.

Virtual Reference Services:

It may be a good idea to join virtual reference services. The "Ask the Librarian" concept will be implemented so that children can quickly access the information they need by interacting with the librarian anywhere via mobile/tablet/laptop/desktop.

Library Infrastructure:

Existing assets should be reviewed and assessment made through appropriate procedures, including the allocation of funds required to deliver new services.

Collection Development:

Acquiring appropriate digital/physical collections is important. A working group can be formed to decide on the model of the new service.

2. Electronic Resource Management:

Files containing information and/or computer programs that are encoded and made available through the use of peripheral devices directly to the computer (such as CD-ROM drives) or by reading and processing them remotely through a network Devices such as the Internet are called electronic devices. This category includes software applications. Electronic books, references, databases, websites, e-books, electronic journals collect information on the Internet. ETC. Public services that are not free to the public often require licensing and certification.

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The following are some of the key features of the ERM library:

• Selection and acquisition: ERM begins with the selection and acquisition of electronic resources that may be appropriate to the library's mission and objectives. Selection criteria will include workspace, quality, accessibility and cost. • Licensing and contract management: Libraries must negotiate and manage licenses and contracts with electronic vendors and suppliers. License and agreement description. Terms and conditions of use, including usage and legal rights.

• Access Control: Access control allows users to access electronic devices easily and safely. It includes setting up and maintaining authentication, enabling remote access, and troubleshooting access issues.

• cataloguing and metadata management: cataloguing and metadata management involves creating metadata files that describe electronic resources and making them discoverable through library catalogs and discovery tools.

• Usage statistics and metrics: Usage statistics and metrics
give users a deeper understanding of energy use. It helps libraries make informed decisions about renovations, disposals and future acquisitions.

• Renewal and Cancellation: Libraries must renew or cancel licenses and agreements based on:

3. Blog :

The website will have links to blogs that users have written after reading books in the online library. There should be someone in the library who can help children with this. The regular involvement of qualified librarians will attract the attention of young people. Users can interact with each other and discuss specific books through this blog.

4. Social Media (Social Network) :

Social media is a social structure that allows users to interact and collaborate with other users, including the ability to browse, search, and invite friends to connect and interact with the online world. Considering that the value or capacity of libraries in the information field is being questioned, social software in the Web 2.0 world not only increases the physical usability of libraries, but also helps reduce the costs of adding to their work**.**

5. Cloud Computing :

Libraries around the world are using cloud computing to make library services easier and more affordable. This library management plays an important role in the development of digital libraries or knowledge bases. Cloud computing also uses library resources, infrastructure, human resources, etc. also benefits. Additionally, technology is used for library automation and rapid data retrieval. Additionally, in digital libraries, cloud computing enables third-party services to manage servers, perform upgrades, and create backups.

Here are some of the ways libraries use cloud computing:

• Storage and backup: Cloud computing provides libraries with a secure and reliable backup solution. Libraries can use cloud-based solutions such as Google Drive or Dropbox to store digital manuscripts, archives, and other documents.

• Library management systems: Cloud-based library management services (such as Retrieval and World Share Management Services) allow libraries to manage their collections, distributions, listings, and purchases via web chat. Cloud-based library management systems provide libraries with greater flexibility, scalability and accessibility than traditional systems.

• Digital storage: cloud computing can be used for digital storage, including the storage of digital documents and digital devices. Cloud-based digital preservation systems such as Preservica and Rosetta provide libraries with secure, long-term storage.

• Virtual tools and collaboration: Cloud computing provides libraries with virtual

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Tools and collaboration tools such as chatbots, video conferencing, and collaboration tools such as Google Docs and Trello. These tools allow libraries to deliver services remotely, facilitate staff collaboration, and increase user engagement.

• Data analysis and visualization: Cloud-based data analysis and visualization tools such as Tableau and Google Analytics enable libraries to analyze and visualize data about their collections, usage, and users. This provides libraries with information to help them make decisions and improve services.

6. Internet of Things :

The integration of library software and LMS/LMS software already uses the Internet of Things (IoT) to deliver information without human intervention. Libraries use IoT to manage inventory, prevent theft, and identify users. It also helps to improve the quality and speed of work at the table. Additionally, IoT accelerates detection and prevention of private books, library fires, and e-library services.

Here are some examples of how IoT technology is being used in libraries:

• Smart lighting and climate control: IoT sensors can be used to monitor and improve lighting and climate control in libraries, increasing energy efficiency and improving the library. lighting and climate control. User experience.

• Asset tracking: It sensors can be used to track library assets such as books, notebooks, and

other materials. This allows libraries to manage collections more efficiently and improve users' access to information.

• Environmental monitoring: It sensors can be used to monitor the environment such as temperature and humidity in library storage areas. This will help preserve the collection and reduce the risk of harm to the environment.

• User tracking: IT sensors can be used to track user behaviour in the library, allowing libraries to gain a deeper understanding of user needs and preferences. This information can be used to improve library services and adapt the collection to meet users' needs.

• Automatic check-in and check-out: IoT technology can be used to streamline the library's check-in and check-out process, making it faster and easier for users to borrow and return documents.

7. Big data and data visualization :

Big data and data visualization is the process of presenting big data through tables, charts, maps and any other form found. This allows the human brain to understand more data and makes it easier to spot trends, patterns, and outliers in large data sets. These technologies have helped digital libraries become more global while accessing more information. It makes the library easier for readers to access useful information.

8. Artificial Intelligence :

Artificial Intelligence (AI) uses the power of robots or computers to perform tasks usually performed by humans. The most common use of artificial intelligence in libraries is chatbots that receive and solve questions from users. They can inform users about book delivery times, direct users to relevant libraries and make appointments.

9. Mobile Based Library Services :

Libraries can offer new services and faster access to collections with mobile services such as SMS and WhatsApp. It also includes the Learning Management System (LMS), a software application that provides a framework for handling all aspects of the learning process and tracking educational content.

10. Smart Library Search and Federated Search :

Federate Search and Smart Library Search are technologies that collect information from many different sources through federal searches using a single question and a search. Technology contributes to a large library in the rapid collection of information and it makes for a bad combination. Libraries also use technology for descriptive cataloging, content analysis, information search and collection development.

11. Digital Display:

Here are some uses for digital display in libraries:

• Posters: Digital screens can be used to announce upcoming events, discussions, and other library events.

• Support: Digital images can be used to support library services, resources and collections.

• Book Guide: Digital images are available to showcase new books, staff picks, and other special items.

• Information: Digital images may be used to provide information about library policies, procedures and services.

• Interactive: Digital images can be used to create interactive materials, quizzes, and other activities to promote library products and services.

• Virtual exhibitions: Digital displays can be used to create virtual exhibitions showcasing special collections and archives.

Conclusion:

Technology has undoubtedly made our lives easier. Libraries are not the same as they were ten years ago. Modern university and corporate library software provides easy access to the latest technology in your library. The information revolution has brought many new ways to deliver services using new technologies, which will automatically lead to new acquisitions for libraries to fill the gap. Modern issues and new technologies create challenges not only for librarians and information professionals, but also for the community of patrons, users, researchers, and publishers. In fact, a new environment brings with it many unprecedented features and methods, and the interesting thing is that if we know how to make the most of it, we will see that there are many ways and most of them are free. . New technologies offer libraries a unique opportunity in the digital age to improve customer service and facilitate collaboration between libraries and their users. Complying with some of these standards and using some web technologies can increase the reputation and position of the library in society. Some of these may be successful in attracting new users to the library, some may help retain existing members, or make the library more important as a cultural center and give history to its city and schools. These new services and these constant changes have the potential to make libraries more interesting, relevant and accessible. However, the approach, use and content of libraries will continue to change.

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Implementation of Cloud Computing Technology In Academic Library

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Abstract:

Technological development has brought a dramatic change in every field. These changes also impacted to the libraries**.** Information technology impacted positively on library and information system and services they provide for users. Cloud Computing has lot of applications in Academic Libraries which is described in detail in this paper. Libraries are updating towards cloud computing technology for upgrading digital libraries. Cloud computing comes in several different forms. In order to minimize the cost and avoid duplication of resources, infrastructure, software, hardware, manpower use of emerging technologies like server virtualization and cloud computing in libraries are increasing. This article provides brief information about the basic concept of cloud computing and how its enhanced to the academic library services.

Introduction:

Today we are living in the age of information technology. Information technology plays very vital role in library science i.e. for collection, Storage, organization, processing, and analysis of information. Library filed facing many challenges in the profession due to applications of information technology.Cloud computing is the technology of computing, which is totally based on internet media. Using internet technology many servers shares resources in terms of offering common platform for the use of software applications, different resources including information, networking computer and devices which are attached on request with the control of electricity grid. Technologies such as cluster, grid, and now, cloud computing, have all geared toward permitting access to massive amounts of computing power in a very totally virtualized manner by aggregating resources and offering a single system view. Utility computing describes a business model for on-demand delivery of computing power; consumers pay providers based on usage ("payas-yougo"), the same as the means within which we have a tendency to presently get services from traditional public utility services such as water, electricity, gas, and telephony.

What is cloud computing?

The cloud image is often accustomed represent the web.. Cloud computing is now commonly used to describe the delivery of software, infrastructure and storage services over the web. Users of the cloud will like different organizations delivering services related to their information. software and other computing needs on their behalf, without the need to own or run the standard physical hardware (such as servers) and software (such as email) themselves. Cloud computing is that future stage inside the evolution of the cyberspace , it provides the means through which everything — from computing power to computing infrastructure, applications and business processes---are often delivered to you as a service where and whenever you need them.

Definition Cloud Computing:

The Greek myths tell of creatures plucked from the surface of the Earth enshrined as constellations in the night sky. Something similar is happening today in the world of computing. Data and programs are being swept up from desktop PCs and corporate server rooms and installed in "the compute cloud". In general, there is a shift in the geography of computation. What is cloud computing exactly? As a beginning here is a definition

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"An emerging computer paradigm where data and services reside in massively scalable data centers in the cloud and can be accessed from any connected devices over the internet"

Like other definitions of topics like these, an understanding of the term cloud computing requires an understanding of various other terms which are closely related to this. While there is a lack of precise scientific definitions for many of these terms, general definitions can be given. Cloud computing is an emerging paradigm in the computer industry where the Computing is moved to a cloud of computers. It has become one of the buzz words of the industry. The core concept of cloud computing is, quite simply, that the vast Computing resources that we need will reside somewhere out there in the cloud of Computers and we'll connect to them and use them as and when needed.

Characteristics Of Cloud Computing

- Resources are shared among users. It works very fast in the distributed computing environment.
- It ensures "on-demand" provision of resources, without having engineers for peak loads.
- By sharing common infrastructure, it ensures to work efficiently with multiple users and multiple applications. It reduces the cost of services.
- It is the characteristic of Cloud computing that users can access it from any corner of the world simply through the internet connection because the infrastructure is provided by a third-party.
- These applications are easy to maintain as compared to individual applications, since they are installed on a common platform and can be accessed from different places.
- There are minimum chances of infrastructure failure, so servers are more reliable and highly available.
- As the company need not to set its own infrastructure, so there are cost reductions through pay-as-per usage of resources.
- User can access services by using Application Programming Interfaces (APIs) on the cloud and pay as per the usage.

Types of Cloud Computing :

Infrastructure as a service (IaaS)

- Most basic cloud service model
- Providers offers computers, as physical or virtual machines, block storage, firewalls, load balancers, like switches and routers, and networks
- Users install OS and application software
- User responsible for patching and maintaining the operating systems and application software

Benefits: On-demand Self-Service, Broad network access, Measured Service, etc.

Platform as a Service (PaaS)

- Offers operating system, programming language execution environment, database and web server
- Provides for every phase of software development and testing
- No need to buy and manage the underlying hardware and software layers by the customer
- Can be specialized around a particular area like content management

Benefits:Weneednottoinvestinphysicalinfrastructure,andTeamsinvariouslocationscanwork together:Itoffers;Security,Adaptability,etc

Software as a Service (SaaS)

- Delivery model in which software and associated data are centrally hosted on the cloud

- Cloud infrastructure and platform on which the application is running is managed by a service provider
- Based on multi-tenancy architecture
- Cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients

Benefits:Noadditionalhardwarecosts,payforwhatyouuse,AutomatedUpdates,Accessiblefro manylocation.

Application of Cloud Computing in Libraries

Cloud computing is a popular and critical phenomenon in the provision of library and information services in advanced countries. Here comes the imperatives of the application of computer technology (cloud computing), hardwares and softwares as done in advanced countries to critical aspects of library services and guaranteeing the security and stability of data stored in various remotely connected computers. Critical areas of library services amendable to cloud computing include;

Computing E-books Lending Services: Cloud platform is popular and workable in lending in e-books and other electronic book format information resources. It makes information resources to get to users instantly.

Union/Share Cataloguing/OPAC: Networking libraries have the privilege of using the same platform in giving access to their collection on one platform. Through cloud computing creation of union catalogue and information resource sharing becomes very easy.

Digital Preservation/Scanning Service: Digitization and scanning work with cloud computing is done centrally to avoid duplication and save time. With this cloud service libraries can preserve their collection in digital form in the form of archives.

Article Delivery Service: Libraries can use cloud computing for article delivery service to their patrons. Publishers are already using this technology for providing access to libraries for online acquisition transactions.

Current Awareness Service (CAS): To provide current awareness service to all patrons has become easy with cloud computing.

Bulletin Board Service: The application of cloud computing technology in libraries is amendable in using it to provide new services on bulletin board.

Information Common: Like the bulletin board, information common is a kind of display of some aspects of information resources using cloud computing service. Libraries have the opportunity of displaying bibliographical data, content pages, cover pages, question papers, syllabus and other reading materials on one platform. It is cost effective and makes libraries avoid duplication of purchase.

Collection Development: Cloud computing is used for collection development. Duplication is easily avoided and alternate resources can be located and made accessible to patrons. 18

File Sharing: To share various files in electronic form is easy with cloud computing.

Information Delivery: Cloud provides a platform to store all information that one can access anytime from anywhere. Information searching and delivery becomes easy and timely and it is very useful for researchers.

E-learning: In the E-learning environment, cloud computing is a boom. Cloud computing makes learning worthwhile for students. Study materials are kept on the cloud for easy accessibility to students for reference purpose and online examination can also be conducted. Discussions and revisions can be done at a time from different places.

Information Literacy and Orientation: Cloud computing has made it feasible and possible for libraries to conduct information literacy and orientation courses for students. This is made realizable because tutorials are kept in the cloud for users to access.

Cloud Computing Services

There are various services those which can offered in cloud computing to the academic libraries are as under:

- Serial Solutions: In cloud computing environment, serial solutions can be easily managed.
- Delivery Customized services: It is only due to cloud computing which focused on delivery customized services.
- Open Infrastructure (e.g. amazon, EC2): In cloud computing environment, open infrastructure is the major advantage.
- Publishing (e.g. Wordpress.com, twitter, You tube): Publishing becomes easy due to cloud computing environment.
- Integrated library Systems: It is only due to cloud computing, Integrated Library Systems can be possible.
- Digital asset management: Digital asset management can be possible only due to cloud computing.
- Electronic resource Management Systems: We can perform Electronic resource management Systems.
- Web-based management Systems: Web-based management systems can be formulated due to cloud computing.
- OCLC based ILS services: OCLC based ILS services can be provided in the cloud computing environment.
- Circulation, acquisition, cataloguing, search: Maximum Library operations can be performed in cloud computing environment
- Cloud based services, data collaboration e.g. Lockss: Cloud based services and data collaboration can be done in cloud based environment.

Advantages/ Disadvantages of Cloud Computing:

Advantages

Cloud-based computer code offers corporations from all sectors variety of advatages, including the ability to use software from any device either via a native app or a browser. As a result, users can carry their files and settings over to other devices in a completely seamless manner.

Cloud computing is way quite simply accessing files on multiple devices. Thanks to cloud computing services, users can check their email on any computer and even store files using services such as Dropbox and Google Drive. Cloud computing services also make it possible for users to backup their music, files, and photos, ensuring those files are immediately available in the event of a hard drive crash.

It also offers big businesses huge cost-saving potential. Before the cloud became a viable various, companies were required to purchase, construct, and maintain costly information management technology and infrastructure. Companies will swap expensive server centers and IT departments for quick net connections, where employees interact with the cloud online to complete their tasks. The cloud structure permits peoples to save lots of cupboard space on their desktops or laptops.

It conjointly lets users upgrade computer code additional quickly as a result of computer code corporations offers their products via the online instead through additional ancient, tangible methods involving discs or flash drives. For example, Adobe customers can access applications in its Creative Suite through an Internet-based subscription. This allows users to transfer new versions and fixes to their programs simply.

Disadvantages

With all of the speed, efficiencies, and innovations associate with cloud computing, there square measure naturally risks. Security has continuously been a giant concern with the cloud particularly once it comes to sensitive medical records and financial information. While rules force cloud computing services to shore their security and compliance measures, it remains associate degree in progress issue. Encryption protects important info, but if that encryption key is lost, the data disappears

Servers maintained by cloud computing firms could fall victim to natural disasters, internal bugs, and power outages, too. The geographical reach of cloud computing cuts each ways: A blackout in golden state may paralyze users in New York, and a firm in Texas could lose its data if something causes its Maine-based provider to crash

Digital Librarian

The manpower required for cloud computing deployment is minimal. Probably, two personnel skillful on IT having good knowledge relating to system installation, networking and Internet management are good prerequisite for managing the Server/Thin client workstations and wireless access points. The roles of the IT personnel spans from authentication, authorization, access (AAA) control and monitoring of the usage flows. Even though open access is the custom of library's information dissemination tag, it is however, necessary to institutionalize element of control on the use of library resources, in order to optimise use, facilitate access and guard against misuse.

Role of Cloud Librarian

- To provide inter library loan facility
- To track usage record of cloud resources
- To develop digital collection
- To keep record of physical resources to of or providing referral service
- Tomaintainownvirtualprofilebycreatinghisorherblogorsocialnetworkprofiletointeractwiththeuser.Thesameplatformcanbeusedforprovidingreferenceservicesandeducatingtheusersoncloudresourcesorhowtousethe Cloudinfrastructure.
- usehisorherstrategicplanninganddecisionmakingabilityatdifferentstagesofdevelopinga Cloudlibrary

Conclusion:

Concluding it can be said that the library services becomes very easy to perform due to Cloud Computing. Cloud computing is already part of everyday lives of everybody. Integrating libraries into the cloud computing technology will definitely transform library into smart library Cloud based Library is now the world emerging eSmart Library category. Cloud Computing helps libraries to deliver its resources, services and expertise at the point of need, within user workflows and in a manner that users want and understand. It should free libraries from managing technology; so more focus is on collection building, improved services and innovation. The cloud computing model will encourage libraries and their users to participate in a network and community of libraries by enabling them to reuse information and socialize around information. This technology can also build a dominant, unified presence for libraries on the Web and give users a local, group and global reach. In addition to it, due to financial crunch and lack of technical expertise, cloud computing becomes more relevant in the modern environment of Information and Communication Technology.

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Impact of Information Technology on Collection Development of CollegeLibraries and Its Challenges

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Abstract
All library services rely on collection development. A library cannot serve its users in the information age unless it has the requisite collections of both printed and unprinted items, as wellas adequate library staff. During her research, the researcher discovered that library professionalsconfront challenges in creating collections due to the impact of IT, a lack of supportive roles of authority, a lack of funds/grants, infrastructure, and proper staff. There is currently no sufficient policy for information technology adoption in College Libraries, and librarians are unable to integrate new technologies responsibly in their libraries. The researcher overviewed the impact of IT on collection development in college libraries as well as challenges faced by them.

1. Introduction

The underlying attitude of mankind launched the concept of knowledge preservation, andthis concept of preservation gave rise to the concept of library. Knowledge has been regarded asa source of power since the birth of civilization. Libraries are the repository of this power manifested in books and other reading materials. The traditional function of libraries was to collect, process, disseminate, store, and retrieve books, information, and expertise in order to provide better services to users. Libraries today have a recognized social function of making knowledge available to all.

The information explosion and information revolution have occurred to a large extent in the previous several decades. This enormous increase of knowledge has had an impact on all organizations, including libraries. In truth, libraries and information centers have always been in the business of enabling information to their diverse categories of users, from leaves to clay tablets, manuscripts to microfilms, printed papers to non-printed electronic resources (National Knowledge Commission). The introduction of information and communication technologies, the internet, and, in particular, the www (World Wide Web), have altered virtually everything. Information Technology has recently established a strong presence in libraries and information centers. It has radically changed the way information is collected, processed, stored, retrieved, and communicated, as well as assisting library and information professionals to execute their tasks considerably more precisely, efficiently, and effectively.

These developing technologies have the greatest impact on libraries and information centers. Libraries are transitioning from being custodians of conventional information resources
to providers of service-oriented digital information resources. The widespread use of computers, growing reliance on computer networks, the quick rise of the Internet, and the explosion in the quality and amount of information prompted libraries to adopt new means and methods for information storage, retrieval, and dissemination. Library automation, digital library development, and the use of innovative information and communication technologies have expanded dramatically because they enable improved customer satisfaction, cost effectiveness, faster replies, and simpler operational procedures. Due to the rapid advancement of information and communication technology, the design of library collections has undergone tremendous modification for more than three decades. The essential functions

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of any library, collecting and accessing recorded information sources, have taken numerous forms and become a challenging undertaking in the emerging hybrid library environment (Kanwal, 2006).

Libraries and information centers are increasingly utilizing IT and electronic information resources and services to meet their users' diversified information demands. E-journals, CD- ROM databases, online databases, e-books, web-based resources, and other electronic media are gradually replacing traditional library resources.

In this digital age, the role of libraries is changing in order to provide a competitive advantage for its users, because the library must use both traditional and nonconventional resources and services. Because a library's collection is the pivot around which all of its activitiesrevolve, much emphasis is placed on its development, both in physical and electronic form. The need for a well-evaluated and selected document collection has become more pressing as a result of several factors, including: a large proliferation of subjects, complex and varied information needs of users, rising document costs, and the use of information communication technology in information handling and dissemination. With the introduction of the internet and modern communication technology, the fundamental concept of collection development in libraries is changing. The application of these new technologies can significantly improve and expand a library's collection. In these days of skyrocketing book prices, the usage of these technologies would be a huge boon to collection development in college libraries. With the introduction of theinternet and the digital era, there has been a shift in collecting from printed or hard copy to non- printed or digital format. As a result, the collection development policy must be revised to integrate digital content in the collection. Information technology has also had an impact onother collection creation methods such as planning, acquisition, selection, evaluation, and preservation, filtering out materials, and assessing user needs. Selection has become tough in the electronic age due to the amount of internet resources, thus it should be done cautiously as it has become harder due to information explosion. The information explosion, combined with limitingfinances, forces selection to consider alternatives to physical ownership, such as licensing electronic databases and providing document delivery. The library of the twenty-first century will essentially become a resource sharing library, with no local, national, or international boundaries.

2. Role of Libraries in Higher Education

Libraries are now linked to a wide ocean of Internet-based services that are continually evolving. Academic libraries serve as the nerve centers of their respective institutions, supportingteaching, research, and other academic programs. The significance of library collections can be traced back to the ancient era, when our forefathers learned the art of communication and writing, recording information, knowledge, and wisdom in the form of texts and manuscripts thatpassed down the legacy of traditions, customs, and knowledge from generation to generation.

Under different schemes, the UGC gives financial help to colleges that are registered under Section 12(b) of the UGC Act 1956 for the development of library facilities as well as faculty improvement programs. It has made significant contributions to the advancement of university and college libraries. Recognizing the importance of libraries and their role in higher education, the UGC accepted the majority of the recommendations of various committees and commissions for financial assistance for collection development, acquisition of books and periodicals, purchase of furniture and equipment, and construction of new library buildings.

3. Library Collection Development Problems and Challenges

All activities at a library revolve around the library collection. A well-equipped and well- managed library collection is the cornerstone and backbone of today's educational structure. The collection is the most significant of a library's three key functions, which are collecting, storage, and dissemination of reading and related materials. A library's collection is the axis around which all of its operations revolve. The library that has a sufficient and well-balanced collection based on user demands may resist the onslaught of the users' more focused information. The statement exemplifies the significance of the Library Collection. It’s not how many books you have, but whether they're good or not (Smith and Johnson, 1993).

The impact of information technology on collection development has been significant. Libraries, being the core of the education system, have seen significant global transformation in recent years, both in terms of collection development and service structure. Collection development is difficult in today's digital information age for a variety of reasons, including information overload, an increase in electronic publishing, price negotiation, user demand for e- publications, increased use of internet resources, resource evaluation, limited budget, multiple resources, and so on. The availability of open source, mass storage capacity, library consortiums,Union catalogues, and other factors are all important in collection creation.

The scholarly communication scenarios, more intensive use of digital resources, high demand from students for all types of resources to meet their challenges in several competitive examinations, inclusion of IT-based teaching, lack of proper fund, lack of standard policy for computerization of libraries, lack of training programs, and reducing number of library staff are challenges to library management and posing enormous pressures on library policy and procedure. The lack of collection development policy is the biggest impediment to collection development in libraries. NAAC accreditation, as well as the delivery of UGC grants based on NAAC accreditation, has caused significant issues for libraries.

According to Inglis et al., (2002), education, like all other sectors of society, is undergoing major transformation, rationalization, restructure, and redefinition in order to respond to many socio-economic developments and educational needs of the modern society, and as an integral part of the campus, the collection development policy and procedure in academic libraries are also facing and profoundly influenced by changes in the academic system. According to Virkus and Wood (2003), the European Commission has also highlighted the challenges of libraries, such as increased demand for higher education, internationalisation of education and research, collaboration between universities at national and international levels, knowledge reorganization, and the emergence of new expectations. According to the UNESCO
Report (2003), the strong impact of information technology on the organization of studies and curricula, as well as the modes of study program delivery, as well as the growing concern with academic quality assurance in education and the need to establish a new framework for quality assurance, accreditation, and qualification recognition, have increased the responsibilities of libraries. All of the aforementioned changes have created numerous problems to the deliberate collection growth of an academic library.

The academic library is usually built with the intention of delivering accurate and up-to- date information to a specific group of readers, therefore it must have high-quality books and be accessible even in congested areas. The volume of research and the number of researchers are increasing, as is the amount of published content, making it difficult to offer the appropriate information to the right person at the right time. Inaccurate knowledge in any library can devastate society. Due to the rising cost of materials, insufficient money, shrinking space, and a lack of employees, proper collection development has become a difficulty. Furthermore, the impact of technology has produced issues with information access. Libraries must not only purchase relevant and appropriate print materials, but they must also deliver information in electronic and non-printed formats. Digitalization of printed collections is another difficulty that libraries with restricted budgets face. According to Gessesse (2000).

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"The future of the college library in the twenty-first century is technological. Students and users read, refer to, and study e- books and periodicals using computers, mobile phones, laptop computers, and other media. This is one of the problems for library professionals to collect, organize, and disseminate electronic versions of books and journals, and when the changes occur, library professionals must adapt their collection development policy and practice.

With the introduction of information technology, several new responsibilities in the realm of collection development in academic libraries have emerged. The researcher discovered the following significant developments that are currently influencing collection development planning and method.

1. financial management policy
2. budget allocation criterion for printed and electronic resources
3. Subscription policy for electronic journals and books
4. E-collection hardware and software policies
5. selection of typical library automation software
6. establishing criteria for evaluating and selecting e-resources
7. electronic information organization and preservation
8. selection of library participation in several networks and consortiums
9. establishing policies for the digitization of printed materials
10. establishing guidelines for internet censorship in libraries
11. library staff training to keep up with technology

Most of the college libraries in developing countries are facing these changes.

4. Conclusion

Technological advancements are causing a slew of concerns and obstacles in the areas of collection, organization, and services. The most pressing difficulty, however, is devising techniques to manage the shift from the print version to the electronic form. In this new environment, where users are fast developing their own virtual libraries and everyone appears to be a Web expert, it is prudent for professionals to re-examine their responsibilities and functions,according to Strauch (1992). Government College libraries have a limited collection of electronicresources. There is an urgent need for policy to get e-resources and membership in various consortia in all college libraries, thus the responsible authority should formulate policy based on the needs of the users and the goals of the library.

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Features and Utilities of WINISIS for Knowledge Management System: application with reference to academic libraries of Mahila Mahavidyalaya, Amravati and Arts, Science and Commerce College Chikhaldara

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Abstract :
This research paper explores the techniques for designing and managing the bibliographical database by using the Windows-based ISIS (WINISIS) library software package and specified the brief description of steps taken to create a database of all bibliographic materials as well as features of WINSIS are taken into consideration. The purpose of the paper is to be acquainted college librarians with the distinctive features of the Windows-based ISIS because Microsoft Windows is described as a graphical user environment, which gives the user more control over the work as well as enables the user to use more of the power of the computer. The authors has applied practical methods to put forth the techniques for designing and managing the bibliographical database of Doctoral Theses by using WINISIS software package. The authors has attempted to find out various aspects to describe the features of the various modules of Windows-based ISIS (WINSIS) library software which would be valuable for those college librarians who faced the crunch of budget and are distressed to manage databases, especially those colleges are situated in rural and tribal areas of India. This paper is originally based on the bibliographical database of Doctoral Theses submitted to Sant Gadgebaba Amravati University, Amravati made by the authors through the application of WINSIS, a library Software.

Keyword: Bibliographic; Database; Doctoral Theses; FDT; FST; WINSIS; Prototype

Introduction:

The recent years, libraries and information centers, as well as other organizations, are attempting to survive in a knowledge-driven society. Moreover, they are called upon to redefine their structure and management processes to increase their competitive advantage through their learning capability and their knowledge assets. Knowledge has become their core element that contributes to the development and improvement of their services through knowledge management (KM) initiatives, connected with knowledge assets creation, sharing, and exploitation.

In recent years database technology has become one of the most rapidly growing areas of computer and information science. The database is basically a computer based record keeping system those records and maintains the user information. According to James Martin, “Database is a collection of interrelated data stored together without harmful or unnecessary redundancy to serve multiple applications.

“The term Database was defined by Williams (1974) has an organized set of machine readable records containing bibliographic and document related data”

A database is an organize form of records (a set, a character make a field, a set of fields make a record) collected or created to satisfy the information requirements of a given user community. For the purpose of information storage and retrieval, a database means a bibliographic database in machine readable form.

In other words, an organization of data files having information and reference material on a particular subject, or subjects. It is typically structured so that headings and keywords can be referenced easily, which permits efficient and simple access to – and retrieval of – records. A database is a mechanical formally defined and centrally controlled collection of data used in an organization.

Versions of CDS/ISIS for DOS and WINDOWS

CDS/ISIS for Windows is an information retrieval package developed by UNESCO (the United Nations Educational, Scientific, and Cultural Organization) which runs under Microsoft Windows. Version 1.4 (release 19) was circulated on CD-ROM to distributors in March 2001 and is dated January 2001. This followed version 1.3 which appeared in January 1999 and was the first formally-released version of the package, though beta-test versions had been available to existing license holders for some time. Version 1.0 was released in 1998. it is designed to run in Windows environment.

The version is release 19b which is available to license holders from UNESCO's FTP site and which corrected some bugs in release 1998.

The package has many features, which distinguish it from commercially produced software. To understand why, it is necessary to look at the history of the package.

CDS/ISIS for Microcomputers was released by UNESCO in 1985. It was called officially **CDS/ISIS Mini-Micro Version** but is usually called **CDS/ISIS** or simply **ISIS**. In Latin America, where the minicomputer package **MINISIS** (developed in Ottawa, Canada, by the International Development Research Centre) is prevalent, the original DOS version was always called **Micro-ISIS;** the Windows version is called **Micro-ISIS** or **WINISIS**.

CDS/ISIS FOR WINDOWS (WINISIS)

Since 1989, when most new microcomputers were supplied with a new operating system called Microsoft Windows, it was inevitable that the users of CDS/ISIS would call for a Windows version, and UNESCO began to develop one in 1995.

Unlike the DOS version, ISIS for Windows is not written in Pascal but in a combination of languages, primarily C and C++. Following the philosophy of the DOS version, a program library is available of programs which can be utilized in the user's own routines in a similar way to that in which Pascal was used in the DOS version. BIREME (the Latin American and Caribbean Center for Health Sciences Information) has cooperated with UNESCO in developing this 'library' and a Dynamic Linked Library (ISIS_DLL) is available containing these routines.

Aims and objectives:

The present paper primarily aims to put forth the techniques for designing and managing the bibliographical database of Doctoral Theses by using WINISIS software package.

Specifically the objectives are:

1) To setting up the database and basic features of CDS/ISIS for Windows.
2) To deals thoroughly with all the steps of creation of bibliographic database of doctoral theses including up to printing of records;
3) To describe the features of the various modules of WINSIS.
4) To focuses on implementation of WINISIS on Microsoft Windows.

Scope of the study:

The scope of the present study has confined to design aspects bibliographic databases of Doctoral Theses for effective resource sharing and providing better information retrieval services in libraries by using CDS/ISIS for Windows (WINSIS) software package.

Methodology:

The present study deals with the knowledge management system in the library of Mahila Mahavidyalaya, Amravati. Under which a successful attempt was made to implement a knowledge management process using WINSIS library software developed by UNESCO. The author has applied practical method to put forth the techniques for designing and managing the bibliographical database of Doctoral Theses by using WINISIS software package.

Statement of Problem:

In the era of information technology, the I.T. Professionals and other organizations are designing effective but very costly software. The small library does not have capacity to carry too much financial burden by purchasing these types of software. However they wish to get their libraries automated and make the resources available to their users by applying very cost-effective software.

As a result, to promote CDS/ISIS for Windows (WINSIS) a cost free software package the author has opted in for problem namely "**Database Management with WINISIS, Library Software : a special reference to Mahila Mahavidyalaya, Amravati**"

Creating Database :

WINISIS (Window version of CDS/ISIS) a menu driven generalized Information Storage and Retrieval System. The major advantage to design the database in WINISIS is that it is free from writing computer programming for implementation the system as per the local need of any library. The system can be implemented at any place even if the person has little or no prior computer experience. The complete detail of designing this database and then retrieval of information is discussed below.

Database Structure:

The proposed design of the database facilitates various information retrieval operations. The display format has been designed such that data can be displayed according to AACR-2 as far as practicable. Thus the proposed design of the database covers four components.

- the Field Definition Table (FDT)
- the Data Entry Worksheet
- the Display Format
- the Field Selection Table (FST).

Steps Taken to Create the Bibliographic Data: The following steps were taken to create the bibliographic database of Doctoral Theses.

Field Definition Table (FDT):

The FDT defines the fields that may be present in the database and certain parameters for each field. Thus the proposed design of the database covers

- almost all the mandatory fields in the CCF,
- some of the optional fields, and
- some newly added fields which have been considered necessary.

For defining the FDT the values are entered in the boxes which are as follows:

(a) Tag – A tag is a field identifier in the database tag is used to identify the field that is containing the bibliographical details of document. To select the number, or type it in the up and down arrows can be use.

(b) Name – Name is the name of the data fields this is to help for identify the field. It can be up to 31 characters long and can contain spaces. When to set up the data entry worksheet, this name will be used as the prompt for the field. It is also used to specify the field in the "Guided Search" form.

(d) Type. - Type column indicates the type of field such as alphabetic, numeric or alphanumeric. In the CDS/ISIS the field type is a one character code, the field type may be one of the following.

X-Alphanumeric,

A-Alphabetic,

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N-Numeric.

(e) Rep -Rep stands for 'repeatable' it allow multiple occurrences of this field, e.g. several authors or several descriptors etc.

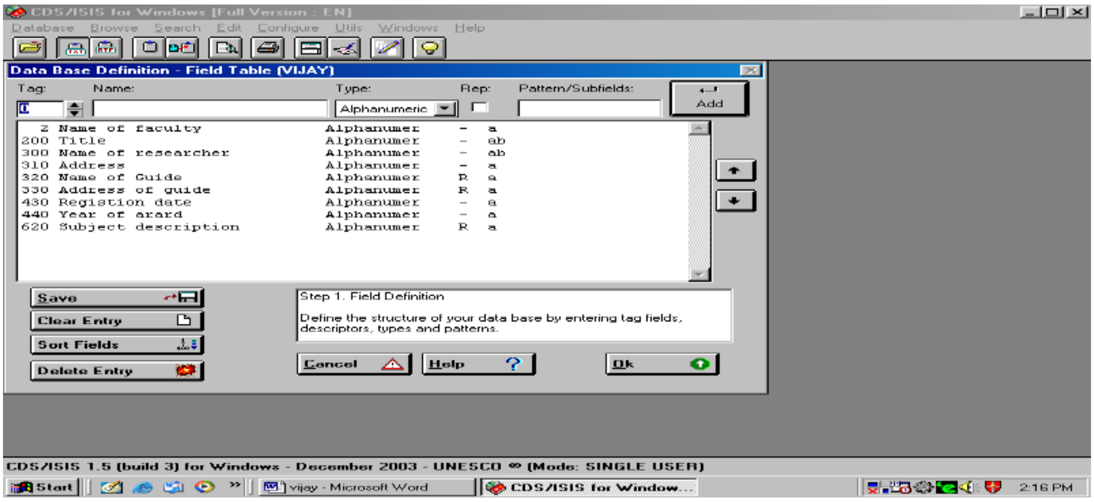
(f) Pattern/subfields. In a pattern field, the contents of the field have a specific predefined pattern. If the field are dividing into subfields, should list the subfields here (without punctuation or spaces) e.g. abc

If subfields are not using, press the ™ key to leave this box blank.

When entered the data for each field, the focus will be on the **Add** button. Either click the button or press {Enter} to add the field to the table (displayed in the large box). If it has need to correct the details for any field, just click on that entry in the large box and the details will be copied into the boxes used for editing. If needed to remove an entry, highlight it and click the **Delete Entry** button.

Creation of Field Definition Table:

In this step the researcher has to select and define the fields and sub-field as a name work and alphabets like (a,b,c,d…….z) respectively which are essential for searching the database i.e. Title, Name of Research, Name of Guide Year of award etc. and also the details all about Ph.D. thesis as shown in window no.1.



Window no. 1 Field Definition Table

Data Entry Worksheet:

Data entry worksheets are used to enter records or modify records in a database. The data entry worksheet is the electronic equivalent of a pre-printed form for entering data. Once exit the FDT, the system will automatically activate the worksheet creation process and will prompt you to create the data entry worksheet to be used for inputting records in to database. in this step the fields defined in FDT are selected for preparing the worksheet, which is the media for entering the bibliographic data of Ph.D. thesis in the database. This step also facilitates to avoid the fields which are present in FDT but currently not useful for data entry and also facilitates to add it in worksheet. For that single arrow towards right side and single arrow towards left side as shown in (window no.2)

Creation of Worksheet:

In this step the fields defined in FDT are selected for preparing the worksheet, which is the media for entering the bibliographic data of Ph.D. thesis in the database. This step facilitates to avoid the fields which are present in FDT but currently not useful for data entry and also facilitate to add them in worksheet when required. For that purpose single arrow towards right side and single arrow towards left side are given as shown in window no.2.

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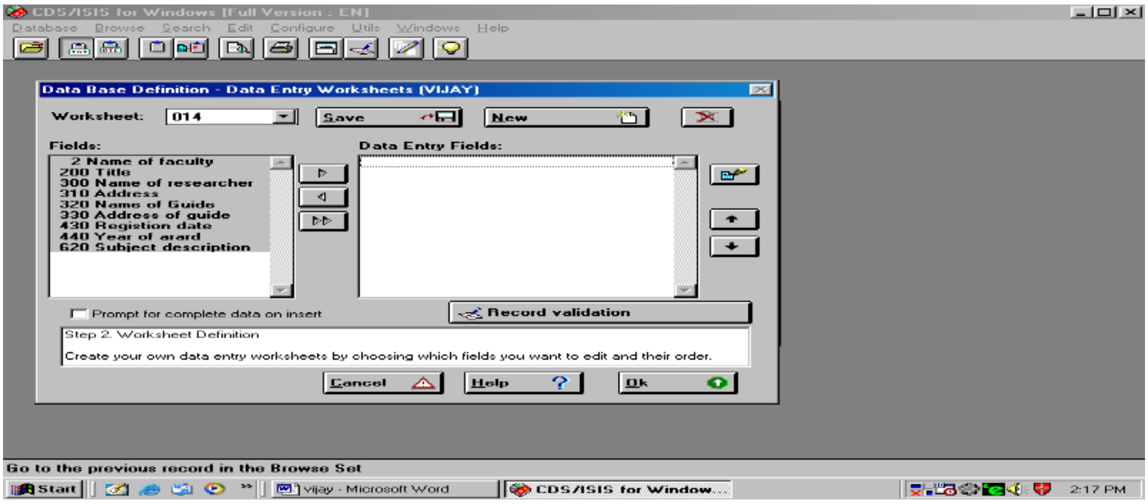


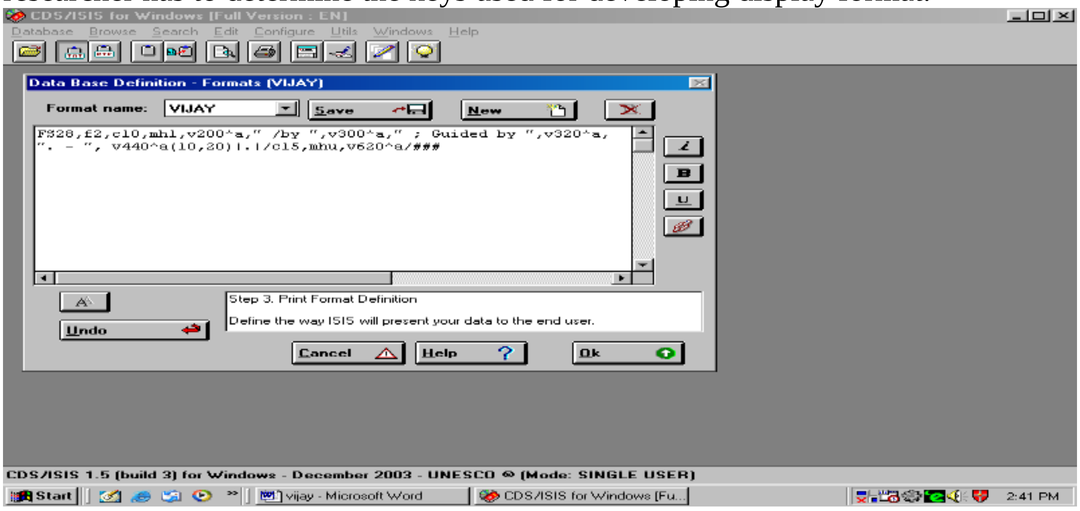
Window no.2 Data Entry Worksheet

Display Format:

Once the worksheet is created the system will prompt to create the default display format. This step facilitates to create display format. A format essentially specifies how the contents of a record are to be displayed at the time of retrieval. It is also used to specify how a record has to be printed. The display format could be as below.

Creating Display Format:

This step facilitates to create Display format, according to the requirement of user's output of bibliographic database of Ph.D. thesis. The software has its inbuilt display format like normal style, CDS/ISIS Dos compatible, Decorated format, HTML Normal and HTML table with Header; besides this the searcher or the user can develop the Display for as he required i.e. as per AACR-2, CCF or any other standard. But to develop Display format researcher has to determine the keys used for developing display format.



Window no.3 Display Format

Field Selection Table (FST)

The last step in the creation of a database is to define the FST(Field Select Table).This step involves selection of fields for searching point of view. FST is a combination of display format technique and indexing technique. This step involves selection of fields, which are useful for searching the database i.e. Author, Title and Keywords etc. as shown in (window no.4).

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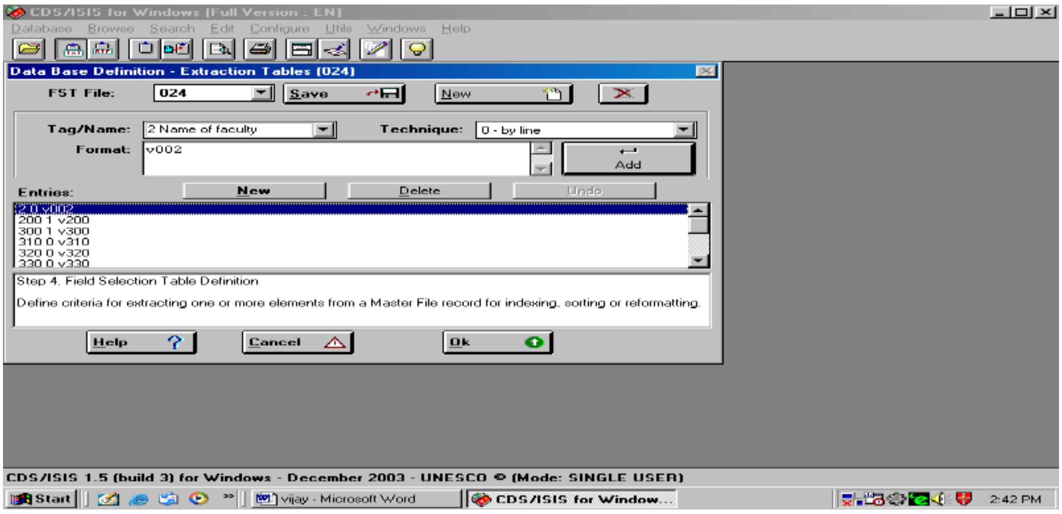
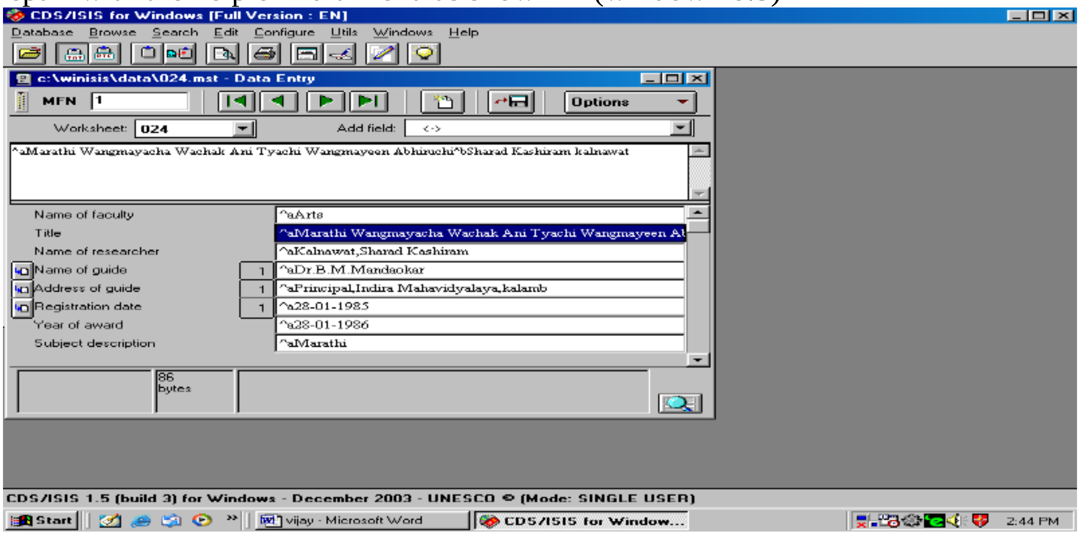


Window no.4 Field Select Table

Creation of Data Entry:

Once the structure of a database has been defined, records can be input into the database using Data Entry Services. Data entry permits addition, modification, editing and deletion of records. This function is available in the 'EDIT' menu of the WINISIS software. While entering the data in field and sub-field the key " ^ " (cap) is used before the alphabets used in FDT to denote the sub-fields. Mistake in data entry directly affect the output of search, but it can be repair with the help of Edit Menu as shown in (window no.5)



Window no.5 Data Entry Window

Developing Search Strategy

It is frequently necessary to combine two or more terms in a search for specific piece of information for that, WINISIS provides expert search and guided search in which logical operators ' AND', 'OR' and 'NOT' are used to broaden or narrow the search denoted by *, +, ^ respectively. Similarly it is also facilitate truncation search denoted by "$" sign to look for a number of words or terms starting with the same letters as shown in window no.6A and 6B.

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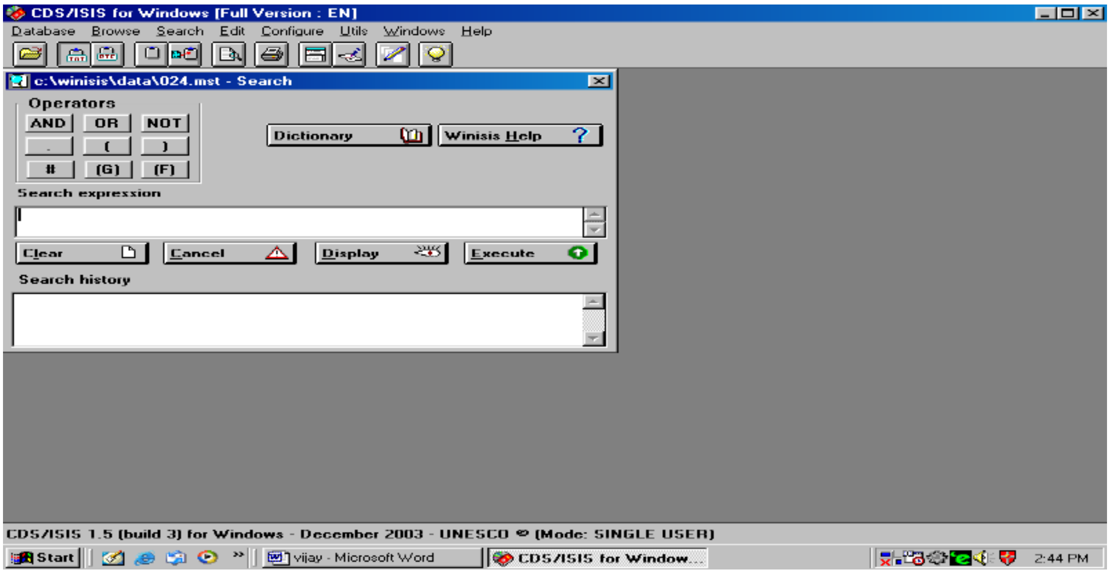
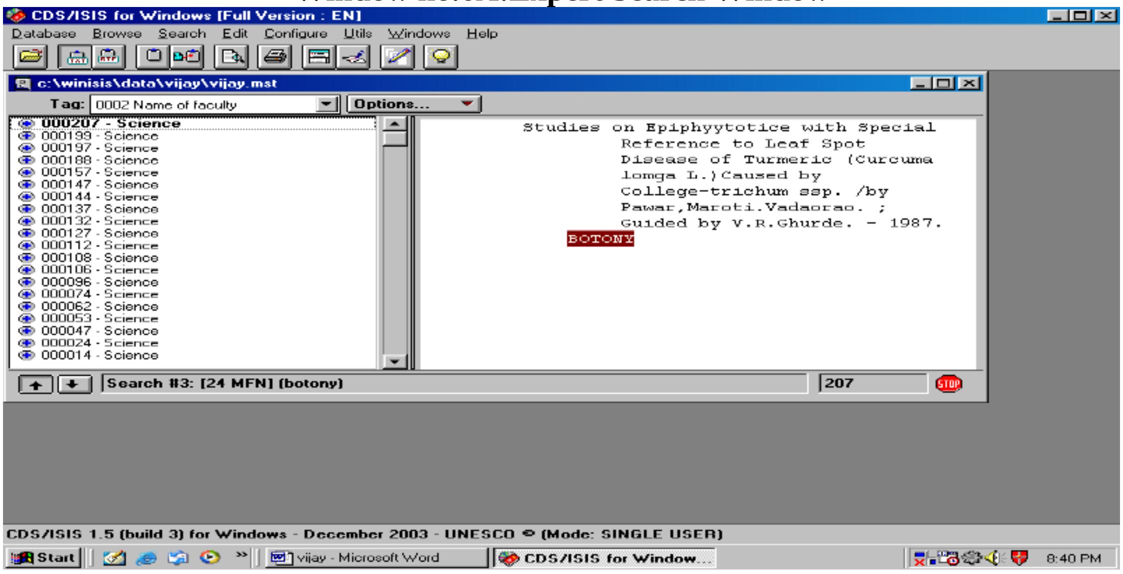
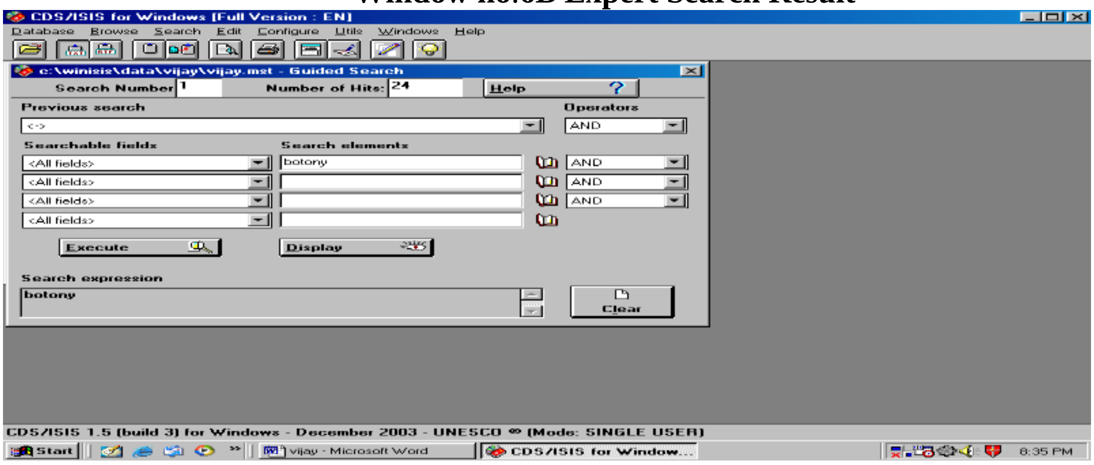


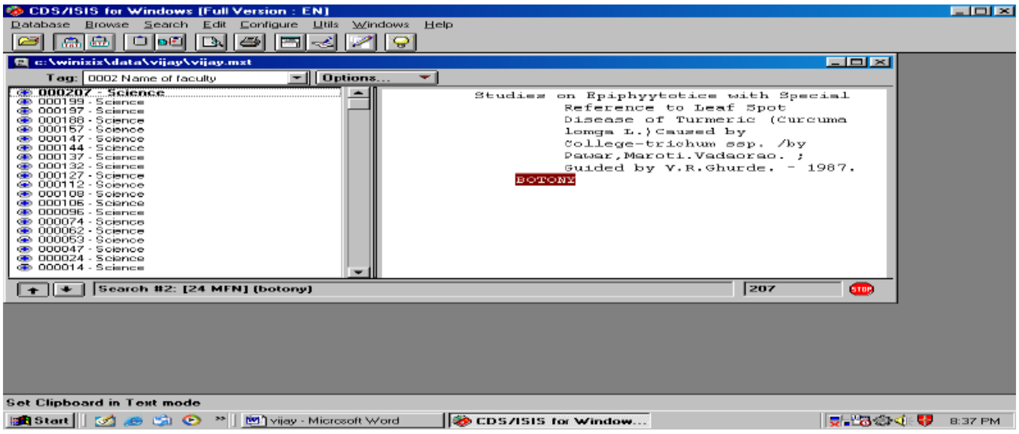
Window no.6A:Expert Search Window



Window no.6B Expert Search Result



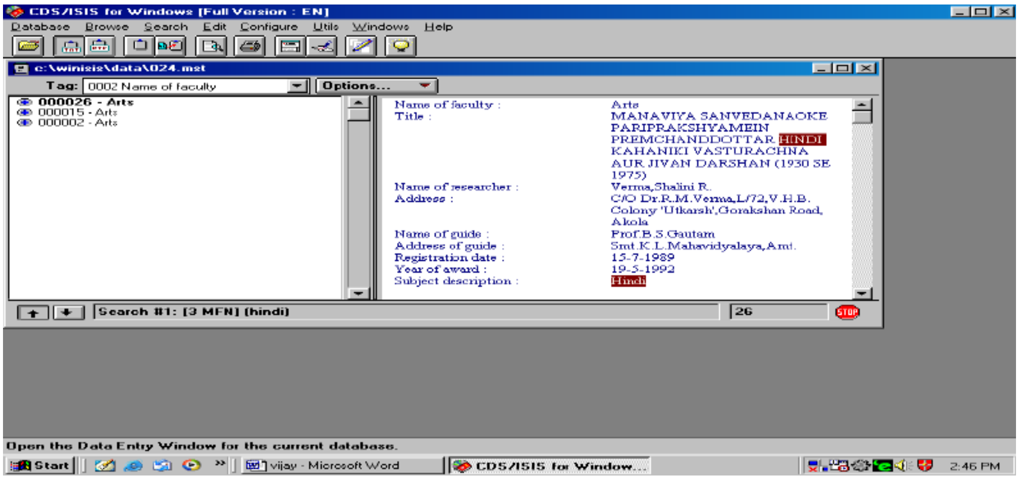
Window no.6 C Guided Search



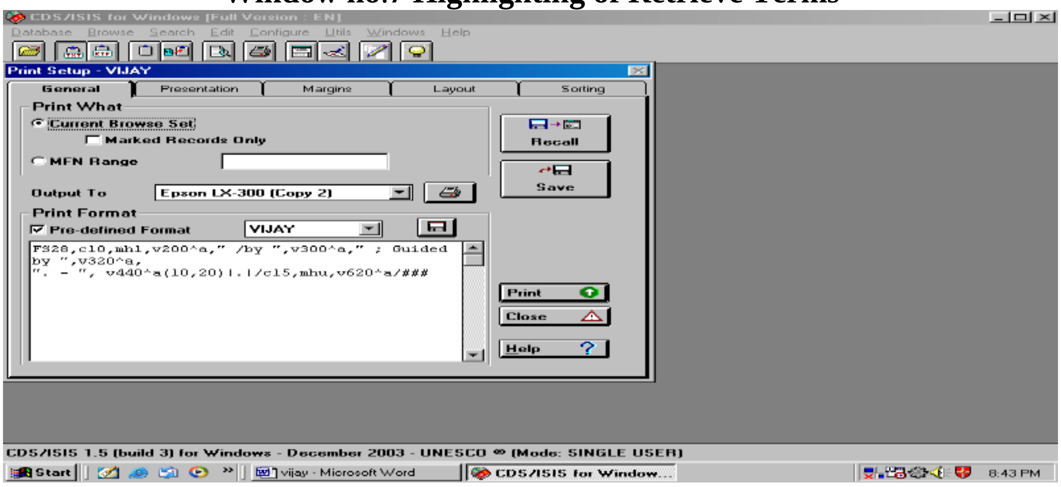
Window no.6D Guided Search Result

WINISIS provides the option of Guided Search with the help of this any keyword type in search element all the entries will display with highlighting the terms as shown in Window no.6C, and 6D.

The result of the search, retrieved records and display the list of retrieved items in the left side of the window, by clicking on the items listed one can see the details about the record on the right side of the window as shown in **Window no**.7. Each term searched on is highlighted wherever it occurs in the record even if the search is specified on one field only as shown in the **Window no**.7.

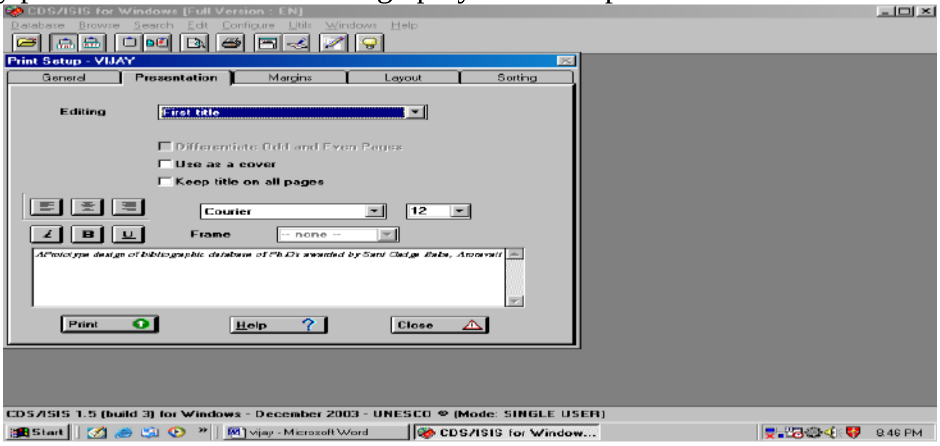


Window no.7 Highlighting of Retrieve Terms



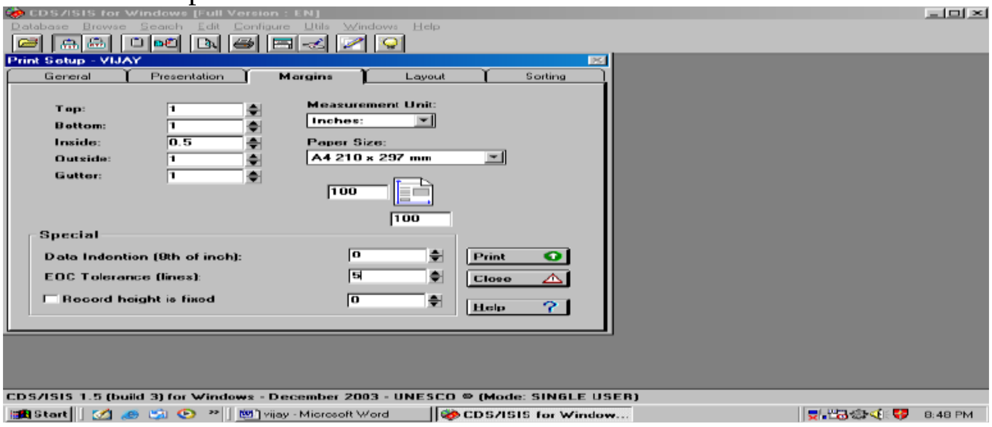
Window no.8 Sorting and Printing (General Setting)

Above window provides the facility of printing setup which has involved, the records with the marks to print, MFN range, selection of printer, selection of formatting language and after all this selection the user can ‘save’ the setup and able to print the job. This all selection of every provided facilities are setting up by author as possible as better.



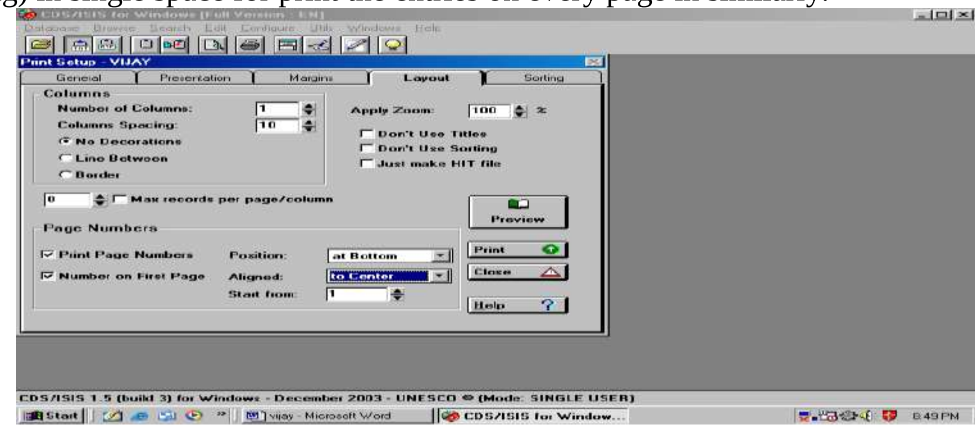
Window no.8A Presentation Window

In this window 8A the presentation of printing job on paper has been selected by the researcher to present appropriately the setup which are as follows, Editing-to select the First title, Second Title, Third title of the particular job, the window also provides the font setup i.e. font type, font size, font style, alignment of the paper i.e. left, right or center of text all these has been selected setup of the researcher.



Window no.8B Margins setting for Print Format

The above figure is the part of previous window (8A), it the setup of page margins or page setup to take the print outs on paper in appropriate manner. The researcher has selected measurement in Inches Unit, the top and bottom is 1” Outside and Gutter is 1” and inside has selected 0.5 inches of text. The paper size is A4 (210 x 297) and EOC Tolerance is 5 (line spacing) in single space for print the entries on every page in similarly.



Window no.8C Layout setting for Print Format

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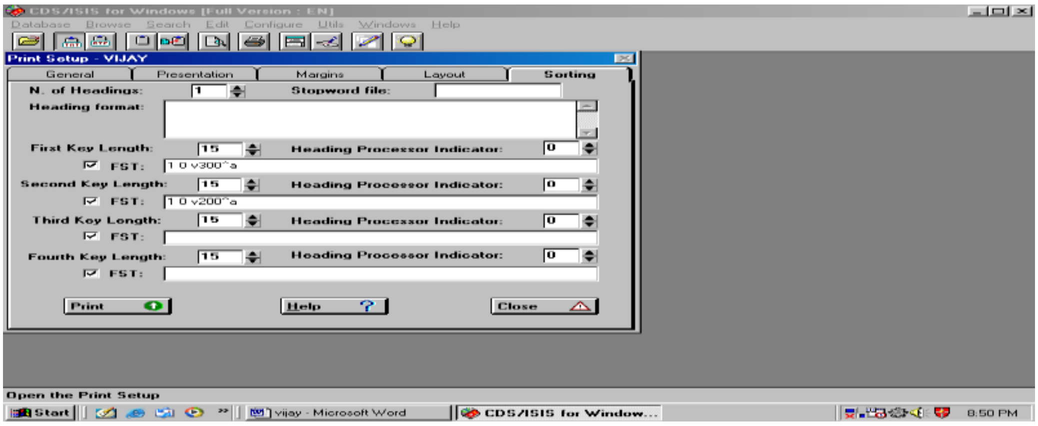
This figure shows the complete layout of the page which has to print on paper in proper setting up, the researcher has selected the single column, column spacing is 10, the zoom is 100%, page numbers position has selected at bottom and the number aligned to center and these page numbers starts from no. **1**.



Window No.8D Sorting Setting for Print Format

This last setup window of CDS/ISIS to print the job appropriately. ‘Sorting’ the main presentation of the print out on paper the above window prints the job as per the selection of researcher’s activity. The researcher has selected the First, Second and Third key length is 15 characters, which sort on ‘Title’, and ‘Author’.

In such a way, the bibliographic database of Doctoral Thesis can be ready by WINSIS, which is also free of cost, so that the library with financial credentials should take advantage of this internationally acclaimed software.

Conclusion:

KM practices in academic libraries are as per "information to right person at the right time". Academic libraries are playing it's exact role in the whole academic community. CDS/ISIS for Windows is, as its name implies, a Windows-based system. Windows programs have many distinctive features as a result of the Windows operating system. Microsoft Windows is described as a graphical user environment, which gives user more control over the work as well as enabling user to use more of the power of the computer. It allows running more than one program at the same time. Thus it allows user to have more than one CDS/ISIS database open.

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12

Digital Library Management: Planning and Implementation

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1. INTRODUCTION

Several terms have been coined at different times to represent the concept of library without books, Libraries having influence on computer readable format or having access to influence on digitized or digital format. The terms which have been in vague at different times include: Paperless library, electronic library, virtual library, libraries without boundaries and now it has been moved to digital libraries.

The tenn digital library on one hand, is used to refer to a system or application whose functions are chiefly to extend electronic access to material available in a conventional library to a remote user. On the other hand, it is used to describe both commercial and academic systems designed to enable electronic access to a large collection of electronic documents to authorized users.

The term's digital library and electronic library are used interchangeably and synonymously. The term "virtual library" or "library without walls" usually refers to the meta resources, subject portals that extend virtual accessibility of digitalcollections from several diverse sources without the users even knowing where the resource actually resides. A virtual library wuld potentially be enormous, linking huge collections from all around the globe, or it could be very small, consisting of few hundred links to digital resources maintained by an individual.

The hvbrid librarv is in the continuum between the conventional and digital libraries where electronic and paper-based information sources are used alongside each other. The challenges associated with the management of the hybrid library is to encourage end-user to provide information in variety of formats and from a number of local and remote sources in a searnlessly integrated way. The hybrid library aims to bring a range of technologies from different sources together in the context of a working library. In effect a hybrid library maintains all or its major parts of its collection in a digitize form as an alternative to supplement the print material currently found in Libraries. It has a web-enabled computerized catalogue (WEBPAC) accessible through the Internet and most of the in-house services like acquisition, books processing circulation are computerized. A hybrid library has a strong presence in the internet with a home page for the library providing an integrated access interface, not only to digital collections available locally, but also to the other commercial and non-commercial web-based digitized collections across world.

2.CHARACTERISTICS OF DIGITAL LIBRARY

- Digital Libraries are the digital counterparts of traditional libraries and include both electronic (digital) as well as print and other (e.g. audio, video, graphics, animation etc) materials.
- A digital library owns and controls the information. It provides access to information, not just pointers to it
- A digital library has a unified organizational structure with consistent points for accessing the data.
- A digital library is not single entity, it may also provide access to digital material and resources from outside the actual confines of any one digital library.
- Digital libraries support quick and efficient access to a large number of distributed but inter linked Information sources that are seamlessly integrated.

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3.WHY DIGITAL LIBRARIES?

With the advent of the below technologies have forced traditional libraries to go for Digital Library and also these forms the basic requirement of Digital Library.

- Emergence of Internet and web technologies as a media of information delivery and access
- Availability of highly evolved, extraordinarily simple and intuitive user interface, e.g.. Internet Explorer and Netscape Navigator for all prevalent platforms 3. Advances in online storage technologies enabling storage of large amounts of contents at increasingly affordable cost

4.**COMPONENTS OF DIGITAL LIBRARY**

Digital Library consists of

- User Interfaces or user
- Storage Media or (Repository)
- Identifiers Infrastructure, Digital Collection, Systems function
- Telecommunication facility, Human resources
- Hardware Requirements are:
- Computer servers, Networks, LAN/WAN,Converters, Scanners
- Internet Connectivity, Storage media,Multimedia Interface, UPS
- Software Requirements are:

5 .Basic Needs for Digital Library

- Computer:Server, PC,withmultimedia,UPS, etc.
- Software: Any suitable software, which is interconnected and suitable for LAN and WAN connection
- Network: LAN,MAN,WAN, internet, etc.
- Storage devices: Optical storage device, CDROM,Jukebox, etc.
- Scanner: H.P. Scan Jet, Flatbed, sheet feeder**,**
- Drum Scanner, Slide Scanner,Microfilm Scanner,digital camera, Barcode Scanner, etc.
- Printer: Laser Printer,DotMatrix Printer.DigitalGraphic Printer, etc.
- AudioVisual:ColorTV,V.C.R, Sound box, Telephone

6.Planning For Digital Library

There are some points to be kept in mind when plan for creating digital library:

- **Information Needs**
- **Quality in plan**
- **Security issues**
- **IT Infrastructure**
- **Digitization**
- **Access**
- **Staffing**
- **Funding and Budget**
- **Digital Library Committee**
- **Creation of Digital Library**

7.DEVELOPMENT OF DIGITAL LIBRARIES

Some of the important points to be considered in developing a digital library are

- Digital collection or material selection
- Conversion of existing Print, Audio and video into digital format.
- Cataloguing or Metadata creation
- Storing

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- Creating portals or gateway to the electronic collection available on the web 6. Integrated access interface.

8.Guidelines for Digital Library Implementation

The following aspects can be considered as guidelines for the implementation of the digital library architecture.

- **Scalability**
- **Practicality**
- **Privacy:**
- **Time Frame**

9.Building Digital Collections

Various methods adopted for building digital collections are:

- Directly creating the digital documents
- Downloading the digital information frominternet.
- By digitizing the existing collections.
- Procurement of digital materials such as ejournals,e-books, e-reports, etc.
- Getting the digital materials information online

10.There are some another aspects for implementation of digital library

- **MaintenanceOfDigital Libraries**
- **Digital Preservation**
- **Standards for digital preservation**
- **Digital Preservation Policy**
- **SoftwaresAvailable for Digital Preservation**
- **Digital Preservation Strategies**
- **Responsibilities of Librarians**
- **Role Of Librarian in Digital Environment**
- **Role Of Librarian in Digital Environment**

11.Digital Libraries In India

- **Given below are some digital libraries of India:**
- **Digital Libraryof India, IIS, Bangalore**
- **Nagri Pancharini Sabha,Varanasi.**
- **Kumaun University, Nainital.**
- **G. B. Pant University of Agriculture & Technology,Pant Nagar.**
- **Technology, Pant Nagar.**
- **TheMillion Book Project.**
- **Digital Library of India Institute of Management, Kozhikode.**
- **DigitalLibraryofLibrary&Information Science.**
- **ETD at Indian Institute of Science.**
- **IndiraGandhiNationalCentre for theArtsDigital Library**
- **NalandaDigital Library**
- **Vidyanidhi : Digital Library**

Conclusion

There will be continuing expansion of digital libraryactivities. LIS and computer science professionals face challenges that will lead to improved systems.More and more libraries will have departments and programs in the digital libraryarena. Digital libraries will build upon work being done in the information and data management area. Digital libraries provide an effective means to distribute learning resources to students and other users. Planning a digital library requires thoughtful analysis of the organization and its users, and an acknowledgement of the cost and the need for infrastructure and ongoing maintenance (Adams, Jansen, and Smith

1999). Digital libraries present opportunities and challenges for the library and information communities and all stakeholders. It also is going to be part of day to day professional activity in the next couple of years. In simple words, it is quite impossible for libraries and information centers to meet the various information needs of the present day society without library networking.One hope in the near future that all the libraries in world will be without walls, and resources of all libraries will be available to the whole user communitythrough networked digital libraries.The relevancy of the Ranganthan's Five Law of LibraryScience is still prevalent in this newdigital era also as information scientists have reinterpreted it in the following manner

- Digital resources are for use.
- Every user his/her digital resources.
- Each digital resource for its user.
- Save the time of the digital resource user.
- Digital library is an overgrowing organism.

As such to realize their mission and goal, professionals working in the digital library environment need to develop skills to render services in themost efficient and effective manner to meet the needs of the users. The digital preservation is process that requires the best available technology, careful thought, administrative policy and procedures. Preservation in the area of digital technology is chargedresponsibility. Therefore, the information professionals are to be trained in area of digital preservation and digitization techniques.

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13

An Evaluation of Knowledge Management in Academic Libraries

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Abstract
Academic libraries are information centers established in support of the mission of their parent institutions to generate knowledge, and people equipped with knowledge in order to serve the society. The concept of knowledge based economy has generated remarkable change recent days. Knowledge management is a process of knowledge creation and modernization through an efficient organization and sufficient exploitation of information and knowledge resources. Define Knowledge, Management and Knowledge Management. The main objective of knowledge management in libraries is to promote knowledge innovation. Presented the Role of Library Professional in Knowledge Management framework. Over the past few years, the Web has had a tremendous effect on the growth of information and the speed of transmission Although KM is a useful tool, there are some potential obstacles to implementing this in academic libraries

Keywords: Knowledge management, Knowledge Management System, Academic Library, Knowledge Centers.

Introduction

Knowledge is created, categorized, and changed. It might be shared and indexed. The process of producing, preserving, disseminating, and repurposing organizational information to help a company meet its goals and objectives is known as knowledge management. The idea of a knowledge-based economy has brought about some amazing development recently. The process of creating and modernizing knowledge via effective organization and adequate use of information and knowledge resources is known as knowledge management. Effective knowledge development and study, the creation of knowledge supports, knowledge sharing and exchange among library staff members and users, staff training, expediting the explicit processing of implicit knowledge, and realizing knowledge sharing should be the main goals of knowledge management in libraries.

Knowledge

Knowledge is a product of human experience and it can be defined as the management of creating, sustaining, applying, and renewing knowledge resources of an organization including its relationship with seeker and service provider. Knowledge can be broadly divided into two types:
Tacit knowledge, and
Explicit knowledge

Management

Management is a mental process. Management as the process of coordinating total resources of an organization towards the accomplishment of desired goals of that organization through the execution of a group of inter-related functions such as planning, organization, staffing, directing and controlling

Knowledge Management

Knowledge Management is a process, which deals with knowledge creation, acquisition, packaging and application or reuse of knowledge. It is basically consists of the following four steps:

- Knowledge Collection

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- Organization
- Data protection and presentation
- Dissemination of Knowledge Information

Knowledge Management is the way to keep knowledge growing through sharing and such sharing is best done either in material or human terms. The relationship between the knowledge and social development can be understood with the help of the following flowing chart:

Knowledge Creation → Understanding Knowledge → Knowledge Processing

Pricing for Knowledge ← Knowledge Enhancement ← Knowledge Distribution ←

→ Generating Wealth → Development of Human Society

Definitions

According to Srinivasan, "Knowledge Management refers to a collection of process, technologies and principles that serves to promote a learning environment supportive of the search community goal." Knowledge Management is the process of capturing value, knowledge and understanding of corporate information, using IT systems, in order to maintain, re-use and re-deploy that knowledge. [Source: OIC Document Management] Knowledge Management is the systematic process of finding, selecting, organizing, distilling and presenting information in a way that improves an employee's comprehension in a specific area of interest. [Source: Knowledge Management Server]

Concepts of Knowledge Management Data → Information → Knowledge, and → Wisdom The following chart indicates how knowledge can be transferred as wisdom

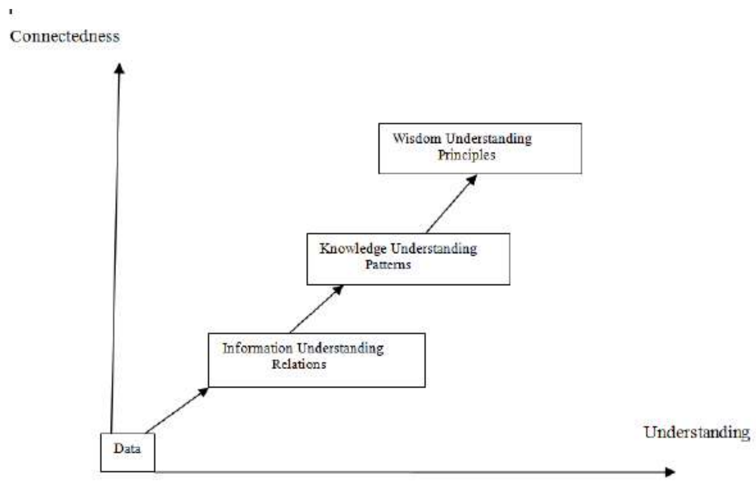

Figure : 1 Conceptual Progression from data to Wisdom. (Source : Filemon A. Uriarte Jr., "Introduction to Knowledge Management", ASEAN Foundation,2008.)

Objectives of KM

The main objective of knowledge management in libraries is to promote knowledge innovation. The purpose of KM is to deliver the right information to the right person at the right time. Other objectives are;

- To create knowledge repositories;
- To promote scientific research;
- To promote relationship between library and users;
- To enhance the knowledge environment and
- To improve Service capability of Faculty and staff of Libraries in the electronic environment.

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Role of Library Professional in Knowledge Management framework:

Library professionals seek to accomplish following tasks:

- Able to deal with new technology.
- Generating new knowledge.
- Expert in capturing and transferring of information.
- Sharing knowledge without any geographical limitation.
- Manage knowledge as an asset.
- Representing knowledge in documents and database.

Changing environment and issues facing academic libraries

Multiple formats of information

The rapid growth of information and communication technologies (ICTs) said to be changing the way academic libraries operate today. Academic library collections are no longer collections comprised almost entirely of printed materials but collections comprised almost of materials in multiple formats and media (Budd, 1998). Information technologies such as computers, multimedia and CD-ROMs are bringing unprecedented abilities to academic libraries in providing services and resources to the university community. Over the past few years, the Web has had a tremendous effect on the growth of information and the speed of transmission. The problem with the Web is that, there is no real of information like in the case of libraries. New means to deliver information over the Web places a challenge to academic librarians in terms of helping students make sense of information found on websites.

Another challenge facing academic libraries in the networked online environment is to exploit all forms of digital and telecommunication technologies and find new ways and means to provide feasible forms of collections; services and access to library materials (Foo et al., 2002). These technologies however, require greater responsibility to academic librarians. The challenge for academic librarians is to manage services, which offer users a carefully selected mix of multiple formats and media. Academic libraries should rethink their role in the whole university community. There is a need to support the needs of the users since the teaching and learning patterns in universities have changed.

As information and research resources become more varied, this places a challenge to academic libraries. Hazen (2000) argued that the changes information, in research strategies and the structure of higher education are affecting academic libraries. These changes define much of the shifting context within which academic libraries must operate. The changes brought by electronic media necessitate transformation in the way librarians think about their jobs, the users of information and communication process of which they are part (Budd 1998, p.270). Academic librarians must strive to remain competent navigators of each medium order to assist the library users.

Knowledge Management Obstacles

Although KM is a useful tool, there are some potential obstacles to implementing this in academic libraries. The challenge of tacit knowledge has been discussed earlier, but also the challenge of motivating employees must be considered. Mapping of competencies will often also map out lack of competencies. This could, in some cases, even demotivate employees. Also, knowledge is difficult to measure. "The choice of which KM strategy to pursue is typically based on other strategic thrusts and the value discipline that the enterprise pursues challenges it faces, and opportunities it wishes to act upon" (Wiig, 1997, p. 9). One size does not fit all, and knowledge management must be adjusted to its settings be of use. This being said elements of knowledge management will, in all likelihood, be of value when working with knowledge and information enterprises, including academic libraries.

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CONCLUSION

Academic libraries are thus playing a vital role in crossing the borders, the key to opening all gateways to knowledge. Librarians should train themselves and their staff to develop the appropriate knowledge management systems and use information technologies to libraries to provide better, faster and pinpointed services to clients/ users. Knowledge Management helps library and information professionals in improving the services being rendered to their users. Information professionals have to recast their roles as knowledge. The librarian's roles should not be limited to being the custodians of information but they have to acquire skills to keep themselves updated cope intelligently and objectively with the effective and efficient knowledge management in Academic libraries.

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Open Access Publication: freely Available Literature for Researchers

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Abstract:

At all levels of life has been affected by the Internet revolution and the same as the case of education, especially technical education. Institution to put their academic resources and online services have anxious to bring the international community on a common platform and the use of the internet and related tools and software to researchers and students. But due to the technical challenges like artificial intelligence lot of sources are available. Free open sources provide global view to the researchers. So various repository play vital role This paper is based on the open access publication opportunities and adoption of online sources.

Keywords: Open Access Publication, journals, open Access Repositories

Introduction:

Scholarly periodicals are one of the most important sources of up-to-date information and research literature in different disciplines. But due to increasing costs, libraries are reducing the number of periodicals they subscribe to. This means that if libraries can no longer afford to pay the annual subscription cost, researchers are left with no retrospective access at to quality researches published in different parts of the world. Institutional libraries, particularly of developing countries are facing this situation more. This situation is impacting in two ways. First, researchers are bound to consult and rely on the out-of-date research materials. Second, they are forced to adopt a parochial perspective where they mostly cite papers produced by their own research groups or look mainly at the literature produced in one country or continent.

Open Access: Concept and Perceived Benefits

The concept of open access is not entirely new and has been around for several years, people have begun to realize its importance only recently, owing to the support from government, educational and research institutions, and other funding agencies. The label "open access" was coined at a meeting in Budapest in 2002, but the concept has existed since the earliest days of the World Wide Web. Open access means the free unrestricted access to scientific publications and data in electronic format on the Internet. In other words, open access refers to unrestricted online access to articles published in scholarly publications. Describing open access literature, Suber (2013) writes, "Open-access (OA) literature is digital, online, free of charge, and free of most copyright and licensing restrictions",

Open Access has immense prospective to impact and -empower developing countries. With the availability of insufficient funding to libraries and institutions, this type of unrestricted access to information helps researchers in the developing world stresses that considering the limited financial resources available the potential for researcher’s educators and institutions in developing countries to benefit from open access is great. Open Access is important for future technological and economic development in these countries. Having better access in their own countries also provides the impetus to remain in their countries and contribute to further developing them rather than migrating to more developed countries.

Open Access Publications: Meaning and Types

In general, open access refers to a publishing model where the research institution or the party financing the research pays for publication and the article is then freely accessible. Open access publication is a kind of literature that is free of price barriers and permission barriers that normally limit access and usage of all published literature to only subscribed or licensed journals (OMICS Group, 2014). Open access publications are freely and permanently available online to anyone with an internet connection. Unrestricted use, distribution and reproduction in any medium is permitted, provided the author/editor is properly attributed (Springer Open, 2014).

Open Access Journals

Open-access journals are scholarly journals that are available online to the reader "without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself (Suber, 2013). Open Access (OA) journals refer to electronic journals, which give access to all users and are subscription free. Peer reviewing is undertaken in OA journals and, in this case the accepted articles will then be made freely available to users (Zainab, 2010, p.97). Open-access journals use a funding model that does not charge readers or their institutions for access. Some open- access journals are subsidized and are financed by an academic institution, learned society or a government information center. Some are financed by payment of article processing charges by submitting authors.

Open Access Repositories

An Open Access Repository or archive preserves and makes its content freely and openly available online. To define an open access repository we must combine the meanings of open access and repository. As discussed earlier, open access (OA) is free, immediate, and unrestricted availability of content. Prosser (2003) defines OA as free and unrestricted access on the public Internet to literature that scholars provide without expectation of direct payment. According to Reitz (2014), a repository is the physical space reserved for permanent or intermediate storage of archival material. Thus, an OA repository can be defined as, "an online database... that makes the full text of items (or complete files) it contains freely and immediately available without any access restrictions" (Pinfield, 2005).

Finding Research Literature: Useful Open Access Publications

Open Access publications have emerged as one the major source of knowledge for young and aspiring generations who are keen in pursuing any kind of research. These publications provide easy and free access to variety of research literature like journal articles, research reports from different organizations, project reports, etc. As discussed earlier, open access journals and open access repositories are main reservoirs of open access publications. Among these, names and URL of some useful reservoirs of open access publications are listed below for benefit of individual researchers and research communities:

Directory of Open Access Journals (DOAJ) (http://www.doaj.org)

Directory of Open Access Journals (DOAJ) covers free, full text, quality controlled scientific and scholarly journals, aiming to cover all subjects and languages. As of Nov 2023, this directory contains 20,090 journals also journals without fees are 13,521 and 9,522,306 Articles in 80 Languages and 136 countries

Open Access Journals Search Engine (OAJSE) (http://www.oajse.com/about_us.html)

The Open Access Journals Search Engine (OAJSE) service covers free, full text, quality a controlled journals. This search engine aims to cover journals in all subjects that are published in English language. There are now 18650 journals and 8,265,272articles available in the directory.

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Education Research Global Observatory (http:// www.ergobservatory.info/about.html)

ERGO is a project on the National Education Policy Center at the University of Colorado, Boulder. The ERGO is dedicated to the promotion and dissemination of open access scholarship in education.

Excellent Open Access Journals for Educators (http://www.onlinecollege.org excellent-open-access-journals-for-educators

All these open access journals provide scholarly information available at no cost. Most of these journals s are published just once or a few times a year and mainly focus on research, practices, and specific approaches to education on all levels including college students in bachelor degree programs, and graduate students.

African Journals Online (AJOL) http://www.ajol.info)

African Journal Online (AJOL) is the world's largest and pre-eminent collection of peer-reviewed, African-published scholarly journals. In partnership with hundreds of journals from all over the continent, AJOL works to make available African-origin research output to Africans and to the rest of the world. There are now 713 Journals are available and out of 454 are open access and 1,63,244 open access full articles are available

Electronic Journals Library (http://rzblxl.uni- regensburg.de)

University Library of Regensburg offers the Electronic Journals Library, which contains over 11,4075 titles, of which over 77530 journals can be read free- of-charge. The Electronic Journals Library was founded in 1997 by the University Library of Regensburg in co-operation with the Technical University Munich Library within the framework of a project.

OMICS Group International (http:// omicsonline.org)

OMICS Group hosts over 700 leading-edge peer reviewed Open Access Journals and have over 15 million readers. The group has a strong editorial board which contains over 50,000 eminent personalities that ensure a rapid, quality and quick review process. More than 1000 International Societies are supporting in making scientific information Open Access.

British Library for Development Studies (BLDS) (http://blds.ids.ac.uk)

BLDS houses Europe's most comprehensive print collection of research on development issues, providing an unparalleled range and depth of coverage. This E- library contains a wide range of different kinds of online information resources relevant to development issues and majority of these are open access.

RePEc (http://ideas.repec.org)

RePEc (Research Papers in Economics) is a collaborative effort of hundreds of volunteers in 82 countries to enhance the dissemination of research in Economics and related sciences. From this site, over 4,500,000 items of research can be browsed or searched, and over 4,1,00,000 can be downloaded in full text.

eifl (http://www.eifl.net)

eifl is an international not-for-profit organization based in Europe with a global network of partners. Working in collaboration with libraries in more than 60 developing and transition countries in Africa, Asia. Europe, and Latin America, eifl enables access to knowledge for education, learning, research and sustainable community development. EIFL works to expand access to knowledge in a cost effective and sustainable way by supporting the establishment and development of strong national library consortia.

HighWire Free Online Full-text Articles (http:// home.highwire.org)

High Wire Press is one of the largest archive of free full-text science articles. Presently, it is assisting in the online publication of 2,374,456 free full-text articles and 7,326,835 total articles. In this portal, there are 27 sites with free trial periods, 107 completely free sites and 280 sites have free back issues.

Global Development Network (GDN) - Free Journal Access Portal (http://www.merlot.org) multimedia Education Resource for learning and online learning

GDN has linked policy research institutes from 11 regions and more than 100 countries. GDN offers a range of journals services to address the difficulty faced by many researchers in the global south in accessing journal articles to support their research. GDN has linked policy research institutes from 11 regions and more than 100 countries. GDN offers a range of journals services to address the difficulty faced by many researchers in the global south in accessing journal articles to support their research. There are 103,189 learning resources are availabl in the following areas: Humanities. Communication, World History, Language, Global Economy and Regional Studies.

Directory of Open Access Repositories (OpenDOAR) (http://www.opendoar.org)

Open DOAR is primarily a service to enhance and support the academic and research activities of the global community. Open DOAR lists the wide variety of institutional and subject-based Open Access research archives and repositories which have grown up around the world. OpenDOAR maintains a comprehensive and authoritative list of institutional and subject-based repositories.

OAIster (http://www.oclc.org)

OAIster is a collection of freely available, previously difficult-to-access, academically oriented full-text resources searchable without restriction. Today, OAIster includes more than 50 million records representing digital resources from more than 2000 contributors.

ePrints-UK Project (http://eprints.org)

The ePrints-UK project aims to provide national, discipline-focused searching for access of journal articles, technical reports and web pages in electronic institutional archives of 30 selected UK universities and colleges. Funded by JISC-FAIR, the ePrints UK project developed subject-based, national services through which the higher and further education. community can access the collective output of e-print papers available from compliant Open Archive repositories.. particularly those provided by UK universities and colleges.

Bielefeld Academic Search Engine (BASE) (https://www.base-search.net)

BASE is one of the world's most voluminous search engines especially for academic open access web resources. Operated by Bielefeld University Library, BASE provides more than 346 million documents from more than 11 thousand content provider sources. One can access the full texts d of about 70% of the indexed documents. The index is- d continuously enhanced by integrating further OAI sources as well as local sources. Base is operated by Bielefeld University Library.

International Network for the Availability of Scientific Publications
(INASP) (https://www.inasp.info)

INASP is an international development charity working with a global network of partners to improve access, production and use of research information and knowledge, so that countries are equipped to solve their development challenges. This network provides access to scientific and scholarly information through electronic means. It includes more than 40,700 full- text academic online journals, current awareness databases, and document delivery of major scientific, technical, medical, social science, and humanities materials from a wide range of sources.

USAID's Development Experience Clearinghouse (http://www.usaid.gov/results-and-data/ information-resources/development-experience- clearinghouse-dec)

USAID's Development Experience Clearing- house is the largest online resource for USAID-funded technical and program documentation from more than 50 years of USAID's existence. USAID provides access to abstracts and full text documents including: Reports, r development project documents, and citations of documents held by USAID Information

Centers. Presently, there are more than 155.000 documents a available for viewing and electronic download.

Eldis Gateway to Development Information (http:/ /www.eldis.org)

Over 16,000 full text, abstracted development- oriented documents are available from Eldis. Documents are of "strategic, policy or practical interest" for development practitioners based in both the North and the South. There are journal articles in the following areas: Agriculture, Education, Health and Nutrition, Economic Development, Environment and Business. Their database includes over 50000 summaries and provides free links to full text research and policy documents from over 8000 publishers.

UN-HABITAT Best Practices Database (http:// mirror.unhabitat.org/bp/bp.list.aspx)

This database is a free public access for urban database with approximately 4,000 proven solutions to the common social, economic and environmental problems. The database allows one to search for a practice via simple or advanced search options. This database is also searchable by country, scale (global, national, regional, village, etc.) and by subject category.

The HKUST Institutional Repository (http:// library.ust.hk/info/db/repository.html)

The HKUST Institutional Repository (Hongkong university of Science and Technology) collects, makes available, and preserves in digital format the scholarly output created by the HKUST community. Its interface provides for easy self-archiving by faculty. and organizes the documents in logical, easily retrieved .Here Thesis, Articles Conference papers Books, Book review, Technical Reports datasets, Patents Audio- videos are available

Conclusion:

Open access publications have emerged as a new source of freely available research literature in digital format and thousands of these publications are available these days. The good part is that researchers can easily access these publications via internet on their computers or smartphones. Gone are the days when libraries were one and only source of research literature, now open access publications offer anytime, anywhere and 24x7 access to update research literature. This is welcome news for researchers relying mainly on libraries to search research literature. Researchers particularly of developing countries must learn about and take benefit of these publications for improving their research outputs.

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Library Management System Software LIB-MAN

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Abstract:-

In academic libraries, knowledge is generated by aligning with user needs, understanding institutional curricula, and catering to specific requirements. The advent of information and communication technology has influenced both individuals and organizations, notably impacting library systems and underscoring the significance of knowledge management. Typically, libraries are recognized for collecting, processing, storing, disseminating, and utilizing information to offer services to their user community, specifically for academic and research purposes. Adapting to evolving environments, libraries undergo transformation to align with their needs. Well-trained academic libraries play a crucial role in the education system, significantly contributing to the advancement of research and development. The functions of academic libraries and their personnel are evolving to parent institutions. The significance, particularly in fast-tracking services, is pivotal for the success of academic libraries. In the current knowledge era, academic libraries can enhance their services effectively through knowledge management. This process encompasses creating, capturing, sharing, and utilizing knowledge as essential components. Moreover, ongoing knowledge management practices within academic libraries are the focus of this paper. The objective is to comprehend the library's knowledge organization status and establish how engaging with software-based knowledge management enhances the quality and value of academic library services.

Keywords:- Knowledge organization, Knowledge management, Academic libraries, Lib-Man Software and its Function. Learning management Software (LMS)

Introduction:-

A library's primary goals include promoting literacy, disseminating practical daily information, and fostering daily information, and fostering lifelong learning through its reading materials and resources. Libraries extend resources beyond the library's physical location, reaching users who might otherwise miss the opportunity to benefit from them. Renowned as the knowledge management hub within their institutions, libraries play a crucial role in elevating service provision. Libraries are categorized into four distinct groups. These are National, Academic, Public and special. Each category possesses unique characteristics inherent to its nature and services, particularly academic libraries affiliated with the educational system. Advancements in technology have made information and knowledge ubiquitous, transforming them into vital resources accessible everywhere in society.

The proliferation of information and knowledge in society has significantly impacted academic libraries, leading to a myriad of changes in their functions and exchanges. Libraries in academic institutions be it schools, college, or university, are integrals components of the respective culture. The evolving role of academic libraries aims to furnish a competitive advantage for their parent institutions. Establishing an organizational culture of knowledge sharing and expression within libraries is a verbal method to achieve knowledge management. Organization, including academic libraries, can build a robust knowledge base through intentional implementation of effective knowledge management practices. The effectiveness of academic libraries hinges on their capacity to leverage the information and knowledge held by their staff to enhance services for the academic user community.

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Libraries are adapting to new technologies, reshaping their services to users in innovative ways as the times evolve. The library services have greatly advanced by utilizing an ICT-based infrastructure to enhance their offerings. With the help of those thinks libraries can produce new services and provide faster access to their collection. It also includes a learning management system (LMS), a software application that provides the framework that handles all aspects of learning process and tracks your training content.

Knowledge organization:- knowledge organization is a multidimensional field encompassing systematic methods to manage, classify, and structure information for effective retrieval and utilization. It involves the development of taxonomies, ontologism, and classifications to create meaningful relationships among data. Technology like metadata creation, indexing, and cataloging play crucial role in organizing diverse information sources. In the digital age, technologies like Information and Communication Technology (ICT) contribute significantly to evolving and enhancing knowledge organization practices. Efficient knowledge organization fosters improved information retrieval, supports research endeavors, and facilitates a more structured and accessible information landscape.

Knowledge management:- Knowledge management (KM) is a comprehensive approach that involves capturing, organizing, and utilizing an organization's collective knowledge to enhance decision- making problem-solving, and innovation. It encompasses various processes, technologies, and strategies to create, share, and apply knowledge within an organization. Key components of knowledge management include knowledge creation, storage retrieval, transfer, and application.

In a knowledge management framework, organization often implement strategies such as creating knowledge repositories, fostering a knowledge-sharing culture, and utilizing technologies like knowledge based and collaborative platforms. KM aims to leverage both explicit knowledge (tangible, codified information) and tacit knowledge (informal, experiential insights) to improve overall organizational performance.

Effective knowledge management can result in increased productivity, better-informed decision- making, and the development of a learning organization culture. It is particularly crucial in today's rapidly changing business environment, where adaptability and innovation are paramount for sustained success.

Academic libraries:- Academic libraries are integral components of educational institutions, playing a crucial role in supporting learning, teaching, and research endeavors. These libraries go beyond merely housing books; they provide access to a diverse range of information resources, including digital materials, journals, and multimedia content. More detailed overview:

1) Information resources: academic libraries curate extensive collections of books, journals, databases, and multimedia resources. They aim to offer a board spectrum of materials to support the diverse need of students, faculty, and researchers.
2) Reference Services: librarian in academic libraries offer reference services, helping users navigate and locate relevant information. This may include assistance with research, citation, and utilization library resources effectively.
3) Digital Transformation: with the advent of technology, academic libraries have undergone significant digital transformation. They now provide access to electronic databases, e-books, and digital archives, fostering a more dynamic and accessible learning environment.
4) Information literacy: Academic libraries contribute to developing information literacy skills among students and faculty. They offer workshops to help individuals critically evaluate and use information effectively.

5) Archives and Special collection: Many academic libraries house archives and special collections, preserving unique and rare materials that contribute to historical and research interests.
6) Interlibrary Loan Services: Academic libraries often participate in interlibrary loan programme, allowing users to borrow, thereby expanding the range of available resources.
7) Technology integration: academic libraries leverage technology for cataloging, circulation, and data management. They may also incorporate emerging technologies like virtual reality, artificial intelligence, and data analytics to enhance services.
8) Community engagement: Beyond serving students and faculty, academic libraries actively engage with the broader community. They may organize events, lectures, and foster a sense of community and promote lifelong learning.
9) Open Access initiatives: academic libraries are at the forefront of supporting open access initiatives, advocating for the free and unrestricted access to scholarly research and publications.

   In essence academic libraries are dynamic entities that evolve to meet the changing needs of the academic community, embracing technology and innovation to enhance the learning experience.

Learning management software (LMS) LIB-MAN

A library management system is software that is designed to manage all the functions of a library. It helps librarian to maintain the database of new books and the books that are borrowed by members along with their due dates. This system completely automates all your library's activities. The best way to maintain, organize, and handle countless books systematically is to implement a library management system software. A library management system is used to maintain library records. It tracks the records of the number of books in the library, how many books are issued, or how many books have been returned or renewed or late fine charges, etc.

You can find books in an instant, issue/reissue books quickly, and manage all the data efficiently and orderly using this system. The purpose of a library management system is to provide instant and accurate data regarding any type of book, thereby saving a lot of time and effort.

Lib-Man Library Management System:

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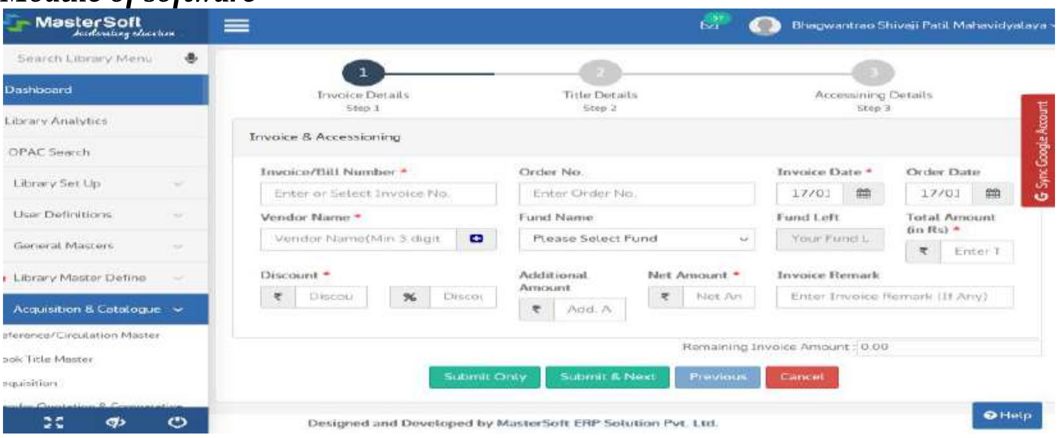
The major Modules of Lib-Man are:-

1 Acquisition & Cataloguing

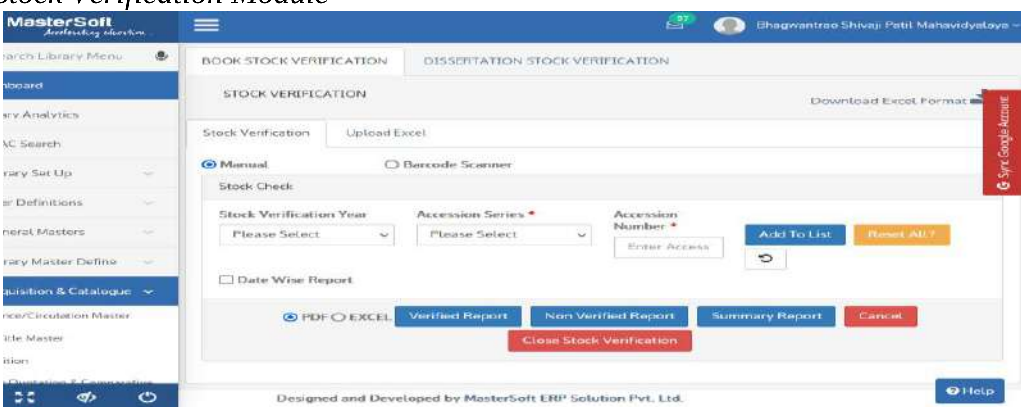
- Requisition
- Vendor Quote & Comparative Statement
- Supply order & Follow-up
- Invoicing & Accessioning
- Payment Requisition & release
- Book Binding
- Withdrawal / Write off Books
- Loss of Books / Missing
- Stock Verification
- Budget Utilization Analysis
- Book Indexing

Dasha Board of software

Invoice Module of software



Books Stock Verification Module

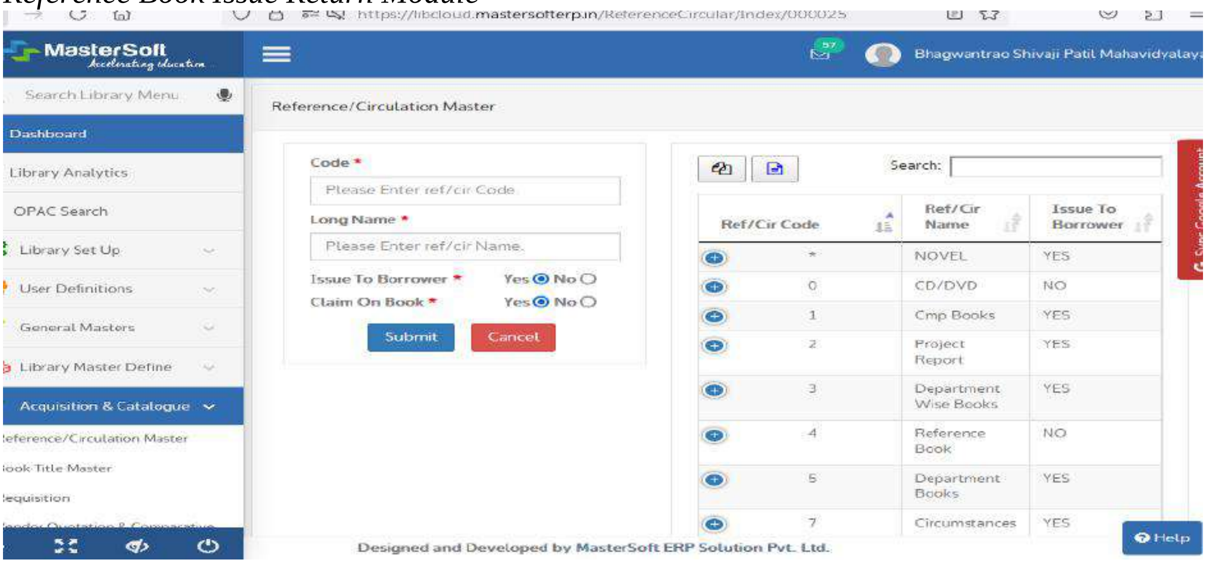


2 Circulation:-

- B.T. Card Records
- Document Circulation- Issue, Return & Renewals
- Reference Book Issue Return
- Reservation / Claims
- Overdue / Recall Notices
- Lib Clearance
- Book Bank

Issue, Return & Renewals Module

Reference Book Issue Return Module



OPAC- On line public access catalogue:- Information About Documents can be search using powerful search engine according to:-

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- Author, Co-Author, Subject, Publisher
- Class No. ISBN No. Publication Year
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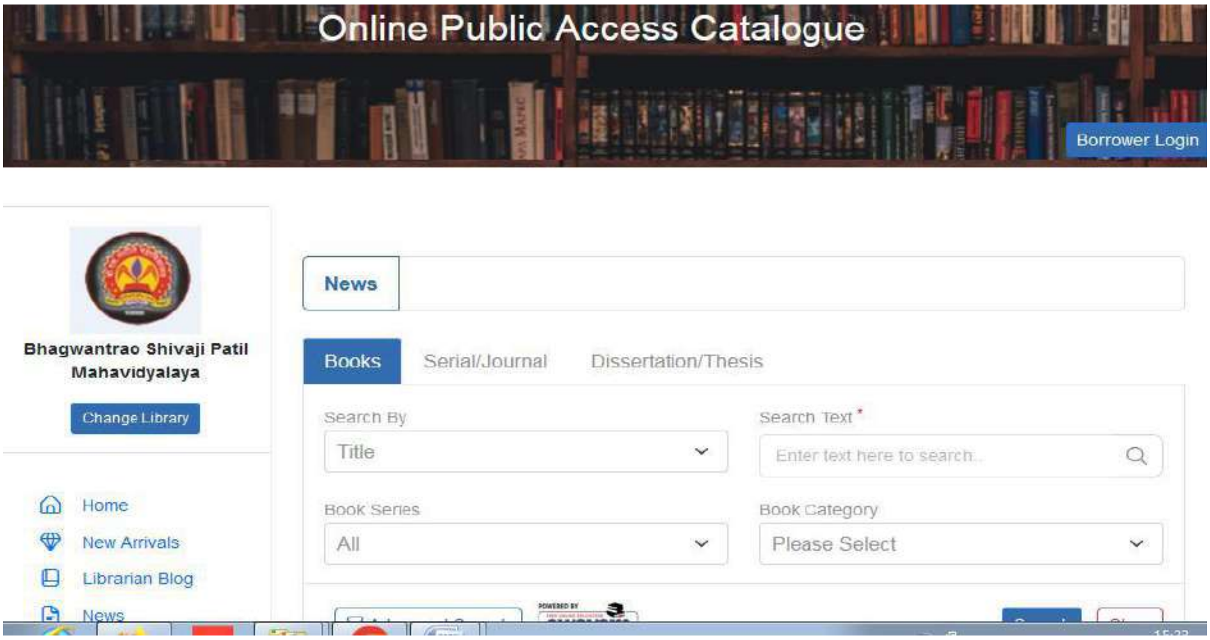
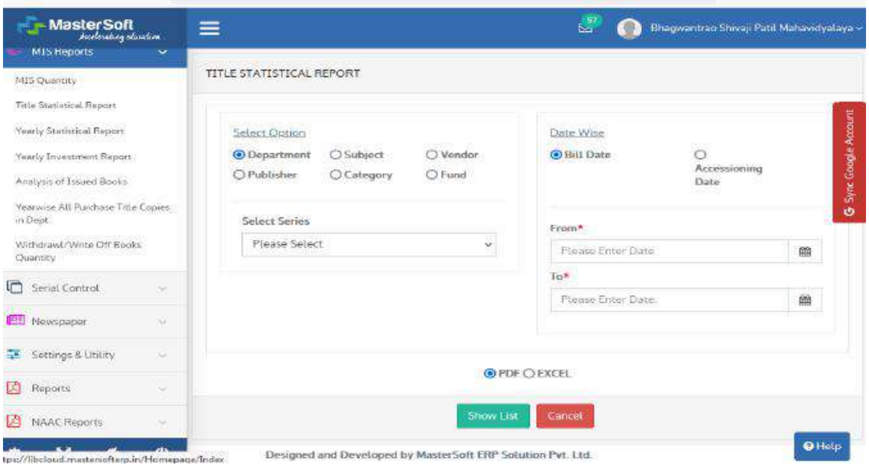


Serial control:-

- New / Renewal Subscription order
- Reminders for Non –Receipts of Serials
- Binding of Serials, Accession of serials
- Serial OPAC
- Daily Newspaper Entry
- Serial Indexing
- Bound Volume Creation

Reports:-

- Accession Register
- AACR2 Catalogues
- Barcode, QR & Spine Labels
- Circulation Reports
- Claim & Fine Report
- MIS Reports
- Serial Accession Register
- Budget Analysis Reports



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RF LIB-Man - Integrated Library Management Software

LIB-MAN® is a highly integrated, user-friendly, and compatible library automation system for complete computerization of all the in-house operations of any size or type of library. The library management software is intuitive, efficient, and compliant. Lib-Man is embedded with multilingual fonts, Barcode & QR Code fonts. The integrated library software developed in consultation with prolific senior library professionals is currently being used by as many as 500 libraries. The client-server version of Lib-Man is embedded with free Devanagari Fonts. It supports all the latest technologies which include cloud hosting, mobile app, tablets, SMS, email, UHF RFID, secured payment gateway, etc.

Lib-Man has an optional UHF RFID integration for the absolute library automation. It also supports the smartphone or mobile app for book search – MOPAC.

What Is Learning Management System (LMS)?

A learning management system is software for educational institutions to track reporting, training programs, automation and delivery of educational courses, learning & development programs, maintain classroom activities records, create the best syllabus, teaching plans, and online assessments to maximize students' learning outcomes.

Learning has shifted from Life Long to Life Wide Learning. The ‘new’ educational landscape demands a ‘new’ version of teaching-learning methodologies where teachers can perform exam analysis and goal output analysis & plan appropriate teaching syllabus and help students learn at their own pace, communicate with them at any time, and plan their studies for achieving their goals.

Key Feature of LIB-MAN

- Fully secured & Maintenance Free
- Best Onsite Training & Service Support
- User Friendly Software with well documented user manual.
- Report’s Export facility to MS word, Ms Excel, PDF Formats etc.

MOPAC-Mobile Phone Based APP for Library Book Search:-

Master Software Group Nagpur a most trusted ERP Partner for educational Institutions has launched a simple to use smart phone based mobile OPAC search engine App MOPAC for all the patrons in the world. Institution library can have their own library software. Library can upload the data of library in a simple Excel format in MOPAC data base and instantly your library is on OPEN mobile OPAC Platform. The mobile OPAC offers a great new way to find items and prepares library for future requirements, today. MOPAC APP provides search according to Title, Publisher, Keyword, and Subject.

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An example of the **best LMS software** is Module. The OPAC mobile application is a classic example of mobile-based library services. The platform is operated by SLIM Software's and aims at converting conventional libraries to digital libraries.

The Advantage of MOPAC App to College, Librarian & Patrons:-

- Simple to use, Low cost & Instant Implementation, No training required.
- Due to easy-no time consuming search
- Hosted on Cloud, 24X7 accesses to all.
- No dependency on us.
- On line free support to libraries.
- Inter library loan request utility for librarians.

Conclusion:

Library software plays a pivotal role in efficient library management by automating tasks such as cataloging, circulation, and inventory management. It enhances accessibility, facilitates resource discovery, and provides accurate information on book availability. Additionally, it aids in tracking user borrowing patterns, simplifies administrative tasks, and promotes a streamlined approach to library operation. Overall, library software contributes to a more organized, user-friendly, and effective library management system.

Lib-Man library Software keeping a thorough database of members, the management system store each user's name, ID and password for aiding in determining the member's history. The Lib-Man software is user-friendly and improves the effectiveness of the librarian and library administration. All books whether new or old, have bar codes that are based on the book's title, author, subject, and publication date. The RFID sensors on the other hand are used to quickly read barcode when books are scanned upon issuance or return so that the database is automatically updated. Access to several affiliated libraries is made possible through the web-based library management system software. This broadens the search space, greatly the user experience. To self-check-in and self-check-out books, the member of digital libraries can log in search for, choose, issue, and return books on their own thanks to the library management system software. To maintain each member's account and collect membership payments, the library system covers it all. The fine that is owed for lost, damaged, or non-returned books is calculated by the program. The mechanism notifies the members of the fine. To keep track of book movement and maintain an electronic inventory of the library's holding, the library management software provides a seamless process of any book's whereabouts at any given time. Library management software is designed to streamline the various tasks involved in running a library efficiently. Popular library management system includes Koha, Evergreen, Alma, and SirsiDynix Symphony. The choice of software depends on the specific needs and scale of the library.

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Deviant Behaviour among Library Users: The Control Perspective View

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Abstract
This study examines the extent to which the application of library management theory can help prevent deviant behavior among library users. The approach used was an interview with a librarian and observation of a library of common deviant acts maintained by users, particularly undergraduate students in some academic libraries in Gondia. The findings of the study revealed that the majority of anti-social acts committed by students were the result of deficiencies identified in the activation of security and protection of information resources in the library. Many said the students engaged in the act because they wanted to prove the vulnerability of the library's security system. This document recommends streamlining user education and socialization and content packaging, installing modern theft detection equipment, ensuring regular inventory, and finally, the library should invest more in purchasing electronic resources that are less prone to misuse. The paper provides recommendations to libraries that want to limit deviant user behavior and ensure the long-term use of their library resources.

Introduction
A library can be said to be an organization where information is collected, processed, stored and disseminated in book and non-library form to users who need information from a qualified librarian. Library users vary by library type and use the library and its resources for different reasons. Users exhibit certain behaviors in the library, deviant behavior being one of them. A deviant user is one who violates library rules and regulations and thus becomes a threat to intellectual property through theft, mutilation, and other forms of abuse. The way to control deviant behavior among users is to implement a proactive mechanism to help reduce deviant behavior even after users are trained, as some will inevitably deviate. Librarians charged with managing the library must be aware of this deviant behavior and not be partners in crime by their actions or inaction. Also, a functioning and effective mechanism should be put in place to check the deviant actions of users "because a porous security system will only lead to more deviance among users.

Deviant behavior among library users
Every society, organization, group, etc., has its own set of norms and values held by all members of the group, organization, or community. Individuals often stray, stray and deviate from the set standards by their actions and inactions, that is why we call them deviants. Deviation as a concept does not have a direct definition, but has been defined by various experts, and all definitions point to a specific problem that violates some established norms. Deviance may be seen as prohibited or controlled behavior that is likely to elicit punishment or disapproval.

Deviant behavior is defined as failure to observe standards and social norms that allow members of society to coexist peacefully. Deviant behavior is characterized by aggressiveness, disobedience, lack of communication and cooperation, impulsiveness, disregard for the safety of oneself, others and materials, irresponsibility, lack of remorse, inflated self-esteem and many other characteristics. Adults with deviant conduct disorders show this pattern before the age of fifteen, according to the Diagnostic and Statistical Manual of Mental Disorders (DSMM). Therefore, parents must participate in socialization with children to help them grow into well-adjusted people in society and encourage children to be autonomous and behave well. Poor discipline, supervision, insufficient parental care, coldness and rejection, physical and sexual abuse, parental conflict, substance abuse, melancholy or stress, and failure of parents to fulfill their responsibilities are all factors that contribute to deviant behavior in emergent individuals. Some parents believe that school is part of a mesosystem (combination of home and social environment) that influences student behavior, and that instructors have a responsibility to manage deviant behavior because most of these children spend some of their time in school. Other school problems that can lead to deviant behavior include poor grooming, poor teaching, poor role modeling and peer pressure in some schools. Any deviant behavior in the library is an unacceptable activity that harms both the individual and the library community. In this context, it refers to the constant violation of socially acceptable norms and patterns in the use of library resources. Mutilation of library materials, defacement of books, theft, hiding library books between shelves, and possession of overdue library materials are examples of deviant behavior in the Knowledge Center. Other deviant behaviors include: noise, chewing, eating and drinking in undesignated areas of the library, littering, loitering, indecent dressing, vandalism, loud phone calls, harassment, computer crimes, abuse, violence, arson, and other criminal activities. This disruptive behavior violates library rules and regulations and, if repeated, may result in sanctions, expulsion, and withdrawal of library resources. Deviant behavior in the library is on the rise, causing a serious problem with book hoarding and collection development. This means that deviant behavior is a threat to library development. Therefore, for effective service delivery, librarians are becoming increasingly sensitive to user studies as it offers a way to understand library clientele, establish levels of needs and services, and direct services to meet client interests and needs. It is essential to measure library usage from the users' perspective in order to strategize how best to provide effective services.

The main objective of the university's Knowledge Resource Center is to provide access to print and non-print collections. Therefore, accessibility requires proper planning and behavior between knowledge resource center staff and customers. The important role that libraries play in modern education cannot be overemphasized.

However, libraries around the world face a number of challenges, particularly in Africa, where many archival materials are either missing or stolen from the shelves.

These are, among others, some of the deviant and criminal activities that have accompanied libraries over the years.

Nature and causes of deviant behaviour in Libraries

The library is a repository of knowledge related to the various fields studied in the parent institution. Libraries have dynamics because of different types of people. This difference can be seen in various areas such as education, culture and moral values. These differences also account for the different causes of deviant behavior among library users. This also explains the different nature of the deviant behavior we witnessed among library users. The nature of deviant behavior among library users includes but is not limited to the following;

1. Theft: this is direct theft of information materials from libraries. Libraries have recorded cases where information materials have been stolen by users, thereby depriving other users of access to these materials. In the words of Jenkins (1982), book thieves can be divided into five categories: "(1) a kleptomaniac suffering from a compulsion to steal books (2) a thief who steals books for personal use or possession (3) a thief who steals in anger and is likely to destroy materials (4) the casual thief who steals when the opportunity presents itself, and (5) the thief who steals for profit.'

2. Mutilation: mutilation of information materials, especially printed materials, is another way library users exhibit deviant behavior. Experience has shown that pages have been torn out of several books in the library. This happens especially in cases where there are few copies of the book and many users. Sometimes it can also be because some users want to deprive other users of said book, especially during exam period or key term paper.

3. Contamination: pages of information materials in printed form in libraries were also defaced. This can be in the form of writing notes on printed pages, painting over images or text, spilling liquids such as coffee, tea or soup on printed materials. Spilling food on a book will not only deface the book, but also invite rodents into the library, which could affect another book.

OBJECTIVE OF THE STUDY

The broad objective is to examine deviant behaviours among users of academic libraries while the specific objectives are;

1. To investigate the deviant behaviours predominant among users of the libraries under study.
2. Find out the causes of these deviant behaviours among users of the libraries under study
3. To determine the measures already in place to curb these deviant behaviours.
4. To find out from the staff perspective, strategies that may be taken to curb these behaviours.

The application of Control theory in the library

This will be explored in three directions, namely: user education and socialization, security measures, and discipline and punishment. Parents help their children develop self-control by socializing them, supervising them, and punishing their deviant actions. This can also be applied in the library.

User education and socialization

User education has many benefits and goals. It is generally a way to raise awareness or guide users about library facilities, collections, services, etc. for new and old users, this type of guidance is necessary (Kumar & Phil, 2009). Academic libraries understand the need for students to be able to acquire, use and apply information in order to be successful. An organization that offers goods or services for sale recognizes the importance of informing the customer of opportunities to spend money. Similarly, the library should inform its users about the resources and services that are offered, where to find them and how to use what is available (Bello, 2003).

A literature review revealed the importance of user education in academic libraries. User education is believed to improve users' skills in using library resources and services, which can lead to increased library use. In his conclusion, Bello (2003) states that a greater percentage of respondents agree that the user education courses have benefited them to a great extent in the proper handling and use of library resources. In a summary of their studies, Oyesiku, Buraimo and Olusanya (2012) cited lack of orientation towards library use as one of the main causes of library user delinquency. Akussah and Bentil (2010) in their study recommended library orientation and awareness program for new and old users, they said that the use of signs, notices, circulars and newsletters would help. Damaged materials should be displayed with a focus on the damage caused and how expensive it will be to repair or replace. They also said that disciplinary action against theft, mutilation of documents and refusal to return borrowed books and keeping books long past their due date should be part of user education and must be enforced.

Security precautions

The effectiveness of the security measures put in place in a library will largely determine whether law and order will be maintained in such a library or not. The question is: “Why do people in one country follow law and order and suddenly become relaxed in another country? however, the answer can be seen in the effectiveness of agencies and security measures in these countries. As a mediator of the dissemination of information, the library must face the threats that users throw at its resources. This can be done if adequate and effective security measures are in place in the library. Improved supervision was highest in responses to the safety of library materials in Akussah and Bentil (2010). The library can provide security in the library by:

- Installation of surveillance cameras.
- Improved library supervision.
- Motivating janitors and security personnel for better work performance.
- Effective user search strategy.
- Installation of electronic theft detectors.
- Constant library inventory and record keeping.
- Installation of radioactive equipment in books, etc.

Discipline and Punishment

Sociologists have identified four basic reasons for punishment: they say that punishment is intended for retribution, deterrence, rehabilitation, and for social protection. Retribution as a justification of punishment is an act of moral revenge where the offender is made to suffer the same as the crime committed, deterrence punishment is when it is done to deter potential offers from committing such a crime. Unlike suffering, which promotes retribution and intimidation, rehabilitation seeks to provide offenders with a platform to learn acceptable behavior, make amends, and encourage constructive improvement. Finally, punishment such as the exclusion of offenders from society or the complete exclusion of the offender can help protect society from future occurrences. Libraries may punish deviants for all or any of the reasons listed, discipline and punishment must include library staff who are partners in crime. Many studies have suggested ways of punishing deviants in the library (Awujoola, 2013; Ajegbomogun, 2004; Akussah and Bentil, 2010; Bello, Opaleke2002; Bello, 1997, Lorenzen, 1997). They concluded that library punishment should include:

- Make the offender pay the full price of the misused materials.
- Banning offenders from entering the library.
- Possible public display of user identities.
- Suspending the abuser for a certain period of time
- Make the culprits, both employees and users, face a disciplinary committee.
- Exclusion or termination of appointment as appropriate.
- using strict charging and discharging policies that are controlled by both staff and users.
- Make a deviant user work for the library for a period of time (parole).
- Rewards for conformists.

Challenges

The main challenge to the operation of management theory in the library could be the attribute of the shrinking budget of the library for the acquisition of equipment for the protection of information resources. Others are the nature of the library, which wants to encourage users to use the library as much as possible and not discourage them, the library is understaffed and burdened with more work than necessary, the nobody syndrome, ineffective user education methods. All these and many more keep the library at bay from the occurrence of deviant behavior and its repetition in the library.

Prospects

As most of the library collection consists of printed materials that are prone to misuse, the application of control theory will help to reduce the occurrence of deviant behavior in the library, proper socialization will help to build students' self-control, it will help to unravel the library's areas of weakness so that it can work to strengthen them, the application of this theory it makes the library staff aware because they are also punished when they are involved in a deviant act. The library is committed to achieving its goals, materials are secure and extended for future use, users use library resources for personal and research purposes.

Conclusion and recommendation

The abuse of library materials and deviant act among users has pose great concern to the library, this however is a result of the poor strategy of protection employed by the library, it is on this note that a new and proactive method of deviance control is affirmed to be inevitable. The library should therefore put an active protection strategy on ground that will guard against deviant act among users and even staff. The writer recommends that user education and socialization be made effective and content packed, modern theft detector devices be installed, regular stock taking be ensured and finally, the library should invest more in procurement of electronic resources which are less susceptible to abuse.

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Use of Information and Communication Technology (ICT) in the Library

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Abstract

Information and Communication Technology (ICT) has transformed library services globally. Most current information are recorded in electronic format, ICT has also contributed immensely to the performance of librarians in the discharge of their duties such as in cataloguing, reference services, circulation management, serials control etc. ICT has contributed to the library in the following specific ways.

Introduction

Modern Internet is rapidly progressing beyond the creation, delivery, management and preservation of its resources to provide quality services for the humanities. The explosion of information through the WWW and human interaction through wireless devices and mobile telephony is increasing day by day ICT tools have become backbone of the human community. Computing technology, communication technology, and mass storage technology are some of the areas of continuous development that reshape the way libraries access, retrieve, store, manipulate, and disseminate information to users. ICT has impacted on every sphere of academic library activity especially in the form of the library collection development strategies, library building and consortia. ICT presents an opportunity to provide value-added information services and access to a wide variety of digital based information resources to their clients. Furthermore, academic libraries are also using modern ICTs to automate their core functions, implement efficient and effective library cooperation and resource sharing networks, implement management information systems, develop institutional repositories of digital local contents, and digital libraries: and initiate ICT based capacity building programmes for library users. Information and Communication Technology (ICT) has brought unprecedented changes and transformation to academic library and information services

Library management software

Libraries utilizes software's designed to manage different library routines and processes. Most of these software's are integrated and have modules for the different activities or tasks carried out in the library like cataloguing, statistics, acquisition processes, serials control etc. Some examples of such software's are CDS/ISIS, GLAS, ALICE for Windows, X-Lib and SLAM. SLAM is used in the University Library FUTA and stands for (Strategic Library Automation Management).

OPAC: This means Online Public Access Catalogue and is the computerized version of the library catalogue or a database of the library holdings. The advantage of the OPAC over manual methods is ease of use and the fact that it saves space. It provides access to the catalogues of a library on the local intranet, extranet or even the internet.

Office Operations: Word processing, accounting,, database management and communication through e-mail are all enabled in the library through ICT.

Networking: Library users can access information of various types such as online databases, e-journals, e- books, government publications digitally through networked systems. Access may be allowed online remotely through the internet or intranets.

Electronic Document Delivery: Libraries may not rely anymore on postal services to send documents to users or carry out interlibrary lending. Libraries send documents through electronic networks that can deliver documents in various formats

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Online user education or tutorials: Libraries can use the internet or CD –ROMS to educate their users or carry out information literacy programmes. Virtual tours can be offered online making user education more convenient for all.

E-reference services: Some services such as SDI (Selective dissemination of information) or Current Awareness Services (CAS) and virtual reference desks, announcements of new acquisitions and other reader advisory services can be made easier through the internet. Users can have online interaction with the reference staff.

Library cooperation and resource sharing: A central union catalogue can be better managed through ICT, thus libraries can create and share bibliographic records and other information resources in digital format.

Institutional Repositories: Institutional repositories are publications that originate locally from within the university community such as theses, dissertations, reports, conference papers and seminar papers. ICT has made it possible not only to provide better access to these resources but also to ensure the preservation of the resources.

E- libraries: Digital libraries depend on information recorded on digital formats like CD-ROMS. Virtual libraries are libraries that do not exist in physical space or structure but can be accessed via networks.

Social Media Networks: Social media networks like twitter, face book and linked In, are some interactive internet services that are presently serving as communication forum for librarians and their uses. These networks can be deployed for educational uses. Discussion groups, list serves and communities also assist library services

E- mails: This is a means of communication between the library and the users.

Library websites: A medium of communication for libraries to their users. It is also used to promote the library and publicise it.

Online searching: searching of of online databases like AGORA, ERIC. Browsing and surfing the internet through search engines, meta search engines and subject directories to supplement library sources

Advantages of Using ICT in the library

• ICT makes library work easier, faster, cheaper and more effective.
• Helps to manage information overload as information retrieval is made easier in computerized systems.
• Remote access is enabled through networked systems
• Computerization saves space and reduces paper.

Challenges of using ICT in libraries

• Poor funding of ICT infrastructures
• Constant change of software and hardware
• Erratic power supply
• Insufficient bandwidth
• Lack of technical IT knowledge by library staff
• Copyright and intellectual property rights management

Key Benefits Key Benefits

Target candidates and organisations Public library staff who've completed the PN training New to the work-place Staff from other sectors Staff seeking to improve their promotion prospects Staff using the qualification as evidence for part of the framework for professional qualifications

Benefits to employer's Workforce Development Sector-specific award Content supported by strategic agencies Supports IIP and Charter Mark Links to CILIP Framework for Qualifications UK-wide relevance

Benefits to individual's Increases employability Supports staff development Accredits People's Network training Validates experiential learning Gives qualification/s Provides academic credits Links to CILIP Framework for Qualifications Diploma in Applications of ICT

ICT – Based User Services

Some library users are adopting electronic habits, making increasing use of the new ICT including computers, the Internet, the Web, Intranet, Extranet and other technologies. As a result, library users are placing new demands on their libraries. They require access to the latest information, updated information resources and access to ICT facilities that they could use in their work.

- Use of ICT in libraries enhances users satisfaction. It provides numerous benefits to library users. Some of the benefits are:
- □ Provide speedy and easy access to information
- □ Provides remote access to users
- □ Provides round the clock access to users
- □ Provides access to unlimited information from different sources
- □ Provides information flexibility to be used by any individual according to his/her requirements
- □ Provides increased flexibility
- □ facilitates the reformatting and combining of data from different sources
- Libraries are also providing various ICT-based services to their user, including the following
- □ Provision of Web access to OPACs
- □ Electronic document delivery
- □ Networked information resources
- □ Delivery of information to user desktops
- □ online instructions
- □ online readers advisory services

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Knowledge Management System in Academic Libraries

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Abstract:-

Knowledge in the context of academic libraries can be created through understanding the user needs and requirements as well as understanding the academic institutional curricula. Knowledge has been used by several organizations to plan smart and effective actions. Emerged Information Communication Technologies (ICTs) made an impact on everyone including organizations, also on library system; which made knowledge management important.Academic departments, or even faculty and students, may purchase or build their own portals to meet their academic and/or research needs.To prove their relevance and value, academic libraries must strive to provide the right amount of information to the right clientele at the right time with a right expense of financial and human resources. With a stagnant or dwindling library budget, academic libraries have to increase their operational efficiency in order to meet the challenge. One management tool that can help in this regard is Knowledge Management .Knowledge management is a viable means in which academic libraries could improve their services in the present knowledge era.This paper mainly focuses on the concept of Knowledge Management and its role in Academic libraries, Objectives of Knowledge Management in Academic Libraries

Keywords: Information, Knowledge, Knowledge Management, Library, Library & Information Profession, academic institutional curricula

Introduction :-

In the present information and knowledge era, knowledge has become a key resource. Theconventional function of academic libraries is to collect, process, disseminate, store and utilise information toprovide service to the community. Knowledge management is very essential to the success of the organization as it not only helps is discovering the resources, but in the current scenario also help in evolving new business rules and models. When we refer to knowledge, most of us mainly tend to think of codified and documented knowledge like patents, databases, manuals, white papers etc. There is no universal definition of knowledge management, just as there is no agreement as to what constitutes knowledge in the first place. For this reason it is best to think of knowledge management in the broadest context. Knowledge management is the process through which organization generate value from their intellectual knowledge-based assets. Most often, generating value from such assets involves sharing them among employees departments and even with other companies in an effort to devise best practices. It is important to note that the definition says nothing about technology, while knowledge management is often facilitated by Information Technology. Information Technology by it self is not knowledge management. Knowledge Management in libraries should be focused on effective research and development of knowledge, creation of knowledge bases, exchange and sharing of knowledge between library staff, users, training library staff, speeding up explict processing of the implicit knowledge and realizing of its sharing. Knowledge management will inject new blood into the library culture. The main contents include; Mutual trust, open exchange, studying sharing and developing knowledge operations mechanism of libraries, enjoying the knowledge management process. User's delight staff's quality and enrichment as well as an all - round improvement of library starting from house keeping activities to knowledge marketing will become important objective of knowledge management in Business and Management libraries.

Knowledge Management: An overview

Knowledge management is a concept that has emerged explosively in the business community and has been the subject of much discussion over the past decade by various researchers and authors. Knowledge Management is not about managing or organizing books or journals, searching the internet or arranging for the circulation of materials. How ever, each of these activities can in some way be part of the knowledge management spectrum and processes. Knowledge Management is about enhancing the use of organizational knowledge through sound practices of information management and organizational learning. It is the process of transforming information and intellectual assets into enduring value. It connects people with the knowledge that they need to take action, when they need it.

Types of Knowledge:-

• **Tacit Knowledge:-** Tacit knowledge is knowledge embedded in human mindthrough experience and jobs.Tacit knowledge is defined as subjective andexperience-based knowledge which cannot be expressed in words or numbers, therefore, it cannot be transmitted andshared easily [4]. It is highly personal, embedded in an individual's experience, and involving intangible factors aspersonal beliefs, perspectives, values, and instincts. It is personal knowledge which is in the human mind, difficult toformalize, and difficult to communicate [5].

• **Explicit Knowledge:-**Explicit knowledge, on the other hand, is formal and systematic knowledge that can be expressed in words or numbersand can be stored in databases as electronic records [6]. Explicit knowledge can be retrieved and transmitted more easilythan tacit knowledge. Because Explicit knowledge can be captured, stored, and transferredadequately with the help of electronic tools, while tacit knowledge is more difficult to capture, store, and disseminate.

• Externalized Knowledge: One of the aspects of tacit knowledge is thecognitive dimension that comprises beliefs, ideals, values and mental models.

Need for Knowledge Management:-

• Translate what has been learned into a form that other can use.

• To interact and retain new information seeker.

• To increase public faith in the organization to strive meet and manage needs ofuser community.

• To be able to justify the spending of funds allocated to the organization library and information center by the parent body.

• Recruiting the best people for the job.

• Exposing professional to the complexity of real problem to stimulate andcultivate professional's knowhow to retain professionals to react in problemsolving techniques.

Scope of Knowledge Management :-

Knowledge Management is a term that has worked its way into the main stream of both academic andbusiness arenas since it was first coined in the 80's. The current state of the knowledge management fieldis that it encompasses four over lapping areas;

i) Managing organization. (creating, sharing, retaining, storing, using, updating, retrieving)

ii) Organizational Learning.

iii) Intellectual Capital

iv) Knowledge Economics

A close look at many aspects of knowledge management practices shows that it can well be accepted thatthey bear a close resemblance to well established practices in librarianship and information management. This means that there is considerable opportunity for librarians to use their traditional skills toassume a new function of managing knowledge within the library which would compliment the traditional library services function. The aim of knowledge management for a library is to become more competitive through the capacities of their staff and clients to be more flexible and innovative.

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Value of Knowledge Management :-

Knowledge is not the same thing as a knowledge worker. And just as there is a difference between theknowledge that exists in a knowledge management systems and knowledge that exists in the mind of theknowledge worker, there is also a difference between the kind of knowledge that exist in the mind of theknowledge worker and that, which exists within a community of knowledge worker. This distinction makesis easier to account for knowledge assets. A knowledge worker is an asset that appreciates over time.Knowledge itself is more often a depreciating asset. Patents, for example, lose their value if not convertedinto product or licensed quickly.

Objectives of Knowledge Management :-

1. To promote collection, processing, storage anddistribution of knowledge
2. To promote scientific research
3. To promote relationship between library andusers
4. To protect the intellectual property right, ininformation technology era
5. To create knowledge repositories and manageknowledge as an asset
6. To organize the value of knowledge andimprove effective research

Knowledge Management in Academic Libraries :-

Knowledge Management is a process, which deals with knowledge creation, acquisition, packaging and application or reuse of knowledge. It is basically consists of the following four steps:

• Knowledge Collection
• Knowledge Organization
• Data protection and presentation
• Dissemination of Knowledge Information

Knowledge Management is the way to keep knowledge growing through sharing and such sharing is best done either in material or human terms (Raja, Ahmad and Sinha, n.d). KnowledgeManagement has become a powerful tool for promoting innovation and realizing reengineeringthe various walks of life. It occupies very outstanding position in the creation of knowledgeinnovation systems of a country. Knowledge management is a process of knowledge creation andmodernization through an efficient organization and sufficient exploitation of information andknowledge resources. Knowledge managementtherefore comes as a strategy to harness academic libraries and enhance the capacity to deriverelevant knowledge from information. . Knowledge Management in libraries should include such aspects as followes :-

Knowledge Innovation Management- Knowledge Innovation Management in libraries refers to the managementof the production, diffusion and transfer of knowledge as well as of the network system constructed by relatedinstitution and organization. It includes three aspects- i) theoretical, ii) technical and; iii) organization innovationmanagement.

Theoretical innovation management is to enrich and enlarge the theoretical and practical researchconstructed by institution. It supports the evolution from conventional libraries to electronic or digital libraries.Organizational innovation management supports to create an effective management system adaptable to theoperation procedures of libraries.

Knowledge Dissemination Management - Libraries may play the part of knowledge pool, and use diversemedia and channels to disseminate various new knowledge. Dissemination or communication of knowledge isan integral part of KM. Technology helps libraries to share knowledge recourses and expertise. Availability ofopen resources on internet and www and online education has made knowledge multi -sourced in “anywhere,anytime” paradigm.

Knowledge Application Management – Library should attach importance to provision of services for people tonetworks. It may be possible by setting up virtual libraries or Information Centers for enterprises, government

Human Resources Management- We should pay full attention to diversity and variation of library staffs'requirements, strengthen management of different library staffs by applying contingency management approach.Knowledge management is a conscious strategy of getting the right knowledge to the right people at the right time.KM is being used to improve library operations. Form theoretical point of view, knowledge can be considered as ain the case of libraries through catalouging or metadata, data become information. When inference is added such asreferences, information becomes intelligence, intelligence combined with certitude becomes knowledge and at the top knowledge combined with synthesis becomes wisdom. Libraries have excelled at creating scholarly information andintelligence from data but they have not been as successful in generating organizational knowledge to achieve librarygoals. Knowledge Management is one way to develop and apply the organizational knowledge needed to improve library operations and effectiveness by developing skills.

Role of Library Professional in Knowledge Management framework:-

Library professionals seek to accomplish following tasks:

- Able to deal with new technology.
- Generating new knowledge.
- Expert in capturing and transferring of information.
- Sharing knowledge without any geographical limitation.
- Manage knowledge as an asset.
- Representing knowledge in documents and database.

CONCULSION :-

Knowledge Management helps library andinformation professionals in improving the servicesbeing rendered to their users.Knowledge management plays a role in the academic libraries in the digital age. Knowledge management functions facilitate communication, collaboration and coordination by means of frequent application of technologies conducive to knowledge creation and knowledge sharing. Knowledge sharing facilitates change in an academic library. Information professionals have to recast their roles as knowledge professional. Knowledge Management is not owned by any one group in an organization, nor by any one profession orindustry. Knowledge management requires a holistic and a multidisciplinary, approach to managementprocess and an understanding of the dimensions of knowledge work. It is an evolution of good management practice sensibly and purposely applied. But librarians and information specialists, if they want to be, key players in the emerging knowledge management phenomenon, have to understand the multiple persepectives of the other players. Knowledge Management occupies a very out standing position in thecreation of the knowledge innovation system of a country. Knowledge Management has become a powerful tool for promoting innovation and realizing re-engineering the various walks of life.

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Beyond the Shelves: A Futuristic Exploration of AI-Driven Knowledge Management in Academic Libraries

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Abstract:

Artificial Intelligence (AI) is revolutionizing knowledge management systems in academic libraries by providing new opportunities for information organization, retrieval, and user interaction. This study explores the significant effects of AI technology on academic libraries, discussing the advantages and disadvantages of their implementation. Examining the possible uses, we talk about automated classification and cataloguing, utilizing natural language processing for improved information retrieval, tailored suggestions, and predictive analytics. Simultaneously, issues like algorithmic bias, data privacy, and the need for human supervision are discussed. With an emphasis on user experience, we investigate chatbots, virtual assistants, and AI-driven interfaces, demonstrating how they can improve user engagement. Looking ahead, it becomes increasingly important to foresee new trends. In order to fully utilize AI's potential while navigating ethical issues, the study finishes by highlighting the importance of taking a balanced approach and providing insights for future research in the ever-changing field of AI in academic libraries.

Keywords: AI, Knowledge Management Systems, User Experience, Information Retrieval, Academic Libraries, Obstacles, Possibilities.

1. Introduction:

Leading the way in knowledge dissemination and scholarly endeavor support are academic libraries. The evolution of the digital era is bringing about a transformation in traditional knowledge management systems through the integration of Artificial Intelligence (AI) into academic libraries. This section lays the groundwork by outlining the changing environment and emphasizing how important university libraries are to promoting intellectual inquiry. The introduction of AI signals a paradigm change in these organizations, offering revolutionary improvements in the way information is arranged, accessible, and used.

The paper's main idea is explored in the introduction, which also addresses the necessity for a thorough analysis of AI's impact on knowledge management systems in academic libraries. This section aims to highlight the need of libraries adjusting to technological developments in order for them to continue being active and efficient centers of knowledge dissemination. It does this by setting the scene for the evolving dynamics of information management. Furthermore, it emphasizes the wider ramifications of AI adoption for academic institutions generally as well as for libraries, laying the groundwork for a thorough examination of the opportunities and difficulties in

2. Opportunities and Applications of AI in Academic Libraries:

a. Automated Cataloguing and Classification: Artificial Intelligence (AI) technologies present a revolutionary method for academic libraries' cataloguing and classification procedures. Large volumes of data may be accurately and quickly analyzed and categorized by automated systems using machine learning techniques. This improves resource organization precision and consistency while also speeding up the cataloguing operation. AI may be used by libraries to classify a variety of resources, such as books, papers, and multimedia files, guaranteeing a more user-friendly and effective access system.

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b. Information Retrieval with Natural Language Processing (NLP): NLP is a key component in improving academic libraries' ability to retrieve information. Libraries are able to comprehend and reply to user inquiries more efficiently thanks to AI-driven NLP algorithms. Users can conduct information searches using natural language, and AI systems can retrieve pertinent resources by means of semantic analysis, going beyond conventional keyword-based searches. This supports a more natural and easier-to-use search interface, in line with the changing needs of contemporary library patrons.

c. Personalized Recommendations: AI makes personalized recommendation systems possible by analyzing user behaviour and preferences. Libraries may provide personalized recommendations and improve user experience by monitoring user interactions and content consumption trends. In addition to helping users find pertinent resources, personalization raises user satisfaction and engagement. Recommendation algorithms bring academic libraries closer to modern content delivery models and foster a sense of community among users as they navigate a carefully curated information ecosystem.

d. Predictive Analytics: Academic libraries may now better anticipate user requirements and allocate resources by utilizing AI-powered predictive analytics. Libraries can proactively allocate resources, improve services, and hone collection development strategies by examining past usage patterns and trends. With the use of predictive analytics, libraries can more effectively manage funds and modify their collections to meet changing academic requirements by anticipating the demand for particular materials. With this forward-thinking strategy, academic libraries become dynamic, adaptable organizations that are well-suited to satisfy the constantly shifting needs of the academic community.

3. Challenges and Considerations:

a. Bias in AI Algorithms: Algorithmic prejudice is a difficulty that arises with the incorporation of AI in academic libraries. Algorithms may reinforce preexisting biases in the data as they learn from past data, producing unfair and discriminating results. Libraries need to take action to identify and reduce prejudice, highlighting the value of representative and diverse datasets. The ethical implications of prejudice are significant, necessitating ongoing observation and improvement to guarantee AI systems adhere to fairness and equitable norms.

b. Data Privacy Issues: As AI becomes more widely used in academic libraries, data privacy issues become more pressing. Data security becomes critical when AI systems process and analyses massive volumes of user data. Libraries need to set up strong data security procedures to make sure privacy laws are followed. Building trust and protecting library users' privacy rights requires open communication with users about data collecting procedures and the use of anonymization techniques.

c. Human Oversight: Although AI systems can be more efficient, human monitoring is still necessary. Human intervention is necessary in critical decision-making processes, particularly those that affect the organization and retrieval of information, in order to avoid unintended consequences. To ensure responsible and ethical use of AI, libraries should set up clear standards for human oversight that specify roles and duties. In order to handle complicated questions, reduce bias, and resolve moral conundrums that may come up during AI-driven decision-making processes, human expertise is crucial.

d. Interdisciplinary Collaboration: Information professionals, data scientists, and subject matter experts must work together to successfully integrate AI in university libraries. It is a challenge that calls for interdisciplinary collaboration to close the knowledge gap between technical and domain-specific expertise. Libraries should encourage staff members from different backgrounds to work together in a collaborative setting that promotes knowledge sharing and skill development. Through this partnership, it will be ensured that AI technologies are properly deployed to meet the particular information needs and challenges within academic disciplines.

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e. User Education and Awareness: Users must be made aware of the limitations and capabilities of AI before it can be introduced into libraries. Libraries need to take the initiative to educate users about AI integration in knowledge management systems through proactive user education programmes. Users ought to be aware of the privacy protection procedures in place, the consequences of personalized services, and how AI algorithms operate. Creating open lines of communication guarantees that users have the information they need to make wise choices and fosters confidence in the ethical application of AI in academic library settings.

4. Impact on User Experience:

a. AI-Driven Interfaces: By incorporating AI into academic libraries, user interfaces are transformed and become more responsive and intuitive. AI-powered user interfaces are capable of personalizing the experience by responding to user choices. These interfaces utilize machine learning algorithms to learn from user interactions, customizing the information displayed and streamlining navigation. The dynamic adaption improves customer happiness and streamlines and user-friendliness of the library experience.

b. Chatbots and Virtual Assistants: By providing real-time support, chatbots and virtual assistants driven by artificial intelligence (AI) improve user engagement. These clever systems have the ability to respond to questions, direct users to resources, and offer immediate assistance. In particular, chatbots enhance the user experience by providing prompt responses, freeing up library professionals to handle more complicated queries. Natural language processing-capable virtual assistants provide a conversational interface that enhances user interactions and promotes an approachable, user-focused library environment.

c. Personalized Recommendations: The user experience is greatly impacted by AI's capacity to provide personalized recommendations. Libraries are able to provide customized recommendations for pertinent materials by examining user behaviour and interests. In addition to making resource finding easier, this personalization pushes users to investigate a wide variety of content that is in line with their academic interests. Within the library ecosystem, personalized recommendations generate a positive feedback loop that raises user pleasure and engagement.

d. Enhanced Accessibility: AI-based solutions help make academic libraries more accessible. For users with a variety of needs, text-to-speech features, image recognition, and language translation capabilities enhance resource accessibility. These characteristics enable libraries to serve a wider range of patrons, guaranteeing that all users may take use of the wealth of knowledge found in the library's resources, irrespective of their skills or level of language ability. AI-driven accessibility features promote diversity, which makes academic libraries more egalitarian and user-focused.

e. Continuous Improvement through User Feedback: Iterative feedback systems enable artificial intelligence to support ongoing improvement in the user experience. By examining how users engage with AI-powered services, libraries can pinpoint areas that need improvement and improvement. In order to better match customer expectations and optimize algorithms, interfaces, and services, user input becomes an invaluable resource. By taking an iterative approach, the academic library experience is guaranteed to change according to user requirements, creating a dynamic and adaptable setting that stays at the forefront of technology innovations.

5. Future Trends:

a. Integration of Advanced AI Technologies: Advanced technologies like computer vision, natural language processing, and machine learning models will be integrated into academic libraries in the future. Libraries will be able to create more complex, context-aware knowledge management systems thanks to these technologies, which will improve the precision and effectiveness of information retrieval even further.

b. Semantic Search and Understanding: As AI drives semantic search, libraries will be able to go beyond keyword-based searches. Deeper comprehension of user intent and context by AI algorithms will make search results more accurate and nuanced. Semantic technologies will transform academic libraries and improve information retrieval by making it more contextually relevant and user-friendly.

c. Integration of Augmented Reality (AR) and Virtual Reality (VR): The future of academic libraries could greatly benefit from the integration of AR and VR technology. While virtual reality (VR) environments can offer immersive virtual experiences for study and learning, AI-driven augmented reality (AR) applications can offer users enhanced information overlays in physical library spaces. With the help of these technologies, the idea of a library as a physical location will be reinterpreted, and user participation and cooperation will be increased.

d. Explainable AI (XAI): This emerging topic in academic libraries will address the interpretability and transparency of AI systems. XAI makes ensuring that decision-making processes powered by AI are transparent and responsible. AI systems that give concise justifications for their suggestions and actions will be given priority implementation in libraries in order to build user and librarian confidence.

e. AI Collaboration in Research Support: Artificial Intelligence will become more and more integrated into research support services. AI systems that help researchers with literature reviews, data analysis, and knowledge synthesis will be adopted by academic libraries. Researchers will be able to expedite their research, find pertinent materials more quickly, and optimise their processes with the use of collaborative AI tools.

f. Ethical AI Frameworks: The creation and implementation of ethical AI frameworks will be crucial as AI permeates more aspects of academic library operations. Libraries will set rules and regulations, addressing concerns like bias, privacy, and transparency, to guarantee the ethical and responsible use of AI technologies. AI deployment tactics in academic library environments will increasingly incorporate ethical aspects.

g. Dynamic Learning Environments: AI will help academic libraries develop dynamic, adaptable learning environments. AI-powered smart learning environments will tailor lessons to each student's interests and learning preferences. AI will be used in these settings to customize content, events, and support services, resulting in a dynamic ecosystem that meets the various demands of teachers, researchers, and students.

h. Cross-Institutional Collaboration: Academic libraries will work together across institutions to fully utilize artificial intelligence. Libraries will be able to pool knowledge and resources through the creation of AI consortia, cooperative research projects, and shared AI resources. This cooperative strategy will encourage creativity and enable academic libraries to work together to solve problems and make use of AI technologies for the good of the larger academic community.

6. Conclusion:

To sum up, the incorporation of artificial intelligence (AI) into academic library information systems offers revolutionary prospects, ranging from automated cataloguing to improved user experiences. Even while AI-driven developments are very promising, it's critical to address issues like bias, privacy concerns, and preserving human control. A change towards a user-centric approach is indicated by the impact on user experience, which is typified by personalized recommendations and intuitive interfaces. Future developments, such as cutting-edge technology and moral issues, highlight the necessity of implementing AI responsibly. In order to maintain continuous excellence in knowledge management as academic libraries embark on this path, it is crucial to strike a balance between innovation and ethical norms. The changing environment ushers in a new era of intelligent libraries at the vanguard of scholarly assistance, demanding continual collaboration, interdisciplinary approaches, and a dedication to user-centric design.

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Traditional Library to Mobile App/web based Library for Effective Services of Library

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Abstract
Today‟s era is known as mobile Apps or internet era. It is used to provide fast facility or services in every field through mobile Apps and web. As a result, libraries face new challenges, competitors, demands, and expectations. Libraries are redesigning services and information products to add value to their services and to satisfy the changing information needs of the user community. Traditional libraries are still handling largely printed materials that are expensive and bulky. Information seekers are no longer satisfied with only printed materials. They want to supplement the printed information with more dynamic electronic resources. Technology is one of the foundations of today‟s library. In the present era, libraries are under going a dramatic transformation. On one side they are facing the challenges of high cost of publication, shrinking budgets, increasing cost of maintenance of collection, shortage of space and trained manpower. The Technology is coming like a speeding train or tidal wave invertible and unstoppable. With exponential in the size of storage ,a phenomenal increase in the processing speed ,decrease cost of hardware and user friendly software , the technology provide new services , new products like electronic resources, digital library, ICT enabled services etc. Today‟s users no longer want to visit the library for a few hours of quiet reading. Instead, they want a quick and technology based solution to everything.

Smart phones have made it possible to contact any relevant organization from anywhere for accessing valuable library resources. This paper describe on providing library services through mobile Apps. The Mobile Apps/web based library services, their features, advantages and disadvantages. Different web based services i.e. Mobile Apps, webpage, Web OPAC, ask-a- librarian have been highlighted

Keywords: - Mobile Apps, Web Based Services, Library Web page, Web OPAC, Ask-A-Librarian, Digital Library Services, Electronic Reference Services etc.

Introduction

Advanced in Information and Communication technology and increased use of smart phone, people are increasingly using data connections to fulfill their need. People can access and order for product online, connect to social media, pay bills, check mails, paying games, booking tickets, and many more activities by using different mobile apps. Library can create their mobile apps to give the library services to users. Therefore mobile phone is not a phone it has become an essential human need. Libraries and Information Centers the traditional methods of offering library and information services have changed greatly in recent years because of the development and application of new technology, especially the Internet and web technologies. The demands and expectations of users have also changed considerably.

In this changed scenario, more and more libraries in the world over are exploring and offering new web-based library services. Technology has become the key part of our lives today. Indeed so many aspects of our behavior are governed by the need to stay connected to the world through technology. Today‟s users no longer want to visit the library for a few hours of quiet reading. Instead, they want a quick and technology based solution to everything. In this digital era, information seeking behavior is constantly changing and the younger generations need to be drawn in through newer, more interesting means. This applies equally to the use of the library. Librarians today are facing challenges in making the users aware

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about the library resources and services. There are different aspects through which a library can make the information available instantly to the fingertips of the young generation and attract them. The opportunity to use the library in a different way will directly and indirectly promote the reading habit among young generation. In this emerging era of internet, more specifically the World Wide Web which is one of its major services has completely revolutionized the way to communicate, studying, teaching, business, employment, education, healthcare and more.

Web Based Library Services are mainly provided through the library portal which is a special kind of gateway to web based library resources. It provides integrate access to the metadata of a library"s multiple databases. It gathers a variety of useful information resources into a single webpage that allows users to customize their information resources by selecting and viewing information they find personally useful (Jackson, 2002). Some of the commonly used
web based library services are library webpage, CD"s, e-books, audio book, Blu-ray, web OPAC, Bulletin Board Services, Ask-a-Librarian services, web forms, digital reference services, online document delivery, interlibrary loan, online help and information skill tutorials, online current awareness bulletins, e-mail based services, online reference services, electronic journals (UGC- INFONET digital library consortium), online circulation service, electronic SDI services, online acquisition, electronic article alert service, etc.

What are the library services?

Library Services: Library Services are defined as the facilities provided by a library for the use and dissemination of library material like books, journals, theses, dissertations, etc. in order to meet the users" requirement.

Let us know the meaning of the terms „Mobile phone" and „Mobile App"

Mobile / Smart Phone?

According to Oxford Advanced Lerner"s Dictionary „Mobile phone means a telephone that does not have wire and works by radio, which can be carried and used anywhere"

„App" means application software. Actually in the 2010 „App" is listed as word of the year by American Dialect society.

Mobile App?

Mobile app is a computer program designed to run on mobile device such as smart phones which are usually available through application distribution platform which originated in 2008 some or the apps are free and some are chargeable. It is usually helps users to access internet user- friendly.

Types of Mobile Apps: there are three types of app Native, Web and Hybrid these are currently available.

What is WEB?

World Wide Web is one of the services of the internet. It is a way of accessing integrated information in the form of web pages over the medium of internet with the help of web browsers. The web is a client or server system used to access all kinds of information to anyone on the net.

The information can be in the form of regular text, hypertext, pictures, sounds, Usenet newsgroups and other types of data. To access this information, use a client program called browser. Within the web, the information is stored in pages. Each page can hold not only information but links to other pages. The WWW may represent an intermediate form between recorded and unrecorded communication and information transfer. Because it is a new medium we have not yet fully identified the dynamics of its behavior. Keeping in mind today's tremendous increase in information and changing users behavior we can say that web is an ideal media for providing information

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Mobile App/Web based Library Services

Web based library service is a kind of digital Library service that manages and develops electronic services, the library websites and library staff. Some of the common web based library services are as follows:

Access to Database

Several publishers today offer web-based, intranet solutions for providing local access to their databases. Examples include Silver Platter, Cambridge Scientific Abstract and Institute for Scientific Information. Journal publishers have also begun to offer similar situation, for example Elsevier, for electronic version of their journals. Large R&D libraries can take advantage of these developments and provide desktop access to key database and electronic publications to their users.

Bulletin Board Services

A bulletin board is a public discussion area where people can post message without sending them to anyone's e-mail address that can be viewed by anyone who enters the area. On CompuServe a bulletin board is called a forum. On the Internet, the equivalent areas are called newsgroups

Frequently Asked Questions (FAQ)

FAQ stands for Frequently Asked Questions. A compilation of Frequently Asked Questions and their answer is referred to as a FAQ list or FAQ article. FAQs are compilations of information which are the result of certain questions constantly being asked hence the name FAQ. There are thousands of FAQs on the World Wide

E-Books;

An electronic book, also known as an e-book or eBook, is a book publication made available in digital form, consisting of text, images, or both, readable on the flat-panel display of computers or other electronic devices. Although sometimes defined as "an electronic version of a printed book", some e-books exist without a printed equivalent. E-books can be read on dedicated e- reader devices, but also on any computer device that features a controllable viewing screen, including desktop computers, laptops, tablets and smartphones.

E-Journals

Electronic journals or e-journals", are used for those journals and newsletter that are prepared and distributed electronically. Electronic journals may be defined very broadly as any journals, magazine e-zine ,webzine, newsletter, or types of electronic serial publication which is available over the internet and can be access different technologies such as WWW, Gopher ,ftp, telnet, email .several traditional journals are now being publish both on the web and in print .content lists for most the journals are available on the web or distributed to subscribers as an email text massages or through technologies like RSS Atom.

Course Material:

A large number of web based course ware and teaching aids are being developed to facilitate flexible open learning by many universities and commercial organizations. Many academic institutions have adopted such course material for their curricula. Libraries can provide access to course material to the learners and teacher and thus contribute to open learning. This can be done by providing links to the courseware sites through subject gateways or provide local access after downloading the material.

Resource Sharing:

Resource sharing „give‟ and „take‟ which is other words means that the library should be prepared to allow other libraries to use your resources and in turn, you can use their resources. The libraries having howsoever large resources cannot be self sufficient. In the ultimate analysis, it will have to depend upon other libraries for information requirement of its readers. The needs of readers have also changed over the years. As a person does not work in his speciality alone, but research or teaching work being interdisciplinary, he has to draw material from other disciplines as well.

Campus News: Information about the new activities of the college or the library can be provided to the user through campus News.

Reference Service:

Asynchronous tools such as email, subject gateways, FAQs, and electronic libraries and interactive tools like chat rooms, virtual reference desk, and ask-me are replacing the conventional means of post, phone or in-person reference enquiries.

Bibliographic Service:

Compilation of bibliographies, reading lists and state-of-art reports are very parts of LIS work, particularly in research and academic libraries. Browsing through the manual indexes and abstracts is a tedious and time consuming work, and does not always produce up to date result. Availability of databases in electronic form on CDROM or online, offers convenient, efficient and cost effective information retrieval. Electronic databases also provide unique search features such as searching on multiple criteria (key-word, subject, author, source, classification code, year of publication, language etc.), and variety of display formats & styles.

Promoting Library Services in the Changing Era

There are various ways that may be explored to promote reading habit among youth

Web OPAC: In the library page OPAC (on line public access catalogue) must be incorporated. This should be a real time catalogue and should be accessible from web/mobile/tab etc. The page may include the new books on display (images of the books should be there). Users can easily search and get to know if any particular book is available in the library or not. If the book is out in that case one should be able to reserve the same online. When the book is back to the library a sms/email alert may be sent from the system itself. An online demo may be placed on the site to help the users to search the catalogue of the library. Online Search Techniques may be added in the demo.

Author of the month: Every month a particular author may be promoted. The page should be designed such a way that it can provide all the necessary information in a compact form. To start

with popular authors may be highlighted and slowly new authors may be introduced so that users can get to know about the new authors and their area of writings and can get attracted to read more books by these authors. Also a link to the author‟s page may be given so that the users can get more information if they wish. This can be accessed any time from their mobiles/tabs/laptops/desktops etc.

Reader corner: There may be a provision for the users to share their views about their reading. Also recommendations from the users about any book/author may be included in the webpage. A virtual reader group may be formed and a physical meet may be organized to read and discuss on a certain interval. Library should be equipped with Tabs and other new technology gadgets to attract readers for this session. A facilitator may be there (may be some author) to make the reader group interactive. The pictures of the reader group (with prior permission from them) with their views may be published on the webpage to make it more interesting.

Blog writing: In the website there may be link to the blogs that users will write after reading library books online. There should be someone from the library who could assist children on this. Skilled library staff is required to coordinate this on a regular basis which is definitely going to attract young adults. Users can interact with each other to discuss a particular book through this blog.

Virtual Reference Service: It may be a good idea to incorporate a virtual reference service. Ask a Librarian concept may be introduced so that children can interact via their mobile/tab/laptop/desktop with the librarian from anywhere to get the required information quickly.

Event alert: If library is organizing any event for e.g. book launch, Author"s talk, video screening, web conferencing on "World-Book-Day" etc. then a pop-up message may be put on the website and an online registration may be allowed. Same may be sent to the users via sms/email and simultaneously be published in social media. Web-casting may be done so that users can participate online.

Project mapping

To run these projects some of the areas need to be checked. Some of them are:

Library Infrastructure: Existing infrastructure needs to be checked and an assessment needs to be done about the required infrastructure including the budgetary allocation that is essential for providing the new service.

Staffing: Proper skill development for the staff is required so that they can take up the challenge. Also building proper behavioral competencies is required to make them feel comfortable in serving the user in a new way.

Collection development: A vital point is to procure appropriate digital/physical collection. A project team may be formed to decide the modalities of the new service.

Proper promotion: Promotion needs to be done such a way so that the target group gets to know about the project and attract to participate.

Advantages of Mobile app / web based services

- There are millions of smart phone users the library can reach the greater number of audience.
- Mobile apps are easy to access and use.
- They are user friendly in operation.
- No need login every time
- No need to remember the user name and password
- To save the precious time of the researchers.
- Some mobile apps are work offline.
- Access information 24/7
- Many more apps are free of cost.
- Uniform look and feel good.
- Availability of less number of library staff to carry out the library works and services
- Less dependence upon the library staff for getting the required information
- Location of laboratories/ departments in different places in the campus
- Instant and elaborate information requirements for R&D activities
- Information for decision making in MIS
- Multifold increase of the cost of books and journals
- Availability of information in different places and also in different formats
- Cut in library budget.

Promoting the Library Mobile App

Creating a library mobile app is not enough, it needs to be promoted. To promote the library mobile app librarians can print a pamphlet or brochure in which they can mention the key benefits available in the app and reinforce how to use the various features of the app. The app can be advertised through.

- Display pamphlets or brochures in the library
- Sending pamphlets or brochures via e-mail or SMS on social media.
- Also get feedback from others about the library app from the same source.

Conclusion

Providing online information and service has become a core function of today"s libraries and information centre. Mobile Apps are the best user friendly way to disseminate library information products and services online. Nowadays Wi-Fi is an available everywhere, especially in College, Railway stations, universities and others places, so that we can use this technology and provide services through mobile apps that are easily accessible to information users.

Web based library services have become a trend. Libraries are taking full advantage of online facilities. They are making necessary changes in the way they provide services. Website content needs to be improved to meet the needs of today's youth and attract the youth. Designing products and other tools for mobile devices is an essential component. Users are very happy with mobile apps and online library services. It can save them time and trouble getting information. Ways to make virtual libraries visible is a challenge and today's libraries must embrace this challenge to survive in the changing era of library information services.

This modern service should be used in all libraries to serve maximum users. If the library is to survive in today's modern era, this aspect must be included.

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Knowledge Management in library-information centers and it's Need for LIS professionals

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Abstract:
A new and emerging discipline like knowledge management (KM) there still will be ambivalence among both LIS educational institutions and their students, as to the need to have KM courses. Investigating the benefits of engaging with these programs might help to clear up this ambiguity. The present paper seeks to shed light on this issue, based on the result of a research study completed in 2008 on the implications of KM for LIS education. The research sought perceptions of the LIS international community and in particular LIS academics.
Keywords: Knowledge Management (KM), Library and Information Science (LIS), education, educational outcomes.LIS profession. LIS education. Library and information centre.

Introduction to knowledge management

There is very limited consensus concerning a definition of knowledge management (KM), partly because of its multidisciplinary origins, ranging from organizational science and cognitive science to library and information science (LIS) (Dalkir, 2009). KM is based on the theories, metaphors, and approaches of a number of disciplines. Its intellectual origins are profound and relatively extensive, influenced by philosophy, economics, psychology, sociology, education, communication theory, and also LIS (Wallace, 2007), making it difficult to achieve one generally used definition. More widely accepted definitions include the following, for example: “knowledge management is the process of capturing, distributing, and effectively using knowledge” (Davenport & Prusak, 2000, p. 107) .

Role of library and information centre:

The basic information role of the library is to collect material containing information through appropriate methods. It is primarily in this sense that a library is described as an information centre. As a learning organization, libraries should provide a strong leadership in knowledge management. Libraries should improve their knowledge management in all of the key areas of library services. To cope with the exponential growth in human knowledge, libraries need to develop their resources, access and sharing strategies from printed to electronic and digital resources. Limited by funding, technology, staff and space, libraries must carefully analyze the needs of their users and seek to develop cooperative acquisition plans to meet the needs of users. Libraries should be developed and maintained an integrated online public access catalogue (OPAC) with both internal and external resources as well as printed and other formats of knowledge. Useful websites and knowledge sources should be regularly searched and knowledge management system should be in place. Latest information technology should be used in the libraries. In this regard, the library director/librarian should consider himself as the chief knowledge officer of the entire organization and should work together with the chief information officer, heads of the planning department, the computer and information technology center, the human resource management department, the finance department etc., to design and develop such a system. Such knowledge management system should be built on the existing computer and information technology infrastructure including upgraded intranet, extranet, internet and available software programs to facilitate the capture, analysis, organization, storage and sharing of internal and external information resources for effective knowledge exchange among users, resource persons (faculty, researchers, subject

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experts etc.), publishers, government agencies, business and industries and other organizations via multiple channels. In recent years, many of the newly developed information technology for databases and information/document management can be utilized in knowledge management such as data warehousing, data mining, text mining etc. Library and information centers should be developed / modified based on the perfect environment for new media applications. Due to impact of globalization, economic competition and revolution of ICT, the libraries are undergoing tremendous change in its environment. ICT tools and techniques, knowledge management systems, internet, web resources, digital libraries have made a significant change in the existing library systems and services. It is a major challenge for the library professionals. Knowledge acquisition is the starting point of knowledge management in Libraries. The application of IT enlarges the scope of knowledge acquisition, raises knowledge acquisition, speed and reduces knowledge

Attending to favorable working conditions and environment, this will contribute to better staff retention. The utmost goal of knowledge management is to provide users with a variety of quality services in order to improve the communication, use and creation of knowledge. Information about each user can be obtained by analyzing the records of user registration, surveys, circulation and inter library loan, frequently asked reference questions and the use of e- journals and digital resources etc. User satisfaction and needs should be collected through periodical user's surveys. The findings should be used for the planning and redesign of the existing library services. Some of the manual services of the library such as "new publication alert" and "dissemination of information" should be done automatically by employing the "push technology" with great efficiency and convenience. Each library user can also set up his virtual "my library/portal" for new information/resources provided by the library.

Services in knowledge management information network in India

The recognition of the vital role in Library, Information Systems and Services in India) could play in the educational, scientific, and industrial and over-all socioeconomic development of India began to receive acceptance only after independence in 1947, when the government embarked upon several programmers of national development and reconstruction. Infrastructure of LIS has been developed in the country during the past five decades or so. Though much remains to be done in this field yet the achievements already made can largely be considered as commendable providing an optimistic basis for the future. Besides the developments in different types of libraries, documentation/information centers, bibliographical services, etc; library and information networks at local level such as DELNET and CALIBNET and at the national level such as ENVIS, NISSAT and INFLIBNET and others are being developed. Access through information networks such as NICNET, ERNET, SIRNET, INDONET and several others is being utilized in the LISS in the country for services such as CAS and SDI. INTERNET facilities are being used in many libraries and information systems for benefit of the users. The development in teaching and research in social sciences certainly emphasizes the need for well stocked libraries and information centers with proper library and information services and manned by well qualified staff. The total number of libraries in social sciences either as part of the universities, government departments, autonomous or semi-autonomous organizations or institutions can be estimated to be around 850.

Conclusion :-

There are a few basic changes that pose challenges to modern libraries towards acquiring and managing larger and larger bodies of knowledge; they are: globalization, decentralization, customization and acceleration. Modern libraries are dependent on technology, which is highly diversified in their product and services they offer. These factors make decision making extremely difficult. These problems can be overcome with the effective

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utilization of traditional resources as manpower, materials and money as well as information and knowledge resources. That is where the role of knowledge managers comes into play.
Internet a wonderful invention of modern society has revolutionized the entire work culture and managerial aspects of libraries and information centres and LIS professionals by playing a key role in building the true image of knowledge management .Most of the technological tools now available in LIS segment tend to help in how to disseminate information but offer less assistance for how to use Knowledge. Tools that assist in knowledge creation are even less and not well developed particularly in libraries and information centres, however, some of the more user friendly technologies such as face-to-face discussions, the telephone, electronic mail and paper based tools such as books, periodicals, film charts, etc. are traditional tools and are not much effective in knowledge management in changing perspectives and emergence of new sophisticated technologies.

Knowledge creation and management LIS professionals must redesign and re-shape the traditional management tools and techniques and apply more advanced Knowledge Management tools for capturing, processing, preserving, and disseminating the contents to the user in a real time. Knowledge Management and its facets such as content management, content engineering, web content management, etc., require a holistic and multi-disciplinary approach to management processes understanding of the dimensions of knowledge work. Therefore, LIS professionals as they are the ultimate knowledge scientist .

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Embracing Open Science and Open Access Initiatives: A Comprehensive Review

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Abstract: In recent years, the scientific community has witnessed a transformative shift towards openness and accessibility in research. The principles of Open Science and Open Access (OA) initiatives have gained prominence, aiming to make scientific knowledge freely available to the global community. This article provides a comprehensive review of the key concepts, benefits, challenges, and future prospects associated with Open Science and Open Access.
Keywords: Open Science Practices, Open Access Practices, Open Science

Introduction

Open Science and Open Access represent transformative approaches to scholarly research and publication, ushering in a new era of accessibility, collaboration, and transparency in the scientific community. Open Science encompasses a broad set of practices that involve sharing research processes, data, and findings openly, fostering collaboration and innovation. Concurrently, Open Access focuses specifically on removing access barriers to scholarly publications, making research outputs freely available to the global audience.

Open Science:

At its core, Open Science emphasizes transparency and openness throughout the research lifecycle. This paradigm encourages researchers to share not only the final results but also the underlying data, methods, and software used in their studies. By doing so, Open Science aims to enhance the reproducibility of research, facilitate collaboration, and accelerate scientific discovery.

Open Access:

Open Access is a specific aspect of Open Science that addresses the issue of restricted access to scholarly publications. Traditional subscription-based models often limit access to research articles, hindering the dissemination of knowledge (Budapest, 2002). Open Access journals, repositories, and archives aim to eliminate these barriers, ensuring that research outputs are freely accessible to researchers, educators, and the general public (Suber, 2012).

In the following sections of this review, we will delve deeper into the key components of Open Science and Open Access, exploring their benefits, challenges, and future prospects in shaping the landscape of contemporary scientific research.

Need of Open Science & Open Access Initiatives:

Open Science and Open Access Initiatives are essential for promoting transparency, collaboration, and accessibility in research. There have been Accelerating Scientific Progress and open access accelerates Open Access accelerates the pace of scientific progress by allowing researchers to build on existing work, leading to more rapid advancements in various fields. (Tennant et. Al.,2016). According to Nielsen (2011), Open Science facilitates collaboration by breaking down barriers to access, encouraging interdisciplinary work, and fostering innovation through the sharing of ideas and data. As indicated in the literature by Nosek et.al. (2015), Open Science initiatives promote transparency, contributing to the reproducibility of research and ensuring the reliability of scientific findings. More over Open Science emphasizes ethical considerations, fostering a culture of accountability and integrity in research practices. (Resnik & Shamoo, 2017). Open Access ensures that scientific knowledge is accessible globally, promoting inclusivity and allowing researchers worldwide, including those in resource-limited settings, to contribute and benefit (Bucchi & Trench, 2014). Open Science initiatives contribute to public engagement by making research findings accessible, fostering scientific literacy, and allowing citizens to participate in informed discussions.

Significance of Making Research Freely Accessible:

Making research freely accessible significantly increases its visibility and impact. Open Access articles tend to receive more citations compared to those behind paywalls, contributing to the broader dissemination and influence of research findings (Lawrence, 2001). It also ensures that knowledge is not confined to specific institutions or regions. Freely accessible research enables global knowledge sharing, allowing researchers from diverse backgrounds and locations to benefit from and contribute to scientific advancements (Willinsky, 2003).

By removing access barriers, Open Access facilitates collaboration and accelerates the pace of scientific progress. Researchers can build upon each other's work more efficiently, leading to faster advancements in various fields (Suber, 2012). Open Access promotes public engagement with science. When research is freely accessible, it becomes more available to policymakers, educators, and the general public, fostering a better understanding of scientific developments and their implications (Björk & Solomon, 2013). Open Access aligns with the principles of equality and inclusivity. It ensures that individuals, regardless of their financial or institutional affiliations, have equal access to scholarly information, reducing knowledge disparities (Suber, 2015). According to Boulton, freely accessible research encourages interdisciplinary collaboration. Researchers from different disciplines can access relevant information, leading to the cross-pollination of ideas and the emergence of innovative solutions to complex problems (Boulton et al., 2011).

These studies underscore the importance of making research freely accessible, emphasizing its positive impact on the dissemination of knowledge, collaboration, and the advancement of science for the benefit of society as a whole.

Understanding Open Science

Open Science is a multifaceted concept. Open Science is a transformative and inclusive approach to scientific research that emphasizes transparency, accessibility, and collaboration across the entire research process. It entails the open sharing of research outputs, methodologies, and data, making scientific knowledge freely available to the global community. This paradigm seeks to break down traditional barriers in academia, encouraging collaboration, reproducibility, and the democratization of knowledge. (European commission, 2016). While According to Royal Society(2012) Open Science is about making scientific research and data accessible to all, and is often linked with the use of digital technologies."

Key Components of Open Science:

1. **Open Data:** Open data involves making research datasets freely available to the public. This transparency allows others to scrutinize, validate, and build upon the data, promoting reproducibility and collaboration. (Borgman, 2012)
2. **Open Methods:** Open methods involve transparent documentation of research methodologies, including experimental designs, procedures, and analytical techniques. Researchers provide detailed information to enable others to understand and replicate the study. (Nosek & Bar-Anan, 2012)
3. **Open-Source Software:** According to Morin (2012) Open-source software refers to programs whose source code is made freely available for modification and distribution. In the context of Open Science, it involves using and sharing software tools that are openly accessible.
4. **Collaborative Platforms:** Collaborative platforms are online spaces where researchers can share, collaborate, and communicate about their work. These platforms may include repositories, version control systems, and project management tools (Katz, 2018).

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5. **Open Access Publications:** Open Access publications make scholarly articles freely accessible to the public without subscription or payment barriers. Researchers can publish in Open Access journals or deposit their work in institutional repositories.
6. **Citizen Science:** Citizen Science involves engaging the public in scientific research, allowing non-professional scientists to contribute to data collection, analysis, or problem-solving. (Bonney, et. Al., 2009; Haklay, 2013).

These key components collectively form the foundation of Open Science, promoting transparency, collaboration, and accessibility in the research process.

Understanding Open Access

Open Access (OA) is a movement in scholarly publishing aimed at removing barriers to accessing academic research. The goal is to make scholarly publications freely available to the public, allowing anyone with an internet connection to access and use the information without financial or legal restrictions. This movement emerged in response to the rising costs of accessing academic journals and the desire to democratize knowledge by ensuring that research is accessible to a global audience.

Key components of Open Access

Open Access (OA) is a publishing model that provides free, immediate, and unrestricted online access to scholarly research outputs. The key components of Open Access include:

1. **Free Access to Content**: Open Access ensures that scholarly articles, research papers, and other outputs are freely accessible to anyone with an internet connection, removing paywalls and subscription barriers. (Budapest Open Access Initiative, 2002)
2. **Permission for Reuse**: Open Access content typically comes with licenses that allow users to reuse, remix, and redistribute the material, fostering innovation and collaboration.
3. **Author Retains Copyright**: Authors often retain copyright of their works, allowing them to control how their research is shared and reused. (Suber, 2012).
4. **Immediate Online Availability**: Open Access content is published online without delays, providing rapid and widespread dissemination of research findings.
5. **Institutional Repositories:** Universities and research institutions often maintain repositories where researchers can self-archive their works, contributing to the Open Access movement.(Harnad & Brody, 2004).
6. **Gold and Green Open Access:** Gold Open Access involves publishing in OA journals, while Green Open Access involves depositing preprints or postprints in repositories. Both models contribute to OA. (Sale et.al., 2014).
7. **Funding Models:** Various funding models support Open Access, including author-pays (Article Processing Charges - APCs), institutional support, and consortium agreements. (Morrison, 2017).
8. **Open Access Advocacy:** Advocacy efforts by organizations, researchers, and institutions play a crucial role in promoting Open Access principles and policies.

Benefits of Open Science and Open Access

1. **Global Accessibility:** Open Science and Open Access play crucial roles in enhancing global accessibility to scientific knowledge by removing barriers to information and fostering collaboration.
2. **Global Knowledge Sharing:** Open Science and Open Access facilitate the free and unrestricted sharing of research outputs, making knowledge accessible to a global audience. (Suber, 2015)
3. **Inclusivity and Diversity:** Open Science promotes inclusivity by allowing researchers from diverse backgrounds and geographic locations to contribute to and access global knowledge.
4. **Accelerated Scientific Progress:** Open Science accelerates the pace of scientific discovery by enabling real-time collaboration and the rapid dissemination of research findings. (Nielsen, 2011).

5. **Citizen Science Participation:** Open Science encourages citizen participation in research, enabling individuals outside academia to contribute to and engage with scientific endeavors. (Heigwer & Boutros, 2018).
6. **Resource Utilization and Reproducibility:** Open Science promotes efficient resource utilization by avoiding duplication of efforts and fosters reproducibility by making data and methods openly available. (Nosek et. al., 2015).
7. **Global Collaboration and Interdisciplinary Research:** Open Science encourages global collaboration and interdisciplinary research by breaking down traditional silos and promoting the exchange of ideas.
8. **Educational Benefits**: Open Access ensures that educational institutions worldwide can freely access scholarly resources, supporting teaching and learning.
9. **Policy and Decision-Making Support:** Open Access research supports evidence-based policymaking by providing policymakers with freely accessible, up-to-date scientific information.

   By promoting openness and accessibility, Open Science and Open Access contribute to a more collaborative, transparent, and inclusive global research landscape.

VII. Challenges and Considerations

Implementing Open Science and Open Access initiatives faces several challenges that span technological, cultural, financial, and policy dimensions. Here are some key challenges along with relevant sources:

1. **Cultural Resistance**: Researchers and institutions may resist changing traditional publishing practices, often tied to reputation and career advancement. (McKiernan et. al., 2016).
2. **Sustainable Funding Models:** Establishing sustainable funding models for Open Access publications, such as dealing with Article Processing Charges (APCs) and transitioning from subscription-based models. (Morrison, 2018).
3. **Data Management and Sharing**: Ensuring effective data management, sharing, and interoperability, including addressing concerns about privacy, confidentiality, and intellectual property rights. (Fecher et. al., 2015)
4. **Infrastructure and Technology**: Developing robust and interoperable technological infrastructure to support Open Science practices, including data repositories, collaboration tools, and standardized formats. (Kraker et. al., 2011).
5. **Intellectual Property Concerns**: Balancing the desire for openness with concerns related to intellectual property, copyright, and licensing issues. (Samuel, 2015).
6. **Lack of Standardization**: The absence of standardized practices and formats for Open Science outputs, hindering interoperability and data sharing. (Ioannidis et. al., 2015).
7. **Policy and Institutional Support**: Insufficient policy frameworks and institutional support for Open Science and Open Access, including mandates for data sharing and publication in OA journals. (Laakso & Bjork, 2013).
8. **Quality Assurance and Recognition**: Establishing reliable mechanisms for quality assurance in Open Access publications and ensuring proper recognition for researchers contributing to Open Science.

Addressing these challenges requires collaborative efforts from researchers, institutions, policymakers, and publishers to build a more open and accessible research environment. It also involves ongoing discussions and adjustments in policies to foster a culture supportive of Open Science and Open Access.

Conclusion

In the realm of education and academia, the transformative potential of Open Educational Resources (OER) and Open Educational Practices (OEP) cannot be overstated. As we conclude our exploration of the research landscape surrounding OER and OEP, it becomes evident that these initiatives hold the key to unlocking an inclusive and impactful scientific ecosystem.The synthesis of research on Open Educational Resources (OER) and Open Educational Practices (OEP) underscores the transformative potential of open approaches in education. The positive impact on access, learning outcomes, and pedagogical innovation is evident, highlighting the need for a collective commitment to advancing these practices. As we navigate the challenges of OER adoption and OEP implementation, it becomes clear that building an inclusive and impactful scientific ecosystem requires collaborative efforts from educators, institutions, policymakers, and the broader educational community. This collective responsibility involves not only fostering awareness and addressing barriers but also actively promoting a culture of openness, sharing, and continuous improvement. Embracing this shared commitment is essential for realizing the full potential of OER and OEP in creating an education landscape that is equitable, accessible, and responsive to the evolving needs of learners worldwide.

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Current Trends in Library and Information Science in the New Information Era

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Abstract

The study seeks to trace the research trends in library and information science in India from 2000 to 2020, as documented in scholarly publications. Co-word analysis identifies core study themes by calculating the frequency of occurrence and analyzing descriptors assigned to journal articles by Indian authors indexed in the Library and Information Science Abstracts (LISA) database. The findings indicate a research trend centered on library practice, user services, cataloguing, user studies, university libraries, public libraries, information retrieval, library education, citation analysis, and bibliometrics, with a shift towards copyright, library technology, digital libraries, institutional repositories, CD-ROM databases, and electronic periodicals. According to the findings, LIS researchers are interested in open access, Web 2.0, the World Wide Web, the Internet, information access, and other emerging topics.

Introduction:

Research is a method for continuously advancing a discipline. It gives a field the ability to apply knowledge gained in other areas. It uses scientific procedures. In other words, research entails conducting systematic inquiries to establish facts and draw new conclusions. Tejomurthy and Kumar defined research in library and information science as the collecting and analysis of original data on a librarianship problem carried out inside library schools in accordance with scientific and scholarly standards (Barooah, 2001). Libraries and library schools in India do research on a wide range of library and information science areas. Dr. S.R. Ranganathan, the founder of library science, established the groundwork for research in India through his pioneering efforts. He established formal instruction in the library and information science disciplines at universities (Bhagi, 1982). However, the need for specific research centers to conduct specialized research has been discussed. Kanbur (1966) recognized the need for a centre of advanced research to investigate all elements of library and information sciences (Chaterjee *et. al.*, 1995). To strengthen research in library and information science in India, it is vital to understand the present areas of focus as well as identify developing areas of research (Kannappanavar & Vijayakumar, 2000).

There are several methods for identifying the core study areas in library and information science. Several studies have been conducted to assess research output in library and information science. Library and information science (LIS) education in India may be traced back to 1911, when a training course was introduced in the then-State of Baroda (Kumbar & Raju, 2008). Dr.
S.R. Ranganathan's activities at the Madras University Library, in collaboration with the Madras
Library Association, marked the commencement of systematic teaching in LIS from 1926 to 1931. Dr. S.R. Ranganathan oversaw Madras University's summer school that led to a diploma in library science until 1937. Later, Andhra University, Banaras Hindu University, Bombay University, Calcutta University, and Delhi University established Post-Graduate Diploma Courses in Library Science in 1935, 1941, 1944, 1946, and 1948, respectively. Aside from these universities, DRTC in Bangalore (Sardana & Kumar, 1977; Suriya & Kalavathi, 1990).

LIS education in India began as early as 1911 and was gradually recognized as a full-

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fledged field. Separate departments were established in universities, offering courses leading to bachelor's and master's degrees. This eventually paved the way for formal research activity on the subject. Currently, official research in LIS is undertaken at six levels: Diploma, BLISc, MLISc, M.Phil, PhD, and D.Litt. (Mathew, 1980). According to the literature review, authors researching research trends and characteristics in library and information science primarily used doctoral theses and dissertations for their research, as well as bibliometric methodologies for data analysis. The evaluation shows that few studies have used co-word analysis to investigate LIS research trends in India. As a result, this type of research is necessary (Mangla & Ranganathan, 1984).

Analysis/ Observation:

It has been discovered that 1408 journal papers by Indian writers are indexed with 4735 descriptors. The number of descriptors for each record ranges from one to eleven. The 97 most common descriptions applied to journal articles indexed in LISA. In the libraries, library collection, library practice, and publishing output receive more academic attention than online catalogues, user training, and so on.

The data analysis reveals a study trend that begins with libraries, periodicals, library technology, information technology, classical library science, bibliometrics/scientometrics, and progresses to library materials, professional education, digital libraries, networks, and other areas. Some new sectors have evolved, including the World Wide Web (www), the Internet, information seeking behaviour, online databases, electronic publication, knowledge management, and search. Numerous study fields were discovered through an analysis of descriptor co-occurrence frequencies (Sardana & Kumar, 1977). The core research fields, along with the main descriptions that link them. The extensive research is being conducted on bibliometrics/scientometrics/informetrics, library technology, and public libraries, with a focus on areas such as information technology, digital libraries, library automation, distance learning, online information retrieval and knowledge management. Other areas of interest for researchers include agriculture, science and technology, and study related to scientific publications using bibliometrics, scientometrics, informetrics, or webometrics methodologies.

The network's core research area is university libraries, which are closely linked and have a high relationship density with acquisition, electronic media, library management, collection development, periodicals, scholarly publications, libraries, librarianship, and library technology. Other core study areas include information technology, knowledge management, distance
learning, and digital libraries. The reason could be that people who work in academic institutions publish or that people regularly choose topics linked to university libraries.

Discussion:

Descriptors are used to acquire an understanding of the subject profile of research in library and information science. The descriptors in the records are analysed to determine if the published publications addressed library-oriented or non library-oriented research. Topics/descriptors with terminologies connected to library and information science activity, such as information services, library technology, etc., are considered library-oriented research, whereas topics/descriptors such as scientific and professional communication in non-library- oriented research. In this study, the research conducted by Indian library professionals and researchers is based around the following areas:

- Bibliometrics, Scientometrics, Informetrics, Webometrics.
- Libraries, Librarianship, and Library Management.
- Library technology, information technology, knowledge management, collection development, and technological services.
- User, User Services, and User Studies.
- Other topics include information literacy, distance learning, copyright, educational

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technology, and publishing.

The analysis found that a considerable number of papers were about library and information activities such as acquisition, cataloguing, circulation, collections, categorization, information services, administration, and so on. There are also articles about citation analysis, bibliometrics/scientometrics, distant learning, educational technology, information literacy, and information seeking behavior etc. Bibliometrics/scientometrics is the most popular research field in India (Subba Rao, 1980). This can be linked to the simple availability of bibliographic databases for scholars. Other research areas include library technology, libraries, and librarianship. It was also discovered that many of the studies relied on data retrieved from bibliographic databases or were historical, conceptual, or survey-based. Experimental, case, and action research approaches, as well as system/software analysis design, are underutilized. Bibliometrics dominated empirical research strategies, which were followed by surveys, citation analysis, and assessment (Tejomurthy & Kumar, 1998).

Conclusion:

The selection of high-activity themes has substantial consequences for strategic research planning. This study highlights the use of co-word analysis is a useful method for discovering study patterns. Co-word analysis depicts the interrelationships of the keywords. The co-word analysis results have yielded much more than statistical art fact. The empirical findings presented in this study highlight the key areas of library and information science research in India. Co- word analysis results show a high level of interest in bibliometrics / scientometrics / informatics, library systems, and university libraries. The findings also show that there are significant activity in digitization, digital libraries, and web 2.0. The report highlights opportunities for further

research in library and information science. It is intended that the analytical approach given in this work would help research planners assess and track research development while also identifying gaps and limitations. More studies using different data sources are required to discover characteristics of research activities in library and information science in India.

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Role of NDLI Club in College Library

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Abstract

NDLI Club plays a key role in college libraries. In the ever-evolving background of education, college libraries play a key role in facilitating knowledge gaining and research endeavors. The integration of the National Digital Library of India (NDLI) Club into college libraries marks a significant leap forward in harnessing digital resources and fostering collaborative learning environments. This paper explores the distinctive role that the NDLI Club plays in enhancing the functionality and impact of college libraries.

Keywords: NDLI, NDLI Club, College Library**,** Club Authority

Introduction

The NDLI Club serves as an indispensable extension to traditional college library resources by providing a digital repository of diverse and curate educational content. College students and faculty members gain access to a vast array of digital resources, including e-books, research papers, multimedia materials, and many more, thereby enriching their academic pursuits and expanding the scope of available information.

By integrating the NDLI Club into college library systems, institutions empower their students and faculty to engage in collaborative learning and research activities. The club's platform facilitates seamless communication and knowledge sharing among library users, creating a dynamic community that transcends the physical boundaries of the library. This collaborative space enables students and faculty to connect, share insights, and collaborate on academic projects, fostering a culture of collective intelligence and interdisciplinary collaboration.

The NDLI Club's role extends beyond resource access; it serves as a catalyst for technological innovation within college libraries. The platform incorporates advanced tools and features, such as personalized recommendation systems and interactive learning modules, enhancing the overall learning experience for library users. These innovations align with the evolving needs of contemporary learners and contribute to the digital transformation of education within the college library setting.

Moreover, the NDLI Club empowers college libraries to adapt to the changing landscape of information dissemination. By embracing digital technologies and promoting open access to educational content, the club plays a crucial role in democratizing knowledge, ensuring that students from diverse backgrounds have equal opportunities for learning and research.

Academic libraries are vital for educational institutions, serving dual roles to support curriculum and faculty, students, and research. Responsibilities encompass instruction, reference, and staying current with trends and technology.

Objective:

- To know the role and functions of NDLI Club in College Library.

Research Method:

- For this study observation method has been adopted.

Overviews and Observation of NDLI Club:

As of my last knowledge update in January 2024, there was no specific information available regarding the formation date of the NDLI Club. The National Digital Library of India

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(NDLI) is a digital repository that was launched to provide free and open access to educational resources. The creation of specific clubs or initiatives related to the NDLI may have occurred after that date.

Access to diverse learning resources is crucial for skill and knowledge development. NDLI Club members can avail themselves of a vast repository of free resources accessible from any device through the National Digital Library of India. Sponsored by the Ministry of Education, these initiatives contribute to the Digital India Mission, offering educational content for all academic levels and disciplines in multiple Indian languages, fostering inclusive learning and education democratization. The NDLI Club, operating within institutes and nodal bodies, serves as a catalyst for career advancement by organizing both physical and virtual events. These events focus on developing knowledge, skills, and essential traits beyond the regular curriculum, aiding students, job seekers, researchers, and learners in their professional domains.

Now we lets know about objectives, club registration process, responsibilities of club authorities and operations of club, events, advantage to users and colleges.

NDLI Club Website

❖ **Objectives of NDLI Club:**

The main objectives of the NDLI Club are;

- NDLI Club is an online platform for organizing learning-oriented events and proselytizing NDLI.
- An initiative to boost culture of reading and learning using NDLI's huge resources.
- Students enhance their core ability; sharpen their skill & personality feature.

❖ **Club Registration Process:**

There are 18 steps for club registration process. Registration processes can change, and it's recommended to visit the official National Digital Library of India (NDLI) website or contact the relevant authorities for the most up-to-date and accurate information on how to register for the NDLI Club. For process of registration required to visit this page and follow the process likewise: https://ndl.iitkgp.ac.in/static-content/ndli-club-registration-process-v4.pdf

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In addition, for start this process, minimum 4 key executive members are required. So that firstly, we require indentifying these members for club likewise;

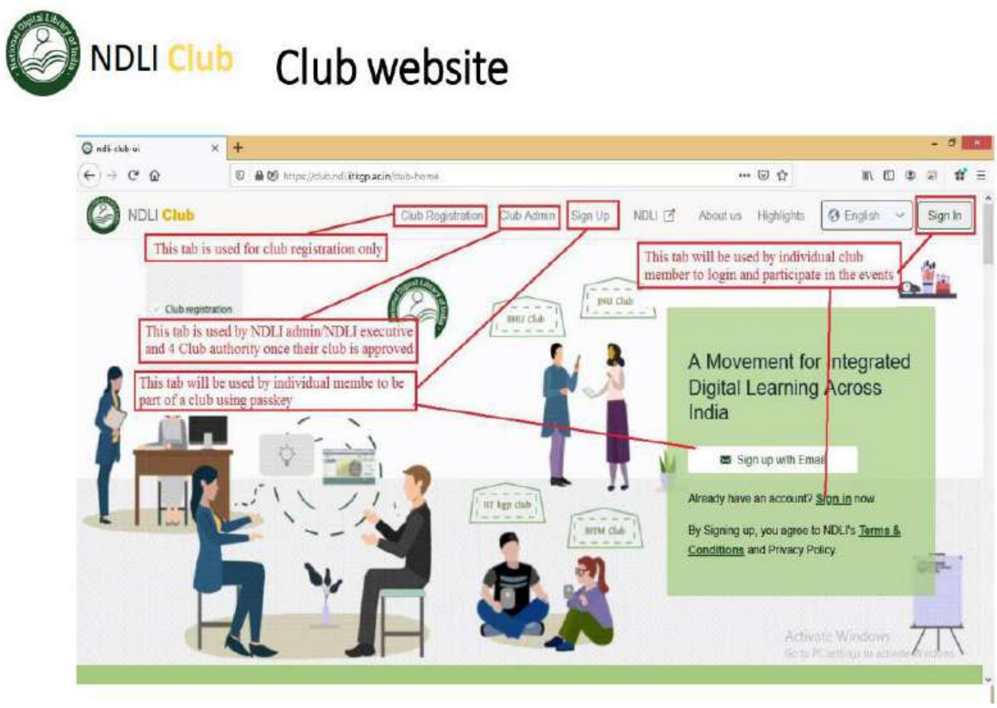
1.) Patron: Head of the Institution
2.) President: Faculty/ Librarian
3.) Secretary: Faculty/ Librarian
4.) Executive Member(s): Faculty/ Student/ Researcher.

These members should have membership/ registration of NDLI. Else they will have to register themselves in NDLI website https://www.ndl.gov.in/

The steps to register the club any one of the club authorities should follow the steps below:

- Visit NDLI club website at https://club.ndl.iitkgp.ac.in
- Access the Club Registration page and login using NDLI credential
- Choose your institute from the options available. In case your institute name is unavailable, select “Other” option and type details of your institute
- Validate or update college contact details
- Upload a minimum of three images representing the institute
- Provide information about four club authorities, with their name, designation, and details
- Make an authority letter, ensuring it is uploaded with a sign and stamp on the college letterhead
- All four authorities/members should verify their email addresses and log in to the club website for “self-verify”, accepting the terms
- Once all four authorities/members are validated, click on "Freeze" to submit the application to NDLI
- The NDLI Team will review and consent the application, and you will receive an email confirmation with the NDLI registration number and passkey.

Different Tabs of NDLI Club



❖ **How to Add the members to the NDLI club:**

The members mean students, faculties and other staff of the concern institute. For member registration fallow the step likewise-

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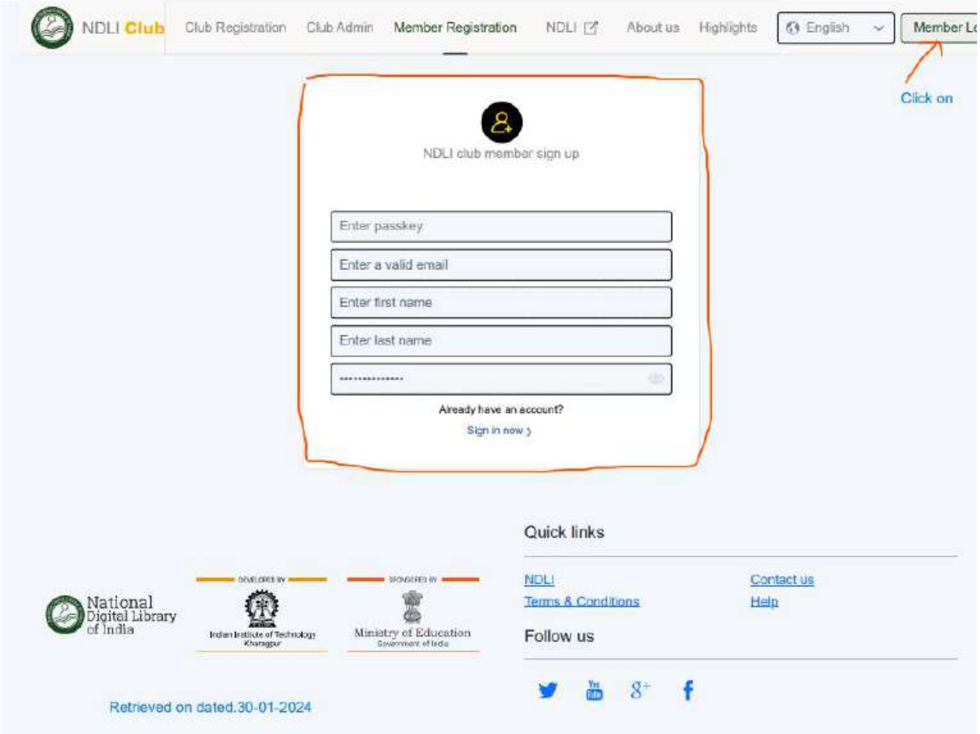
- Use QR code or Pass key for member registration.
- Show the QR code on notice boards, message groups, or share it via email with students and staff.
- Club member registration concurrently registers individuals on the NDLI website, if not earlier registered.



❖ Roles for Club Authorities:

There are main roles of club authorities. The organizational structure for the club includes a Patron (Head of the Institute) responsible for facilitating club functioning and resource allocation. The President (Faculty/Librarian) closely monitors the club, provides technical/academic guidance, suggests events and speakers, and creates an event calendar. The Secretary (Faculty/Librarian) manages actual club operations, organizes events, communicates with stakeholders including NDLI, and maintains event calendars. Executive members (Faculty/students) support the Secretary in organizing events, mobilizing members, communicating with students, and promoting the club.

❖ Event Conduction:

The NDLI Club conducts learning-oriented events, which must be organized through the NDLI Club Platform. Events can be either physical, taking place in classrooms or auditoriums, or online, utilizing platforms such as Zoom, Google Meet, or MS Teams. These events fall into three categories: Local Events (managed by the club), Multi-club Events (involving multiple clubs), and Global Events (involving all clubs). NDLI is responsible for organizing Multi-club and Global events.

Local Events within the NDLI Club should be planned and executed by the club authorities, consenting them to decide on the type and frequency of events. For multi-club events, clubs can request NDLI support for assistance, with the local clubs handling implementation and coordination. Online events, using platforms like MS Teams, Zoom, or Google Meet, are at the discretion of the clubs and should be adequately promoted by the institutes. Sample events, such as NDLI Lecture Series, NDLI Quiz, NDLI Story Talk, NDLI Go Fish, NDLI Film Screening, NDLI Club 15, NDLI Draw, NDLI Role Play, NDLI Write On, NDLI Makerspace, and NDLI Debate, are provided as examples for inspiration.

- **Event outcome, Evaluation & Event Report:**
  - After completion the event, participants can upload their essays, write-ups, and other participation output to the club portal; this is referred to as Event Outcome
  - Club authorities/reviewer(s) are responsible for creating the Event Report and reviewing/grading the submissions (event outcome) of participants.
  - Students can generate a Certificate of Participation in PDF format from the platform
  - Depending on the event, reward points may also be allocated to the students
  - Any recorded video, presentation, pictures, write-up, etc., generated from an event is referred to as the Event Report.

❖ NDLI Club: Advantage to Students/Faculties/Other Staff and Institutions/College:

Participants (members) (Students/faculties/other staff of the institution/College) in club events have the chance to improve their knowledge, skills, personality traits, and leadership qualities. Upon joining an event, each participant/member receives a Certificate of participation. Some events additionally provide Students/faculties/other staff with reward points, earned by uploading outcomes (such as essays or stories) to the club portal. Event reviewers assess these submissions and assign reward points consequently. The collected reward points contribute to the overall participation record of each member.

College/ institutions establish an enriching environment that fosters academic excellence and nurtures personal interests and hobbies among students. Encourage a culture of reading and learning, leveraging the abundant free online resources provided by NDLI. Aligning with the principles of NEP 2020, emphasize activity-based learning. Club registration and promotion of NDLI are mandated by AICTE, contributing to the enhancement of NIRF ranking and overall educational quality.

❖ Conclusion

The integration of the NDLI Club into college libraries signifies a transformative shift in the role of libraries within educational institutions. By leveraging digital resources, fostering collaboration, and embracing technological advancements, the NDLI Club contributes to the evolution of college libraries into dynamic hubs of knowledge creation, dissemination, and collaboration. This innovative approach holds the potential to shape the future of education within the college library context, ensuring that libraries remain at the forefront of facilitating holistic and inclusive learning experiences. The NDLI Club enables the college and students/faculties/other staff are also able to access huge e-resources of National Digital Library of India at open access. By these facilities the college libraries able to provides vast information to their users at open access.

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Role of Academic Library in Career Guidance

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Introduction:

Education is the process of acquiring genera! And specialized knowledge by means of study and learning that develop intellectual powers of reasoning and judgement. Human educational growth and development is a life-long process as it includes acquisition of skills for executing various professional and vocational functions.

Need and importance of career information in the knowledge era:

Career guidance covers a range of activities that are designed to assist individuals to make and implement informed choices related to their career development. These activities include career development programs, career information and career counseling. Career information is a very inclusive concept and consists of job and occupational descriptions, information about employment trends and consequent opportunities or declines in opportunity, details about courses and qualifications, and information about costs, remuneration and financial assistance associated with educational and vocational options. Libraries are one of the logical service providers for this role, and librarians are one of the logical resource persons to enhance the delivery of needed information. Librarians are in a key position of being aware of resource materials that other career/job professionals may not even be aware of. Career/job seekers are in need of current information which the libraries could provide without much difficulty.

People and materials are sourced from one part to the other depending on the requirement and availability. To comply and conform to the rules of the new world order, one has to be equipped with the best of professional education. In this economic scenario there is a need for career guidance in higher education institutions to give the young aspiring minds the freedom to dream and to go after this dream without any inhibitions. There are so many new jobs in the market in the area of Information Technology and Information Technology-enabled services, retail banking, insurance, healthcare and hospitality industries, fitness, entertainment, and education etc. But for all the new jobs being created there still remains millions of graduates unemployed - not for lack of jobs, but unemployability.

Career guidance and higher education: an overview

The fundamental right of every individual as enshrined in our constitution is - education. After graduation, the options available are numerous and the right choice plays a very important role in shaping the future and career of the student. Students should be given all available career options, either further study or job. Students embark upon further study for a variety of reasons: it is a chance to learn new skills. For others it is simply a way to keep on studying a subject they love. Whatever may be the reasons one must think before selecting a post-graduate course. Those who are aspiring for job, need information on how to search for a job. How to prepare the resume, cover letters etc. In either case career guidance is necessary in higher education. (G.Rowley)

Role of college libraries

Education is an effective instrument which can bring about social changes and renaissance in the society. Education is the largest single activity in the world involving crores of students, teachers and supporters Necessities, priorities and excellent principles depend upon the development of education. The aim is to have resourceful, skilled youth who can meet the demands of present day employment market and pave ways for future with their initiatives and

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innovations. This, in its turn, can be attained by having recourse to the vast mine of knowledge contained in the wares of a library i.e., books, periodicals and other materials.

While inaugurating the World Book Fair in New Delhi in 1988, Dr.Shankar Dayal Sharma, the then Vice-President of India observed that "a library is more important than a university because a library can function without a university, where as a university cannot do without a library". In the field of education such facilities include libraries as a basic and essential component. (Nagraj).

Ranganathan (1965) lucidly explains - "In the library, each student will have the freedom to grow at his own speed and along his own lines, to his own fullness, with the help of books just suited to htm under the guidance of the teacher and the librarian." (S.R.Rangnathan)

The face of academic librarianship is changing. While much attention has been focused on the impact of new technologies, new sources of information, and new ways of management, perhaps the most significant change is in the faces across the desk.

Library as a Career Information center

Career information is available early on in most schools, colleges and universities in Western countries as evident from the literature: no comparable situation exists in India. Until recently our educational system gave much importance to imparting knowledge at the academic level and at the same time it neglected the area of equipping the students in basic skills to face the challenges of this fast changing world of work.

One significant aspect, thus far virtually neglected is the career information, which has increasingly vast scope in the library work, particularly in college libraries. As high technology social institutions, libraries and information centres have the responsibility of providing right information to their clientele at the right time. Collection, storage and dissemination of information are the major functions of library or information centre.

Nature of career information collection in higher education institutions

Career collection is a special reference section for career planning. This browsing collection includes encyclopedias, books for career exploration, resume writing, interviewing, career change and general job search information.

It is important for a career resource center to have specific resources available for students so that they can access information independently to help them in their career decision - making. The amount of resources available depends partly on budget as well as availability of such resources.

Books: those that provide information about different types of jobs such as educational requirements, amount of pay and description of the work. The information should be up to date.

Videos: Videos can be made available on various career topics for students to watch. Videos can be on the topic of interviewing skills, where student can watch examples of how to answer questions in a job interview situation.

Well-classified information on careers/jobs: Related jobs could be grouped together. This information should be up to date, relevant, easily accessible and reflective of the nature of the work world and current possibilities for students. There should be information regarding self-employment, part-time work, contract work and managing career transition.

Career tests/assessments: In career counseling, career tests and assessments are often utilized to provide information regarding variety of areas, such as interests or personality style.

Colleges and universities calendars: Colleges and universities typically print calendars describing programs offer. It is useful to have local, national and international information regarding the various educational programmes that are available. These resources can be accessed through CD-ROM or the Internet.

Electronic Resources: CD/DVD collections with textual and videos on interviews etc. A number of career guidance systems are available on CD that can be purchased. Career Search, an online database for career information enables users to develop customized list of employers.

Web-based information: Through the Internet, individuals can easily obtain career information from all around the world. There is also CDROM or web-based career guidance systems that may be purchased. Website addresses are almost endless.

Social Media: Social media can be used for a variety of functions for the guidance practitioner ranging from delivering access to career information, creating an interactive working space, providing a medium for one-to-one education and being a catalyst for policy change and reform.

Organization of career information in libraries

Information regarding various careers should be organized in a proper way. To facilitate organization the library should be centralized as a special guidance reading room where students can find up-to-date pamphlet material, books on how to get a job, how to improve ones personality; college catalogues and university directories. On the other hand the library may be decentralized; each classroom is equipped with a bookshelf of guidance material. A combination of these two organizational patterns is desirable. In the libraries students should be able to find vocational information in books, on bulletin boards, exhibits of book covers, in pamphlets, in magazine articles.

Included in library materials are the special studies and government reports. The Dictionary of occupational titles, articles clipped from current magazines and newspapers dealing with occupational information are useful. All library materials except books, magazine and catalogues can be placed in tile folders and labeled with the name of the vocation or the field of which it applies. Information regarding the subject located in books, magazines and websites can also be placed in the folders.

In a country like India, where the unemployment problem is very acute, almost every one of the educated unemployed and those who are undergoing education in various higher educational institutions are engaged in the preparation for various competitive examinations. College libraries are far behind in providing systematic and efficient career information services to the users. Recently government and public are aware of this need and trying to help these users by starting career corners or career guidance cell in colleges too. It is high time for public and academic libraries to think of providing career information services more effectively covering a wide range of users.

Career Awareness Service: Career information appears in a variety of media and primarily it is the responsibility of public and academic libraries to collect, organize and disseminate such information in an efficient and effective way. The methods used in providing current awareness service can be useful for providing Career Awareness Service too. Among the different methods for CAS, the most efficient and acceptable ones are –

Notification Lists: By this method a user can be alerted to the posts/courses relevant to him advertised. The name of the periodical in which the advertisement appeared along with date and page number of the periodical is to be sent to the user. A user profile consisting of the name, qualifications, experience, job preferences, etc. of each user has to be maintained for this. A post card/e-mail can be used to give information about posts advertised.

Current Awareness Bulletin: In this method, the library has to scan the relevant periodicals and other sources of current information received in the library and identify the employment notifications/competitive examinations/entrance tests etc. relevant to its users. The details are to be collected and classified under various categories of jobs/courses and within each, further grouped on the basis of headings such as government sector, semi-government sector, private sector etc.

Newspaper clipping service: Newspapers are considered to be the most potential source of career information since most of the vacancies are advertised in newspapers.

In this service, each of the newspapers subscribed by the library is to be scanned and the job advertisements, information regarding various competitive examinations, admissions opportunities to different higher educational institutions etc. is to be identified. These advertisements should then be cut and pasted on a sheet of paper. After arranging these cuttings photocopies can be taken and circulated among the users.

Selective Dissemination of Information for career seekers: Selective dissemination of information (SDI) is aimed at providing relevant information according to one's choice and requirements. The career/job interests of the college students range from further educational and job facilities of top class services like Indian Administrative Services (IAS), Indian Police Services (IPS), and Indian Foreign Services (IFS) etc. to the lower clerical cadre in the government sector and various placements in the private sector in the home country as well as in foreign countries.

1) **User profile:** The preparation of user profile in this context means representation of interest field/job according to one's qualification, taste etc. For this the career seekers are to be interviewed and asked to express their specific choice.
2) **Document profile:** This profile can be represented by the terms for specific courses/jobs advertised, the institution/sector where the opportunity available etc. Whenever new advertisements of educational information/job vacancies appear in various publications, they are to be added to the computer database of educational information/job opportunities using standard terms.
3) **Matching:** At regular interval the match between the profile of career seekers (User profile) and the profile of career information (Document profile) are to be determined. As these notifications have only very short life span, the matching has to be done at the shortest possible intervals, preferably daily. The matching is done by the computer.
4) **Notification:** If relevant match between the interest of the career seekers profile (user profile) and the career information file (Document profile) are found that is to be notified to the career seekers. The notification may be a list of advertisements with details of the publications in which they appeared.
5) **Feedback and readjustment:** The user (career seeker) is expected to answer the questions relating to the relevance of the notified items. When the feedback is received in the library, it is to be analyzed to find out whether necessary modifications in the user profile are necessary. If the notification is relevant, it is safe to continue with the present profile.
6) **Browsing the web:** The job and recruitment information are increasingly available on the nternet. Most of the important web search sites have special section devoted to jobs, careers and employment issues.
7) **Publishing personal resumes:** One of the most important advantages of the internet is that, job seekers can even publish their personal resumes through the net where prospective employers can look at person's qualification. This will help the career seekers as well as the employers to get the correct match. Job seekers will, thereby, get the right positions and employers will get the right persons.
8) **Career information literacy:** There is a need to create awareness among the graduates regarding how to search, evaluate, and select career information from the vast ocean of information. They should be educated about the requirement of labour market. Those who are involved in career information literacy should have some foresight to learn the future demand in the job market arena. As we are in an internet era graduates have to learn how to search the web sites and also which are the important sites they should look in for career information. It is necessary to conduct courses in soft skills such as oral and written communication skills, resume writing, cover letter writing, web searching, sending e-mails, sending attachment files, posting of resumes in the net, etc-

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Librarian can conduct seminars or tutorials to help the students to develop self knowledge - i.e. skills to maintain a positive self-concept, effective behaviors etc., to facilitate educational and occupational exploration - skills to enter and participate in education and training, skills to participate in work and lifelong learning, skills to locate, evaluate and interpret career information, skills to prepare to seek, obtain, maintain and change jobs etc.. and to plan careers in which to develop skills to make decisions, understanding the impact of work on individual and family life, skills to make career transition and also to have leadership skills, teamwork skills, management skills etc., (Orgeron)

Role of college librarian in Career information

Providing effective career resources is part of the mission of libraries on most college campuses. As the nature of career information documents are different from the ordinary subjects' documents they should be organized properly. Librarian with his training and knowledge in the field of organization and management can do this work effectively and efficiently. At the same time there is a need for cooperation between librarians and career development professionals.

College librarian has a definite role to play in the career guidance as they are working with all source of information and holds the key to the world of knowledge. Here the librarian can be the leader or can collaborate with other members in the guidance cell by helping them to get the necessary information.

Career guidance has been given prime importance in educational programs of Andhra Pradesh, for example career options for school children has been emphasized by Social Welfare Schools and specified the role of librarian. Librarian should be approachable, friendly, and interactive. As information specialists they are able to identify, analyze and assess the suitability and value of information relevant to career information. They are the right persons in:

Identifying, assessing, selecting and ordering information sources and material in both print and electronic formats.

- Organizing, classifying, maintaining and storing information, often using computer applications for access and retrieval.
- Searching for information, using paper, electronic format and the web.
- Answering information enquiries from service users.
- Providing information support to other guidance personals
- Marketing, advertising and publicizing the services
- Planning and giving presentation and information to students.

As a career resource person librarian can:

- Help the students to explore various occupations
- Provide current career and job market information
- Facilitate the development of life career management skills,
- Help students select appropriate work situations
- Assist in the development of the life long career plans.

College libraries should extend its support in all sphere of knowledge and by providing career information in the library it will be helping the users to have an aim in their lives. A qualitative career service can help the students/graduates to find out their interests and abilities and to attain their dream job in the society. To achieve this library' staff should strive and adapt according to the signs of the time. It is necessary to provide career information through variety of services to the graduates so that they will be equipped with the knowledge about how to seek, evaluate and select career information and this will lead to better decision making for high quality life.

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A Study of Periodical Section Management and Users Satisfaction: In State University Dr Panjabrao Deshmukh Krishi Vidyapeeth PDKV Central Library Akola

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ABSTRACT:

This paper discusses about the periodicals section management and user's satisfaction of Dr Panjabrao Deshmukh Krishi Vidyapeeth PDKV Central Library, Akola. The data has been collected from the periodical section and users in the University of Dr Panjabrao Deshmukh Krishi Vidyapeeth PDKV Central Library, Akola. The periodical section is mainly dealt with the subscription of Indian and Foreign print and online journals, databases, magazines, etc. This research studies mainly focused to user's and user's satisfaction also deals with different aspects of periodicals budget, selection of periodicals, renewal or discontinuation of existing periodical, mode of subscription, selection of publisher and vendor or supplier, approval of library committee, budget allocation, ordering, payment process, receiving and claiming process of supplied and non-supplied periodicals, no of periodicals, Quality of periodicals.

Keywords: PDKV Central Library, Periodical Section Management, Print and Online Journals Subscription, Users Satisfaction and Levels of Users Satisfaction.

1.INTRODUCTION:

State University of Dr Panjabrao Deshmukh Krishi Vidyapeeth PDKV Central Library Akola Maharashtra: -

PDKV Central Library and information centre was set up the college of agricultural in the year 1969. Later it was shift to the main library building in the year 1980 around the nucleus of the Centre for the Post Graduate Institute of Research, Instruction and Extension Education of University having the area of 72,285 sq. ft. of which carpet area is 52,435 sq. ft. Today, today our holdings have crossed one lakh Fifty-seven thousand books covering the wide range of disciplines under agricultural sciences, Animal sciences, Agricultural Engineering, Agricultural Biotechnology, Pure and Applied Sciences and other allied disciplines including the special collection from FAO. It also received more than 150 periodicals gifted by various organisations and institutions. University library is designated Depository Library of FAO publication since 1987.

PDKV Central Library is the single largest information centre of agricultural information resources in the Vidarbha region of Maharashtra and centres not only to the needs of agricultural academic community of region but also serves many scientific, historical and social researchers from the State. With the successful completion of computerising the database of bibliographic details and automating its services our Library is on the threshold of embarking on its new role that of an information resource centre at the service of the academic community of this region, in addition to its traditional function of holding and disseminating of books. The library has presently 1,57,066 books and other reading material such as these, Bound Volumes, and its bibliographic details are store in an open-source software KOHA in a designated server at the University Library and also Cloud Computing Networking.

2. Concept and History of periodicals: -

Periodicals are the primary source of the information. Due to ever increasing research in various fields, Periodicals play a vital role for providing information to researchers and specialists. Today libraries are spending about 70-75 % of their budget for subscription of Indian as well as foreign periodicals. Periodicals are not only useful for research and development but also escape from duplication of research (Verma, 2007)1

(Kaula, 1989)2 states that subsequently, the first English scientific abstract-periodical named Philosophical Transactions (Acta Philosophica) was published only three Month after the appearance of the French periodical. The publication of this periodical involved eminent group of English philosophers, including Boyle, Hooke, oray and Oldenburgthen Secretary of the Royal Society of London. It was published on 6 March 1665. The first issue consisted of sixteen pages comprising a dedication to the Society, nine articles a selective listing of current philosophical books and a selective listing of current philosophical books and extracts from Olbenburg's voluminous foreign correspondence. It was designed to record "the present undertakings, studies and labours of the in genius in many considerable parts of the world".

3 Review of Literature:-

(Birdar, 2011)3 There are several articles in the literature on use of library collection. But there are fewer articles on use of collection in technical libraries particularly, use of periodicals. The following review gives on overview of some user studies performed over the past few year. Periodicals are important information sources and play a major role in communicating research results. They constitute a major part in all technical institutions and research and development organizations and they are spending more than half of their expenditure on periodicals. The present study has been on usage of periodicals by faculty members and their opinion about the existing periodical sources and services offered by the JNNCE Library. The result of study would therefore help not only to strengthen the existing sources and services, but also act as guide to proceed in right direction in the future.

(Padmamma, 2002) another study by Padmamma and others (2002)4 identified the impact of personal attributes on use of periodical. Result of the study revealed that large number of teachers use subject periodicals most frequently. However, it is also observed that a good number of users expressed their general opinion about the lack of secondary periodicals and lack of online and CD-ROM database search facilities in their libraries. Since the secondary periodicals are the guide to the primary periodicals, its necessary to procure the same and importance should also be given to online and CD-ROM database searches to provide pinpointed and exhaustive literature search to teachers and research scholars. It also helps to optimize utilization of existing periodical collection in the library.

4. Statement of the Research Problems: -

Periodicals consist of primary sources of information. Periodicals are essential for meeting information needs of students, teachers, faculty members and researchers. The acquisition of periodicals requires lot of financial sources. Organizing such a large number of periodicals requires a definite system that can ensure the proper utilization by making available for access to its users. In keeping view of its information value, its use and the cost involved in acquisition of it, the following

5. Aims and Objectives of the study: -

1 • To explore the total numbers of Periodicals, Journals and E-journals available PDKV Central Library for Various faculty and subject.
2 • To find out the Periodical are Organized in PDKV Central Library.
3 • To find out the Periodical section are Management in PDKV Central Library.
4 • to find out Problems in subscription of periodicals in PDKV Central Library.
5 • to assess and compare the use of printed journals with e-journals
6 • to find out user's preference on print us electronic journals.

7 • to find out satisfaction of user about the adequacy of journals for various faculty.
8 • to recommend the appropriate periodical management system based on the suggestion of users.

6. Scope and Limitations of the Study: -

Twenty-Five State Universities Libraries in Maharashtra Region, Only SGBAUA KRC Library is select for this study. PDKV Central Library librarian, Staff and Library users selected as respondents for the Research study. Random Sampling Technique used for the distribution of questionnaire. Also 2021-22 and 2022-23 only two-year periodicals sections and users' data collected for research study.

- This study describes about the availability of total numbers of periodicals on Various Faculty in PDKV Central Library.
- This study portrays the collection strength of journals and e-journals available in Various Faculty in PDKV Central Library.
- The study is intended to describe about the Various Faculty Printed Journals, E-Journals daily newspapers, magazine in its study.
- Data gathering for this study is limited to the PDKV Central Library.

7. Methodology: -

This study is based on survey (questionnaire) method. The questionnaires method helps of data collection, based Random Sampling Technique was used for the distribution of questionnaire. The questionnaire distributed of faculty members, research scholars, students and Librarian of PDKV Central Library. The data was personally collected from the Users and Librarian. Besides, observation of periodical section, personal interviews were also conducted with Librarian and Library staff to journal subscription, availability and assess the problems relating to use of printed and e-journals by the all users.

8. Hypotheses: -

•Sufficient Periodical, Journals and e-journals are available in the PDKV Central Library.

•Organization of periodical and management of periodical section are excellent in S PDKV Central Library.

•Sufficient and adequate services are provided to the user efficiently. Availability and assess the problems relating to use of printed and e-journals by the all users.

•To determine to what extent the users of PDKV Central Library are using journals and ejournals for their research and extension work.

9. Significance of the study: -

- This study explains about of the Various Faculty Journals and Periodicals in PDKV Central Library.
- It helps to find out the collection strength of the journals in PDKV Central Library.
- It helps to know about user's satisfaction about availability and adequacy of journals in PDKV Central Library.

10. Collections of Data, Analysis, Findings and Discussion

Table 1: Questionnaires Distribution to Librarian-PDKV Central Library and information centre

No. of Questionnaires Distributed to PDKV Central Library and information centre Librarian	No. of Collected Questionnaires	Response In %
1	1	100 %

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Table 1-A total 1 copies of questionnaires distributed to the PDKV librarian and 1 copy (100 %) were returned. The response rate of 100 % was considered adequate for the study because the slandered and acceptable response rate for most studies is 60%

Table 2: Book's and other Print Collections Budget in the Library

Sr. No.	Name of Collections	Year Wise Budget	
		2021-22 (Budget) -RS.	2022-23 (Budget) -RS.
1	Book's	10,00,000 (Ten Lakhs)	Nil
2	Periodicals / Journals / Magazine E-Books, E-Journals / Databases E-journal Consortium	2,00,000 (Two Lakhs)	Nil

Table 2- For the year 2021-22, ten lakh rupees have been received for the purchase of library books and two lakh rupees have been received for periodicals and other e-literature, the above amount is satisfactory. Similarly, when we discussed with the librarian about the above funds not being available in 2022-23, he said that the budget has been delayed due to Covid-19. Yes, in the last three years, Covid-19 has made a difference to the financial economy.

Table3: Book's and other Print Collections available in the library

Sr. No.	Name of Collections	Year Wise No. of Collections	
		2021-22 (No. of collections)	2022-23 (No. of collections)
1	Book's	2,45,009 (Two Lakh Forty-Five Thousand Nine)	2,45,590 (Two Lakh Forty-Five Thousand Five Hundred Ninety)
2	Dissertation	20,354	20,836

Table 3-In the year 2021-22, the number of books in the library are 245,009 and the number of theses are 20,354 which is satisfactory as per State University library. Similarly due to Covid-19 books were not purchased in the year 2022-23, so there was no increase in the collection of books.

Table 4: No. of Printed Periodicals / Journals and other Collections in the Library

Sr. No.	Name of Collection	Year Wise No. of Collections	
		(2021-22) No. of	2022-23 No. of
1	Periodicals / Journals / Magazine	671	315
2	Back Vol. of Periodicals	58,366	58,366
3	Newspapers	16	16

Table 4-In the year 2021-22 the number of periodicals are 671 and the number of periodical volumes are 58,366 and the number of newspaper are 16. The periodical and periodicals volume are satisfactory and the no of newspapers are low and should be increased. Similarly, in the year 2022-23, there is no increase in the above periodicals and periodicals bound volumes due to Covid-19.

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Table 5: No. of Library Users in the Library

Sr.no.	Library Users	No. of
1	Faculty Members	12
2	Research Scholars	18
3	Students	1393
4	Casual Membership	165

Table 5- Faculty Members, Research Scholars, Students and Casual members-total number of members of this library is 1588. The number of research scholars is low and needs to be increased.

Table 6: Questionnaires Distribution and Collection of PDKV Central Library and information centre Users

No of Questionnaires Distributed to PDKV Central Library and information centre Users	No of Collected Questionnaires	Response In %
50	**50**	**100 %**

Table 6-A total 50 copies of questionnaires distributed to the PDKV library student and 50 copies (100 %) were returned. The response rate of 100 % was considered adequate for the study because the slandered and acceptable response rate for most studies is 60%.

Table 7: Various services provide to Readers and Users in periodical section

Sr. No.	Services provide to Readers and Users	Yes	%	No	%
		No of Responses		No of Responses	
1	Can you take printed Periodicals and Journals at home for reading or photo copy	26	52 %	24	48 %
2	Can you take Periodicals back vol. at home for reading or photo copy	37	74 %	13	26 %
3	E-Journals and E-Resources Service	48	96 %	02	04 %
4	CAS (Current Awareness Service)	46	92 %	04	08 %
5	SDI (Selective Dissemination of Information)	44	88 %	06	12 %
6	Abstracting Service	49	98 %	01	02 %
7	Indexing Service	49	98 %	01	02 %
8	Web-based Services	50	100 %	00	00 %
9	FAQs (Frequently Asked Questions)	49	98 %	01	02 %
10	Reader Advisory and Guiding Service	50	100 %	00	00 %
11	Newspaper Clippings Service	49	98 %	01	02 %
12	Referral Service	44	88 %	06	12 %
13	Translation Service	43	86 %	07	14 %
14	Reprographic Service	44	88 %	06	12 %

15	New Arrivals (Journals) Display Service	48	96 %	02	04 **%**
16	Online Service of your University Library or Knowledge Resource Centre	49	98 %	01	02 **%**
17	Printed and Online Document Scanning Service	22	44 %	28	56 **%**
18	Printed and Online Document Printing Service	23	46 %	07	14 **%**

Table 7-Serial number 1, 17, 18 services are provided below 60 percent, while other services are provided above 60 percent. Serial number 1, 17, 18 services need to be increased. Web based services and reader guidance services are provided 100 percent.

<u>Table 8: Are you satisfied with the service provided by the periodical section?</u>
<u>s</u>

Sr. No.	**Services provide Satisfaction of Users**	**Satisfied Users**		**Satisfied Users**	
		Yes	**%**	**No**	**%**
		No of Responses		**No of Responses**	
1	**50 Questionnaires Distributed to PDKV Central Library and information centre Users**	50	100 **%**	00	00 %

Table 8-When the library users were asked whether they are satisfied with the service in the periodical section, they stated that they get 100% satisfactory services in the PDKV library and that is the real success of the library.

11. Conclusions: -

The findings received through this study provided some understanding about issues related with students' University library use pattern, collection strength of periodicals and choice of format of periodicals, and familiarity on organization of periodicals in the PDKV Central Library and information centre. Investigation regarding frequency of visit, purpose of visit by students, awareness about periodical section, purpose of visit to periodical section, familiarity of the periodical section, revealed positive response rate from the respondents. Information service constitutes a major responsibility of the library, there were variations in responses regarding choice of periodicals format. But the study showed that users seemed to be more interested in printed copy of periodicals. In terms of fast and easy access, electronic periodicals should be the first choice of periodicals to meet information needs.

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Epistemologies of Knowledge in the Knowledge Management

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ABSTRACT
The emphasis on knowledge in today's organizations is based on the assumption that barriers to the transfer and replication of knowledge endow it with strategic importance. Many organizations are developing information systems designed specifically to facilitate the sharing and integration of knowledge. Such systems are referred to as Knowledge Management System (KMS). Because KMS are just beginning to appear in organizations, little research and field data exists to guide the development and implementation of such systems or to guide expectations of the potential benefits of such systems. This study provides an analysis of current practices and outcomes of KMS and the nature of KMS as they are evolving in fifty organizations.

INTRODUCTION

As the globalization has created challenges to the organizations, there are many organizations competing each other in order to defeat the competition and win the customers. The organizations have to face the high risks of competition and the possibilities of losing customers. One of the main reasons which causes this problem is the organizations have difficulties in responding to the rapid changes of market trends. Nowadays, libraries and information services, as well as other organizations, face the challenge of surviving in the so-called 'knowledge society' The organizations' competitive advantage is connected with their learning capability and their knowledge assets (Prusak, 1997). Knowledge is an essential key resource for organizations; its effective and efficient management can contribute to the development and improvement of organizations' services

DEFINITIONS OF KNOWLEDGE MANAGEMENT

I) "The physical toil of manufacturing is being replaced by a world where we work more with our brains than our hands" – Sewell

II) Knowledge management refers to identifying and leveraging the collective knowledge in an organization to help the organization to compete with their competitors.

III) "Knowledge management (KM) is an effort to increase useful knowledge within the organization. Ways to do this include encouraging communication, offering opportunities to learn, and promoting the sharing of appropriate knowledge artifacts" - McInerney, C.

IV) "KM [Knowledge Management] involves blending a company's internal and external information and turning it into actionable knowledge via a technology platform"

KNOWLEDGE SOCIETY AND NATIONAL DEVELOPMENT

Becoming a knowledge power by 2020 is a very important mission for the nation. While a knowledge society has a tow-dimensional objective of societal transformation and wealth generation, a third dimension emerges when Indian has to transform into a knowledge power. The hard-earned wealth and the transformed society which are the two pillars on which the knowledge society is supported, have to be protected in order to sustain a knowledge society.

THE IMPORTANCE OF KNOWLEDGE MANAGEMENT

The term knowledge is nothing but how the employees process the information and utilize the same in his job. When he combines the information with management information system or decision support system he uses the technology to complete his work. This will help to complete the work faster and he gains knowledge on every transaction. The productivity of the employees is increased. It is important feature to apply the knowledge and practice them

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constantly in their job. This will result in the awesome results in the organization context and customers will be delighted in the services provided by the firm. Most importantly it will create value addition at all levels and it creates intellectual capital which can be used for the survival of the firm in the long run. The organization believes that instead to predicting the future it is better to know how to utilize the tacit knowledge to create the products. They also believe that no need for external help when they utilize both explicit and tacit knowledge of their employees which results in reducing the cycle time

NEED FOR KNOWLEDGE MANAGEMENT

There is sufficient evidence of many companies who have benefited from knowledge management initiatives. Based on these experiences, knowledge management experts argue that, for organization and institutes to be successful and competitive today, they need to continually engage in two activities. I) Find effective way to translate the institution's on going experience into knowledge (By taxonomically structuring the knowledge and by building enterprise. Wide vocabulary through key words, which facilities effective retrieval. II) While transferring and leveraging companies and institutions knowledge across time and space (Through Internet Technology) for better leverage, it is necessary to consider the following key issues; a) Find a method for transferring the knowledge to a group or individual who can reuse it. b) Translate what has been learned into a form that other can use. c) The receiving team or individual adapts the knowledge for use in a particular context.

TYPES OF KNOWLEDGE MANAGEMENT INITIATIVES

Knowledge Management Initiatives are taken by organizations and learners world wide, which reveal how these companies create value from their intangible assets. There are three types of knowledge management initiatives: i) External Structure Initiatives Gaining information and knowledge from customers for example through net scope, USA, a close link via the Net for opinion leaders among customers, who are encouraged to report problems, enables it to create new generations of soft ware at a fast pace. ii) Internal Structure Initiatives Building knowledge sharing culture should be done for example, 3M USA with 60,000 products of their own innovation process has an organization that balances between creativity and conservatism. 3 M's values encourage learning and risk asking, but managers are required to link continues learning to revenues. iii) Competence Initiatives Creation of careers based on knowledge management for example IBM USA and most Japanese large companies encourage dual careers, Employees are encouraged to switch between professional and managerial jobs, in order to gain holistic knowledge about the company.

SCOPE OF KNOWLEDGE MANAGEMENT:

Knowledge Management is a term that has worked its way into the main stream of both academic and business arenas since it was first coined in the 80's. The current state of the knowledge management field is that it encompasses four over lapping areas; i) Managing organization. (Rating, sharing, retaining, storing, using, updating, retrieving) ii) Organizational Learning. iii) Intellectual Capital iv) Knowledge Economics 146 A close look at many aspects of knowledge management practices shows that it can well be accepted that they bear a close resemblance to well established practices in librarianship and information management. This means that there is considerable opportunity for librarians to use their traditional skills to assume a new function of managing knowledge within the library which would compliment the traditional library services function. The aim of knowledge management for a library isto become more competitive through the capacities of their staff and clients to be more flexible and innovative.

INFORMATION TECHNOLOGY AND KNOWLEDGE MANAGEMENT

Information technology can provide many benefits. These benefits include fostering better communications and knowledge exchanges among the key parties. Modest beginnings can be useful; an organization doesn't have to have the latest or the most complex technology.

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Having a web site and having access to technical personnel to addict in planning for technology in important. Visit other organization's web sites. Some organizations begin their experience with computers by getting external assistance, sometimes form a donated source. Five years should be forecasted for equipment replacement and three years for software. When considering the purchases of equipment the organization should prepare a plan that includes identifying the organization's need analyzing its information requirements, current resources and systems, and developing and circulating a request for proposals. The most critical elements in vendor selection are its capabilities and the satisfaction of its other users.
In order to have a more clear understanding of information technology for an organization, it can be classified as follows:

1 Hardware
2 Software
3 Group Ware

ACADEMIC LIBRARYES

Academic libraries are information centers established in support of the mission of their parent institutions to generate knowledge, equip people with knowledge in order to serve the society and advance the well being of mankind. The primary objective of academic institutions of higher education is advancement of learning and acquisition of knowledge. Academic libraries are part of the university and its organizational culture. Whatever affects universities also has an impact on their libraries too. As a result the role of university libraries is changing to provide the competitive advantage for the university. And today librarians are connected to a vast ocean of network based services. Academic libraries are the nerve centers of academic institutions and are mandated to support teaching, research and other academic programs.

A CONCEPTUAL FRAMEWORK FOR CUSTOMER KNOWLEDGE MANAGEMENT IN ACADEMIC LIBRARIES

The present study extends the three stage CKM cycle model by Dalkir (2005, p.43) by introducing additional activities and relevant knowledge transformations that needed to be explicitly address when applied to the today's user-centric academic libraries. The proposed CKM framework demonstrates various customer knowledge activities and their relationships to one another and can be used as an analytical tool for design and implementation of CKM systems in academic libraries that are characterized by their strong customer-centric and knowledge-based orientations. The main criteria for selection of Dalkir's CKM cycle model for the present study is (i) its emphasis and explicit recognition of cyclic nature of knowledge activities. A cyclic model of customer knowledge activities is representative of many of today's academic libraries that are adopting customer-centric approaches to their management in increasing numbers, as opposed to the traditional static models of knowledge management; and (ii) the Dalkir's model provides required flexibility to accommodate additional KM activities, in our case, 'providing innovative services' activity, addition of a control concept called 'validation/evaluation' phase, and finally, the relevant knowledge transformation concepts, when considering integration of customer knowledge in academic libraries.

CONCLUSION

Academic libraries have, in recent times, been burdened with numerous responsibilities, as they meet users' information needs and, at the same time, support institutional goals. he possible ways in which to manage the growing daily influx of knowledge, and the increasingly complex demands of users, require librarians to apply certain KMP strategies and tools to optimize the support services they render their users. This scenario emphasizes the need for continuous learning, where academic librarians gain more knowledge along with the skills required to optimize their use of KM tools. This undertaking can be strengthened if librarians continue to share their knowledge, experiences and skills, to improve on current best practices. Certain strategies, such as engaging with senior colleagues through critical discourse, intensive face-to-face communication and knowledge audits and where they are guided by policy when making decisions, amongst others, will deepen research approaches and the related activities of library practices.

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28

Digital Library: Characteristics and Importance in Modern Era

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Abstract

Digital libraries are more benefits, especially for e-learning in digital or mobile times. The library and information professionals are required to acquire such knowledge and skills as the library is one of the highly IT influenced service profession. This paper gives information about digital library, Concepts & characteristic, functions, advantage, disadvantages of DLs in Modern Era.

Keywords: Digital Library,Information technology, Networking, Multiple Access, Digitization, etc.

1. Introduction

In India, the library, information and computer technology research community began to track research in the digital library field from 1996, with the 62nd International Federation of Library Associations and Institutions Conference being held in Beijing in 1996. At this conference, DL became an official national technology development plan with China presenting its own DL definition, which subsequently led to future localized large-scale DL construction work [1]. Digital libraries put a world of information centers in it.

2. Definitions & Concept of "Digital library"

Google, the most successful commercial internet search engine, entered a keyword "digital library" in the internet, and then Wikipedia and various other sources define "digital library" as a "library in which collections are stored in digital formats (as opposed to print, microform, or other media) and accessible by computers." There are many definitions of a "digital library." Terms such as "electronic library" and "virtual library" are often used synonymously. The elements that have been identified as common to these definitions are: Digital Library is a "Collection of digital objects (text, video and audio) along with method for access and retrieval, [as far as users are concerned] and also for selection, organization, and maintenance [1]. Delving into this definition, the library is an organized body that holds collections – digital objects that have been grouped into categories, presumably for access purposes. So, a digital Library is an informal collection of information, stored in digital formats and accessible over a network, together with associated services. The digital library is not merely equivalent to a digitized collection with information management tools. It is also a series of activities that brings together collections, services and people in support of the full life cycle of creation, dissemination, use and presentation of date, information and knowledge. The rapid development of the internet in the 1990s and its embrace by the library and information community enabled the concept of the digital libraries (DLs), as a branch of library, research on digital libraries in the mid of 1990s with the advent of the Internet coupled with the need to make information open and easily accessible [2]. Library and information centres are providing various types of information resources and services. Information content and services are changing with the Modern Era. The global network internet has brought forth new dimension to libraries of modern digital world. In order to keep pace with the cyberspace librarians are to be furnished libraries with latest version of sophisticated technology. In this new library digital networking and communication infrastructure provides a global platform over which the people and organization devise strategies, interact, communicate, collaborate and search for information. This platform includes, a vast array of digitizable products that is databases, news and information, books, magazines, TV and radio programming, movies, electronic games, musical CDs and software which are delivered over the digital infrastructure anytime, anywhere in the world [3].

3. Characteristics of Digital Library

All conventional libraries basic functions focus on collection, organization and dissemination of information resources. Traditionally a "library is a place in which books, manuscripts, musical scores, or other literary and artistic materials are kept for use but not for sale". In effect, it is an institution oriented towards collections and custody, where people may make use of the facilities. Whereas a digital library is an assemblage of digital computing, storage and communications machinery together with the content and software needed to reproduce, emulate and extend the services provided by conventional libraries. In other words, a digital library 14 Jie Sun and Bao-Zhong Yuan / IERI Procedia 2 (2012) 12 – 17 is a computer–based system for acquiring, storing, organizing, searching and distributing digital materials for end user access. It is not just a collection of material in electronic form; it includes a browser interface and perhaps a virtual space and society. It requires less space and the data can be made available through communication networks to anyone anywhere, while facilitating searches with speed. The digital is not a single entity and as such is linked to the resources of many such collections are in it. Some of the features pointed out in the definitions of digital library may be listed as follows: (1) A library that served a defined community or set of communities. (2) A conglomerate of multiple entities. (3) Library that incorporate learning and access. (4) Library that provide fast and efficient access, with multiple access modes. (5) A library with a collection which are large and persist over time, well organized and managed, contain many formats and contain objects which may be otherwise unobtainable. Digital libraries will also include digital materials that exist outside the physical and administrative bounds of any one digital library, will serve particular communities or constituencies, as traditional libraries do now, though those communities may be widely dispersed throughout the network, and will require both the skills of librarians and well as those of computer scientists to be viable in Digital Era.

4.Functions of Digital library

The rapid development of the internet in the 1990s and its embrace by the library and information community enabled the concept of the digital libraries (DLs), whose function can be defined as the collection, storage and processing of vast information and knowledge into a systemic project through digitalization and the internet, while providing convenient and highly efficient retrieval and inquiry services. To this effect, at a minimum, the core services expected of a Digital Library System include: a repository service for storing and managing digital objects; a search service to facilitate information discovery; and a user interface through which end users interact with the digital objects. The introduction of the DL has raised library modernization to a new level with over time. Digital libraries promise new societal benefits, starting with the elimination of the time and space constraints of traditional bricks-and-mortar libraries. Unlike libraries that occupy buildings accessible only to those who walk through their doors, digital libraries reside on inter-networked data storage and computing systems that can be accessed by people located anywhere. At their full potential digital libraries will enable any citizen to access a considerable proportion of all human knowledge from any location. From an access vantage the Internet provides a preview of the possibilities. The role of a Digital Library is essentially to collect, manage, preserve and make accessible digital objects.

The following are some of the functions of digital library:

(1) To provide friendly interface to users. (2) To avail network facilities. (3) To support library functions. (4) To enhance advanced search, access and retrieval of information. (5) To improve the library operations. (6) To enable one to perform searches that is not practical manually. (7) To protect owners of information. (8) To preserve unique collection through digitization.

5 Advantages of Digital libraries

Traditional libraries are limited by storage space; digital libraries have the potential to store much more information, simply because digital information requires very little physical space to contain it. As such, the cost of maintaining a digital library is much lower than that of a traditional library. A traditional library must spend large sums of money paying for staff, book maintenance, rent, and additional books. Digital libraries do away with these fees. Digital library has certain characteristics, which make them different from traditional library. It has expansive and accurate system of searching with large volumes of text, image and audio-video resources. Digital libraries do not need physical space to build collection and it can be accessed from anywhere, any time. The user can get his/ her information on his own computer screen by using the Internet. Actually, it is a network of multimedia system, which provides fingertip access. The following are some of the major advantages of digital libraries in Modern Era [6].

1. **No physical boundary**: The user of a digital library need not to go to the library physically; people from all over the world can gain access to the same information, as long as an Internet connection is available.
2. **Round the clock availability**. People can gain access to the information at any time, night or day.
3. **Multiple accesses**. The same resources can be used at the same time by a number of users.
4. **Structured approach.** Digital libraries provide access to much richer content in a more structured manner, i.e., we can easily move from the catalogue to the particular book then to a particular chapter and so on.
5. **Information retrieval.** The user is able to use any search term (word, phrase, title, name, subject) to search the entire collection. Digital libraries can provide very user-friendly interfaces, giving clickable access to its resources.
6. **Preservation and conservation.** Another important issue is preservation - keeping digital information available in perpetuity. In the preservation of digital materials, the real issue is technical obsolescence. Technical obsolescence in the digital age is like the deterioration of paper in the paper age. Libraries in the pre-digital era had to worry about climate control and the de-acidification of books, but the preservation of digital information will mean constantly coming up with new technical solutions.
7. **Space.** Whereas traditional libraries are limited by storage space, digital libraries have the potential to store much more information, simply because digital information requires very little physical space to contain them. When a library has no space for extension digitization is the only solution.
8. **Networking**. A particular digital library can provide a link to any other resources of other digital libraries very easily; thus, a seamlessly integrated resource sharing can be achieved.
9. **Cost**. In theory, the cost of maintaining a digital library is lower than that of a traditional library.
10. Protected information source.
11. Facility for the downloading and printing.
12. Provide faster access to the holding of libraries worldwide through automated better catalogues.
13. Help to locate both physical and digitized versions of scholarly articles and books through single interface. Search optimization, simultaneous searches of the Internet make possible, preparing commercial databases and library collections.
14. The user can peruse them instant.
15. Cross references to other documents.
16. Making short the chain from author to user.
17. Save preparation/ conservation cost,

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18. space and money. Digital technology affords multiple, simultaneous user from a single original which are not possible for materials stored in any other forms.

19. Full text search.

6 Disadvantages of Digital libraries

New technology has brought many advantages for digital library in Modern Erra, but simultaneously it also has certain disadvantage [4] as

(1) Costly affair.
(2) Technology obsolescence (Hardware & Software).
(3) Storage media relate.
(4) Dominance of data creators and publishers.
(5) Trained manpower.
(6) User education and training.
(7) Security against hacking & sabotage.

7 Conclusion

This research paper concludes and inform that what is meaning of Digital Library, Functions of Digital Library, advantages & Disadvantages of Digital Library in Modern Era also. So, this research paper is most important for the library and information professionals and Research Purposes on it.

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Vital Role of Libraries in National Education Policy 2020

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Abstract:
National Education Policy is the first policy of 21st century. Multidisciplinary and technical knowledge is required while moving towards a developed country. This paper has studied the concept and objectives of the National Education Policy. It also focuses on library and informatics policy and role of libraries in NEP 2020. NEP highlights various aspects including the development of enjoyable and inspiring books in different languages in India, accessibility and availability of books in schools/public libraries, strengthening of libraries and creating a culture of reading as well as the importance of libraries and books. It will devise strategies to improve the quality and attractiveness of books to ensure availability of books to disabled and differently-abled persons with the help of government, public and private sector organizations.
Key Word : National Education Policy 2020, Online Education, Digital Libraries, Library services.

Introduction:

Education is an important factor in the progress and development of society. Providing high-quality education to society is important for quality leadership globally. The future of the country will be bright if the youth generation of today is provided with good quality education opportunities. Global knowledge is changing rapidly. Due to the change in science and technology, it is also necessary to change the education system to provide employment opportunities along with the overall development of students. As India moves towards becoming a developed country, there is a need for multidisciplinary knowledge. To meet this need, the method of providing integrated education from various branches of knowledge should be adopted. There has been no change in the education system since 1986. The same old system of education is being followed. Cooperation with Progressive and developed countries can only happen through high-quality education. Therefore, the National Education Policy 2020 is going to be a revolutionary change in the education sector.

National Education Policy 2020

The National Education Policy 2020 is the first policy of the 21st century to be implemented after 1986. The National Education Policy is issued by the Ministry of Education (Human Development Resources), Government of India. This policy has been prepared after an in-depth study of the old education policy and current educational needs. There are four sections namely school education, higher education lifelong and implementation. The main objective of this policy is to provide high quality education and employment opportunities to students at all levels. The vision of this policy is to inculcate the pride of being an Indian in the students not only in their thoughts, but also in their intellect, practice and action, to develop knowledge, skills, character and values that maintain a responsible commitment to social life to become educated citizens of a developed country.

Principles of NEP 2020

1. To promote the holistic development of students.
2. To impart the highest knowledge of basic literacy and numeracy at a childhood.
3. Students are allowed to choose the courses of study according to their interests.
4. Multidisciplinary, multilingual and holistic education system.
5. To lay the foundations of education for students of all levels.
6. Education that fosters logical thinking and encourages innovation.
7. Curriculum promoting development and quality with a future vision for higher education.
8. Restructuring and increasing the efficiency of educational institutions.
9. Creating an environment conducive to learning.
10. To promote quality academic research and professional education.
11. Reforming the regulatory system to revitalize and empower the higher education system.
12. Curbing commercialization of education and streamlining the curriculum at all levels of education.
13. To Promote adult and remote learning.
14. To promote Indian art, language and culture.
15. To enhance quality of online and digital education and provide online platform for teaching.

NEP 2020 has made the following provisions for libraries:

- The policy also suggests that concrete decisions will be taken to cater books to disabled and differently-abled persons.
- The Government, with the help of both public and private educational institutions, will formulate policies to improve library infrastructure, quality of books, development of reading material and attractiveness.
- Digital libraries will be established. Comprehensive initiatives will be undertaken to ensure the availability, accessibility, quality and readership of books for readers at all levels and a National Book Promotion Policy will be formulated.
- Expenditure such as civil works, furniture, racks, fixing and fitting may be considered in the budget proposals of the States/UTs. Sanction of library rooms may be proposed in the annual work plan for schools that do not have library rooms.
- Educational institutions - schools, colleges, universities and public libraries - will be strengthened and modernized to ensure their adequacy. Books will be supplied to meet the needs and interests of students of all levels
- Central and State Governments will take steps to make books available to all people living in remote and deprived areas and economically backward across the country.
- Policies will be formulated to improve the quality and attractiveness of literature published in all languages of India. Efforts will also be made to increase the online accessibility of library books and further expand the reach of digital libraries.
- Teaching and learning of Indian languages must be integrated with school and higher education at every level. Hence there is a need for high-quality teaching and a steady flow of printed material in languages including literature in all languages of India.
- Will continue to strive to modernize and improve library and information systems and services.
- Schools will be encouraged to preserve their traditional or alternative educational styles. Efforts will be made to improve and strengthen libraries and laboratories and provide adequate reading materials such as books, journals, etc., and other teaching-learning materials will be made available.

- The first steps will be taken to ensure that the school environment is decent and conducive to service. Adequate infrastructure, including functioning toilets, clean drinking water, attractive grounds, electricity, computer equipment, internet, libraries, sports and recreational facilities will be provided to all schools. Taking measures to ensure a safe, inclusive and effective learning environment for children with disabilities. Creating a comfortable and motivated environment for teaching and learning.
- NIOS will develop high quality modules for teaching Indian Sign Language and other basic subjects using Indian Sign Language.
- Students with disabilities have different needs so they will be provided with assistive devices, technology-based tools, as well as adequate and language-appropriate teaching-learning materials.
- Training library staff in information and communication technology.

Role of Libraries in NEP 2020:

1. Library Collections: Libraries need to convert library collections into digital collections and increase e-resource collections. The policy also emphasizes that libraries should establish good and quality resources for all levels of readers. Availability and accessibility of books should be improved to inculcate the habit of reading.
2. Changes in services and facilities: Digital and online education has been promoted in the National Education Policy. Therefore, libraries should improve their services and facilities and focus on providing online and digital services and facilities to the users. Libraries should play a wider role in the education system and not limit it to traditional services.
3. Adequately trained library staff: There should be a library staff with adequate knowledge of technology to run a digital library and provide online services. Library staff needs to be trained in new technologies.
4. Collaboration in conducting online courses: Conducting free online courses like MOOC, SWAYAM etc. by libraries. Libraries and information centers should create awareness among students about such platforms and collaborate with the education system.
5. Promotion of reading culture: The objective of NEP is to promote reading culture. Accordingly, libraries should try to inculcate the culture of reading by organizing activities like reading circles, and book clubs.
6. Strengthening research activities: Libraries have immense potential to strengthen research. Libraries and information centers can promote researchers' research by providing qualitative resources with a focus on e-resources, guidance on reference management and information retrieval.
7. Providing services to students from remote and underprivileged areas:
   NEP 2020 also includes special policies for students living in disadvantaged, rural and remote areas. Accordingly, libraries must strive to provide library services to them by implementing special schemes through online and digital libraries.

Conclusion:

The new National Education Policy will be a catalyst for the progress and development of the society. The policy adopted by NEP 2020 will certainly open up new opportunities and innovative directions for library and information science. To fulfill the objectives of this policy, libraries and information centers must be conscious of inculcating a culture of reading and encouraging the development of reading materials.

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Semantic Web Technology And Digital Library

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Abstract:

In the recent years more and more information has been made available on the Web. High quality information is often stored in dedicated digital libraries, which are on their way to become expanding islands of well organized information. However, managing this information still poses challenges. The Semantic Web provides technologies that help to meet these challenges. the SEKT(semantically enable knowledge technologies) project is to develop and exploit the semantic technologies that will underlie the next generation of knowledge management systems. A key element of the project is to evaluate and assess the impact of semantic web technology in case study settings. The overall aim of the case study, how digital libraries benefit from the Semantic Web.

Introduction:

In the recent years more and more information has been made available on the Web. High quality information is often stored in dedicated digital libraries, Information retrieval in such libraries relies primarily on text search engines and free browsing. The Semantic Web initiative of the World-Wide Web Consortium (W3C) has been active for the last few years and has attracted interest and scepticism in equal measure. The initiative was inspired by the vision of its founder, Tim Berners-Lee, of a more flexible, integrated, automatic and self-adapting Web, providing a richer and more interactive experience for users. The W3C has developed a set of standards and tools to support this vision, and after several years of research and development, these are now usable and could make a real impact. However, people are still asking how they can be used in practical situations to solve real problems. In this article we present how digital libraries benefit from the Semantic Web. We define and evaluate how browsing and searching based on the semantic descriptions of resources and users improves the usability of a digital library, and how digital libraries can be interconnected to exchange semantic descriptions.

Some Definition of Semantic Web:

- Semantic web is an expansion of the current World Wide Web, the Semantic Web is a concept of a system that provides software programmers with mechine-interpretable metadata about the information and that has been published on web.
- 'The Semantic Web will bring structure to the meaningful content of Web pages, creating an environment where software agents roaming from page to page can readily carry out sophisticated tasks for users.

What Exactly Is The Semantic Web:

As an expansion of the current World Wide Web, the Semantic Web is a concept of a system that provides software programmers with mechine-interpretable metadata about the information and that has been published on web.to put it another way, we augment the data descriptoes that already exist in current material and data on the web. Therefour, computers, are capable of producting meaningful interpretations in a manner comparable to the way people analyse information in order to accomplish their objectives. In addition to the traditional “web of documents”the world wide web Consortium (W3C) is assisting in the development of a technological stack to enable a “web of data” similar to the kind of data found in databases. The ultimate aim of the world wide web of data is to allow computers to do more valuable work while also developing systems that can support trustworthy interactions across a distributed network.

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The phrase “semantic Web” alludes to the world wide web consortium’s concept of a web of interconnected data. People may use semantic web technologies to construct data stores on the web define vocabularies, and set rules for how data should be handled in various situations.RDF, SPARQL, OWL, and SKOS are some of the technologies that enable linked data to be used.

What The Semantic Web Will Look Like In The Future:

It may be devided into three categories: information retrieval automation, the internet of Things, and personal assistants .these three categories are the foundation of the original concept of the Semantic Web.

What Is Linked Data, And How Does It Work:

There are dates and titles and part numbers and chemical characteristics and any other data that can be thought of on the Semantic Web; it is a Web of data, in other words. The set of Semantic Web technologies (RDF, OWL,SKOS,SPARQL, and so on) creates an environment in which applications may query data, draw conclusions from vocabularies, and so on.

However in order for the Web of data to become a reality, it is necessary to make the massive quantity of data accessible on the web available in a standard format that can be accessed and managed by semantic web tools. Not only does the semantic web need access to data ,but it also requires access to connections between data, in order to build a web of data,which is not yet possible (as opposed to a sheer collection of datasets).Linked data is a term that refers to a collection of interconnected datasets that may be found on the web.In order to accomplish and generate Linked data technologys for a common format(RDF) should be accessible, allowing for either conversion or on-the-fly access to existing databases to be performed (relational,XML,HTML,etc,) it is also critical to be able to configure query endpoints in order to make it easier to retrivev that information. To get access to the data, the W3C offers a variety of technologies (RDF,GRDDL, POWDER, RDFa, the forthcoming R2EML,RIF, and SPARQL) to choose from.

Usefulness of Semantic Web Technology And Ontology-based Applications For Digital Libraries:

The increasing volume of digital information on the internet is re-shaping methods for accessing digital information. The web presents new ways and strategies for digital libraries to use Semantic Web to enhance the processing and usability of digital contents in more effective ways. The potential of web technology offers an open field for digital library researchers to harness web applications and offer unlimited digital contents for users (Garcia et al., 2011). Librarians should use RDF and web ontologies to develop semantic digital libraries and provide access to information available on the web by offering semantic searching (Moran, 2010).

According to Tredinnick (2007), next-generation digital libraries are dependent on networked knowledge organization systems, ontology models, flexible metadata standards and semantic query languages. Different attempts are being made to re-use their data by making it accessible through semantic layers and semantic resource discovery systems. A variety of applications, such as Dwell, DuraSpace, Fedora Commons and DuraCloud, are available for upcoming new semantic digital libraries to enhance library services.

There are different web applications that can be used to integrate digital libraries with Semantic Web technology. Balaji et al. (2012) studied how to integrate digital libraries with semantic technology. Their study found that many web applications offer new protocols to generate Semantic Web services. These protocols include web services modelling ontology (WSMO), web service modelling language (WSML), Semantic Web service language (SWSL) and Semantic Web rule language (SWRL). JeromeDL, the Semantic Annotator, semantic information mashups and social semantic digital libraries are the major semantic technologies for developing Semantic Web-based information services. Yadagiri and Ramesh (2013) found that resource description framework (RDF), RDF schemas, simple knowledge organization system, RDF query language (SPARQL), Notation3 (N3), Turtle and web ontology language are the technologies and standards for structuring linked data to develop semantic digital libraries (SDL).

Thurlow et al. (2006) found that semantic technology has brought a number of benefits for the users of a digital library. The authors presented a case study of a British Telecommunication (BT) archive project and investigated how Semantic Web technologies can increase the functionality of a digital library system. The BT digital library architecture is based on five types of layers to organize the digital contents by using semantic technology; these include the presentation layer, the application layer, the integration layer, the semantic layer and the persistence layer. These layers bring together relevant contents of digital libraries.

Distinct Features And Dynamic Services Of Semantic Digital Libraries: Future Vision:

Next-generation digital libraries will offer a large variety of informational objects. These objects could be in the form of text, tables, images, scientific data, annotations and videos. Heterogeneous information sources would be required to handle new forms of information (Castelli, 2006). In the future, traditional library services and the role of librarians will be replaced by digital tools. Traditional cataloguing will be replaced by automated metadata. Semantic Web shall replace the classification of books. The acquisition of books will be performed through eBay and PayPal. Digital reference services will become more popular, library collections will be preserved in the form of digital archives and library users will be served via online chat (Law, 2009). Different software agents and mobile agents will be used in digital libraries to perform different tasks (Madalli, 2003). Semantic Web is introducing semantic search engines and semantic techniques to develop automatic metadata generation to offer effective digital library services (Tönnies and Balke, 2009).

Semantic digital libraries will offer a vast amount of information by providing interoperability among heterogeneous information systems. These libraries shall offer semantic wikis and semantic blogs. Current examples of semantic digital libraries are SIMILE, JeromeDL and the Building Resources for Integrated Cultural Knowledge System (BRICKS) (Alotaibi, 2010). Semantic search engines have been developed to search for the query in its real context and provide results within that context. Hakia, Kosmix, Exalead, SenseBot, Cognition Search, Lexxe, Swoogle, Factbites and Powerset are the semantic search engines presenting more relevant, precise and accurate results (Radhakrishnan, 2009).

It is obvious from the above review that semantic digital libraries will produce more relevant results. Use of intelligent software and context-awareness applications will increase the use of digital information sources. The review also presented that semantic search engines – that is, SenseBot, Cognition Search, Swoogle and Factbites – have been developed to search for the exact piece of needed information in its real context.

Semantic Web Tools And Ontology-Based Applications For Digital Libraries:

Next-generation digital libraries will apply semantic technology and semantic Web features.semantic annotator semantic information mashups and social semantic digital libraries are the major semantic technologies for developing Semantic Web-based information services. Other features will include federated search, faceted browsing, semantic query expansion, concepts highlighting, tagging and augmented browsing of semantic annotation, social semantics applications, visualization of data, community-driven taxonomies, cross-repository and semantic interoperability for mapping metadata in RDF to present machine-driven services for semantic digital libraries (Balaji et al., 2012). Sure and Studer (2006) stated that semantic technologies are helpful for digital libraries, as they focus on interoperability and ensure access to heterogeneous repositories. The study identified the

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prominent Semantic Web technologies as: ontology editors, OntoEdit, Protege, annotation tools and Knowledge and Information Management (KIM) for developing Semantic Web-based information services.

Ontology helps digital libraries to develop richer semantic relationships between key terms used for searching purposes. It offers a standardized way to manage web contents instead of only developing the index of these contents. Ontology is aimed at understanding how information is organized rather than organizing the information. Librarians can explore ways to use ontologies in the digital library environment to organize web contents in sophisticated ways (Moran, 2010).

The above review shows that the use of ontology-based applications in digital libraries has real potential to fulfil their aims. It will facilitate targeting and retrieving the required information in its real context. It will also be helpful to overcome and disambiguate among similar information and concepts available on the web. This feature will increase accuracy in searching digital libraries. Ontology editors, such as OntoEdit, and Web Service modelling ontology (WSMO) are the applications that can be used for this purpose.

Future digital libraries will use different Semantic Web applications and ontology-based models, flexible metadata standards and semantic query languages to search for information in the web environment and offer meaningful results. There will be a greater use of RDF schemas by information professionals to develop metadata for digital contents.

In future digital libraries, various Semantic Web applications will be used. These applications include WSMO, semantic information mashups, Semantic Annotator, resource description and framework (RDF), functional requirement for bibliographic record (FRBR), KIM plug-ins, ontology editors, Dura-Cloud, OntoEdit and so forth (Figure 1).

By using the abovementioned Semantic Web tools, interoperability among various digital library systems will be increased and it will become possible for library users to search information from various heterogeneous information systems available on the web. Use of ontology will improve the hierarchy of relations among similar concepts. It will facilitate user to understand related concepts for any query in a more comprehensive way. Use of intelligence-based software in next-generation digital libraries will definitely improve the information retrieval of digital contents. Semantic Web applications will enhance the performance of computers in the searching process and the computer will search for exact information.

Use of context-awareness technology in digital libraries shall play a dynamic role in providing information services. There will be a use of detecting sensors in the library environment to analyze the user’s context and detect their information needs. Detectors will inform information professionals on their systems that these users need a specific type of information and then information professionals will send the required information to that user on their mobile phone. Semantic digital library will use the power of web artificial agents for sharing, searching and organizing information available on the web (Han, 2006; Macgregor, 2008; Pandey and Panda, 2014; Thurlow et al., 2006).

Architecture of Digital Library And The Semantic Web:

The Semantic Web based metadata (RDF, FOAF, and ontologies). The main components of the digital library system consists of:

- **Resource management:** Each resource is described by the semantic descriptions according to the DL core ontology. Additionally a fulltext index of the resource’s content and MARC21, and BibTEX bibliographic descriptions are provided. Each user is able to add resources via a web interface. To satisfy the quality of delivered content, each resource uploaded through the web interface has to be approved for publication.
- **Retrieval features:** DL provides searching and browsing features (see section 4.1) based on Semantic Web data.

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- **User profile management:** In order to provide additional semantical description of resources[4], scalable user management based on FOAF (see section 3.2) is utilized.
- **Communication link:** Communication with an outside world is enabled by searching in a network of digital libraries. The content of the DL database can be searched not only through the web pages of the digital library but also from the other digital libraries and other web applications. A special web services interface based on the Extensible Library Protocol (ELP)[8] (see secion 4.2) has been developed.

Semantic Description Of Resources In Digital Libraries:

There are several approaches to constructing the resource description knowledge base for digital libraries. Conventional catalogs and fulltext indexes are just the most popular examples. In addition one can use bibliographic descriptions like MARC21 or BibTEX. MARC21 consists of few keywords and free text values, without a controlled vocabulary. Therefore machines are not able to utilize much of a MARC21 description. Text values are not enough to support machine based reasoning. To perform more intelligent interactions with readers, the knowledge base must be equipped with semantics. The concept of ontology introduced by the Semantic Web is a promising path to extend Digital Library formalisms with the meaningfull annotations. Not exploiting existing standards in Digital Libraries would be a waste of resources. Therefore it is important to introduce ontologies to the digital libraries domain. The ontologies have to be compatible with already existing bibliographic description formalisms.

Conclusion:

In future, use of Semantic Web applications in providing web-based information services by librarians will increase. Thus, it is important for librarians to acquire knowledge of the Semantic Web and its uses for a digital library. The use of information technology in librarianship has opened up new avenues for information professionals to harness modern digital tools and offer information services in the highly complex and technology-based information environment. It is the foremost responsibility of librarians to learn the applications of new technology in librarianship and to play a vibrant role in coping with the challenges of modern technological information environment. Librarians must develop cutting-edge IT expertise and web knowledge to stay at the forefront in a changing information landscape. Librarians should concentrate on their continuous professional education by participating in training workshops, conferences and seminars to develop technical skills. Librarians must take advantage of new technology and use it intelligently to perform different library operations.
the use of Semantic Web applications will increase in the next-generation digital library. There would be a use of ontology, intelligent agents, detecting sensors and context-awareness technology to offer various services for their users. It is obvious that librarianship has become an ever-changing interdisciplinary field.

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Awareness of Open Source Software among Librarians of Colleges Affiliated to Sant Gadge Baba Amravati University, Amravati

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Abstract

The librarian's role in development of today's education field is immense and the introduction of latest technology has made it more dynamic. The sharing of information among the library users now a day requires that the librarians be technologically updated so that the user can benefit from their expertise. More recently, the open source movement has also added to the list of skills one (the librarian) needs to perform his duties more effectively. In view of above, this study was carried out to understand the level of awareness about various aspects of open source software technology among the library and information science (LIS) i.e. librarians working in colleges affiliated to Sant Gadge Baba Amravati University (SGBAU), Amravati. The study is conducted by using a combination of descriptive and exploratory research designs and all the data necessary for this study was collected using a survey questionnaire. The statistical analysis of the data was carried out with the aid of SPSS 18.0 software. Based on the results of this study it is evident that most of the librarians are aware of only some specific open source operating systems such as Linux Mint, Ubuntu, Fedora and Debian Linux. However, Koha and Newgenlib open source library management software system is more than Openbiblio, PhpmyLibrary, and Evergreen among librarians. Among the digital libraries, most of the librarians are aware of Dspace and Greenstone, while Joomla and Drupal are the open source content management software about which most of the librarians are aware. Overall, the awareness about open source software in the context of librarians is somewhat low.

Keywords: *Librarian, awareness, open source software, Linux Mint, Koha, Dspace, Greenstone, Joomla, Drupal*

1.0 Introduction

The role of information n progress of any country is absolutely undoubted. Moreover, it is the ability of the systems to effectively manage and share the necessary information that creates value systems. In view of this the role of computers in general and its role in library science in particular is very important. Many computing technologies are directly developed for the various tasks that are routinely performed in the libraries. During the early years of software development, programmers would often share software in order to learn from one another and grow the field of computer programming (Upasani, 2016). This process encouraged the creation of the Free Software Foundation (FSF) and included David Knuth's TeX typesetting program in 1979 and Richard Stallman's GNU operating system in 1983. In fact, the early web browser Netscape was a free software with source code that would later go on to help develop open source software projects like Mozilla Firefox (a web browser that is still commonly used today). Subsequently, the FSF later was replaced by the Open Source Initiative (OSI); a group of software developers that creates software intended to be freely shared, improved and redistributed by others (Velmurugan and Kannan, 2012; Choi and Yi, 2015).

Today, many experts in the field have joined the free and open source software movement in one way or another. This has created a major shift in how open source software is viewed and used everywhere with library science being no exception (Singh and Nikose, 2023). Currently, open source software is pervasive across all industry verticals, every day;

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more companies use and develop software than ever before. Moreover, the pandemic has also accelerated digitalization, and more businesses have added software to provide their products and services via a website or an application (app). A common theme for next few years is not only the growth of open source technologies but also the incremental awareness that we will see across industries (Khode, 2018; Kampa, 2018). It is expected that the awareness will fuel the open source use and expansion (Gireesh Kumar and Rao, 2017). With the latest technological advancement, one thing is sure that the demand for a librarian with open source skills is going to increase exponentially (Palmer and Choi, 2014). Experienced library professionals will have plenty of opportunities to cater the library users using open source technologies (Blessing, 2012; Shivakumar and Kemparaju, 2018). Moreover, not much is known about the open source software movement in the Indian context (Hanumappa et al., 2014). In view of the above, it is necessary to know the current level of awareness about various aspects of library science vis-à-vis open source software technology. For this purpose a cross sectional study about the awareness of open source software technology among librarians working in the colleges affiliated to Sant Gadge Baba Amravati University (SGBAU), Amravati was carried out.

2.0 Research Methodology

2.1 Study Area

The present investigation was carried out in the western Vidarbha region of Maharashtra. The colleges affiliated to Sant Gadge Baba Amravati University, Amravati were considered for this study.

2.2 Design of Study and Sample Selection

The study is performed by adopting a combination of descriptive and exploratory research designs, wherein the librarians of colleges of study region were selected randomly. The sample size for this study was 300.

2.3 Primary data collection

All the data necessary for this study was collected using a structured research instrument i.e. a short questionnaire and by using survey method. A Google form was used to collect the data electronically.

2.4 Secondary data collection

Secondary data collection was carried out from the general publications, scientific journals, publications of educational institutions and professional associations, internet resources, research institutes and books from National and International authors.

2.5 Statistical Analysis of Data

All statistical analysis of the data was carried out with the aid of Statistical Package for Social Sciences (SPSS) 18.0 software. The descriptive statistics, such as frequency and percentage were determined from the collected data. The inferential statistics such as 'Chi-Square' test was used to analyze the data. The significance level was chosen to be 0.05.

3.0 Results and Discussion

3.1 Awareness about various open source operating systems

Table No. 1: Awareness about open source operating systems among the librarians working in academic Colleges affiliated to SGBAU

	Aware		Not Aware		Total	
	Nos	Per	Nos	Per	Nos	Per
Ubuntu	188	62.7	112	37.3	300	100.0
OpenSUSE	29	9.7	271	90.3	300	100.0
CentOS	51	17.0	249	83.0	300	100.0
Debian Linux	92	30.7	208	69.3	300	100.0
BOSS	21	7.0	279	93.0	300	100.0

Fedora	104	34.7	196	65.3	300	100.0
Linux Mint	169	56.3	131	43.7	300	100.0

Above **Table 1** presents results pertaining to awareness of open source operating systems among librarians working in academic Colleges affiliated to SGBAU, Amravati. The results show that 56.3%, 62.7%, 34.7%, and 30.7% librarians are aware of Linux Mint, Ubuntu, Fedora and Debian Linux open source operating systems respectively. While, 17.0%, 9.7%, and 7.0% librarians respectively showed somewhat low awareness about CentOS, OpenSUSE, and BOSS open source operating systems.

3.2 Awareness about open source library management software

Table No. 2: Awareness about open source library management software among the librarians working in academic Colleges affiliated to SGBAU

Open source library management software	Aware		Not Aware		Total	
	Nos	Percent	Nos	Percent	Nos	Percent
Koha	284	94.7	16	5.3	300	100.0
Newgenlib	174	58.0	126	42.0	300	100.0
Openbiblio	88	29.3	212	70.7	300	100.0
Evergreen	99	33.0	201	67.0	300	100.0
PhpmyLibrary	19	6.3	281	93.7	300	100.0

Above **Table 2** presents results pertaining to awareness of open source library management software among librarians working in academic Colleges affiliated to SGBAU, Amravati. The results show that 94.7%, 58.0%, 33.0%, 29.3%, and 6.3% librarians are aware of Koha, Newgenlib, Openbiblio, PhpmyLibrary, and Evergreen open source library management software systems respectively.

3.3 Awareness of Open Source Digital Library Software

Table No. 3: Awareness about open source digital library software among the librarians working in academic Colleges affiliated to SGBAU

Open source digital library software	Aware		Not Aware		Total	
	Nos	Percent	Nos	Percent	Nos	Percent
Dspace	267	89.0	33	11.0	300	100.0
Eprint	97	32.3	203	67.7	300	100.0
Greenstone	189	63.0	111	37.0	300	100.0
Digital Commons	57	19.0	243	81.0	300	100.0
Dtaversess	21	7.0	279	93.0	300	100.0
dLibra	59	19.7	241	80.3	300	100.0

Above **Table 3** presents results pertaining to awareness of open source digital library software among librarians working in academic Colleges affiliated to SGBAU, Amravati. The results show that 89.0%, 63.0%, 32.3%, 19.7%, 19.0%, and 7.0% librarians are aware of Dspace, Greenstone, Eprint, dLibra, Digital Commons, and Dtaversess open digital library software systems respectively.

3.4 Awareness of Open Sources Content Management Software

Table No. 4: Awareness about open source content management software among the librarians working in academic Colleges affiliated to SGBAU

Source content management software	Aware		Not Aware		Total	
	Nos	Percent	Nos	Percent	Nos	Percent
Joomla	219	73.0	81	27.0	300	100.0
Wordpress	137	45.7	163	54.3	300	100.0
Drupal	185	61.7	115	38.3	300	100.0

Cushy CMS	173	57.7	127	42.3	300	100.0

Above **Table 4** presents results pertaining to awareness of open source content management software among librarians working in academic Colleges affiliated to SGBAU, Amravati. The results indicate that 73.0%, 61.7%, 57.7%, and 45.7% librarians are aware of DJumla, Drupal, Cushy CMS, and Wordpress open source content management software systems respectively.

4.0 Conclusions

4.1 Awareness about various open source operating systems

- Overall, on the basis of the study results it is evident that most of the LIS professionals working in academic colleges affiliated to SGBAU, Amravati are aware of only some specific open source operating systems such as Linux Mint, Ubuntu, Fedora and Debian Linux.

4.2 Awareness about open source library management software

- Thus, on the basis of comparative assessment it is evident that awareness about Koha and Newgenlib open source library management software systems is more than Openbiblio, PhpmyLibrary, and Evergreen among librarians working in academic Colleges affiliated to SGBAU, Amravati.

4.3 Awareness of Open Source Digital Library Software

- In view of the study results it is evident that most of the librarians working in academic Colleges affiliated to SGBAU, Amravati are aware of Dspace and Greenstone open source digital library software.

4.4 Awareness of Open Sources Content Management Software

- In view of the study results it is evident that awareness about Joomla and Drupal open source content management software high in most of the librarians working in academic Colleges affiliated to SGBAU, Amravati.

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Role of Reference Management Tools in Research

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Abstract:
The activity of research has got tremendous importance in academic world. Due to plagiarism reference management has been considered as a very tedious and skillful job. RMT's have made the work of reference management very simple and easy. The article narrates the role of reference management tools in research activities. While emphasizing this role, some exemplary tools such as EndNote, Mendeley, Zotero and RefWorks have briefly been delineated.
Keywords: Reference Management Tool; Citation Management; Mendeley; Zotero; EndNote; RefWorks; RMTs in Research

Introduction:
Reference management is the art of arranging references or citations in scientific way adhering the scientific tradition of reference management. The references can be managed with the help of specific citation style. such as APA, MLA, Chicago or any other similar style. Often the journals have separate reference management systems which can be considered as the scientific system. For example, IEEE journals have their own reference management system.
In previous days the task of citation management was carried out manually. However, today this method would not be suitable as this is era where technology makes things easy to operate. Here lies the significant of RMT approach to the process of doing research work.
There are various research tool's available in the market. Some are freely available while some are proprietary software's. Resorting to these software's will help researchers to store, organise and use the citation without much labour.

Definition of Reference Management Tools
Reference management or citation management software, such as EndNote, RefWorks and Zotero is a software that stores citation in a digital form, either locally or via an online interface, to make organizing research and formatting bibliographies and in-text citation more efficient[1] .
Reference Management Tools are the software that simplifies the process of reference management by allowing the user to collect, store and organize reference, insert to citations at the appropriate place in the body of the manuscript and generate a list of references in an properly formatted bibliographic styles[2] .

Selected Reference management software/Tools:
Following are some of the reference management tools which are largely popular among the academic community.

Mendeley
Mendeley is open-source citation manager that help to the organize researcher and collaborate online discover a new research software offered by Elsevier, is a company based in London (UK) which provides a service for academic and institute researchers[3] .

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Zotero

Zotero is another bibliographic management tool. It is started as advanced Firefox add-on meaning users who wish to use Zotero had to use the Firefox browser. However, there is also now a standalone client for Windows, OS X, and Linux. Zotero is especially made to capture in organized web-based material one of the useful features of Zotero is its proxy detection and redirection. Often library proxies are used to authenticate off campus users. Zotero client is very impressive to capture a metadata when a user provides an ISBN, DOI or PMID[4].

EndNote

EndNote 20 is in market and EndNote 21 is coming soon this is the most popular RMT's across the world. EndNote offers special discount for institutional subscription. EndNote enrich one's research by searching number of online resources, accessing full text. It has the facility to read, to review, annotate, and search PDF's 'Cite While You Write' option of the EndNote integrates citation while writing the research document itself. EndNote is Accurate with regard to updating referencing styles associated with various journals. It matches researcher's paper with appropriate journal using Manuscript Matcher. A user can also customize references in EndNote[5].

RefWorks

RefWorks is web-based commercial reference management software package[6]. Many eminent institutions are subscribing it and making it freely available to the students and researchers it is a product of Ex Libris owned by ProQuest. It imports references from online databases and other similar sources by which automatic formatting of research documents. Many databases provide options to imports references into RefWorks. The data stored and organized in it can be exported to other reference management tool[6].

Who Should Use RMTs[7]:

- Researchers
- Writer/Professional Writers
- Journalists
- Book Authors
- Students

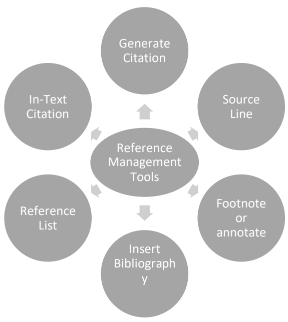
Why to Use Reference Management Tools[8]:

All Citation Management products have following basic features

1) Gathering and transfer reference from databases
2) Organize, annotate, sort and search your reference full text and pdfs
3) Insert in-text citations and references list into documents in a wide variety of styles (MLA, APA, etc.)
4) Create standalone bibliographies in wide variety of style

Figure 1: depicts the Functions of Reference Management Tools

Figure 1: Functions of Reference Management Tools



Role of reference Management Tools in Research

- RMTs offer a great opportunity of citation management by using electronic tool. It is very difficult for researchers in this era to manage the citation of e-books, e-journals, databases or any web-page manually. Hence researcher has no option but to switch over to RMTs.
- It allows user to create different groups to store the documents or citations. The researchers can create as many folders as he thinks necessary considering his research work.
- RMTs allow users to insert citation while writing the current documents. One can remove the duplicate articles and save the full-text pdf.
- The pdf full text can be inserted to bibliographical citation.
- Manually data entry can be done in case bibliographical details is not available online.
- Citation manager supports several citation styles.
- The reference can be shared with other researcher while doing group research.
- Online back-up can be taken of the desktop library.
- Some RMTs help to create subject bibliographies and category bibliographies.
- RMTs support bibliometrics research and scientometrics research.
- The references support from online database can directly be imported to RMTs
- The references from the RMTs can easily be exported to other tools.
- Most of the RMTs offer web searching interface to get desired citations.
- The saved full text in PC can easily be imported into RMTs.
- RMTs Plays an important role in controlling plagiarism.

Conclusion

To conclude, we can say that RMTs have ample of benefits to the researcher. These benefits have been pointed out in the paper. Considering these benefits, it is expected that the researcher should give prime importance to the RMTs for the citation management and maintaining scientific of tradition citation management. For this they must resort to the helps from the library professionals and product websites giving information about respective RMTs.

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माहितीचा अधिकार व सार्वजनिक ग्रंथालयाची भूमिका

विपीन आर लिल्हारे
ग्रंथपाल, छत्रपती शिवाजी कला महाविद्यालय, आसेगाव पूर्णा, ता. चांदूर बाजार जि. अमरवती

प्रस्तावना :-

२०२० मध्ये माहिती अधिकार कायदा २००५ ची द्विदिशकपूर्ती साजरी झाली. व्यापक अर्थाने जाणून घेण्याचा अधिकार भारताच्या समस्त नागरिकास या कायद्याच्या प्रभावी अंमलबजावणीतून प्राप्त होता. परंतू प्रत्यक्ष्यात तसे होताना दिसत नाही. या कायद्यानूसार "सार्वजानिक प्राधिकरणाकडे उपलब्ध असणारी कोणतीही माहिती एखाद्या नागरिकास हवी असेल तर तो मागू शकेल. आणि इच्छित कालावधित ती माहिती त्याला पूरवणे हे त्या सार्वजनिक प्राधिकरणावर बंधंकारक आहे. हा या कायद्याचा गाभा आहे. नागरिकांचा ज्या ज्या सरकारी, निमसरकारी, अनुदानित कार्यालयाशी, महामंडळाशी, सार्वजनिक बँकाशी किंवा स्थनिक स्वराज्य संस्थाशी संबंध येतो. त्या सर्वांचा सार्वाजनिक प्राधिकरण या संज्ञेत समावेश होतो. हे सर्व प्राधिकरण आवश्यक माहिती पुरविण्यात सक्षम आहेत काय **?.** त्या प्राधिकारणातील कर्मचा-याना माहिती संग्रहन, संघटन व पुनर्प्राप्ती सबंधीत कौशल्ये अवगत आहे काय ?. किंवा एखादी व्यक्ती सोलापुर जिल्ह्याची रहिवासी आहे आणि नाशिकला येऊन माहिती विचारते. ती माहिती संबंधित प्राधिकरणाला देणे शक्य होते काय? या प्रश्नातून तसेच" माहिती अधिकाराचा हक्क" या कायद्याच्या मर्यादा आणि संबंधित कुचकामी यंत्रणा यातून सार्वभौम व मालक असलेल्या जनतेला इच्छित माहिती मिळविण्यापासून वंचित राहावे लागत आहे. सार्वजनिक ग्रंथालय व्यवस्था, स्थानिक स्वराज्य संस्था व राष्ट्रीय ज्ञान आयोगाच्या शिफ़ारशी यांची सांगड घालून माहितीच्या हक्काची प्रभावी अंमलबजावनी होवू शकते. या दृष्टीने प्रस्तूत निबंधात" माहिती अधिकार कायदा २००५", माहिती आयोग सक्षम प्राधीकारी, कायद्यानुसार माहिती व अभिलेख याची व्याख्या आणि माहिती पुराविण्याबाबत सार्वजनिक प्राधिकरणावरील आबंधने किंवा मर्यादा तसेच राष्ट्रीय ज्ञान आयोगाच्या शिफ़ारशीनुसार सार्वजनिक ग्रंथालये माहिती अधिकारात कश्याप्रकारे प्रभावी भूमीका वठवू शकतात.याचा आढावा प्रस्तुत निबंधात घेतला आहे.

की वर्ड :-

- माहिती अधिकार कायदा २००५
- माहिती व अभिलेख
- सार्वजनिक प्राधिकरणावरील आबंधने
- राष्ट्रीय ज्ञान आयोगाच्या शिफ़ारशी
- सार्वजनिक ग्रंथालय व त्याची भूमिका

१) महिती अधिकार कायदा २००५

स्वच्छ व पारदर्शक आणि भ्रष्टाचार विरहित राज्य कारभारासाठी जनतेला माहितीचा अधिकार देणे हे सयुक्त पुरोगामी आघाडी (U.P.A.) यांच्या निवडणूक जाहिरनाम्यातील महत्वाचे कलम होते त्यानुसार केंद्र शासनाने राईट टू इन्फरमेशन -२००५ या शिर्षकाने हा कायदा संसदेत मंजुर केला सार्वजनिक प्राधिकरनाने उपलब्ध असणारी कोणतीही महिती एखाद्या नागरिकाला हवी असेल तर ती तो मागू शकेल आणि ठराविक कालावधित ती माहिती त्याला पुरविणे हे त्या सार्वजनिक प्राधिकरणावर कायद्यनुसार पुरविणे बंधन कारक आहे.

"प्रत्येक सार्वजनिक प्राधिकरणाच्या कामकाजामध्ये अधिकाधिक आणि उत्तरदायित्व निर्माण करण्याच्या दृष्टिने सार्वजनिक प्राधिकरणच्या नियंत्रणखालील माहिती नागरीकाना मिळवता यावी म्हणून नागरिकांच्या माहिती मिळण्याच्या आधिकाराची व्यवहार्य शासन पद्धत आखून देण्याकरिता केंद्रिय माहिती आयोग आणि राज्य माहिती आयोग घटीत करण्याकरिता आणि तत्संबधित किंवा तदनुषंगिक बबींकरिता तरतुद करण्याकरिता अधिनियम " या कायद्यात काही महत्वपूर्ण व्याख्या दिल्या आहेत.

अ) समुचित राज्य : या कायद्यात समुचित राज्य याचा अर्थ केंद्र सरकार किंवा संघराज्य प्रशासन या कडून स्थापित झालेल्या त्यांच्याकडे मालकी अथवा नियंत्रित असलेल्या किंवा त्यांच्याकडून प्रत्यक्ष – अप्रत्यक्ष वित्तपुरवठा करण्यात येतो त्यांच्या राज्यशासनाच्या सर्व संस्थांच्या समावेश होतो.

ब) केंद्रिय माहिती आयोग, केंद्रीय जनमाहिती अधिकारी, माहिती आयुक्त, सक्षम प्राधिकारी

राज्यमाहिती आयोग, अपिलीय अधिकारी, माहिती अधिकारी, सहाय्यक माहिती अधिकारी या संरचनेचा समावेश होतो.

क) माहिती : माहिती म्हणजे कोणत्याही स्वरुपातील कोणतेही साहित्य यात अभिलेख, दस्तऐवज, ज्ञापने, ई-मेल, अभिप्राय, सुचंना, प्रसिद्धि पत्रके, परिपत्रके, आदेश, रोजवहया, संविदा, अहवाल, कागदेपत्रे नमुने प्रतिमाने (मॉडेल) कोणत्याही इलेक्ट्रोनिक स्वरुपातील आधार सामग्री आणि त्या त्या वेळी अमलात आलेल्या अन्य कोणत्याही काद्यांन्वये सार्वजनिक प्राधिकरणास मिळवता येईल अशी कोणत्याही खाजगी निकायाशी सबंधित माहिती याचा समावेश होतो.

ड) अभिलेख : यात पुढील बाबिंचा समावेश होतो –

१) कोणतेही दस्तऐवज हस्तलिखित व फाईल

२) एखाद्या दस्तऐवजाचा कोणताही सुक्ष्मपट) मायक्रोफिल्म) मायक्रोफिश आणि प्रतिरुप (फ्रॉसिमल) प्रत

३) संगणकाद्वारे किंवा अन्य कोणत्याही उपकरणाद्वारे तयार केलेले कोणतेही साहित्य.

२) सार्वजनिक ग्रंथालय, मूलभूत तत्वे व कार्ये -

समाजातील सर्वसामान्य अश्या सर्व लोकाना वाचनसाहीत्याच्या माध्यामातून मनोरंजन, माहिती, नवे ज्ञान आणि आजच्या संदर्भात हवी ती आणि त्यास आवश्यक असणारी माहिती देण्यासाठी केलेली व्यवस्था म्हणजे सार्वजनिक ग्रंथालय होय. १ (ज्ञानलालसा व ज्ञानाची तृष्णा भागवणे. २) प्रागतिक नेतृत्व व उदारमतवाद ३ (माहिती साक्षरता राबवीणे ४ (माहिती केंद्र, स्वाध्याय व सांस्कृतीक केंद्र म्हणून काम करणे ही सार्वजनिक ग्रंथालयाचे मूलभूत तत्वे आहेत. त्याच बरोबर सार्वजनिक ग्रंथालयांना करावी लागणारी सर्वसामान्य कार्ये १) माहिती देणारी साधनांची उपलब्धता करणे. 2) स्थानिक वैशिष्ट्यांचे जतन करणे 3) लोकशाही मूल्यांचे जतन करणे , ही आहेत.

(3राष्ट्रीय ज्ञान आयोगाने ग्रंथालयासंबंधी सरकारला केलेल्या शिफारशी -

भारत सरकारने इ. स. २००५ साली डॉ. सॅम पित्रोदा याच्या अध्यक्षतेखाली राष्ट्रीय ज्ञान आयोगाची स्थापना केली. या आयोगाने समाजातील माहिती व्यवस्था बळकट करण्यासाठी महत्वपूर्ण शिफारशी केल्या आहेत, त्यात १) आधुनिक माहिती व संप्रेषणच्या पद्धतीचा उपयोग करून ग्रंथालय व माहिती सेवामध्ये सुधारणा करणे. २) ज्याच्याकडे माहिती आहे आणि ज्यांच्याकडे माहिती नाही अश्या दोन समाजामधील दरी मिट्विण्यासाठी कोणते नवीन उपक्रम सुरु करता येईल याची शक्यता आजमावणे. ३) माहीती निर्मितिचे नवीन मार्ग शोधणे. ४) प्रशासन व संपर्क व्यवस्था अधिक सक्षम करण्यासाठी माहिती व संप्रेषण तंत्रज्ञानाचा वापर करणे. याचा समावेश आहे ही उदिष्टे साध्य करण्यासाठी व सार्वजनिक ग्रंथालये स्थानिक स्वराज्य संस्थेची जोडण्यासाठी **working group on librarics** स्थापन केला आहे. सार्वजनिक ग्रंथालयाची तत्वे व कार्य आणि राष्ट्रीय ज्ञान आयोगाने ग्रंथालयासंबंधी केलेल्या शिफारशी आणि माहितीचा अधिकार कायदा याची मोट बांधून सार्वजनिक ग्रंथालये ही माहितीचा अधिकार मिळवून देणारी स्वतंत्र यंत्रणा म्हणून उद्यास येवू शकते.

४) **सार्वजनिक प्राधिकरणा वरील आबंधने किंवा मर्यादा व सार्वजनिक ग्रंथालयाची भूमिका :** माहिती अधिकार कायद्यानुसार माहिती ही संकल्पना व्यापक आहे. माहिती देण्याची व माहिती संग्रहित करण्याच्या यंत्रणेत सार्वजनिक प्राधिकरणातील व्यक्तिचा समावेश असल्यामुळे व कायद्यानेच प्रधिकरणावर काही आबंधने असल्यामुळे माहिती अधिकाराच्या अमंलबजावनित मर्यादा पडत आहे. माहितीच्या निर्मितीपासून उपयोजकापर्यंतचा माहितीचा प्रवास याचे माहितिशास्त्र असते. माहिती अधिकाराच्या यंत्रणेतील कर्मचारी प्रशिक्षित नसल्यामूळे व त्यांच्या दैनंदिन कार्यभाराच्या अतिरिक्त हा भार असल्यामूळे माहिती वितरण्याच्या कार्यात प्रचंड मर्यादा पडतात. ही अडचण दूर करण्यात सार्वजनिक ग्रंथालये महत्वाची भूमिका पार पाडू शकतात.

अ) माहितीची स्थळ, काळ , मर्यादा :- माहितीचा अधिकार २००५, हा कायदा जम्मू व काश्मिर या राज्याला लागू नाही. ज्या सार्वजनिक प्राधिकरणाची माहिती मिळते. तसेच माहिती कोणत्या कालावधीसाठी हवी आहे. त्याचा निश्चीत उल्लेख करावा लागतो. म्हणून माहिती मिळवण्याच्या अधिकारात मर्यादा येतात. सार्वजनिक ग्रंथालये माहितीच्या स्थळ, काळ मर्यादा दूर करु शकतात.

ब) बाधित व्यक्ती व त्रयस्थ पक्ष :- राज्य घटनेच्या अनुछेद १४, २१ व १९ मधील तरतुदींचा बाधीत व्यक्तींना लाभ मिळावा हा या कायद्याचा मुख्य उददेश आहे. पण माहिती मागणारी व्यक्ती बाधीत आहे काय ? ती ज्यामुळे बाधित आहे त्याच्याशी मागितलेली माहिती संबंधित आहे काय? अश्या कसोट्या लावल्या जातात. या आबंधनमूळे समग्र माहिती जाणून घेण्याची ज्ञानलालसा पूर्ण होत नाही. तसेच त्रयस्थ पक्ष म्हणजे तिसरी व्यक्ती ज्या व्यक्तीबद्दल किंवा संस्थेशी संबंधित कोणती माहिती द्यावी व कोणती देवू नये हे या कलमामुळे स्पष्ट होऊ शकत नाही. सार्वजनिक ग्रंथालयाकडे महिती पुरविण्याचे काम सोपविल्यास हे आबंधन नष्ट होऊ शकते..

क) राजपत्र किंवा अन्यत्र प्रसिध्द झालेली माहीती :- जेव्हा माहीती ही आधीच राजपत्रात किंवा अन्यत्र प्रसिध्द झालेली असून ती जनतेला उपलब्ध आहे किंवा ती अश्या स्वरूपाची आहे की ती परत मिळवणे आणि संस्करण करणे आवश्यक असलेल्या हया मोठया प्रमाणातील माहितीसाठी शासकीय प्राधिकरणाच्या सामग्रीचा मोठया प्रमाणाबाहेर वापर होतो म्हणून अशी माहिती पुरवण्याच्या विनंतीस नकार दिला जातो. तसेच जी माहिती कायदा नियम विनिमय किंवा आदेश या व्दारे विशिष्ट वेळी प्रसिदध करणे आवश्यक असेल अशी माहिती पुरवण्याच्या विनंतीस नकार दिला जातो. हे आबंधन सार्वजनिक ग्रंथालय आपल्या माहिती संग्रहनाच्या कौशल्यामुळे दुर करू शकते.

माहिती अधिकार कायदा व सार्वजनिक ग्रंथालय व्यवस्थेत करावयाचे काही बदल सार्वजनिक ग्रंथालय हे माहितीच्या अधिकारा संदर्भात महत्वाची भूमिका बजावू शकते त्यासाठी व्यवस्थेला खालील मुददे विचारात घ्यावे लागतील

१) स्थानिक स्वराज्य संस्थेशी सार्वजनिक ग्रंथालय जोडणे –स्थानिक स्वराज्य संस्थेची रचना जिल्हापरिषद –पंचायत समिती ग्रामपंचायत व महानगरपालिका नगरपालिका अशी व महसुल व्यवस्थेत जिल्हाधिकारी, तहसिलदार, पटवारी अशी व्यवस्था असते. ग्रंथालय व्यवस्था स्थानिक स्वराज्य संस्थेशी जोडल्यास गावपातळीवरून जिल्हापातळीवर माहीतीची देवाण घेवाण सुलभ होईल ग्रंथालय संचानालय आणि माहिती आयोग यांच्यात समन्वय साधल्या गेल्यास माहिती अधिकार कायदयाची चोख अमलबजावणी होईल

२) माहिती आयोगातील कर्मचारी ग्रंथालय व माहितीशास्त्रातील प्रशिक्षित व्यक्ती नेमणे- माहितीच्या निर्मिती पासून उपयोजकापर्यंत माहिती पोहचविणे, माहिती संग्रहित करणे, व माहिती प्रणाली संबधिचा अभ्यास ग्रंथालय व माहिती शास्त्रात केला जातो .या क्षेत्रातील प्रशिक्षित व्यक्ती माहिती तज्ञ असते .म्हणून माहिती आयोगात अश्या प्रशिक्षित व्यक्तीची नेमनूक केल्यास अमलबजावणीतील त्रुटी कमी होईल.

३) राष्ट्रीय ज्ञान आयोगाच्या शिफारशी स्वीकारणे – ज्ञान आयोगाने ग्रंथालयासाठी राष्ट्रीय आयोग स्थापन करण्याचे सुचविले आहे .तसेच ग्रंथालयांनी पुरववायाच्या सेवांचे आधुनिकिकरण व ग्रामपातळीपासून ते राष्ट्रीय पातळीपर्यत ग्रंथालय जाळयांची निर्मिती करण्याची शिफारस केली आहे .या शिफारशी स्वीकारल्या गेल्या तर माहिती आयोग व ग्रंथालय आयोग मिळून हे कार्य उत्तम करू शकतात. तसेच ग्रंथालय जाळयांची निर्मिती केली म्हणजेच माहिती अधिकाराची स्थळ-काळ मर्यादा नष्ट होईल.

सारांश- माहिती अधिकार कायद्यात सार्वजनिक प्राधिकरणावर काही आबंधने आहेत .त्यामूळे माहितीचा अधिकार यात अडचणी व अडथडे निर्माण होतात .सार्वजनिक ग्रंथालयाची कार्य व उद्दिष्टे लक्षात घेतल्यास व काही कार्यप्रणालीत बदल केल्यास व राष्ट्रीय ज्ञान आयोग व सार्वजनिक ग्रंथालय माहिती अधिकार कायद्याच्या अंमलबजावणीत महत्वाची भूमीका बजावू शकते.

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Barcode Technology Uses and Importance in Libraries

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Abstract:

Barcode have found verities of applications in different fields, including libraries and information centers. Indeveloped countries barcode patterns become a familiar symbol for general masses due to appearance in all personalproducts, books, garments other records, etc. Barcode is not a very new technology; it had been as early as 1940s. Itsfirst commercial application can be back to 1960s as a method for tracking rai/roads In India bar codes are being used invarious companies and the All India Radio as an automatic method of identification, many manufacturing industries andcompanies have been using barcodes. The application of barcode technology in circulation system of a library andinformation centre is most successful due to the speed, accuracy and reliability. This technology of automaticidentification has found wide acceptance in the libraries and information centers.

Introduction:

In recent time, libraries and knowledge centers are facing lots of changes due to the rapid growth of modern technologies. Modern technologies have replaced the out-of-date methods applied in libraries and knowledge centers for storing and disseminating of information. In the world of information technology and computerization, automation of libraries and growing demand for improved facilities to users. Library materials are also changing quickly to the various digital formats from the traditional print formats. In this scenario, Barcode technology plays an important role in automating the functions of the library, especially the circulation process. Application of Barcode increases the speed and accuracy in operations. Barcode technology provides a simple and inexpensive method of encoding text information that is easily read by inexpensive electronic readers. Barcoding also allows data to be collected rapidly and with extreme accuracy. Barcoding is a computer-aided process of generating codified information, which is subsequently printed on a predefined stationery, invariably on a self-adhesive label for several later applications. A Barcode is a combination of a series of parallel, adjacent bars and spaces. Predefined bar and space patterns or "symbologies" are used to convert small strings of character data into a printed symbol. A Barcode reader interprets a Barcode by scanning a light source across the Barcode and calculating the intensity of light replicated back by the white spaces. The pattern of replicated light is identified with a photodiode which produces an electronic signal that exactly matches the printed Barcode pattern. This signal is then construed back to the original data by inexpensive electronic circuits.

What is Barcode:

A Barcode is a square or rectangular image containing a series of analogous black lines and white spaces of varying widths. Barcode is a machine-readable code in the form of numbers and an outline of parallel lines of varying widths, printed on a commodity. Hence a Barcode fundamentally is a way to encode information in a pictographic pattern that a machine can read. The combination of black and white bars signifies different text characters which follow a set algorithm for that particular Barcode.

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Need For Barcode Technology:

Library are going automated digitized now a days users have very less time to find out a piece ofinformation from and entire consent so this technology is very important for providing quick and pinpointedinformation.

- Keep up to date with the modern technical initiatives.
- To improve access more quickly from inside the library as well as from outside.
- To improve working efficiency.
- Cost saving.
- Maintaining through Software is very easy.

Objectives Of Barcoding:

The major objective of bar coding in a library are as follows: -

- ➢ To achieve accuracy.
- ➢ Time saving of users.
- ➢ To reduce operational cost.
- ➢ Improve operational efficiency.

Basic Requirement for Barcode Application:

Implementing Barcodes in library application the following hardware and software are required.

- ❖ Personal Computer.
- ❖ Barcode Scanner
- ❖ Decoder
- ❖ Printer
- ❖ Printing Software
- ❖ Library Software
- ❖ Membership Database.

Application Of Barcode System in Libraries

Automation and networking of libraries are being done with a view to provide effective and efficientservices to its users. A library is not fully automated, if this automatic metro of identification is not included.The application a barcode system is principally quite suitable for circulation job of library besides, the job ofinventory and periodically control can also be effectively carried with the help of barcode technology.

- ✓ Accessioning
- ✓ Membership identification
- ✓ Circulation System
- ✓ Library attendance system
- ✓ Issue of “no due” certificate
- ✓ Inventory and periodical control
- ✓ Stock verification

Advantages Of Using Barcode Technology

- ➢ Barcodes eliminate the possibility of human error in the circulation section of the library
- ➢ Barcodes are inexpensive to design and print. Generally, they cost mere pennies, regardless of their purpose, or where they will be affixed.
- ➢ Barcodes are extremely versatile. They can be used for any kind of necessary data collection in the library.
- ➢ Library material control improves. Because Barcodes make it possible to track library materials so precisely.
- ➢ Data obtained through Barcodes are available rapidly. Since the information is scanned directly into the server, it is ready almost instantaneously.

- Barcodes promote better decision making. Because data is obtained rapidly and accurately, it is possible to make more informed decisions. Better decision making ultimately saves both time and money.

Disadvantages Of Using Barcode Technology

There are some disadvantages for using Barcode technology:

- They are very labour intensive; as they must be scanned individually.
- Barcodes are more easily damaged; as the line of sight is needed to scan, the printed Barcode has to be exposed on the outside of the library materials.
- If a Barcode is ripped or damaged there is no way to scan the library materials.
- Restricted traceability.
- Susceptible to environmental damage.
- Prone to Human Error

Conclusion:

Implications of Barcode technology is one of the best techniques to minimize the time taken at thecirculation section. Bar coding by itself is not system but an identification tool. That provides an accurate andtimely support of the date requirement for the sophisticatedmanagement systems Barcode uses increaseaccuracy in the data collection, save time of the users and improves efficiency in various library operations,every library needs the application of new technology to developed its existing methods this time thus savedcan be utilized for developing advance and additional techniques in the library. It minimizes errors and increasethe efficiency at the of the circulation cost of climating book cards and books pockets. Barcode labels with bothaccession and call number on it can also be used as a book tag. Contribution of Barcode technology withComputer and Application Software Improves Performance and Efficiency in Various Library Operations.

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The significance of Soft Skills for proficient Library Management

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Abstract :

While working in the information world has brought dramatic change to handle information today. Rapidly developing information and communication technology are creating now opportunities and challenges. Library services need to be updated for the users to get their services effectively. There is demand for libraries to struggle to be effective in their services to user in order to remain important in the information age. The aim of the study is to come into used to library professional to develop their soft skills. The paper encourage librarian to take special responsibility regarding soft skills and attain an important role in shape an individual’s personality. The fallout of this paper will help the management of libraries to be more effective in the services they provide to their users for growing encouragement and user need.

Keywords : Time management , Leadership, Communication Skills, User Satisfaction, Interpersonal Skills, , Soft Skills.

Introduction : The current scenario, there is need for libraries to accept modification and make flexible in their function and services for information seekers. The role of libraries and librarians changed of information and care taker to actual learning center and information manger and at the same time the forms and distribution of information also took new shape and way. The specific objectives are to describe as comprehensively as possible the techniques which can be recommended in the soft skills. Soft skills required for the library professional to increase clarity and efficiency of the libraries. The current educational management is highly pinpointed on the quality, knowledge, competency, learning skills, Interpersonal skills, good life skills, flexibility while problems solving and proficiency in using information technology. To manage this challenge, librarians should have some of soft skills which are very much essential to gratify the users.

Task of soft skills: the soft skills are required in day-to-day working for carrying out routine jobs more effectively. Soft skills are an essential for finding, attracting and retaining users. When librarian interaction with users and staff decide to improve their skills, the natural first step is to read about techniques, composition and methods then to decide on a process which will suit their personalities and personal preferences. The usual next step is the real person who has in a problem, need or grumble. For today’s librarians having professional degrees in library and information science but it is not sufficient because the demand for librarians having multidimensional skill in the areas of technical work, administrative work and also in providing user oriented services along with soft skills. Like any other profession, Some of the soft skills and competencies which are essential by the library professionals to execute the core objective of the library profession.

The main tasks of Soft Skills module are to grow and improve:

- Time management and conflict management
- Creativity and cultural awareness
- Etiquette and good manners
- Critical, structural and thoughtful thinking
- Self-management and self awareness skills
- Communication skills, including interpretation.

- Team working and peer support strategies.

Top Soft skills are essential to become a successful library professional :

➢ **Active listing skills :** The library professionals must have good listening skills to interact with different types of users all the time. By carefully listening to users' can identify the exact necessity and then provide the service accordingly. The library professionals must have good listening skill to interact with special types of users all the time.

➢ **Effective communication presentation skills :** Grasp on language is very essential for effective development of skills. It is rarely an inherited gift. It depends partly on acquiring an understanding of technique, also on practical development of competence and confidence. Communication is simply the act of transferring information from one place to another, whether this be a verbal, non verbally or visually. The library professionals must have good communication skills; it is very much needed while interacting with users.

➢ **Development of employability skills relationship:** Librarians have to transaction with all levels of people like Management, users, colleagues in library, vendors etc. To deal with each one on them in rightful manner requires interpersonal skills. The library professionals must be able to build good interpersonal skills among the fellow workers, users and others with whom they work closely.

➢ **Leadership proficiency and Team work:** The ability to lead effectively is based on a number of key skills. These skills are highly sought after by employers as they involve dealing with people in such a way as to motivate, enthuse and build respect. Hence it is required to have leadership skills to manage and guiding the team time to time, as every subordinate is important for carrying out their work efficiently for smooth running of library ,

➢ **Teaching Skills:** It can help to conduct the information literacy classes effectively and smoothly. Teaching skills helps for new user orientation or new service introduced such as MOOC's online courses and database and browsing search engines.

➢ **Manipulate or gain new ICT skills:** To satisfy the information needs of the users is the utmost priority for any library. The librarians must use the new technology to provide useful and appropriate service to user community but in the new era different types of technologies are available for the same purpose. Hence, the library professionals must be able to compare and self update to handle the software and other technical equipments. The advancement in communication technology, the new way of information transfer and communication has come up. Hence the library professionals must able to provide traditional library services in effective way with the help of new technology.

Conclusion : As educational or library professional leader we are tactically positioned to shape the direction of education and of society as a whole. The paper determine the development of soft skills in term of library staff manifestation, effective communication, positive attitude, knack to manage up in different circumstances. It present variety of soft skills likely to be importance to the library and information science professionals. As educational or library professional leader we are tactically positioned to shape the direction of education and of society as a whole. The fruitful conclusion of this paper will help the management of libraries to strive to do their best to see that their users or stakeholders get the best service and satisfaction from the library.

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Consortium for e-Resources in Agriculture: CeRA

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Abstract
Consortium for e-Resources in Agriculture is a e-Consortium of Agricultural Libraries under the Indian Council of Agricultural Research for National Agricultural Research System libraries. The National Agricultural Research System of India comprises Indian Council of Agricultural Research and Central/State Agricultural Universities under Department of Agricultural Research and Education, Ministry of Agriculture, Govt. of India. The paper discusses the background, main features, and advantages of the **Consortium for e-Resources in Agriculture**.
Keyword: - Consortium in agriculture, Indian council of agricultural research, national agriculture research system, information and communication technology

Introduction

Indian Council of Agricultural Research is a major agricultural scientific autonomous organization in the country and unique in having concurrent responsibility for research, education, and extension. Formerly known as Imperial Council of Agricultural Research It was established on 16 July 1929 as a registered society under the Societies Registration Act 1860 in pursuance of the Report of the Royal Commission on Agriculture. The ICAR has its headquarters at Krishi Bhavan, New Delhi and is an apex body for coordinating, guiding, and managing research and education in agriculture including horticulture, fisheries, dairy, and animal sciences in the entire country. ICAR has played a pioneering role in ushering Green Revolution and subsequent developments in agriculture in India through its research and technology development that has enabled the country to increase the production of food grains by four times, horticultural crops by 6 times, fisheries by 9 times (marine 5 times and inland 17 times), milk 6 times, and eggs 27 times since 1950-51, thus making a visible impact on the national foodand nutritional security. It has played a major role in promoting excellence in higher education in agriculture.

AGRICULTURAL LIBRARIES

An agricultural library is the special library, which primarily renders service to the policy makers, specialists, scientists, teachers, students, researchers, and farmers in agriculture and allied subjects. It is the nerve center of all educational, research, trainings and extension activities in agriculture. Its collection and the clientele are discrete and pertaining to agriculture and allied subjects only. Agricultural libraries have now become highly complex center with multiplicity of functions catering to a wide variety of clientele having divergent interests. Every agricultural institute/university has got its ownindependent library with self-contained budget and resources to serve their users. Nowaday's information explosion, diversity of user needs, multidisciplinary research, duplicity of resources, escalation in cost of foreign journals, and financial crunch have made self-sufficiency which lead libraries to opt for resource sharing. But advent of Internet, advancement of ICT facilities, easy and 24x7 accessibility have made the libraries to opt for

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DESIDOC J. Lib. Inf. Technol., 2009, 29(5) 25 consortium of e-journals to get maximum coverage of journals to larger number of users with minimum amount of budget. To maximize discipline-wise coverage, relevance of journals to users, number of users relevant to publishers, economics of pricing models given by publishers for using additional advantages like unlimited access, unlimited downloads, easy accessibility, anywhere at any time accessibility, full-text downloads, etc., made the authorities of ICAR to think about formation of e-Consortium under the Project of NAIP Component I: ICAR as the Catalyzing Agent for Management of Change in the Indian NARS, Sub-component I: Information, Communication and Dissemination System (ICDS), Module I: Information and Communication Technology (ICT) in the name of CeRA (Consortium for e-Resources in Agriculture). Sufficient infrastructure like hardware, software, networking, bandwidth to download full-text of article with images etc., are prerequisite of any e-Consortium. Since these facilities are already provided by ICAR to all its Institutes, Deemed Universities, State Agricultural Universities and Central University in the first phase of World Bank Project National Agricultural Technological Project (NATP 1998-2005) the ICAR straight away considered to form e-Consortium under next phase of World Bank Project National Agricultural Innovation Programme (NAIP 2006-2012). NAIP is the World Bank assisted agriculture project being executed by National Agricultural Research System (NARS) with lifespan of six years, starting from 24 July 2006 to 2012.

3. **FORMATION OF CONSORTIUM FOR E-RESOURCES IN AGRICULTURE**

CeRA was launched successfully on 30 April 2008 at its headquarters at IARI with the following.

Objectives

1) To develop the existing R & D information resource) base of ICAR institutes/agricultural universities, etc., comparable to that existing in world leading institutions/organizations.
2) To create an e-access culture among scientists/ teachers in ICAR institutes/SAU.
3) To develop a Science Citation Index (SCI) facility at IARI for evaluation of scientific publications.
4) To assess the impact of CeRA on the level ofresearch publications measured through SCI

CeRA is being hosted at Unit of Simulation and Informatics, A-0 Block, Lal Bahdur Shastri Building, IARI, New Delhi-110 012. Its functioning is being monitored by the following Committees:

Steering Committee

1) Advisory in nature.
2) Policy issues.Negotiation and Monitoring Committee
3) Negotiate with publishers.

Monitor progress of activities. Working Committee

1) Discuss current activities. Access to CeRA was initially given to the following 124 institutes through IP addresses:
2) Deemed Universities of ICAR: 05.
3) ICAR HQ (KrishiBhavan, KrishiBhavan I, KrishiBhavan II): 03.
4) ICAR Institutes: 42.
5) National Bureaus: 05.
6) National Research Centers: 21.
7) Project Directorates: 09.
8) State Agricultural Universities: 38.

Out of 124 institutes, 114 institutes successfully received access through IP address, but institutes/SAUlocated in remote and north-eastern areas got access through user name and password. Consortium initially entered into agreement for three years under centralized funding and subscription of NAIP by maintaining print subscription of individual libraries who are members of the consortium for the journals of the following publishers on Agriculture, Veterinary Science, Fisheries, Crop Science, Computer Science, Soil Science, Animal Science, etc.

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1) Springer Link: 1300.
2) Annual Reviews: 33.
3) CSIRO Australia: 08.
4) ScienceDirect: More than 300.
5) Open J-gate: 613 (It is an open portal).

MAIN FEATURES/FACILITIES OFCONSORTIUM

Springer Link

It is a platform of Springer and bouquet of e-journals on different subjects like Biomedical Sciences, Life Sciences, Agriculture, behavioral Sciences, Economics, Chemistry, Material Sciences, Engineering, Humanities, Social Sciences, Mathematics, Statistics, Veterinary Medicine, Physics, and Professional and Applied Computers published by Springer. Through this user can access the full text of around 1300+ journals since 1996.

Annual Reviews

Annual Reviews are authoritative, analytic reviews in 33 focused disciplines within the Biomedical, Life,Physical, and Social Sciences etc. CeRA is subscribing 33 Reviews in agriculture including Biochemistry, Biomedical Engineering, Biophysics, Cell and Developmental Biology, Entomology, Genetics, Immunology, Microbiology, Nutrition, Pathology, Pharmacology, Toxicology, Physiology, Phyto pathology, etc., since 1990 onwards.

CSIRO

CSIRO Publishing is an autonomous business unit within Australia´s Commonwealth Scientific and Industrial Research Organization (CSIRO). It publishes globally reputed journals on agriculture, the Plant and Animal sciences, and Environmental Management. CeRA is subscribing 08 journals in Agriculture and Plant Sciences

ScienceDirect

ScienceDirect is the world's leading scientific full text database of Elsevier developed by articles/chapters from more than 2,500 peer reviewed journals and more than 10,000 books. CeRA is subscribing 300+ journals from the field of Agriculture and Biological Sciences.

ADDITIONAL FEATURES/FACILITIES OF CeRA

Apart from having above main feature of **CeRA** the JCCC Service (Journals Customs Content of Consortium) of Informatics, which covers contents of about 28, 770 journals at present (likely to be increased by approximately 50,000 during the 2009) for all 123 member libraries is also available as a value added service. This service is being covered from Consortia journals, subscribed journals of member libraries, and also open access journals of open j-gate since CeRA was implemented through consultancy of Informatics, Bengaluru. Creation and maintenance of CeRA website, promoting, organizing user awareness programmes, trainings to users and librarians are also part of its consultancy activities. When user try to access home page of CeRA, it will be verified with the IP provided by CeRA to Publishers. One official/Librarian has been identified as Administrator from each institute/university and has been assigned User Name, Password to open the admin login. Administrator is also responsible for Document Delivery Service. Members which could not get access through IP address are provided with User Name and Password separately. All functionalities available to Administrator can also be accessed by user except. Admin functionality.

Functionalities/Facilities for Administrator

This module is accessible only to Consortia Administrator or Institute Administrator [7]. The Consortia

Administrator has the following rights:

1) Create new members.
2) Edit the contact details, login details and IP details ofother members.
3) View region wise consolidated report of DocumentDelivery Request (DDR).
4) View Statistics of DDRs sent.

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5) View statistics of DDRs received.
6) View and fulfill the DDRs received.
7) View the status of DDRs sent.
8) View Journals subscribed by consortia or his ownlibrary subscription on click of Journal Configuration.button.
9) Get the usage statistics on click of Usage Statistics button. The Institute Administrator can have all the facilitiesexcept.

Apart from the above privileges, institute Administrator can also see the following functionalities
when login to admin. functionality where facility is not accessible to User.
User: Organization-wise and state-wise institute’s details can be seen.
Usage Statistics: Service-, Journal-, Publishers-, and User-wise usage statistics can also be seen from this feature.

Journal’s Configuration

Through this service Administrator can see the list of journals under open access, Consortium subscribedjournals and individual library subscribed journals covered under JCCC.

Inter-Library Loan

Through this feature Administrator can have the following facilities:

1) Request received from users for document delivery between any particular date with details such asbibliographical details of article, requested by whichinstitute/university, request date, its status likewhether it is available in library or not available, if it is available whether it is dispatched or it is pending.
2) Request sent by user from his own institute fordocument delivery between any particular date orrange of dates with details such as bibliographicaldetails of article, requested to which institute/university, request date, its status like receivedcommunication from other library, whether it isavailable in their library or not available, and if it isavailable whether it is dispatched or it is pending.
3) Request received by his library from users ofdifferent/individual institute for document delivery inreport form with details like institute’s name, numberof requests received, document delivery fulfilled orpending or unfulfilled.
4) Requests sent by user of his own institute to different/individual institute for document delivery inreport form with details like institute’s name, number of request sent, document delivery fulfilled or pending or unfulfilled.
5) Consolidated report of both requests made andreceived by own institute and their status in period of different dates. Consortium Administrator can see status of document delivery of any library.

FACILITIES FOR ADMINISTRATOR AND USER COMMUNITY UNDER JCCC SERVICE

The administrator and users have following facilities under JCCC

Quick Search

User’s query like author, keyword, title can be searched in all peer reviewed journals and/or professional and industry journals. User can simplify his search by selecting subject either by agricultural and biological sciences, arts and humanities, basic sciences, biomedical sciences, engineering and technology, and social and management science or all subjects.

Advanced Search

It will search in all peer reviewed journals and/or professional and trade journals in advanced features by using Booleans operators as well as title, keyword, abstract, author, institute/address and selecting subjects on agriculture, biological sciences, arts and humanities, basic sciences, biomedical sciences, engineering and technology, social and environmental sciences, etc., and also by selecting publication year range or latest updated like last one week or last one month.

Browse Journals

User can browse the journals by subject, title orpublisher in alphabetical order hyperlink.

My Journals

User will get the alerts of his interest after registeringhis name by creating his profile with mandatory details.

Experiencing Problem

User can interact with Consortium administratorthrough online chat about problem facing. When usermade query and retrieve search results each article/journal will be indicated whether it's a ConsortiumSubscribed Journal (CSJ), Library Subscribed Journal ofCeRA members (LSJ) or Open Access Journal (OAJ). If itis CSJ and OAJ, then user will have full text facility, if it isLSJ then Request for Article feature will be displayed withName of the Institute where that particular journal isavailable so that user can simply click on it for requestingcopy of an article so that request will go to particular library's admin account where this journal is available.When Institute Administrator login into.admin. module,the details of articles requested by user to his Institute/ University and requests send by his Institute to other Institute / University and its status can be seen online to enable him take necessary action accordingly. Above all Consortium administrator has the right to see any Institute Administrator module.

CONCLUSION

CeRA has helped in developing the world class R&D information base of ICAR Institutes/agricultural university, and an e-access culture among scientists/teachers. Efforts are being made to bring journals of, John Wiley and Taylor and Francis's, and two journals of Nature. ICAR may also subscribe Web of Science and Indiajournals.com to further increase the scope of information retrieval.

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Service Advancement in the Librarianship

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Abstract:

The research paper titled "Advancement in Library Services" explores the dynamic landscape of libraries in the digital age and examines the transformative measures adopted for the enhancement of library services. The study delves into various facets of advancement, including innovative educational programs, cost-effective infrastructure solutions, and strategic repositioning of services. The paper investigates the integration of add-on courses tangent to research assistance, emphasizing skills vital for contemporary research. Furthermore, it scrutinizes the implementation of innovative infrastructure solutions, focusing on low-cost strategies and the incorporation of cutting-edge technologies. Additionally, the research investigates the repackaging of library services, emphasizing user-centric design, customization, and digital outreach. The exploration of the Human Library concept, psychological support cells, and language modification cells underscores the evolving role of libraries in addressing diverse user needs. Moreover, the paper examines the NPTEL-SWAYAM initiative, showcasing the library's pivotal role in facilitating online learning. Through an interdisciplinary approach, this research contributes valuable insights into the proactive evolution of library services, serving as a guide for institutions seeking to adapt and thrive in the ever-changing information landscape.

Keywords: Librarianship, Library services, SWAYAM-NPTEL,

1.0 Introduction

In the evolving landscape of information management, modern librarianship has undergone a profound transformation, propelled by the rapid advancements in technology and the changing needs of information seekers. The traditional image of librarians as guardians of dusty shelves and guardians of hushed spaces has given way to a dynamic and tech-savvy profession that plays a crucial role in the digital age.

One of the most significant shifts in modern librarianship is the transition from physical to digital collections. In the past, libraries were synonymous with printed books, journals, and periodicals neatly arranged on wooden shelves. Today, librarians curate vast digital repositories, offering access to e-books, online databases, and multimedia resources. The digitization of information has not only expanded the breadth of available materials but has also democratized access, enabling users to explore a wealth of knowledge from the comfort of their homes.

Furthermore, modern librarians actively engage in the creation and maintenance of online platforms, ensuring that users can navigate the digital sea of information efficiently. Librarians are now adept at utilizing content management systems, designing user-friendly interfaces, and employing sophisticated search algorithms to enhance the accessibility of their digital collections. These technological tools empower librarians to curate content, categorize information, and provide seamless access, fostering a more interactive and user-centric environment.

The role of librarians as educators has also expanded in the digital era. Beyond assisting users in locating information, librarians now play a crucial role in promoting information literacy. In an age of information overload and misinformation, librarians guide patrons in evaluating sources, distinguishing between reliable and unreliable information, and honing critical thinking skills. Librarians collaborate with educational institutions to integrate information literacy into curricula, ensuring that students develop the necessary skills to navigate the complexities of the digital information landscape.

In addition to their educational role, modern librarians embrace the concept of lifelong learning. Librarians themselves engage in continuous professional development to stay abreast of emerging technologies, evolving research methodologies, and changing information landscapes. They attend workshops, conferences, and webinars to acquire new skills, explore innovative approaches to librarianship, and exchange knowledge with their peers. This commitment to lifelong learning ensures that librarians remain effective stewards of information, capable of adapting to the ever-changing demands of their profession.

Collaboration has become a cornerstone of modern librarianship. Librarians actively seek partnerships with diverse stakeholders, including researchers, educators, technology specialists, and community leaders. These collaborations extend beyond traditional library walls, creating synergies that amplify the impact of library services. Librarians collaborate on research projects, contribute to community development initiatives, and work with technology experts to implement cutting-edge solutions for information management.

2.0 Objectives of the study

1. To overview the existing services of the academic libraries.
2. To know the current status of the some extra outstanding activities carried out by the librarian for the improvement of the services.
3. Suggest some services for the service advancement for librarianship.

3.0 Existing Library services given by the librarians

3.1 Reference Assistance:

Librarians provide reference assistance to students and faculty, helping them locates relevant information, use library resources effectively, and navigate databases. They offer guidance on research strategies and assist in finding authoritative sources.

3.2 Information Literacy Instruction:

Librarians conduct information literacy sessions to teach students how to evaluate, access, and use information critically. These sessions may include workshops on database searching, citation styles, and effective use of library resources.

3.3 Collection Development:

Librarians play a crucial role in developing and maintaining the library's collection. They assess the needs of the academic community, acquire new materials, and weed out outdated or irrelevant resources to ensure a current and diverse collection.

3.4 Interlibrary Loan Services:

Librarians facilitate access to resources beyond the college library by managing interlibrary loan services. This allows users to request materials not available locally and expands the range of resources accessible to the academic community.

3.5 Technology Support:

Librarians assist users with technology-related issues, such as accessing electronic resources, troubleshooting problems with library databases, and helping with the use of digital tools for research and learning.

3.6 Library Outreach Programs:

Librarians organize outreach programs to promote library resources and services. This may include workshops, book talks, and awareness campaigns to encourage a culture of reading and engagement with library resources.

3.7 Information Preservation:

Librarians are responsible for the preservation of physical and digital resources. They implement measures to protect books, documents, and electronic materials from damage, ensuring the longevity of the collection.

3.8 Reader's Advisory:

Librarians offer reader's advisory services, helping users discover books and other materials that match their interests and preferences. This service encourages a love for reading and supports recreational learning.

3.9 Collaboration with Faculty:

Librarians collaborate with faculty to integrate information literacy into the curriculum. They work with educators to design assignments that enhance students' research and critical thinking skills.

3.10 Curation of Special Collections:

Librarians curate and manage special collections, which may include rare books, manuscripts, archives, and unique materials. These collections often serve as valuable resources for specialized research within the academic community.

These services collectively contribute to the educational mission of the college library, supporting teaching, learning, and research endeavors within the institution.

4.0 Some Service Advancement in the Librarianship

Librarianship requires continual advancement to keep pace with the dynamic information landscape and changing user expectations. This includes adapting to technological innovations, addressing cultural diversity, participating in open access initiatives, managing digital preservation challenges, supporting data-driven research, fostering interdisciplinary collaboration, embracing emerging technologies, and ensuring community engagement. In essence, staying current in librarianship is essential for libraries to remain relevant and valuable in serving the diverse needs of their communities.

4.1 Add-on Courses Tangent to Research Assistance:

Grant Writing Workshops:

Offer courses on grant writing to help researchers secure funding for their projects. This empowers them to effectively communicate the significance of their research to potential funding agencies.

Collaborative Research Skills:

Develop training programs that focus on fostering collaboration among researchers, including interdisciplinary collaboration and effective communication within research teams.

Presentation Skills Training:

Provide courses to enhance researchers' ability to communicate their findings effectively through presentations, posters, and other mediums.

Digital Humanities Courses:

In the era of digital research, introducing courses on digital humanities can help researchers leverage technology for their projects.

Project Management for Research:

Equip researchers with project management skills to help them plan, execute, and complete research projects efficiently.

4.2 Innovative Infrastructure in Low Cost:

Virtual Reality (VR) Libraries:

Explore low-cost VR solutions for creating virtual libraries or interactive learning spaces. VR can provide users with immersive experiences, making the library more engaging.

Gamification of Learning:

Implement gamification elements in library services to make learning and research more enjoyable. This could include interactive challenges, rewards systems, and educational games.

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Energy-Efficient Technologies:
Invest in energy-efficient technologies for lighting, heating, and cooling within the library space to reduce operational costs and promote sustainability.
Digital Signage and Interactive Displays:
Utilize digital signage and interactive displays to communicate information effectively, promote library resources, and engage users in a dynamic way.
Remote Access Technologies:
Enhance remote access capabilities, allowing users to access library resources and services from anywhere. This is especially valuable in a digital era where users may not always be physically present.

4.3 Repackaging the Services:

Personalized Research Profiles:
Offer researchers the ability to create personalized profiles within the library system, showcasing their expertise, publications, and research interests. This fosters a sense of community and facilitates collaboration.
Mobile Library Apps:
Develop mobile applications that provide users with on-the-go access to library resources, services, and real-time updates. This enhances user convenience and engagement.
Community Engagement Programs:
Create outreach programs that involve the community in library activities. This could include book clubs, author talks, and events that connect the library with the broader community.
Feedback Mechanisms:
Establish effective feedback mechanisms to continuously improve library services. Actively seek input from users to understand their needs and preferences.
Cross-Institutional Collaboration:
Collaborate with other libraries and academic institutions to create a network of shared resources, services, and expertise. This enhances the overall value proposition for users.
These additional points should contribute to a more in-depth analysis of each aspect in your research paper on library service advancement. The services like building the Digital library having the self help videos form the open platform like YouTube is the best example for the modern repackaging services.

4.4 Human Library, Psychological Cell, Language Modification Cell by Library:

4.4.1 Human Library:

Diversity Outreach Programs:
Actively seek individuals with diverse backgrounds, experiences, and perspectives to participate in the Human Library. Develop outreach programs to encourage participation from underrepresented communities.
Regular Events and Rotations:
Organize regular Human Library events where "books" are rotated, ensuring a fresh and dynamic experience for users. This also encourages a sense of community and ongoing engagement.
Training for Human Books:
Provide training sessions for individuals serving as human books. Focus on effective communication, addressing sensitive topics, and ensuring a positive and respectful interaction with users.

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4.4.2 Psychological Cell:

Confidential Counseling Services:

Emphasize the confidentiality of counseling services provided by the Psychological Cell. Create a safe space for users to discuss personal challenges, academic stress, and mental health concerns.

Workshops on Stress Management:

Develop workshops and seminars on stress management, resilience building, and mindfulness. These can be conducted regularly to proactively address mental health and well-being.

Collaboration with Health Services:

Establish partnerships with health services on campus or in the community to ensure a holistic approach to mental health. This collaboration can provide users with additional resources and support.

4.4.3 Language Modification Cell:

Language Exchange Programs:

Facilitate language exchange programs where users can practice and enhance their language skills through conversation with native speakers or peers proficient in the language of interest**.**

Writing Clinics:

Offer writing clinics to assist users in improving their writing skills. Provide feedback on academic papers, essays, and other written assignments to enhance clarity, coherence, and language proficiency**.**

Multilingual Resource Collections:

Curate a diverse collection of resources in multiple languages, catering to the linguistic diversity of the user community. This can include books, digital materials, and language learning tools.

4.4.4 Professional Development Workshops:

Organize workshops on professional communication skills, including business communication, email etiquette, and presentation skills, to prepare users for academic and professional success.

Collaboration with International Student Services:

Collaborate with international student services to address language-related challenges faced by non-native speakers. This partnership can enhance support for language learners.

4.5 NPTEL-SWAYAM Initiative from the Library:

Customized Learning Paths:

Assist users in creating customized learning paths based on their academic goals and interests. This ensures that NPTEL-SWAYAM courses align with their individual learning objectives.

Integration with Course Curriculum:

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Work with academic departments to integrate NPTEL-SWAYAM courses into the formal curriculum. This creates a seamless learning experience for students and enhances the relevance of online courses.

Support for Specialized Domains:

Identify and promote NPTEL-SWAYAM courses in specialized domains that align with emerging trends and industry demands. This enhances the library's role in providing cutting-edge knowledge to users.

Digital Literacy Training:

Provide training on digital literacy skills to ensure that users can navigate online platforms, access course materials, and participate in NPTEL-SWAYAM courses effectively.

Community of Learners:

Foster a community of learners engaged in NPTEL-SWAYAM courses. Facilitate discussion forums, study groups, and collaborative projects to encourage peer learning and knowledge exchange.

4.6 Self development for Librarian

Certainly! Librarian self-development and advancement are crucial for staying relevant in a rapidly evolving information landscape. Here are some points to consider:

1. Continuous Learning and Professional Development:

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- Attend workshops, conferences, and seminars related to library science, information management, and emerging technologies.
- Enroll in online courses and certifications to stay updated on the latest trends in library services and information sciences.
- Join professional associations and participate in their activities to network with peers and access valuable resources.

2. Digital Literacy and Technology Integration:

- Develop proficiency in the use of digital tools and technologies relevant to library services, such as library management systems, digital repositories, and online databases.
- Stay informed about new technologies shaping the information landscape, including artificial intelligence, machine learning, and block chain, and explore their potential applications in library services.

3. Specialized Training in User Services:

- Participate in training programs focused on user services, including customer service skills, reference interviewing techniques, and user experience design.
- Explore specialized training in areas such as data management, copyright issues, and open access publishing to provide comprehensive support to library users.

4. Research and Publications:

- Contribute to the field by conducting research on library-related topics and publishing articles in professional journals.
- Share best practices and experiences through presentations at conferences or workshops to contribute to the collective knowledge within the library community.

5. Leadership and Management Skills:

- Pursue training in leadership and management to develop skills in team building, project management, and strategic planning.
- Seek opportunities for mentorship and coaching to enhance leadership capabilities and contribute to the effective management of library services.

6. Advocacy and Community Engagement:

- Engage in advocacy efforts to promote the value of libraries within the community and advocate for funding and support.
- Collaborate with local organizations, schools, and community groups to enhance the library's role as a community hub and information resource.

7. Cultural Competence and Inclusivity:

- Attend diversity and inclusion workshops to develop cultural competence and create an inclusive environment within the library.
- Stay informed about diverse perspectives and cultural trends to better serve the needs of a diverse user base.

8. Soft Skills Enhancement:

- Improve communication skills, both written and verbal, to effectively convey information and engage with library users.
- Develop interpersonal skills to build positive relationships with colleagues, users, and community partners.

9. Time Management and Work-Life Balance:

- Learn effective time management techniques to prioritize tasks and responsibilities efficiently.
- Foster a healthy work-life balance to prevent burnout and maintain overall well-being.

10. Adaptability and Resilience:

- Cultivate adaptability to navigate changes in technology, user needs, and library policies.
- Develop resilience to overcome challenges and setbacks, fostering a positive and forward-looking attitude.

By actively pursuing these areas of self-development, librarians can enhance their skills, contribute to the improvement of library services, and position themselves as valuable assets within the evolving information landscape.

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A Growth of Literature on "Knowledge Management" Based on Library and Information Science Abstracts Database: A Scientometric Study

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Abstract

The purpose of this paper is to explore the current research trends in Knowledge Management (KM) through a scientometric analysis of all literature published LISA Database in 2022 and 910 articles retrieved. The study elucidates wide global interest in KM and an increasing trend towards multi-author collaboration.Multiple author's paper were mere 337(37.03) which usually most collaborative authorship patterns in Knowledge Management articles.KM research productivity has grown recent year compatibly previous year's results of the study.

Keyword: - Knowledge management, Scientometric, Literature, LISA

Introduction:

Knowledge management is the employment and development of the knowledge assets of an organization to achieve the organizational goals. This knowledge consists of both explicit and implicit knowledge. Knowledge management involve the creation, manipulation, storage and sharing of knowledge among people in a community of practice. Knowledge management manages the knowledge flows in an organization. To enhance organizational performance, knowledge management strategies must be incorporated and implemented so that the organization attains a competitive edge.

Getting the correct information to the right person at the right time is the fundamental goal of knowledge management. While this may not sound very complicated, it does require a solid grasp of the locations and forms of information, the creation of cross-functional processes, and the assurance of projects' acceptance and support by members of the organization. Assuring an organization's capacity for learning and its ability to access and utilize its knowledge assets in current applications when needed are key components of this process. The systematic and ordered handling of organizational knowledge is known as knowledge management. In order to improve organizational effectiveness, this process comprises gathering, organizing, maintaining, applying, sharing, and renewing employees' tacit and explicit knowledge.

Library and Information Science Abstracts (LISA)

The Library and Information Science Abstracts (LISA) is an international abstracting and indexing tool designed for library professionals and other information specialists. LISA covers the literature in Library and information science (LIS) since 1969 and currently abstracts 440+ periodicals from 68+ countries and in 20+ languages.

LISA was originally published by the Library Association. Bowker-Saur began publishing LISA in 1991.Cambridge Information Group acquired Bowker in 2001 and LISA began being produced by subsidiary Cambridge Scientific Abstracts.CSA merged with ProQuest in 2007.

Definition

Literature

Virginia Woolf: Virginia defined literature in a perfect way. “Literature is strewn with the wreckage of those who have minded beyond reason the opinion of others.”

Ezra Pound: “Great literature is simply language charged with meaning to the utmost possible degree.”

Knowledge management

According Oxford Dictionary to Knowledge management: “efficient handling of information and resources within a commercial organization.”

“Knowledge Management is the management of knowledge through systematic that can enable one to build on earlier experience and obviate the need for costly reworking of learning by making the same repetitive mistakes.” - By World BankKnowledge management (KM) is the process of capturing, developing, sharing, and effectively using organizational knowledge.

Scientometrics

According to Tague-Sutcliffe (1992) defines Scientometrics as "the study of the quantitative aspects of science as a discipline or economic activity. It is part of the sociology of science and has application to science policy-making. It involves quantitative studies of scientific activities, including, among others, publication, and so overlaps bibliometric to some extent”.

Objectives of study

The allied objectives of the research were as following:

- To study the literature in knowledge management.
- To study Authorship pattern of articles.
- To study Author’s productivity in the article.
- To study Ranking Author in the articles.

Scope of the Study:

The scope of study was limited to the LISA database .The database provide article published in the journals. The researcher has selected year 2022study for 910 articles.

Review of Past Study

Few relevant reviews are as following:

Dhande, Shankar (2021) Knowledge management (KM) literature has been continuously increasing in the world. This study is about mapping of knowledge management concept published literature in the Web of Science database and to find out the Knowledge Management literature productivity in web of science. This study is about the development in the field of knowledge management productivity from last 10 years in web of science database. To know about the most productive author country in the field of knowledge management field.

Kaba and Ramalah (2020) examined the research productivity of knowledge management (KM) from 1960-2017. They retrieved 63474 documents from Scopus and reported that the research in the area increased from 1960 to 2003. USA and China were the most productive territories while the top three authors were from Australia, the USA, and Norway. The “Journal of Knowledge Management” published most of the publications while the journal of “Expert System with Application” was topped in the number of citations

Hussein, Mohammad (2020) in this study examined the year-wise publications, authorship pattern, total count of citations, citations per year, most cited publications and the most prolific authors. The data for the study was extracted from Google Scholar by using bibliometric tool "Public & Perish". The data was further analyzed on different parameters with the help of Publish & Period and MS Excel 2016

Methodology and Data Collection

Methodology applied in the present paper involves literature and analysis of articles. The literature was accessed through LISA online from the year 2022.The documents included in

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the present paper were identified via LISA, All the articles on knowledge management were identified, the search was open and for a limited time period. The retrieved data records out of which were 910 journal articles.

Table no.1 Authorship Pattern

Authorship Pattern		
Author	**No. of Author%**	%
Single Author	119	13.1
Two Author	247	27.14
Three Author	207	22.75
Multiple Author	337	37.03
Total	**910**	**100**

Authorship Patterns Author collaboration is an important trigger for the growth of publications, but the data shows that around 119(13.1) papers were no collaborative. Table-1 reveals the authorship pattern of papers which includes 910 authors. Two authors contributed the largest group of 247(27.14) of papers, while three authors contributed papers were around 207(22.75) Multiple authors paper were mere 337(37.03) which usually most collaborative authorship patterns in Knowledge Management articles

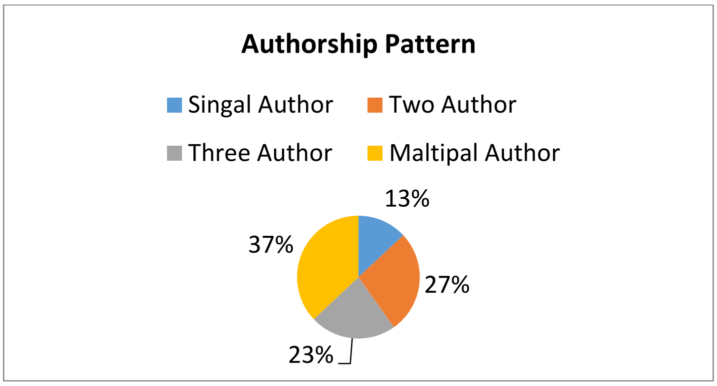

Fig No.1: Authorship Pattern

Table no.2 Authorship Productivity

Sr. No.	**No. of Authors**	**Articles**	**%**
1	1	1448	92.41
2	2	106	6.76
3	3	7	0.45
4	4	5	0.32
5	5	1	0.06
Total		**1567**	**100**

The table no.2 provides information related to the author's productivity. In all authors1567 contributed in the subject of Knowledge Management out of 1448 (92.41) articles contributed one author followed by two author contributedi.e.106 (6.76) Majority of authors have contributed a single article. The largest number of articles were contributed by an author is 1.

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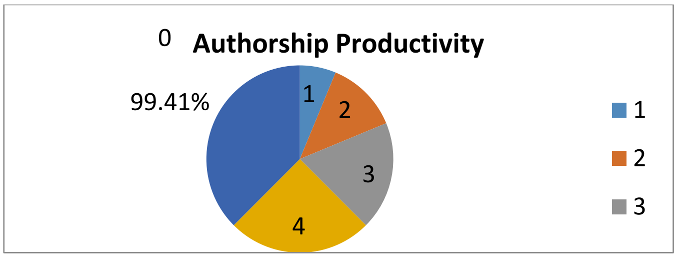

Fig No.2: Authorship Productivity

Table no.3 Author Ranking

Sr.No.	Rank	Name of Author	No. 0f Articles by Author
1	I	Chiu, Dickson KW	6
2	II	Kumar, Satish	4
3		Olubiyo, Peter Olubunmi	
4		Shafiq Ur Rehman	
5		Bench-Capon, Trevor	
6		Ho, Kevin KW	
7	III	MdAnwarul Islam	3
8		Rana, Nripendra P.	
9		Dwivedi, Yogesh K.	
10		Mäntymäki, Matti	
11		Wen-Lung Shiau	
12		Araszkiewicz, Michał	
13		Francesconi, Enrico	
14	IV	Phong Ba Le	2
15		Lyons, Paul	
16		Hossain, M A	
17		Yu, Liangzhi	
18		Jiang, Wei	
19		Otike, Fredrick	
20		Naghshineh, Nader	
21		Song, Yanhui	
22		Wang, Wei	
23		Goh, Mark	
24		Akhtar Abbas	
25		Olubiyo, Lydia Mercy	
26		Mansour, Essam	
27		Jin, Jiahua	
28		Yan, Xiangbin	
29		Kravčenko, Dmitrijs	
30		MurtazaAshiq	
31		Sivarajah, Uthayasankar	

Table No 3 reveals that the most productive author is shared by Chiu, Dickson KW with 6 articles in the year 2022 .Second ranking author Kumar, Satish, Olubiyo, Peter Olubunmi, Shafiq Ur Rehman, Bench-Capon, Trevor and Ho, Kevin KW with 4 articles in 2022 and so on.

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Table no.4 Document Types

Document Types	No of Document	%
Journal Article	826	89.0
Book Review	30	3.23
Feature	15	1.62
Editorial	13	1.40
Case Study	5	0.54
Blogs	2	0.22
Evidence Based Healthcare , Journal Article	26	2.80
Back Matter	2	0.2
General Information	7	0.75
Product Review	1	0.11
News	1	0.11
Total	**928**	100

It is evidence from the table no 4 most of record under Knowledge Management Literature in LISA Database was published as Journal Article. The highest type of documents published in LISA under Knowledge Management during the study in the year of 2023 (89.0) Journal Articles

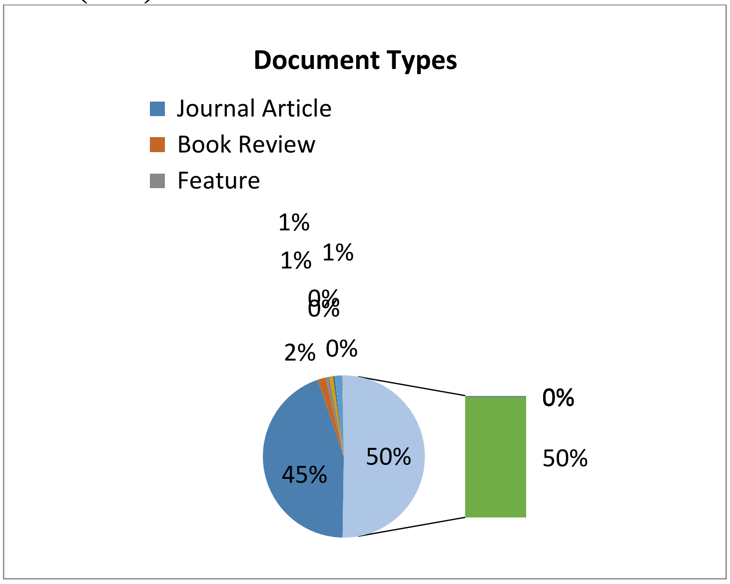

Fig No.3:Document Types

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Knowledge Sharing Behaviour Among Library Information Science Postgraduate Students In Sant Gadge Baba Amravati University

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Abstract
This research paper investigates the knowledge sharing behavior among Library Information Science (LIS) postgraduate students in Sant Gadge Baba Amravati University. Knowledge sharing is crucial in the knowledge-based economy, impacting organizational, group, and individual performance. The study aims to identify factors facilitating or hindering knowledge sharing, offering insights into dynamics within educational institutions. Through a quantitative research method, data was collected using a structured questionnaire from LIS postgraduate students. The analysis includes awareness of knowledge sharing, its importance, sources used for knowledge acquisition, digital/social platforms utilized, and methods of sharing knowledge. The findings contribute to understanding knowledge sharing behaviors in academic settings, providing recommendations for improvement.

Keywords
Knowledge sharing, knowledge sharing behaviour, postgraduate students.

1. Introduction

Knowledge sharing (KS) is a crucial element in today's knowledge-based economy, significantly impacting organizational, group, and individual performance. It encompasses shared practices, information exchange, and the sharing of best practices through various mediums such as face-to-face discussions, coaching, email exchanges, and e-learning platforms. This process is vital in research, particularly among LIS postgraduate students who actively engage in learning, innovating, and sharing their knowledge. However, obstacles like lack of trust, incentives, and opportunities can hinder effective knowledge sharing.

This study focuses on investigating the knowledge sharing behaviors of LIS postgraduate students in Sant Gadge Baba Amravati University. It aims to identify factors that facilitate or hinder knowledge sharing and proposes recommendations for improvement. Successful knowledge management strategies recognize knowledge sharing as central to their success, enabling the reuse and regeneration of knowledge at both individual and organizational levels. Organizations worldwide, including those in Malaysia, are increasingly emphasizing a knowledge-sharing culture and implementing strategies to make their workplaces more knowledge-friendly.

In the context of universities, the knowledge-based view underscores substantial knowledge sharing in terms of academic knowledge and expertise, often driven by peer-competition rather than altruism. This poses potential implications for the formation of knowledge-sharing groups like communities of practice, where members are informally bound by common interests and mutual engagement. Valuing knowledge as an asset is crucial, and this study specifically explores the knowledge-sharing behaviors of postgraduate students in selected universities, aiming to provide insights into the dynamics of knowledge sharing within educational institutions.

2. Definition's:

a) Knowledge: -

According to Albert Einstein "Knowledge is Experience; everything else is information."

b) knowledge Sharing: -

Connelly (2000) defined knowledge sharing "As the exchange of knowledge, or the behaviour that helps others with knowledge."

c) Knowledge sharing behaviours: -

"Knowledge sharing behavior is defined as individual behavior that pertains to the exchange of information, experience, ideas, and skills with other individuals or groups of people inside an organization in order to enhance the company's sustainability."

d) P.G. Student: -

"A postgraduate is a student who has successfully completed an undergraduate degree level course at a college or university and is undertaking further study at a more advanced level."

3. Objective of the study: -

- To identify the various modes of knowledge sharing among LIS post graduate students in Sant Gadge Baba Amravati University.
- To identify the familiarity of knowledge sharing behaviour among LIS post graduate students in Sant Gadge Baba Amravati University.

4. Scope of the study:

The scope of the study was among LIS postgraduate students from Sant Gadge Baba Amravati University has been selected.

5. Review of the past study

The few relevant Reviews were found as below

1) Rosaline, O. O. (2014), The study explored the knowledge sharing behaviors of postgraduate students in selected Nigerian Universities. Using a descriptive survey design and a validated questionnaire, the study involved 503 postgraduate students. The findings indicated that 55.6% of the participants preferred face-to-face knowledge sharing, and individual studies were the most commonly shared knowledge (92.8%). The study identified three factors (individual, institution, and technology) influencing knowledge sharing, with only the individual factor significantly affecting students' behaviors. The results suggested that university policymakers should promote a culture of knowledge sharing and collaboration among postgraduate students, especially those pursuing Masters (MSc) and Doctorate (PhD) degrees, for sustainable training and development.

2) Safdar, M., Batool,(2022), This study explores the knowledge-sharing behavior of engineering students in Pakistan, considering individual and classroom factors. Conducted across universities in Punjab, Khyber Pakhtunkhwa, Sindh, and Islamabad, the quantitative research, utilizing survey questionnaires and SPSS-22 analysis, reveals a predominantly positive trend in knowledge sharing. The research identifies significant impacts of individual and classroom-related factors on Pakistani engineering students' knowledge-sharing behavior. As the first study of its kind in Pakistan, it contributes to literature by advancing understanding of knowledge-sharing behavior among engineering students. The findings can aid educational institutions, students, and academicians in enhancing positive factors and addressing negative influences.

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3) Saleh, I. I. (2023), Knowledge sharing is the process of individuals imparting expertise to others, enabling recipients to apply that knowledge. A study at Usmanu Danfodiyo University explored knowledge sharing behavior among law undergraduates, with 296 respondents. Using a descriptive survey design, the findings indicate a positive attitude towards knowledge sharing, as most students are willing to share their knowledge with peers. The study reveals that knowledge sharing is perceived as beneficial for academic performance. Recommendations include sensitizing students at the Faculty of Law, UDU, about the advantages of knowledge sharing.

6. Significance of the Research Paper

This research paper significantly contributes to the field of knowledge management within academic settings, particularly among Library Information Science (LIS) postgraduate students. By examining knowledge sharing behaviors, the study enhances our understanding of factors that either facilitate or impede knowledge exchange, informing tailored knowledge management strategies for educational institutions. The research delves into sources of knowledge acquisition and methods of dissemination, providing valuable insights for designing effective channels within academic communities. Moreover, the study informs educational practices, guiding the promotion of collaborative learning and peer interaction among postgraduate students based on identified modes of knowledge sharing. The findings also offer evidence-based recommendations for policymakers and institutions to cultivate a culture of knowledge sharing, guiding the development of policies, programs, and initiatives. Additionally, by addressing challenges such as trust issues and lack of incentives, the research provides valuable insights for stakeholders to overcome barriers and create an environment conducive to collaborative learning and innovation.

7. Research Methodology

This research used a quantitative research method and the survey method has been used to collect data from LIS postgraduate students of Sant Gadge Baba Amravati University, Amravati.

7.1. Data Collection

A structured questionnaire was used to collect data in the Google Form, those collected data were analysed using statistical tools like descriptive statistics.

7.2. Data Analysis

1. Do you have an awareness for knowledge sharing?

Table No. 1		
Sr. No	Awareness	No. of Student
1	Little bit	1
2	Yes	30
	Grand Total	31

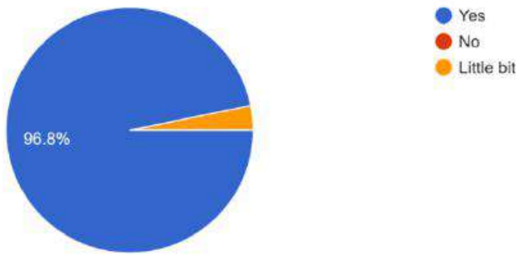

Table No. 1 show that awareness about knowledge sharing of library professionals is high 96.8 % respondents have positive response among 31.

2. How important is knowledge sharing to gain knowledge?

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Table No. 2		
Sr. No	Gain of Knowledge	No. Student
1	For Improvement	12
2	Multitasking Performance	10
3	Perfection	6
4	Simplify the work	3
	Grand Total	31

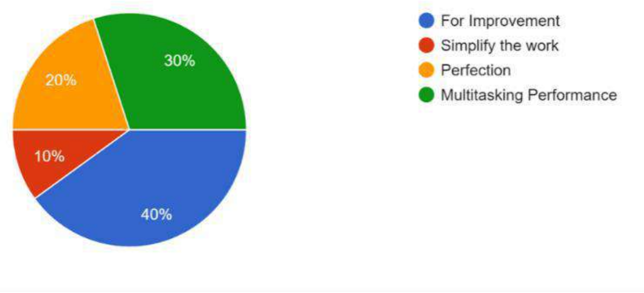
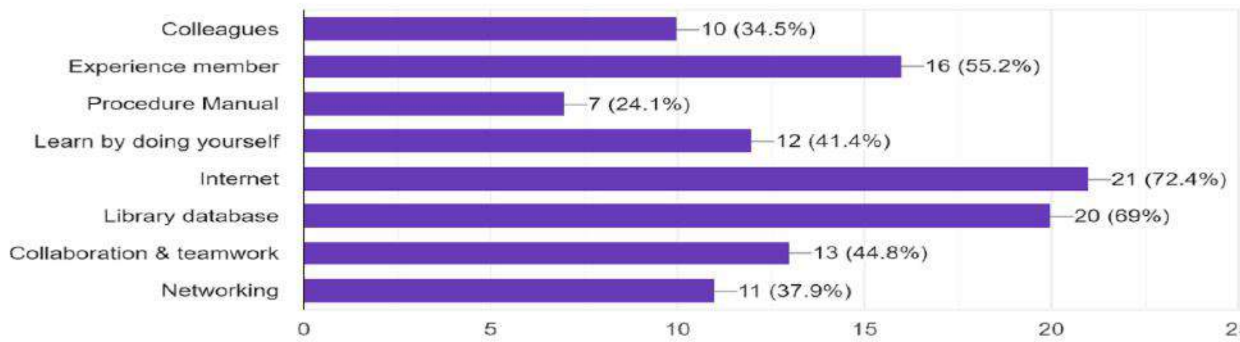


Table No. 2 show that importance of gain of knowledge for improvement (40%) and (30%) for the Multitasking Performance

3. What are the sources you use to acquire knowledge?

Table No. 3			
Sr. No	Sources of acquire Knowledge	Respondents	Percentage
1.	Colleagues	10	34.5%
2.	Experience member	16	55.2%
3.	Procedure manual	7	24.1%
4.	Learn by doing myself	12	41.4%
5.	Internet	21	72.4%
6.	Library database	20	69%
7.	Collaboration & teamwork	13	44.8%
8.	Networking	11	37.9%

Table No. 3 shows the sources through which the respondent gains knowledge. About 72.4% of the respondents note that they gain knowledge from the Internet. and 69% of respondents gained knowledge through library databases. Similarly, 55% of respondents gain knowledge from experience members, learn by doing themselves, and network. Likewise, the remaining respondents gain knowledge from colleagues through collaboration and teamwork and the



procedure manual.

4. How many times do you use digital/social platform to acquire knowledge?

Table No. 4		
Sr. No	Use of digital/social platform	No. Student
1	Always	17

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2	Sometimes	9
3	Often	3
4	Never	2
	Grand Total	31

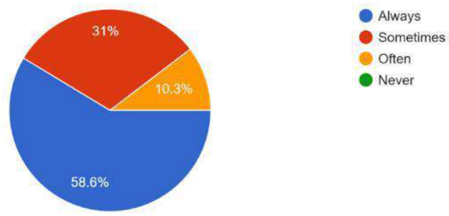
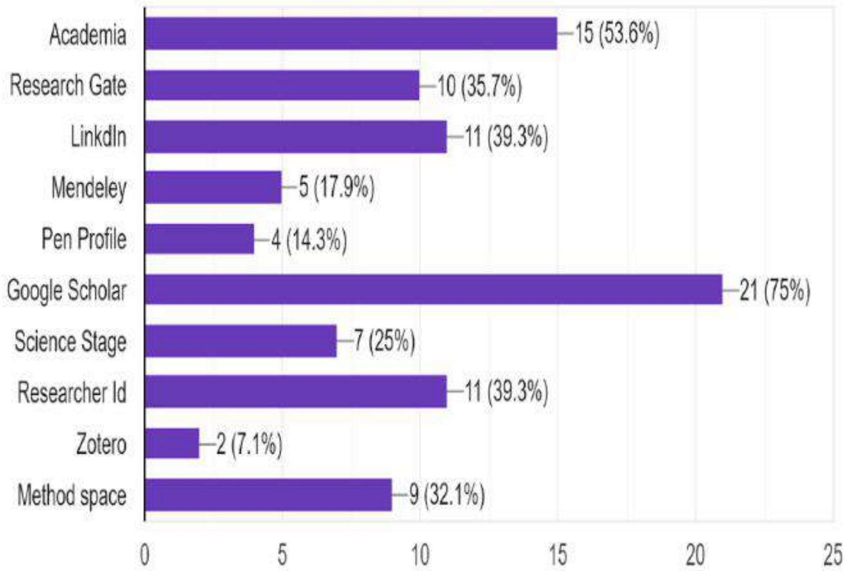


Table No. 4 shows that 58.6% of respondents always used digital/social platforms to acquire knowledge and 31% of respondents used sometimes.

5. Which digital/social platform you use to acquire knowledge?

Table No. 5			
Sr.no	Digital platform use to acquire knowledge	Respondents	Percentages
1.	Academia	15	53.6%
2.	Research gate	10	35.7%
3.	LinkdIn	11	39.3%
4.	Mendeley	5	17.9%
5.	Science stage	7	25%
6.	Researcher Id	11	33.9%
7.	Zotero	2	7.1%
8.	Method space	9	32.1%
9.	Google Scholar	21	75%
10.	Pen Profile	4	14.3%

Table No. 5 shows that 75% of respondents use social or digital platforms to acquire knowledge through Google Scholar. 53.6% of respondents acquired knowledge through Academia and LinkdIn 39% of respondents acquired knowledge through social or digital. Remaining respondents use digital and social platforms to acquire knowledge: Research Gate (35.7%), Researcher ID (33.9%), Method Space (32.1%), Zetero (25%), Science Stage (25%), Mendeley(17.9%) and Pen Profile (12.5%).



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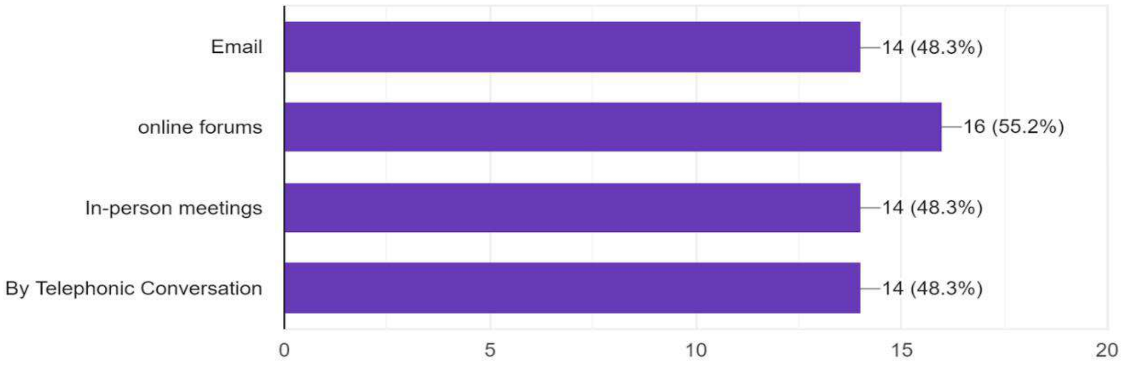
6. What methods do you use to share knowledge with your colleagues? (Multiple Choice)

Table No. 6			
Sr. No	Methods do use to share knowledge with your colleagues	Respondents	Percentages
1.	Email	14	48.3%
2.	In-person meetings	14	55.2 %
3.	Online forums	16	48.3%
4.	By Telephonic conversation	14	48.3%

Table No. 6 shows that 55.2% of respondents used In-person meetings to share their knowledge with their colleagues and 48.6% of respondents used Email, Online forums and By



Telephonic conversation to share their knowledge.

7. Mode of knowledge sharing

Tick how you share your knowledge through various channels (Multiple Choice

Table No. 7			
Sr. No	Tick how you share your knowledge through various channels	Respondents	Percentage
1.	Face-to-face intension	23	76.7 %
2.	The use of mobile phone	22	73.3 %
3.	E-mail	21	70 %
4.	Formal/informal meeting	16	53 %
5.	Seminar, workshops and symposia	12	40 %
6.	Mentoring	6	20 %
6.	Peer assistance	5	16.7 %
7.	WhatsApp	23	76.7%
8.	Google scholar	14	46.7%
9.	Notice board	11	36.7 %
10	Library news bulletin	12	40 %
11.	Yahoo messenger	6	20%
12.	Networking	9	30%
13.	Library portal	13	43.3%
14.	Twitter	10	33.3%
15.	Knowledge repositories	9	30 %
16.	Facebook	16	53.3 %
17.	LinkedIn	8	26.7%
18.	Memoranda	5	16.7%

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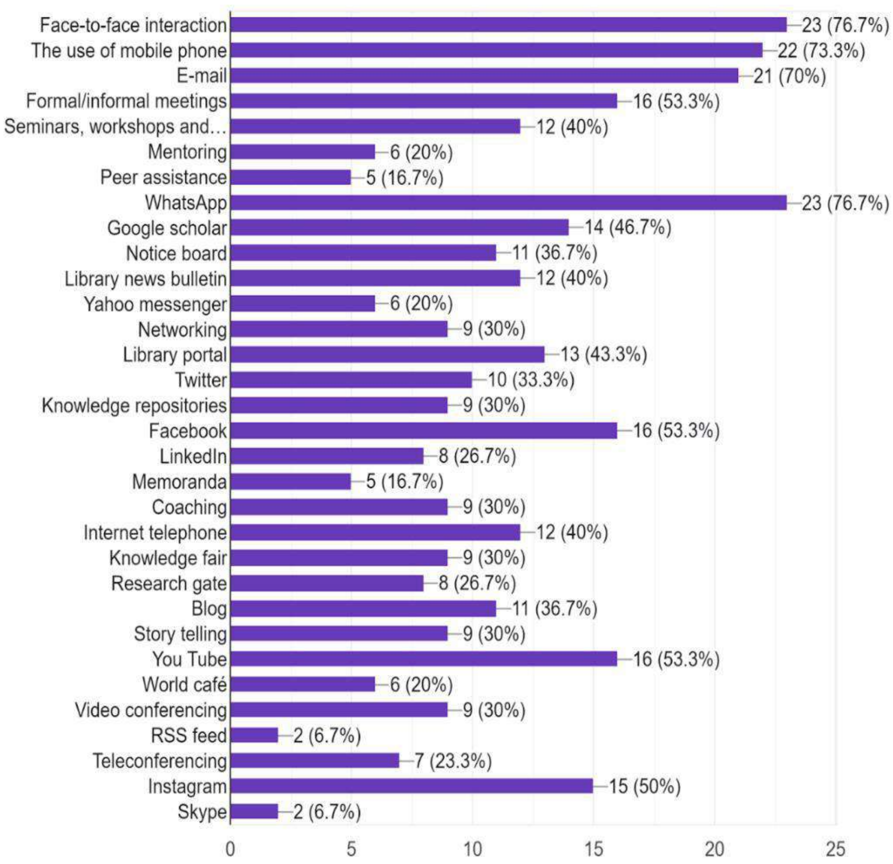
19.	Coaching	9	30%
20.	Internet telephone	12	40%
21.	Knowledge fair	9	30%
22.	Research gate	8	26.7%
23.	Blog	11	36.7%
24.	Story telling	9	30%
25.	You tube	16	53.3%
26.	World café	6	20%
27.	Video conferencing	9	30%
28.	RSS feed	2	6.7%
29.	Teleconferencing	7	23.3%
30.	Instagram	15	50%
31.	Skype	2	6.7%

Table No. 7 reveals that a significant majority of LIS post graduate students prefer face-to-face interaction & WhatsApp (76.7%) and frequently use mobile phones (73.3%) and email (70%) for knowledge sharing. Formal or informal meetings are also popular (53.3%), along with Youtube & Facebook and Instagram (50%). This diverse array of channels highlights a balanced reliance on both traditional and modern methods, emphasizing the importance of personal interaction and technological tools in the knowledge-sharing practices of respondents.



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8. Conclusion

The research paper investigates the knowledge sharing behavior among Library Information Science (LIS) postgraduate students in Sant Gadge Baba Amravati University. Through a quantitative research method, data was collected using a structured questionnaire to identify factors facilitating or hindering knowledge sharing. The findings reveal high awareness of knowledge sharing among respondents, with significant reliance on digital and social platforms for knowledge acquisition and dissemination.

The study underscores the importance of face-to-face interaction alongside digital channels in knowledge sharing practices. It highlights the diverse array of channels utilized by postgraduate students, emphasizing the need for a balanced approach to knowledge sharing encompassing both traditional and modern methods.

Overall, the research contributes to understanding knowledge sharing behaviors in academic settings, providing valuable insights for educational institutions, policymakers, and practitioners seeking to foster a culture of collaboration and innovation among postgraduate students in LIS programs.

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The Evolving Role of Libraries to Boost Research in Humanities

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Abstract:
Libraries have long been essential institutions supporting research in humanities disciplines. However, as the landscape of scholarship evolves, so too must the role of libraries. This paper explores the evolving role of libraries in boosting research in humanities, examining the challenges and opportunities presented by digital technologies, interdisciplinary approaches, and changing scholarly practices. Drawing on theoretical frameworks and case studies, this research highlights the innovative strategies adopted by libraries to facilitate access to resources, foster collaboration, and enhance scholarly communication in the humanities. By examining the evolving role of libraries, this paper aims to contribute to ongoing discussions about the future of research support services in humanities disciplines.
Keywords: Libraries, Humanities, Research, Digital Technologies, Interdisciplinary, Scholarly Communication

Introduction:

Libraries have historically served as vital hubs for scholarly research, providing access to a wealth of resources, expertise, and support services. In the humanities, where research often relies on extensive reading, critical analysis, and interdisciplinary engagement, libraries play a central role in facilitating scholarly inquiry and advancing knowledge. However, as the digital revolution transforms the research landscape and scholarly practices evolve, libraries face new challenges and opportunities in supporting research in humanities disciplines. Libraries play a pivotal role in assisting researchers in reaching their research goals by providing access to a wealth of resources, expertise, and support services. Through their extensive collections of books, journals, manuscripts, and digital archives, libraries offer researchers access to a diverse range of primary and secondary sources relevant to their research interests. Moreover, libraries employ knowledgeable librarians who can assist researchers in navigating complex databases, locating obscure materials, and refining their research strategies. Additionally, libraries may offer specialized research assistance services, including workshops, seminars, and one-on-one consultations, to help researchers develop their research skills and enhance their scholarly productivity. By serving as invaluable repositories of knowledge and expertise, libraries empower researchers to conduct rigorous and comprehensive research, ultimately enabling them to achieve their research goals and make meaningful contributions to their field of study.

This paper explores the evolving role of libraries in boosting research in humanities, examining how libraries are adapting to meet the changing needs of researchers and scholars.

The environment for libraries and research:

The environment for libraries and research in humanities is undergoing significant transformation in response to technological advancements, evolving scholarly practices, and shifting funding priorities. In today's digital age, libraries are adapting to meet the changing needs of researchers in humanities disciplines by providing access to a wide range of digital resources, online databases, and specialized collections. Moreover, libraries are fostering interdisciplinary collaboration and promoting open access to scholarly materials, facilitating the exchange of ideas and knowledge across disciplinary boundaries. However, libraries also face challenges such as budget constraints, rising subscription costs for electronic resources, and the need to ensure equitable access to information for all users. Despite these challenges,

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libraries remain vital hubs for research in humanities, serving as catalysts for innovation, exploration, and discovery in an increasingly interconnected and dynamic scholarly landscape.

The Impact of Digital Technologies:

The advent of digital technologies has revolutionized the way research is conducted in humanities disciplines. Digital libraries, online databases, and digital humanities tools have expanded access to scholarly resources and facilitated new modes of research and collaboration. Libraries have responded by digitizing their collections, developing online research guides, and providing training in digital tools and methodologies. By leveraging digital technologies, libraries are enhancing the discoverability and accessibility of humanities research materials, empowering researchers to explore new avenues of inquiry and analysis. Libraries are continually adapting to meet the changing needs of researchers and scholars by embracing new technologies, expanding their collections, and providing innovative services. One way libraries are adapting is by digitizing their resources, making them accessible remotely to accommodate the increasingly digital nature of research. Through online databases, digital archives, and electronic journals, libraries ensure that scholars have access to a wealth of resources from anywhere in the world. Moreover, libraries are enhancing their support services by offering specialized research assistance, including workshops, consultations, and training sessions on research methodologies and digital tools. Additionally, libraries are fostering interdisciplinary collaboration by creating collaborative spaces, organizing interdisciplinary seminars, and facilitating partnerships between scholars from different disciplines. By adapting to the changing needs of researchers and scholars, libraries are ensuring that they remain invaluable partners in the pursuit of knowledge and scholarship.

Interdisciplinary and Collaboration:

Interdisciplinary approaches are increasingly prevalent in humanities research, as scholars draw on insights from multiple disciplines to address complex questions and challenges. Libraries are playing a key role in facilitating interdisciplinary collaboration by providing spaces for cross-disciplinary dialogue, organizing interdisciplinary workshops and seminars, and curating interdisciplinary research collections. By fostering collaboration across disciplines, libraries are enriching the research ecosystem and stimulating innovative scholarship in humanities disciplines.

Enhancing Scholarly Communication:

Scholarly communication is undergoing a transformation in the digital age, with new models of publishing, dissemination, and peer review emerging. Libraries are at the forefront of this transformation, advocating for open access publishing, supporting digital scholarship initiatives, and providing platforms for sharing and disseminating research outputs. Through institutional repositories, digital archives, and scholarly publishing services, libraries are empowering researchers to reach broader audiences and maximize the impact of their work. Moreover, libraries are promoting ethical and responsible research practices, advocating for transparency and integrity in scholarly communication.

Technological Enhancement:

In the age of technological enhancement, the evolving role of libraries is playing a pivotal role in boosting research in humanities. Libraries, once known primarily for their vast collections of physical books and journals, have transformed into dynamic hubs of digital resources and technological innovation. Through digitization efforts, libraries have made invaluable historical manuscripts, rare texts, and scholarly articles accessible to researchers around the globe, breaking down barriers of time and space. Moreover, libraries have embraced cutting-edge technologies such as artificial intelligence, text mining, and data visualization tools, empowering researchers in humanities to analyze vast amounts of data, uncover hidden patterns, and generate new insights. Additionally, libraries serve as incubators for digital humanities projects, providing scholars with the resources, expertise, and collaborative spaces needed to explore innovative research methodologies and interdisciplinary approaches. By harnessing the power of technology, libraries are revolutionizing the research landscape in humanities, facilitating new avenues of inquiry, fostering interdisciplinary collaboration, and advancing knowledge in the digital age.

Evolving role of libraries:

Libraries are undergoing a significant evolution to boost research in humanities, adapting to the changing needs and technological advancements of the digital age. One key way libraries are evolving is through the expansion of their digital resources and services. Digitization efforts have made vast collections of historical manuscripts, rare books, and scholarly journals accessible online, breaking down geographical barriers and allowing researchers to access materials remotely. Furthermore, libraries are embracing innovative technologies such as artificial intelligence, text mining, and data visualization tools to facilitate research in humanities. These tools enable researchers to analyze large datasets, uncover patterns, and gain new insights into complex cultural phenomena. Additionally, libraries are fostering interdisciplinary collaboration by providing collaborative spaces, organizing interdisciplinary seminars, and facilitating partnerships between scholars from different fields. By evolving to meet the changing needs of researchers in humanities, libraries are playing a crucial role in advancing knowledge and scholarship in this dynamic field.

The Future of Research in Humanities:

The future of research in humanities is poised for exciting developments as scholars and institutions adapt to the evolving needs of the digital age. With technological advancements and interdisciplinary approaches becoming increasingly prevalent, the future of humanities research promises to be characterized by innovative methodologies, collaborative endeavours, and global engagement. Digital humanities initiatives will continue to play a significant role, as scholars leverage computational tools, data analysis techniques, and digital archives to explore complex questions and generate new insights. Interdisciplinary collaboration will also flourish, as scholars from diverse fields come together to address pressing societal challenges and explore the intersections of culture, history, and technology. Moreover, the future of humanities research will be shaped by a commitment to inclusivity, diversity, and social justice, as scholars strive to amplify marginalized voices, challenge dominant narratives, and foster meaningful dialogue across cultures and communities. By embracing these opportunities and confronting the challenges ahead, the future of research in humanities holds immense potential for transformative scholarship and positive societal impact.

Conclusion:

The evolving role of libraries in boosting research in humanities reflects the dynamic and multifaceted nature of contemporary scholarship. By embracing digital technologies, fostering interdisciplinary collaboration, and enhancing scholarly communication, libraries are adapting to meet the changing needs of researchers and scholars in humanities disciplines. As libraries continue to evolve, it is essential to recognize their pivotal role in supporting and advancing research in the humanities, and to continue exploring innovative strategies for enhancing research support services in the digital age. Through collaboration and innovation, libraries will remain indispensable partners in the pursuit of knowledge and understanding in the humanities.

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Literary Lighthouses: Navigating the Role of Libraries in Enriching English Literature Research

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Abstract:

This paper explores the pivotal role of libraries in facilitating and enriching research in the field of English literature. By serving as intellectual hubs and repositories of knowledge, libraries provide invaluable resources, assistance, and spaces conducive to scholarly inquiry. Through an examination of diverse library services, including access to books and journals, digital resources, archival collections, and librarian support, this paper elucidates the multifaceted contributions of libraries in advancing literary research. Furthermore, it highlights the evolving role of libraries in adapting to technological advancements and fostering collaborative environments that promote exploration and discovery in English literature research.

Key words:- English Literature, Repositories, Multifaceted, Digital,

1. Introduction:

Libraries have long served as literary lighthouses guiding scholars through the vast ocean of knowledge in English literature. As repositories of literary treasures and havens of scholarly inquiry, libraries play a crucial role in enriching research endeavours in this field. This paper navigates the multifaceted role of libraries in supporting and enhancing English literature research, shedding light on the diverse resources, services, and collaborative spaces they offer to scholars and researchers.

Throughout history, libraries have stood as enduring beacons of knowledge, illuminating the path for scholars navigating the expansive sea of English literature. Like lighthouses perched on rugged cliffs, they offer guidance and direction, leading seekers of knowledge through the intricate maze of literary works and critical discourse. More than mere repositories of books, libraries are sanctuaries of learning, where minds converge and ideas flourish in the pursuit of scholarly inquiry. This paper embarks on a journey to unravel the intricate tapestry of the role played by libraries in nurturing and enhancing research endeavours within the realm of English literature. By delving into the multifaceted dimensions of library services, resources, and collaborative spaces, it endeavours to shed light on the invaluable contributions libraries make to the scholarly community. From rare manuscripts to cutting-edge digital resources, libraries serve as custodians of literary treasures, fostering an environment conducive to exploration, discovery, and intellectual growth for scholars and researchers alike.

2. The Foundation of Knowledge:

Libraries form the bedrock of English literature research by providing access to a vast array of books, journals, and literary works. From classical masterpieces to contemporary critical analyses, libraries offer a rich tapestry of resources that serve as the foundation upon which scholarly inquiry thrives.

At the core of English literature research lies the indispensable role of libraries, which serve as the bedrock upon which scholarly pursuits are built. Within the hallowed halls of these institutions, a vast and diverse array of literary treasures awaits exploration, beckoning scholars to embark on a journey through the annals of human creativity and expression. From revered classics that have withstood the test of time to the latest critical analyses shaping contemporary discourse, libraries curate a rich tapestry of resources that encapsulate the breadth and depth of

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literary scholarship. Here, within the pages of meticulously catalogued books, journals, and literary works, lies the foundation upon which scholarly inquiry thrives, providing researchers with a reservoir of knowledge from which to draw inspiration, insight, and understanding. Whether delving into the timeless prose of Shakespeare or exploring the nuanced poetry of modernist writers, scholars find themselves immersed in a realm where the past converges with the present, shaping the trajectory of literary discourse and scholarly discovery. In this way, libraries stand as guardians of intellectual heritage, preserving the literary legacy of generations past while simultaneously nourishing the minds of scholars who seek to illuminate the path forward in the ever-evolving landscape of English literature research.

3. Digital Horizons:

In the digital age, libraries have expanded their horizons to encompass a wealth of digital resources that enhance research accessibility and efficiency. E-books, online databases, and electronic journals enable researchers to explore literary landscapes from anywhere in the world, transcending the limitations of physical space and time.

In the digital age, libraries have undergone a transformative evolution, extending their reach far beyond the confines of brick-and-mortar institutions to embrace the boundless realm of cyberspace. In this virtual domain, libraries have curated a treasure trove of digital resources that revolutionize the landscape of literary research, enhancing accessibility and efficiency in unprecedented ways. Among these digital marvels are e-books, which offer readers instant access to an extensive array of literary works at the click of a button. Whether perusing the pages of a classic novel or delving into the latest scholarly monograph, researchers can now immerse themselves in the world of literature from the comfort of their own devices, transcending the limitations of physical libraries and opening doors to new realms of knowledge and exploration.

Moreover, online databases serve as invaluable repositories of scholarly articles, critical analyses, and historical documents, providing researchers with a vast reservoir of information at their fingertips. From specialized databases dedicated to literary criticism to comprehensive archives spanning centuries of literary history, these digital collections empower scholars to conduct thorough and nuanced research with unparalleled ease and efficiency. For example, platforms like JSTOR and Project MUSE offer access to a wealth of peer-reviewed journals and academic publications, enabling researchers to stay abreast of the latest developments in literary scholarship and engage with diverse perspectives from around the globe.

In addition to e-books and online databases, electronic journals represent another cornerstone of digital resources available through libraries. With a multitude of scholarly journals now accessible in electronic format, researchers can explore cutting-edge research and critical discourse in English literature with unprecedented speed and convenience. Whether seeking to uncover groundbreaking insights or surveying the breadth of contemporary literary theory, scholars can navigate the vast landscape of academic publishing with ease, harnessing the power of digital technology to propel their research endeavours to new heights.

In this digital age, libraries serve as gateways to a world of literary exploration without boundaries, where researchers can traverse literary landscapes from anywhere in the world, transcending the constraints of physical space and time. By harnessing the power of digital technology, libraries empower scholars to navigate the ever-expanding horizons of English literature research with agility, precision, and boundless curiosity.

4. Guardians of Literary Heritage:

Beyond contemporary literature, libraries safeguard the literary heritage of the past through archival collections and special repositories. Rare manuscripts, letters, and documents housed within libraries provide researchers with invaluable insights into the lives and works of literary figures, enriching the tapestry of English literature scholarship.

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In addition to preserving literary artifacts, libraries play a crucial role in promoting scholarship and public engagement with literary heritage through exhibitions, educational programs, and digital initiatives. By making these resources accessible to scholars, students, and the general public, libraries ensure that the legacy of past literary achievements continues to inspire and enrich contemporary discourse in English literature. In this way, libraries serve as custodians of cultural memory, preserving the treasures of the past while nurturing the intellectual curiosity and creativity of future generations.

5. Navigating the Seas of Information:

Librarians serve as expert navigators; guiding researchers through the seas of information and helping them navigate library catalogs, databases, and research tools. Their expertise and assistance are instrumental in facilitating efficient and effective literature searches, ensuring that researchers can navigate the vast expanse of literary resources with confidence.

In the vast ocean of information, librarians stand as experienced navigators, equipped with the knowledge and expertise to guide researchers through the complex currents of literary resources. With an intimate understanding of library catalogs, databases, and research tools, librarians serve as indispensable guides, steering scholars towards the treasures that lie hidden beneath the surface of the digital and physical collections.

6. Collaborative Beacons:

Libraries serve as collaborative beacons, fostering environments that encourage intellectual exchange and collaboration among scholars. Through workshops, seminars, and collaborative projects, libraries provide platforms for scholars to engage with one another, share ideas, and advance the boundaries of knowledge in English literature.

At the heart of this collaborative ethos are a myriad of initiatives and programs orchestrated by libraries, designed to foster a culture of intellectual exchange and interdisciplinary dialogue. Workshops, seminars, and colloquia serve as dynamic forums where scholars can come together to share their research findings, exchange insights, and engage in lively debates that transcend the boundaries of individual disciplines. Whether delving into the intricacies of literary theory, analyzing the socio-political implications of canonical texts, or exploring innovative approaches to digital humanities, these collaborative platforms provide fertile ground for the cross-pollination of ideas and the cultivation of new perspectives.

7. Adapting to Technological Tides:

In an era of rapid technological advancement, libraries must adapt to evolving trends and embrace innovative approaches to support English literature research. From digitization initiatives to the integration of cutting-edge research tools, libraries continue to evolve as dynamic hubs of scholarly inquiry in the digital age.

One of the most significant initiatives undertaken by libraries in response to the digital age is the widespread adoption of digitization initiatives. Recognizing the importance of preserving and making accessible rare and fragile materials, libraries have embarked on ambitious digitization projects to digitize their vast collections of manuscripts, rare books, and archival materials. By digitizing these resources, libraries not only ensure their long-term preservation but also broaden access to scholars and researchers around the globe, transcending the limitations of physical distance and enhancing the discoverability of invaluable literary treasures.

In addition to digitization, libraries are harnessing the power of cutting-edge research tools and technologies to enhance the research experience for scholars in English literature. From text mining and data visualization tools to artificial intelligence and machine learning algorithms, libraries are leveraging a diverse array of technological innovations to facilitate deeper insights and more nuanced analyses of literary texts and critical discourse. These tools empower researchers to uncover hidden patterns, explore thematic connections, and gain new perspectives on familiar works, opening up new avenues for inquiry and discovery in the field of English literature.

8. Conclusion:

As literary lighthouses guiding scholars through the ever-expanding seas of knowledge, libraries play an indispensable role in enriching research endeavours in English literature. By providing access to diverse resources, expert assistance, and collaborative spaces, libraries empower researchers to navigate the complexities of literary scholarship with confidence and curiosity. As we chart a course towards new horizons in the field of English literature research, libraries will continue to serve as beacons of inspiration and discovery, illuminating the path for generations of scholars to come.

In conclusion, libraries stand as venerable lighthouses guiding scholars through the vast and ever-expanding seas of knowledge in the realm of English literature. Throughout history, these institutions have played an indispensable role in enriching research endeavours, serving as bastions of learning and guardians of intellectual heritage. By providing access to a diverse array of resources, offering expert assistance, and fostering collaborative spaces, libraries empower researchers to navigate the intricate complexities of literary scholarship with confidence and curiosity.

As stewards of knowledge and champions of intellectual curiosity, libraries will continue to illuminate the path for generations of scholars to come, ensuring that the legacy of English literature endures and thrives in the ever-changing landscape of academia. Through their unwavering dedication to the pursuit of learning and discovery, libraries embody the spirit of enlightenment, enriching the lives of scholars and researchers and inspiring a lifelong love of literature and learning. In the centuries to come, libraries will remain beacons of inspiration and discovery, guiding scholars towards new horizons and illuminating the path towards a deeper understanding of the richness and diversity of human expression in English literature.

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Social Media as a Tool to Disseminate Knowledge in Library and Information Science

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Abstract:
This paper looks at how social media can be a useful tool for library and library professionals to share text, images, information, and events. The paper describes popular social media platforms like Facebook, Instagram, Twitter, Linkedin, WhatsApp, Snapchat, Pinterest, Tiktok, Reddit, Youtube and the procture to create business account to connect with needy users. It emphasizes the need for LIS professionals to adopt social media to stay relevant to effectively share information

Introduction:-
Social media is an integral part of our lifestyle transforming the way we communicate share information and build society. Social media has become an essential tool for library professionals working in academic libraries offering the opportunity to develop services engage with users and connect with the academic community. In the field of library professionals, these platforms have brought about significant changes in how they connect with users to circulate information and collaborate with professional colleagues. Social media is like a big online meeting place where we all depend every day. It's changed how we talk to each other, share things, and create groups of friends. Instead of just chatting in person, we use the internet to share our thoughts, pictures, and videos. Libraries use some social media platforms like Facebook, Instagram, WhatsApp, and Twitter to provide the information about library's new book collection, new services, databases, research tools, and upcoming events, and users can ask the question through social media. Social media is a very easy tool for library professionals to connect anywhere in part of India or a foreign country. Social media makes it very easy to collect feedback from users and stockholders as well as celebrate achievements, publications awards and they can easily update their users about new services and alternative arrangements. Social media give special space to marketing different events like book exhibitions workshops lectures book fairs social media helps to promot these events and reach wider needy people and live converge to our events.

Social media platforms are often divided into six categories: social networking, social bookmarking, social news, media sharing, micro blogging, and online forums. The times of emergency social media helps to connect each other. Social media is a very strong communication tool for library and social media users. Social media fast to update users about new services and changes in their service libraries are very easy to connect with society and library users.

What Is Social Media:-
A computer-based technology facilitates the share of ideas, thoughts, and information through virtual networks and communities. Social media refers to a variety of technologies that facilitate the sharing of ideas and information among their users.

Social media is digital technology that allows the sharing of ideas and information, including text and visuals, through virtual networks and society.

Social media typically features user-generated content that lends itself to engagement via likes, shares, comments, and discussion.

Social media is credited with helping people build community and is faulted for facilitating disinformation and hate speech.

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Social media is also an increasingly important part of marketing campaigns.
Types of important social media:-

1. **Faceboo**
2. **Instagram**
3. **Twitter**
4. **Linkedin**
5. **WhatsApp**
6. **Snapchat**
7. **Pinterest**
8. **Tiktok**
9. **Reddit**
10. **Youtube**

Create Facebook Page:-

First, you have to create your Facebook account with all the details and then create a page and choose your library or company and fill in all basic information according to your needs like address, phone no, email logo, and image, and add the cover photo which suitable to your company page and write a brief description about the library and which services you have to give to your users. Then choose a username for your library page create a unique URL like library.com and add this URL to your college website. Create a call to action button on your Facebook page that is useful to your users for messages for mail or for calling. Then you have to write basic information as the initial post to know the users or public and what type of content you can upload on this page at the same time you have to invite the people or your friends to start your page users. Now role of the librarian starts here librarian must upload information about newly updated books new services, new events for the page followers. As well as Librarians must also create Facebook groups or join different library groups share the library page with all groups promote the library event services book club and other activities maintain message comments and respond to them promptly to engage with users or followers.

Create Instagram Business Account:-

If you do have not an Instagram account, then you have to download the app from the Google Play Store and sign up and this account convert into a business account. You have to switch your account to a professional account and under this setting select the business account. Then add a profile photo and give a short write-up on your business attach the link of your services and give details about contact no. email address at the same time selects the right people for the business and plans your contain which type of this like images, videos, and carousel posts, and prepares a schedule for content posts. Use Instagram Insight to analyze the performance of your content and audience engagement. Whatever questions or comments respond promptly and engage with your users after this if you have the budget then run your advertisement on a large scale of users. Instagram gives you regular reviews and understands the performance of the audience.

Create Twitter Business Account:-

You have to open the Google web browser select a Twitter website and sign up button and enter your name, cell number, e-mail address, and password. Use a unique name for your account and this name will appear with your URL Twitter also suggests an alternative name for the URL. After uploading all the right information about you click on the sign button and Twitter asks you for bio-data once the account verifies your uploaded information. You follow the instructions and complete the verification customize your profile by adding a picture image and short and the account is ready to open your Twitter platform for your connected people.

Create a LinkedIn Business Account and Page:-

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You have to open Google web browser and select LinkedIn and create your account then go to create a separate business page and fill in the details about your job like logo, cover image to make your page visual and the same time create your page URL.

Create YouTube Account:

You have a Google account to create your YouTube sign in to YouTube and select Tube Studio from the download mean then look for the Create button on the left sidebar click on it choose Upload Video and proceed and create your channel once the channel is created give name to channel that is public name and customize your channel by adding picture, banner, and channel description.

Social media apps like WhatsApp, Snapchat, Pinterest, Tiktok, and Reddit help us to connect with our users, and in a very simple way, we can download this all on our mobile by using the Play Store and uploading photo image wallpaper banners as a sign for recognition of aim and objective of our account. You have the right to add and move the members and at a very low cost, you approach your target.

Conclusion:-

Social media is a powerful tool for LIS professionals to share knowledge effectively Platforms like Facebook, Instagram, Twitter, Linkedin, WhatsApp, Snapchat, Pinterest, and Reddit connect with diverse audiences or users promoting resources and building a sense of community. This paper encourages LIS professionals to leverage social media for effective knowledge dissemination and engagement of users and adopt information share practice.

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Comparative Study of Digital Library & Traditional Library

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Abstract:-

In the rapidly evolving landscape of information and knowledge management, two distinct paradigms have emerged as cornerstones of scholarly pursuits and intellectual enrichment: the Digital Library and the Traditional Library. These two entities represent distinct approaches to organizing, preserving, and disseminating information, each with strengths and limitations. The Digital Library harnesses the power of modern technology to transcend physical boundaries and provide unprecedented access to a vast array of digital resources, while the Traditional Library, rooted in centuries-old practices, continues to uphold the tangible and tactile experience of seeking wisdom within the hallowed walls of its physical holdings. As we embark on a journey to explore the nuances, advantages, and challenges of these two divergent yet interconnected worlds, we gain insight into the evolution of human knowledge preservation and the dynamic interplay between tradition and innovation.

Keywords- digital, traditional, references, index, staff, users, link. media, preparation.

Introduction:-

What is Digital Library?

A Digital Library is a virtual repository of digitized information and resources, encompassing diverse digital content such as books, articles, images, videos, manuscripts, and more. Unlike traditional libraries, which rely on physical collections, a digital library leverages technology to store, organize, and access these materials over the Internet. This digitalization of resources enables seamless and global accessibility, empowering users to explore, search, and retrieve information remotely. By embracing advanced search functionalities, multimedia integration, and interactive features, digital libraries enhance how individuals engage with knowledge, offering a dynamic and customizable learning experience. While expanding access and convenience, digital libraries also grapple with challenges like data preservation, copyright management, and the need for ongoing technological adaptation. As technology evolves, digital libraries play a pivotal role in reshaping the landscape of information dissemination and scholarly exploration.

What is Traditional Library?

A Traditional Library embodies the longstanding essence of knowledge preservation and scholarly pursuit. It is a physical repository of printed materials, often comprising a rich collection of books, journals, periodicals, manuscripts, and reference materials. In contrast to digital libraries, traditional libraries provide a tangible and immersive environment where patrons can engage with physical resources, explore quiet reading spaces, and participate in face-to-face interactions with librarians and fellow enthusiasts. These libraries serve as cultural and intellectual hubs within communities, fostering an atmosphere of quiet contemplation, research, and exploration. While the traditional library model may lack the instantaneous accessibility of digital counterparts, it offers a unique and tactile experience that connects individuals with the historical legacy of printed works and the art of browsing physical shelves in search of hidden treasures.

Difference Between Digital Library & Traditional Library:

The justaposition of the Digital Library and the Traditional Library encapsulates a fascinating interplay between the age-old conventions of knowledge preservation and the transformative potential of modern technology. As these two distinct paradigms converge on the dissemination of information, they unveil a spectrum of differences that range from the tangible presence of physical volumes to the virtual accessibility of digitized resources. The intricate balance between the tactile allure of traditional libraries and the boundless reach of digital repositories encompasses considerations of access, interaction, preservation, and the evolving nature of scholarly engagement. Exploring these differences sheds light on the evolving nature of information management and invites reflection on the fundamental principles underpinning the timeless pursuit of understanding and learning.

The distinction between a Digital Library and a Traditional Library lies in their fundamental approaches to acquiring, storing, accessing, and disseminating information. Here are some key differences between the two:

Difference between Traditional and Digital Library: There are several differences between traditional and digital library given below.

Digital Library	Traditional Library
A Digital Library primarily consists of digitized and electronically formatted resources. These include e-books, online journals, multimedia content, databases, and other digital materials.	A Traditional Library houses physical materials such as printed books, manuscripts, newspapers, magazines, maps, and other tangible items.
Digital libraries offer remote and global access through the Internet, allowing users to retrieve information from anywhere at any time, provided they have an Internet connection.	Access to resources is limited to physical presence at the library's location during its operating hours.
Advanced search algorithms enable efficient and precise searching for specific information within digital libraries, often resulting in quicker and more accurate results.	Users rely on catalog systems, library classifications, and manual browsing to locate materials, which can be time-consuming and may require assistance from librarians.
Digital libraries may offer interactive features like annotations, multimedia integration, and social sharing, enhancing user engagement and collaboration.	While physical libraries provide a serene environment for focused reading and research, interactions are often limited to face-to-face discussions with librarians or fellow patrons.
Digital materials can face challenges related to technology obsolescence, file formats, and digital preservation, which require ongoing efforts to ensure long-term accessibility.	Physical materials require preservation techniques to prevent deterioration but generally have a longer lifespan than digital formats.
Digital libraries require minimal physical space, as resources are stored electronically, reducing the need for extensive storage areas.	Traditional libraries demand substantial physical space to house and organize their collections, which can lead to spatial constraints.
Digital libraries can be cost-effective for storage and distribution but may involve digital infrastructure, licensing, and access expenses.	Traditional libraries have costs associated with building maintenance, physical storage, and printed materials.

Digital libraries offer dynamic and customizable learning experiences through multimedia integration and online tools.	Traditional libraries offer a tactile and immersive experience, physically engaging users with books and artifacts and fostering a sense of historical connection.
Digital libraries offer remote and global access through the Internet, allowing users to retrieve information from anywhere at any time, provided they have an Internet connection.	Access to resources is limited to physical presence at the library's location during its operating hours.

Limitations and Merits of Digital and Tradition Library

Digital Libraries and Traditional Libraries have their own merits and limitations, and the choice between them often depends on users' and institutions' specific needs, preferences, and goals.

A digital library is a library where you can find digital repositories, or digital collections, online databases of digital objects that may include text, still images, audio, video, digital documents, or other digital media formats. Objects can contain digitized content such as prints or photographs, as well as primarily produced digital content such as word processor files or social media posts. In addition to storing content, digital libraries provide a way to organize, search, and retrieve the contents of a collection.

Whereas traditional libraries emphasize the archive and preservation of physical items especially books and periodicals that were the custodians of the librarian library. Information is physically gathered in one place; Users need to learn what is in the library and use it.

Conclusion:-

From the foregoing, it has been made abundantly cleared that digital library or E library operation is far better than the traditional system, especially at this auspicious period when hardcopy documents or paper based materials are gradually facing out in all fares of human sectors. Though, E library is not without its own shortcomings, for instance, in Nigeria or any other African countries where epileptic power supply and poor Internet technology Architecture or unstable Telecommunication Infrastructure are evident, digital operations cannot thrive. Therefore, Governments in all the tiers of governance including the Federal and State legislative houses respectively should make policies and legislate bills that can improve on the power supplies and the Internet Architecture Infrastructures in the Country, because this is the platform and bane through which Nigeria can meet up with the developed Nations of the world technologically in the 21st century.

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पश्चिम विदर्भातील सार्वजनिक ग्रंथालयांच्या स्थितीचा चिकित्सक अभ्यास

अतुल वानखडे व डॉ. किशोरसिंह आर. चुंगडे

गोषवारा :—

सामाजिक विकासात साहित्य संपदेची फार मोठ्या प्रमाणात भूमिका आहे. याकरीता महाराष्ट्र शासनाने लहान मोठ्या सर्व गावात सार्वजनिक ग्रंथालये उपलब्ध व्हावे याकरीता दर वार्षिक अंदाजपत्रकात आर्थिक करतूद केलेली आहे. या अनुदानाद्वारे सार्वजनिक ग्रंथालयाचा निरंतर विकास होऊन जनता ज्या समाजात राहते त्या समाजाचा देखिल विकास होणे अपेक्षित आहे. वर नमुद केलेल्या उद्देशपूर्तीसाठी (सामाजिक विकास) सार्वजनिक ग्रंथालयाचे नियमित सद्य स्थिती परिक्षण करणे आवश्यक आहे. जेणेकरून या संस्थांच्या (सार्वजनिक ग्रंथालयांच्या) विकासाला हातभार लावता येईल. याकरिता प्रस्तुत संशोधन कार्यात महाराष्ट्राच्या अमरावती प्रशासकीय विभागात येणाऱ्या सर्व जिल्हातील सार्वजनिक ग्रंथालयांची स्थिती जाणून घेण्याचा प्रयत्न करण्यात आला. तथ्य संकलन प्रमाणीकृत प्रश्नावली व सर्वेक्षण पध्दतीला अनुसरून करण्यात आली. प्राप्त माहितीच्या सांख्यिकिय विश्लेषणावरून असे निदर्शनास येते की संशोधन क्षेत्रातील सार्वजनिक ग्रंथालयात उपलब्ध मुलभूत सुविधा तुलनेने कमी प्रमाणात आहे. बहुतांश सार्वजनिक ग्रंथालयातील वातावरण (उजेड, हवा व पर्याप्त जागा) योग्य असून ग्रंथालयातील ग्रंथसेवा देखिल पर्याप्त असल्याचे आढळले. ग्रंथालयातील वाचकांची संख्या तुलनेने कमी असल्याचे आढळले व जे वाचक नियमित ग्रंथालयाला भेटी देतात त्यांना कथा, कादंबरी व धार्मिक साहित्यात अधिक रूची असल्याचे आढळले. एकंदरीत सर्व प्रकारच्या साहित्याला मागणी अधिक नसून केवळ विशिष्ट साहित्यच सार्वजनिक ग्रंथालयातील वाचकांद्वारे अधिक मागणी आहे.

सूचक शब्द : सामाजिक विकास, सार्वजनिक ग्रंथालये, ग्रंथालयांची स्थिती

१.० प्रस्तावना:

मानवाच्या जशा तीन मूलभूत गरजा अन्न, वस्त्र आणि निवारा, तशीच आधुनिक काळातील मानवाची आणखी एक महत्वाची गरज म्हणजे माहिती होय. आजच्या आधुनिक युगात माहितीचे बदलले स्वरूप लक्षात घेता माहितीचे योग्य प्रकारे व्यवस्थापन करण्यावरच आपले यशापयश अवलंबून आहे. या अनुशंगाने ग्रंथालयाचे आणि ज्ञानसाधनांचे महत्व अनन्यसाधारण होत आहे व ज्ञानदानाचे, ज्ञानसंक्रमणाचे कार्य अविरतपणे चालत राहणार आहे. आज माहिती ही सर्वाच्या निकडीची बाब बनली आहे. माहितीचा उपयोग करणारे गरजू केवळ शैक्षणिक क्षेत्रातीलच उपभोक्ते नसतात तर समाजातील सर्व व्यक्ती असतात. या सर्व (संशोधक, व्यावसायिक किंवा समाजातील इतर घटक) घटकांना कोणत्या तरी गोष्टींविषयी सातत्याने आधुनिक, प्रचलित किंवा ऐतिहासिक स्वरूपातील माहिती हवी असते.

ग्रंथालयाच्या प्रकारानुसार त्याठिकाणी येणारा वाचक/उपभोक्ता हा निराळा असतो व अशाच प्रकारचे ग्रंथालय म्हणजे सार्वजनिक ग्रंथालय होय. सार्वजनिक ग्रंथालय हे वर्तमान काळातही स्वयंशिक्षणाचे एक उत्तम साधन आहे. सार्वजनिक ग्रंथालयात सर्वच प्रकारचे वाचक येत असतात. या (सार्वजनिक ग्रंथालय) ग्रंथालयात येणारा वाचक हा सर्व वयोगटातील बाल, स्त्री, पुरूष कोणीही असू शकतो. त्यामुळे सर्वच प्रकारच्या व सर्वच स्तरावरील वाचन साहित्याचा व साधनांचा समावेश सार्वजनिक ग्रंथालयात होतो. सुरूवातीच्या काळात केवळ समाजातील मान्यवर लोक या ग्रंथालयात एकत्र येत व विविध विषयांवर चर्चा करीत. त्यामुळे या ग्रंथालयांना सामाजिक स्वरूप प्राप्त झाले आणि त्यांनी ग्रंथालय हे समाजाचे एक शक्तिस्थान आहे, हा विचार समाजमानसात रूजविला. लोकांनी, लोकांसाठी चालविलेली लोकप्रशासित ग्रंथालये म्हणजे सार्वजनिक ग्रंथालये, सार्वजनिक ग्रंथालयांचे कार्य आणि सेवाची व्याप्ती इतर सर्व प्रकारच्या ग्रंथालयापेक्षा मोठी आणि आगळ्यावेगळ्या प्रकारची आहे. 'जनतेची विद्यापीठे' आणि 'निरंतर शिक्षणाची केंद्रे' म्हणून या ग्रंथालयांचे स्थान अत्यंत महत्त्वाचे ठरते.

वरील माहितीवरून लक्षात येते की समाजाच्या सर्वांगीण विकासामध्ये सार्वजनिक ग्रंथालयांचे योगदान महत्त्वपूर्ण आहे, त्यांचे समाजाशी अतूट असे नाते आहे. समाजाच्या विकासाचा ती आधार आहेत. समाजातील विविध थरातील लोकांना जिज्ञासातृप्तीसाठी, ज्ञानलालसा भागविण्यासाठी, छंद, कला जोपासण्यासाठी वाचनसाहित्याची गरज असते.

भारतातील इतर राज्याच्या तुलनेत महाराष्ट्र सार्वजनिक ग्रंथालये उत्कृष्ट असे कार्य आहे. महाराष्ट्रात जिल्हा, तालुका व गावपातळीवर असलेल्या शासनाच्या सार्वजनिक ग्रंथालयावर नियंत्रण ठेवण्यासाठी विभागीय कार्यालयातील संचालक तथा निरिक्षकाचे पद निर्माण केले आहे. शासकीय अनुदाचा वापर योग्य होण्यासाठी महाराष्ट्र शासनाची ग्रंथालय संचालनालय ही यंत्रणा कार्य करीत असली तरी या अनुदानाचा विकासासाठी कितपत वापर होतो याचा अभ्यास करणे आवश्यक आहे. त्याचबरोबर सार्वजनिक ग्रंथालयासाठी शासनाने सुरु केलेल्या विविध योजनेव्दारे कसा, कितपत फायदा होतो हे अभ्यासून त्यामधील उणीवी दूर करण्याच्या दृष्टीने प्रस्तुत संशोधनकार्य करण्यात आले आहे.

२.० संशोधन पद्धती:

प्रस्तुत संशोधनकार्यात निर्दोष माहिती मिळण्यासाठी सर्वेक्षण पद्धतीचा उपयोग करण्यात आला. प्रस्तुत संशोधनाचे कार्यक्षेत्र क्षेत्र म्हणुन महाराष्ट्रातील अमरावती प्रशासकीय विभागाची निवड करण्यात आली ज्यात अमरावती, अकोला, बुलडाणा, वाशिम व यवतमाळ या जिल्ह्यांचा समावेश आहे. संशोधनक्षेत्रातील सर्व सार्वजनिक ग्रंथालयांचा अध्ययन विश्व म्हणून विचार करण्यात आला आहे. संशोधन क्षेत्रात एकुण १९५७ सार्वजनिक ग्रंथालये आहेत यामधुन ७९८ सार्वजनिक ग्रंथालयांची (४०

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टक्के) निवड संभाव्यता पद्धतीतील साधा यादृच्छिक नमुना निवड पद्धतीद्वारे करण्यात आली. संशोधनात तथ्यांचे योग्य संकलन करण्यासाठी वर्णनात्मक व विश्लेषणात्मक अशा मिश्र संशोधन आराखडयाची निवड करण्यात आली.

अध्ययनाकरीता लागणारी माहिती संशोधनक्षेत्रातील सार्वजनिक ग्रंथालयातील ग्रंथपालांकडून प्रमाणिकृत प्रश्नावलीद्वारे मिळविण्यात आले आहेत. त्याचप्रमाणे, दुय्यम तथ्य संकलनासाठी विषयासंबंधी साहित्य, विविध दैनिक, साप्ताहिके, पुस्तके, ग्रंथ, व शासनाच्या विविध विभागांमार्फत प्रकाशित साहित्य, अहवाल यांचे अवलोकन आणि परीक्षण करण्यात आले. तथ्यांचे विश्लेषण करण्याकरीता सांख्यकीय तंत्रातील विविध ग्राह्यता चाचणीचा विशेषत्वाने उपयोग करण्यात आला व त्या आधारावर निष्कर्ष काढण्यात आले. प्राप्त माहितीवरुन वारंवारीता व बहुलक काढण्यात आले. अभ्यासातील विविध घटक, पडताळण्याकरिता देण्यात आलेले गृहित प्रमेय आणि वापरण्यात आलेला संशोधनाचा आराखडा लक्षात घेता काई वर्ग मूल्य चाचणीचा वापर करण्यात आला. संभाव्यता पातळी ०.०५ निर्धारीत करण्यात आली.

३.० माहितीचे विश्लेषण आणि समीक्षा

३.१ ग्रंथालयातील मुलभूत सुविधा

सारणी १: ग्रंथालयातील मुलभूत सुविधेसंबंधी माहिती दर्शविणारी सारणी

मुलभूत सुविधा	५ पेक्षा कमी		५ ते १०		१० पेक्षा अधिक		एकूण	
	संख्या	टक्के	संख्या	टक्के	संख्या	टक्के	संख्या	टक्के
टेबल	५३७	६७.३	१८३	२२.९	७८	९.८	७९८	१००.०
खुर्च्या	१९८	२४.८	१३९	१७.४	४६१	५७.८	७९८	१००.०
रॅक	६७१	८४.१	७६	९.५	५१	६.४	७९८	१००.०
कपाट	५६७	७१.१	११३	१४.२	११८	१४.८	७९८	१००.०
कार्ड कॅबिनेट	६२४	७८.२	१५५	१९.४	१९	२.४	७९८	१००.०
अग्निशामक यंत्र	७९८	१००.०	०	०.०	०	०.०	७९८	१००.०
संगणक	७४५	९३.४	५३	६.६	०	०.०	७९८	१००.०

वरील सारणी क्रमांक १ मध्ये विदर्भातील सार्वजनिक ग्रंथालयातील मुलभूत सुविधेसंबंधी माहिती दर्शविण्यात आली आहे.

- टेबल : सारणीत दर्शविलेल्या माहितीनुसार ६७.३ टक्के ग्रंथालयामध्ये ५ पेक्षा कमी टेबल उपलब्ध असून २२.९ टक्के ग्रंथालयामध्ये ५ ते १० टेबल उपलब्ध असल्याचे आढळले. तसेच ९.८ टक्के ग्रंथालयामध्ये १० पेक्षा अधिक टेबल उपलब्ध असल्याचे आढळले.
- खुर्च्या : २४.८ टक्के ग्रंथालयामध्ये ५ पेक्षा कमी खुर्च्या उपलब्ध असून १७.४ टक्के ग्रंथालयामध्ये ५ ते १० खुर्च्या उपलब्ध असल्याचे आढळले. तसेच ५७.८ टक्के ग्रंथालयामध्ये १० पेक्षा अधिक खुर्च्या उपलब्ध असल्याचे आढळले.
- रॅक : ८४.१ टक्के ग्रंथालयामध्ये ५ पेक्षा कमी रॅक उपलब्ध असून ९.५ टक्के ग्रंथालयामध्ये ५ ते १० रॅक उपलब्ध असल्याचे आढळले. तसेच ६.४ टक्के ग्रंथालयामध्ये १० पेक्षा अधिक रॅक उपलब्ध असल्याचे आढळले.
- कपाट : ७१.१ टक्के ग्रंथालयामध्ये ५ पेक्षा कमी कपाट उपलब्ध असून १४.२ टक्के ग्रंथालयामध्ये ५ ते १० कपाट उपलब्ध असल्याचे आढळले. तसेच १४.८ टक्के ग्रंथालयामध्ये १० पेक्षा अधिक कपाट उपलब्ध असल्याचे आढळले.
- कार्ड कॅबिनेट : ७८.२ टक्के ग्रंथालयामध्ये ५ पेक्षा कमी कार्ड कॅबिनेट उपलब्ध असून १९.४ टक्के ग्रंथालयामध्ये ५ ते १० कार्ड कॅबिनेट उपलब्ध असल्याचे आढळले. तसेच २.४ टक्के ग्रंथालयामध्ये १० पेक्षा अधिक कार्ड कॅबिनेट उपलब्ध असल्याचे आढळले.
- अग्निशामक यंत्र : १००.० टक्के ग्रंथालयामध्ये ५ पेक्षा कमी अग्निशामक यंत्र उपलब्ध असल्याचे आढळले.
- संगणक : ९३.४ टक्के ग्रंथालयामध्ये ५ पेक्षा कमी संगणक उपलब्ध असून ६.६ टक्के ग्रंथालयामध्ये ५ ते १० कार्ड संगणक उपलब्ध असल्याचे आढळले.

३.२ ग्रंथालयात उजेडाची, हवेशीर व पर्याप्त जागेची उपलब्धता

सारणी २: ग्रंथालयात उजेडाची, हवेशीर व पर्याप्त जागेची उपलब्धता याबाबत माहिती दर्शविणारी सारणी

प्रतिक्रिया	संख्या	टक्केवारी
होय	७५७	९४.९
नाही	४१	५.१
एकूण	७९८	१००.०

काई–वर्गमूल्य: ६४२.४२६य स्वातंत्र्यांश: १;तालिका मूल्य:३.८४; चमूल्य:ढ०0०५

वरील सारणी क्रमांक २ मध्ये विदर्भातील सार्वजनिक ग्रंथालयात उजेडाची, हवेशीर व पर्याप्त जागेची उपलब्धता याबाबत माहिती दर्शविण्यात आली आहे. सारणीत दर्शविलेल्या माहितीनुसार ९४.९ टक्के ग्रंथालयात उजेडाची, हवेशीर व पर्याप्त जागा उपलब्ध असून ५.१ टक्के ग्रंथालयात उजेडाची, हवेशीर व पर्याप्त जागा उपलब्ध नसल्याचे निदर्शनास आले.

३.३ ग्रंथालयातील एकुण ग्रंथसंख्या

सारणी ३: ग्रंथालयातील एकुण ग्रंथसंख्या दर्शविणारी सारणी

एकुण ग्रंथसंख्या	संख्या	टक्केवारी

३०० पेक्षा कमी	७	०.९
३०१ ते ५००	१८	२.३
५०१ ते १०००	६४	८.०
१००१ पेक्षा अधिक	७०९	८८.८
एकूण	७९८	१००.०

काई–वर्गमूल्य: १७४४.१०५; स्वातंत्र्यांश: ३;तालिका मूल्य:७.८२; चमूल्य:ढ०ण्०५

वरील सारणी क्र. ३ मध्ये विदर्भातील सार्वजनिक ग्रंथालयातील एकुण ग्रंथसंख्या याबाबत माहिती दर्शविण्यात आली आहे. सारणीत दर्शविलेल्या माहितीनुसार ०.९ टक्के ग्रंथालयात ३०० पेक्षा कमी ग्रंथ असून २.३ टक्के ग्रंथालयात ३०१ ते ५०० ग्रंथ असल्याचे आढळले. त्याचप्रमाणे ८.० टक्के व ८८.८ टक्के ग्रंथालयात ५०१ ते १००० व १००१ पेक्षा अधिक ग्रंथ असल्याचे निदर्शनास आले.

ग्रंथालय वाचकवर्ग (संख्या)

३.४ ग्रंथालयात दररोज वाचन करणारे वर्गणीदार सभासदांची संख्या

सारणी ४: सार्वजनिक ग्रंथालयात दररोज वाचन करणाऱ्या वर्गणीदार सभासद वाचक वर्गाच्या संख्येसंबंधी माहिती दर्शविणारी सारणी

वाचकवर्ग	संख्या	टक्केवारी
१०० पेक्षा कमी	१७९	२२.४
१०१ ते २५०	३४२	४२.९
२५१ ते ३००	८५	१०.७
३०१ पेक्षा अधिक	१९२	२४.१
एकूण	७९८	१००.०

काई–वर्गमूल्य: १६९.८९य स्वातंत्र्यांश:३;तालिका मूल्य:७.८२; चमूल्य:ढ०ण्०५

वरील सारणी क्र. ४ मध्ये विदर्भातील सार्वजनिक ग्रंथालयात दररोज वाचन करणाऱ्या वर्गणीदार सभासद वाचक वर्गाच्या संख्येसंबंधी माहिती दर्शविण्यात आली आहे. सारणीत दर्शविलेल्या माहितीनुसार २२.४ टक्के ग्रंथालयात दररोज १०० पेक्षा कमी सभासद वाचन करीत असून ४२.९ टक्के ग्रंथालयात दररोज १०१ ते २५० सभासद वाचन करीत असल्याचे आढळले. त्याचप्रमाणे १०.७ टक्के व २४.१ टक्के ग्रंथालयात दररोज २५१ ते ३०० व ३०१ पेक्षा अधिक सभासद वाचन करीत असल्याचे निर्दशनास आले.

३.५ ग्रंथालयात दररोज वाचन करणारे बालक व युवा विद्यार्थ्यांची संख्या

सारणी ५: सार्वजनिक ग्रंथालयात दररोज वाचन करणारे बालक व युवा विद्यार्थी वर्गाच्या संख्येबाबत माहिती दर्शविणारी सारणी

बालक व युवा विद्यार्थ्यांची संख्या	संख्या	टक्केवारी
१०० पेक्षा कमी	६०४	७५.७
१०१ ते २००	९८	१२.३
२०१ ते ३००	७०	८.८
३०१ पेक्षा अधिक	२६	३.३
एकूण	७९८	१००.०

काई–वर्गमूल्य: ११०६.७४२य स्वातंत्र्यांश:३;तालिका मूल्य:७.८२; चमूल्य:ढ०ण्०५

वरील सारणी क्र. ५ मध्ये विदर्भातील सार्वजनिक ग्रंथालयात दररोज वाचन करणारे बालक व युवा विद्यार्थी वर्गाच्या संख्येबाबत माहिती दर्शविण्यात आली आहे. सारणीत दर्शविलेल्या माहितीनुसार ७५.७ टक्के ग्रंथालयात दररोज १०० पेक्षा कमी बालक व युवा विद्यार्थी दररोज वाचन करीत असून १२.३ टक्के ग्रंथालयात १०१ ते २०० बालक व युवा विद्यार्थी दररोज वाचन करीत असल्याचे आढळले. तसेच ८.८ टक्के व ३.३ टक्के ग्रंथालयात २०१ ते ३०० व ३०१ पेक्षा अधिक बालक व युवा विद्यार्थी दररोज वाचन करीत असल्याचे निर्दशनास आले.

३.६ ग्रंथालयात दररोज वाचन करणारे ज्येष्ठ नागरिकांची संख्या

सारणी ६: सार्वजनिक ग्रंथालयात दररोज वाचन करणाऱ्या ज्येष्ठ नागरिक वर्गाच्या संख्येसंबंधी माहिती दर्शविणारी सारणी

ज्येष्ठ नागरिक संख्या	संख्या	टक्केवारी
५० पेक्षा कमी	५१८	६४.९
५१ ते १००	१२८	१६.०
१०१ पेक्षा अधिक	१५२	१९.०
एकूण	७९८	१००.०

काई–वर्गमूल्य: ३५९.१८८य स्वातंत्र्यांश:२;तालिका मूल्य:५.९९; चमूल्य:ढ०ण्०५

वरील सारणी क्र. ६ मध्ये विदर्भातील सार्वजनिक ग्रंथालयात दररोज वाचन करणाऱ्या ज्येष्ठ नागरिक वाचन वर्गाच्या संख्येसंबंधी माहिती दर्शविण्यात आली आहे. सारणीत दर्शविलेल्या माहितीनुसार ६४.९ टक्के ग्रंथालयात दररोज ५० पेक्षा कमी ज्येष्ठ नागरिक वाचन करीत असून १६.० टक्के ग्रंथालयात दररोज ५१ ते १००ज्येष्ठ नागरिक वाचन करीत असल्याचे आढळले. त्याचप्रमाणे १९.० टक्के ग्रंथालयात दररोज १०१ पेक्षा अधिक ज्येष्ठ नागरिक वाचन करीत असल्याचे निर्दशनास आले.

३.७ ग्रंथालयात दररोज वाचन करणाऱ्या महिला सभासदांची संख्या

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सारणी ७:सार्वजनिक ग्रंथालयात दररोज वाचन करणाऱ्या महिला सभासद वर्गाच्या संख्येसंबंधी माहिती दर्शविणारी सारणी

महिला सभासद	संख्या	टक्केवारी
१०० पेक्षा कमी	५६७	७१.१
१०१ ते २००	१५३	१९.२
२०१ ते ३००	५४	६.८
३०१ पेक्षा अधिक	२४	३.०
एकूण	७९८	१००.०

काई—वर्गमूल्य: ३५९.१८८य स्वातंत्र्यांश:३;तालिका मूल्य:७.८२; चमूल्य:ढ०ण्०५

वरील सारणी क्र. ७ मध्ये विदर्भातील सार्वजनिक ग्रंथालयात दररोज वाचन करणाऱ्या महिला सभासद वर्गाच्या संख्येसंबंधी माहिती दर्शविण्यात आली आहे. सारणीत दर्शविलेल्या माहितीनुसार ७१.१ टक्के ग्रंथालयात दररोज १०० पेक्षा कमी महिला सभासद वाचन करीत असून १९.२ टक्के ग्रंथालयात दररोज १०१ ते २०० महिला सभासद वाचन करीत असल्याचे आढळले. त्याचप्रमाणे ६.८ टक्के व ३.० ग्रंथालयात २०१ ते ३०० व ३०१ पेक्षा अधिक महिला सभासद दररोज वाचन करीत असल्याचे निर्दशनास आले.

३.८ ग्रंथालय महोत्सवासाठी अनुदान प्राप्ती

सारणी क्र. ८: सार्वजनिक ग्रंथालयांना सुवर्ण महोत्सव, हिरक महोत्सव अमृत, महोत्सव, शतक महोत्सवासाठी प्राप्त होत असलेले अनुदान यासंबंधी माहिती दर्शविणारी सारणी

अनुदान	संख्या	टक्केवारी
५० वर्ष सुवर्ण महोत्सव १५०००० लाख रूपये	५९७	७४.८
६० वर्ष हिरक महोत्सव १५०००० लाख रूपये	१०२	१२.८
अमृत महोत्सव १५०००० लाख रूपये	७३	९.१
शतक महोत्सव २००००० लाख रूपये	२६	३.३
एकूण	७९८	१००.०

काई—वर्गमूल्य: १०७०.७६२य स्वातंत्र्यांश:३;तालिका मूल्य:७.८२; चमूल्य:ढ०ण्०५

वरील सारणी क्र. ८ मध्ये विदर्भातील सार्वजनिक ग्रंथालयांना सुवर्ण महोत्सव, हिरक महोत्सव अमृत, महोत्सव, शतक महोत्सवासाठी प्राप्त होत असलेले अनुदान यासंबंधी माहिती दर्शविण्यात आली आहे. सारणीत दर्शविलेल्या माहितीनुसार ७४.८ टक्के ग्रंथालयाला ५० वर्ष सुवर्ण महोत्सवाकरीता १५०००० लाख रूपये अनुदान प्राप्त झाले असून १२.८ ग्रंथालयाला ६० वर्ष हिरक महोत्सवाकरीता १५०००० लाख रूपये अनुदान प्राप्त झाले असल्याचे आढळले. तसेच ९.१ टक्के व ३.३ टक्के ग्रंथालयाला अमृत महोत्सवाकरीता १५०००० लाख रूपये व शतक महोत्सवाकरीता २००००० लाख रूपये अनुदान प्राप्त झाले असल्याचे निर्दशनास आले.

३.९ योजनेद्वारे मिळालेल्या ग्रंथांना वाचकांचे प्राधान्य

सारणी ९ :योजनेच्या माध्यमातुन मिळालेल्या ग्रंथांना वाचकांद्वारे मिळणारे प्राधान्य याबाबत माहिती दर्शविणारी सारणी

ग्रंथ	संख्या	टक्केवारी
कथा/कादंबरी	६२८	७८.७
नाटक	१०३	१२.९
चरित्रात्मक	९४	११.८
धार्मिक	६०२	७५.४
संदर्भग्रंथ	३७	४.६
स्पर्धा परीक्षा	४०७	५१.०
अन्य	२११	२६.४

वरील सारणी क्र. ९ मध्ये विदर्भातील सार्वजनिक ग्रंथालयांना योजनेच्या माध्यमातुन मिळालेल्या ग्रंथांना वाचकांद्वारे मिळणारा प्राधान्य याबाबत माहिती दर्शविण्यात आली आहे. सारणीत दर्शविलेल्या माहितीनुसार ७८.७ टक्के ग्रंथालयातील वाचकांद्वारे कथा/कादंबरीला अधिक प्राधान्य दिले जात असून १२.९ टक्के ग्रंथालयात वाचकांद्वारे नाटकांना प्राधान्य दिले जात असल्याचे आढळले. तसेच ७५.८ टक्के, ७.६ टक्के व ५१.० टक्के अनुक्रमे ग्रंथालयात वाचकांद्वारे दररोज धार्मिक, संदर्भग्रंथ, स्पर्धा परीक्षेच्या पुस्तकांना प्राधान्य दिले जाते तर २६.४ टक्के ग्रंथालयात अन्य ग्रंथांना वाचकांद्वारे प्राधान्य दिले जात असल्याचे निर्दशनास आले.

४.० निष्कर्ष :

४.१ ग्रंथालयातील मुलभूत सुविधा

- प्राप्त परिणामांवरून असे निदर्शनास येते की, संशोधन क्षेत्रातील (विदर्भातील) बहुतांश सार्वजनिक ग्रंथालयात टेबल, खुर्च्या, रॅक, कपाट, कार्ड कॅबिनेट या पाच पेक्षा जास्त मुलभूत सुविधा उपलब्ध आहे.

४.२ ग्रंथालयात उजेडाची, हवेशीर व पर्याप्त जागेची उपलब्धता

- प्राप्त परिणामांवरून असे निदर्शनास येते की, संशोधन क्षेत्रातील (विदर्भातील) बहुतांश ;चढ०.०५द्ध सार्वजनिक ग्रंथालयात उजेडाची, हवेशीर व पर्याप्त जागा उपलब्ध आहे.

४.३ ग्रंथालयातील एकुण ग्रंथसंख्या

- प्राप्त परिणामांवरून असे निदर्शनास येते की, संशोधन क्षेत्रातील (विदर्भातील) ;चढ०.०५द्ध बहुतांश सार्वजनिक ग्रंथालयात १००१ पेक्षा अधिक ग्रंथ आहेत.

४.४ ग्रंथालयात दररोज वाचन करणारे वर्गणीदार सभासदांची संख्या

- प्राप्त परिणामांवरून असे निदर्शनास येते की, संशोधन क्षेत्रातील (विदर्भातील) ;चढ०.०५द्ध बहुतांश सार्वजनिक ग्रंथालयात दररोज १०१ ते २५० सभासद वाचन करतात.

४.५ ग्रंथालयात दररोज वाचन करणारे बालक व युवा विद्यार्थ्यांची संख्या

- प्राप्त परिणामांवरून असे निदर्शनास येते की, संशोधन क्षेत्रातील (विदर्भातील) ;चढ०.०५द्ध बहुतांश सार्वजनिक ग्रंथालयात १०० पेक्षा कमी बालक व युवा विद्यार्थी वाचन करतात.

४.६ ग्रंथालयात दररोज वाचन करणारे ज्येष्ठ नागरिकांची संख्या

- प्राप्त परिणामांवरून असे निदर्शनास येते की, संशोधन क्षेत्रातील (विदर्भातील) ;चढ०.०५द्ध बहुतांश सार्वजनिक ग्रंथालयात दररोज ५० पेक्षा कमी ज्येष्ठ नागरिक वाचन करतात.

४.७ ग्रंथालयात दररोज वाचन करणाऱ्या महिला सभासदांची संख्या

- प्राप्त परिणामांवरून असे निदर्शनास येते की, संशोधन क्षेत्रातील (विदर्भातील) ;चढ०.०५द्ध बहुतांश सार्वजनिक ग्रंथालयात दररोज १०० पेक्षा कमी महिला सभासद वाचन करतात.

४.८ ग्रंथालय महोत्सवासाठी अनुदान प्राप्ती

- प्राप्त परिणामांवरून असे निदर्शनास येते की, संशोधन क्षेत्रातील (विदर्भातील) ;चढ०.०५द्ध बहुतांश सार्वजनिक ग्रंथालयांना ५० वर्ष सुवर्ण महोत्सवाकरीता १५०००० लाख रूपये अनुदान प्राप्त झाले आहे.

४.९ योजनेद्वारे मिळालेल्या ग्रंथांना वाचकांचे प्राधान्य

- प्राप्त परिणामांवरून असे निदर्शनास येते की, संशोधन क्षेत्रातील (विदर्भातील) सार्वजनिक ग्रंथालयातील ;चढ०.०५द्ध बहुतांश वाचकांद्वारे दररोज कथा/कादंबरीला अधिक प्राधान्य दिले जाते.

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Collection Development of Libraries in Digital Era

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ABSTRACT:
Change is the nature of law, therefore requirements and environment of library staff, working condition, and user's demand are also changing. The impact of the internet and digital products on libraries has been widely discussed. Amazing growth of e-resources changed library operation dynamically. In today's period life is so fast and everybody wants to go fast. This paper contains the library collection and e-resource development in digital library and how they provide the services to the user's the paper further it discusses the e-resource types and its use for user and it also describes the advantages of digital facilities.

INTRODUCTION:-

We all know how the information explosion and the information revolution have occurred in the last three decades. But the advents of information and communication Technologies, the internet and particularly the World Wide Web have revolutionized literally everything under the sun. (shrivastava)

Electronic Resources is one of the emerging environments in libraries Information communication in the competitive service. E-Resources usually consist of e - books, e - journals,articles,newspaper,thesis,dissertation, databases and CD - ROM, which are likely to be the alternative to the print media. Emerald,Ensco,Scopus are some of the examples of online databases. All updated information is published in this e - sources. The familiarity and use of electronic information resources in the libraries for rapid of development is necessary and important. (Dhanavandan, 2012)

Library collection development is the process of meeting the information needs of the people (a service population) in a timely and economical manner using information resources locally held, as well as from other organizations.

Collections are developed by librarians and library staff by buying or otherwise acquiring materials over a period, based on assessment of the information needs of the library's users. In addition to ongoing materials acquisition, library collection development includes:(Evans , 2007)

- the creation of policies to guide material selection
- replacement of worn lost materials
- removal (weeding) of materials no longer needed in the collection
- planning for new collections or collection area
- cooperative decision - making with other libraries or within library consortia

MEANING AND DEFINATION OF DIGITAL LIBRARY

The term digital library has been applied to a wide variety of offerings from collections of electronic journals to software agents that support inquiry based education to collections of email to electronic versions of a public library , to personal information collections , and even to the entire internet .

Definition

"An informal definition of a digital is a managed collection of information, with associated services where the information is stored in digital formats and accessible over a network. A crucial part of this definition is that the information is managed. A stream of data sent to earth from a satellite is not a library. The same data, when organized systematically,

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becomes a digital library collection. Most people would not consider a database containing financial records of one company to be a digital library, but would accept a collection of such information from many companies as part of library. Digital libraries contain diverse information for use by many different users. Digital libraries range in size from tiny to huge. They can use any type of computing equipment and any suitable software. The unifying theme is that information is organized on computers and available over a network, with procedures to select the material in the collections, to organize it, to make it available to users, and to archive it." (Arms)

E-resources

An electronic resource is defined as a resource which requires computer access or any electronic product that delivers a collection of data , be it referring to full text bases , electronic journals, image collections other multimedia products and numerical , graphical of time based as a commercially available that

• **Multi – access**: Networked products can provide multiple points of access of multiple point in time (24 hours a day 7 days a week) and to multiple simultaneous users

• **Speed:** An electronic resource is it quicker to browse or search, to extract information from, and to integrate that information into other material and to CROSS - search or reference between different publications

• **Functionality:** E - resource will allow the user to approach the publication to analyze its contain new ways by click of the mouse on search mode.

• **Content:** The c resources can contain amount of information, but more importantly the material can consist of mixed media i.e. Images video, audio animation which could not be replaced in print

Apart from the above some other advantages of sources may include international reach, unlimited capabilities, reduced cost , convenience search and linking . (Bajpai , Mal . A Bajpal.2009)

Types of Electronic Resources

Below are some brief descriptions of the types of electronic resources which are available through the University of Chicago Library.

- **Research Guides by Subject**
- **Indexes :**
- **Electronic Books and Texts :**
- **Electronics Journals :**
- **Library catalogs :**
- **Reference Sources :**
- **Statistical Sources**
- **Sounds Recordings :**
- **Image databases (Art , Maps , Medical etc) :**

CONSORTIA SUBSCRIPTION TO E RESOURCE

It is known that libraries and information carton not able to procure organize and disseminate vast amount of information due to lack of adequate fund and budget. Nowadays, consortia subscription to resources through consortia of libraries is a viable solution to increase the access to a lower cost. Library consortia refer to cooperation.co-ordination and collaboration among the libraries institution for the purpose of resource sharing The libraries all over the word are forming cost of all types and all levels with an objective to take advantage of global network to promote better faster and most cost effective ways of providing resources to the information seekers. The collective strength of consortia members facilitates to get the benefit of wider access to electronic resources Affordable constant at the best terms and conditions (Devi&Devi)

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ADVANTAGES

The advantages digital libraries as a means of easily and rapidly accessing books, archives and images of various types are now widely recognized by commercial interests and public bodies alike

• **No physical boundary.** The use of a digital library needs not to go to the library physically; people from all over the world can gain access to the same information, as long as internet connection is available.

• **Round the clock availability.** A major advantage of digital libraries is that people can gain access 24/7 to the information

• **Multiple accesses.** The same resources can be used simultaneously by number of institutions and patrons This may not be the case for copyrighted material library may have a license for " lending out only one copy at a time this is achieved with a system of digital rights management where a resource can become inaccessible after expiration of the lending period or after the lender chooses to make it inaccessible (equivalent to returning the resource)

• **Information retrieval.** The user is able to use any search term (word,phrase , title , name and subject) to search the entire collection Digital libraries can provide very user - friendly interfaces , giving clickable access to its resources.

• **Preservation and conservation** , Digitization is not long - term preservation solution for physical collections , but does succeed in providing access copies for materials that would otherwise fall to degradation from repeated use Digitized collections and born - digital object pose many preservation and conservation concerns that analog materials do not Please see the following problems " section of this page for examples

• **Space.** Whereas traditional libraries are limited by storage space, digital libraries have the potential to store much more information; simply because digital information requires very little physical space contain them and media storage technologies are more affordable than ever before.

• **Added value.** Certain characteristics of objects, primarily the quality of image may be improved. Digitization can enhance legibility and remove visible flaws such as stains and discoloration. (Wikipedia)

DISADVANTAGES

The computer viruses, lack of standardization for digitized information quick degrading properties of digital material different display standard of digital product and its associated problem, health hazard nature of the radiation from monitor etc. Makes digital libraries at times handicap. (LISWiki.2011)

• **Copyright:** Digitization violates the copyright law as the thought content one author can be freely transfer by other without his acknowledgement. So one difficulty to overcome for digital libraries is the way to distribute information.How does a digital library distribute information at will while protecting the copyright of the author?

Speed of access: As more and more computer are connected to the internet its speed of access reasonably decreasing. If new technology will not evolve to solve the problem then in near future internet will be full of error messages.

Initial cost is high: The infrastructure cost of digital library i.e. the cost of hardware,software: leasing communication circuit is generally very high .

• **Band width :** Digital library will need high band for transfer of multimedia resources but the band width is decreasing day by day due to its over utilization .

• **Efficiency:** With the much larger volume of digital information, finding the right material for a specific task becomes increasingly difficult.

• **Environment:** Digital libraries cannot reproduce the environment of a traditional library. Many people also find reading printed material to be easier than reading material on a computer screen.

• **Preservation:** Due to technological development, a digital library can rapidly become out - of - date and its data may become inaccessible.

CONCLUSION

In modern times the internal and particularly the world we have revolutionized literally everything under the sun and in this modern world the information gets so easily through the internet. The user can access the information through internet Digital library plays an important role in information world. E resources can help to store the information and serve the service to the users E - resource provides various services to the users. E - Resource provides various service to the users through which the library collection and its development is improved.

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Impact of Social Media on Society

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Introduction

Social media is a powerful revolution that has changed our lives day to day basis. The first social media platform in the world went live in 1997. Six Degrees is the very first social networking site founded by Andrew Weinreich in May 1996. The telecommunications company Videsh Sanchar Nigam Limited (VSNL) unveiled the first public internet service in India, in the cities of Mumbai, Delhi, Kolkata and Chennai on August, 15, 1995. It enabled users to upload a profile and make friends with other users. In 1999, the first blogging sites became popular for user-generated content, creating a social media sensation that's still popular today. Bharatam is India's first own Social Networking platform. It is a platform of the Indians, by the Indians, and for the Indians. Facebook and YouTube are the most popular social media networks in India.

Impact on Society

At present social media is an integral part of every citizen of India. The social media platforms are very popular in India because of their easy access, ease to handle, less time-consuming, cheap, and user friendly. Any technology has both sides, it depends on how the user is associated with the technology. Social media helps individuals to connect and deepen their relationships with the world of interest.Social media also encourages students to learn and grow in the area of their choice. Social media can empower businesses to build their audiences and boost their bottom-line consumers. Social media can make it easy to find groups of like-minded people or make new friends. It helps to find out a close-knit community that can help us to feel valued and accepted. Social media is also an easy way to nurture existing relationships with family and friends who have moved away. Send messages, share photos, call, or host video chats to stay in touch.Social media is such a platform through which you can reach out to new connections and start developing relationships with them as well. Whether they live nearby or on the other side of the world, you can easily communicate and share content. This level of connectedness is a unique advantage of social media.

Under the umbrella of social media people of all ages can use social media to develop a platform with a larger audience than they'd have in any other setting. This can help individuals build confidence, gain new communication skills, and quickly spread positive and important messages. Take **TikTok**, for instance. Teens and young adults have successfully grown enormous platforms where their messages reach thousands or even millions of people regularly. Social media platforms **provided Indians with a platform to raise their voice against injustice and inequality**.

There is great impact of social media on politics. It is due to the social media some political news out before the television broadcast. It is the media that gives easiest access to the common man.These online platforms also allow people to air out their political grievances to their political leaders and demand for actions to be taken. It's also a medium where mass political rallies are formed, campaigns are carried out and even political unrest are most felt.

Social media has impacted job recruitments significantly. The majority of companies make their hiring decisions based on one's social portfolio. Recruiters also use online networks to post job vacancies through which they get their ideal candidates. It has also made it easy for job seekers to get access to job posts. This is evident on platforms like LinkedIn, where job seekers can create their profile containing their skills and see what job opportunities recruiters are posting.

You can use social media to raise awareness about a cause you believe in or support others who already do. You can also offer and receivesupport for the work you're doing – whether it's starting a new business, sharing photography, or writing poetry. Find others in your niche to connect with and share what you've learned.

Social media is known for bringing up new topics. While many conversations (or arguments) may seem too controversial and divisive, they can bring up important themes to discuss with people you care about and trust. You can also join groups for specific hobbies or industries to engage in discussions, learn, and grow. News from just about any part of the world can spread like wildfire on social media. While this can be overwhelming at times, it can also keep us in tune with important events. This can be an outstanding benefit if you need to get the word out fast about something. For example, if someone from a small town lost their dog, they could get the message out on social media. Everyone in the area could keep an eye out and report back with information instantly.

As a new business that wants to get the word out about your impressive offerings, you can use social media to build an interested audience. Share valuable content and establish a brand voice that resonates with your target consumers. Social media is also an excellent place for more established businesses to grow and sell through marketing and advertising. By sharing expert content and building relationships with individuals and other brands on social media, you'll start building trust and authority. More and more people will spread the word about your great business and content.

Social media is a great place for students to find mentors and training programs to learn new skills and take steps toward future career goals. It's also a great place for businesses to advertise their services, software, and programs. On YouTube, you can find amazing tutorials to hone your skills for free. The sky's the limit when it comes to online learning opportunities today. There's no end to the number of successful businesses, entrepreneurs, and influencers on social media. This can be inspiring for everyone, but especially students and young professionals with big dreams and goals. Many speakers will openly share their knowledge to help others grow. Following people that inspire you to hold to your values, dream big, and change the world can be life-changing.

Negative Impact of Social Media

- Sharing personal information, one's privacy is at risk of impersonations, theft and stalking
- Posting **anything** abusive or embarrassing could make you lose that job opportunities, because 'the internet never forgets'.
- Online social platforms are *addictive* and this has drastically reduced productivity at workplaces.
- Cyberbullying is another worrying impact of social media.
- As the information travels faster online, a piece of false information could quickly reach a big number of people and cause great panic among the recipients.

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NEP 2020 and Digital Education

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Education is one of the key factors in the national development of a country. A National Education Policy (NEP) is a comprehensive framework to guide the development of education in the country. The New Education Policy-2020 emphasizes the pace of technology and its impact on education and the changes that are visible in the present day context. The rapidity of digitalization and its impact in education is attributed to the development of technology in all the domains of education. The policy continues by stating that technology integration and utilisation to enhance a variety of educational goals shall be encouraged and accepted, provided that these interventions be thoroughly and openly assessed in pertinent settings prior to being expanded.

Major Highlights in NEP – 2020 :

- GDP investment on education is planned to be raised at least up to 6 %.
- This policy proposes 5+3+3+4 pattern to fellow wherein the formal education of child starts at the age of three.
- Human Resource Development Ministry is renamed as Ministry of Education.
- The mother tongue or local/regional language will be medium of instruction in all schools up to class 5 (preferably till class 8 and beyond)
- Vocational integration is planned to initiate from class 6 onwards. Every child will come out of school adept in at least one skill.
- The new NEP focuses on overhauling the curriculum and making board exam easier. Sanskrit language will be offered at all levels and foreign languages will be offered from the secondary level school.
- A common guiding set of National Professional straights for Teachers (NPST) will be developed by 2022, by National Council of Teachers Education (NCTE).
- This policy ends science-commerce-arts streams. It has eliminated the rigid separation of streams.
- The National Educational Technology Forum (NETF) will be created to provide a platform for free exchange of ideas on the use of technology to enhance learning, assessment, planning, administration etc.
- Holistic undergraduate programmes to be provided multidisciplinary approach will be adopted.
- NEP prepares to introduce a 4 year multidisciplinary UG programme with multiple entry and exit options. Students can exit after one year with a Certificate, after two year with a diploma, after three years with a bachelor’s degree making them eligible for masters. And after four years the students will be eligible for a research (M.Phil. to be discontinued).
- Many regulators in education like UGC, NGE, AICTE etc. will be combined into a single regulatory body. Higher Education Commission of India to be a sole body to administer Higher Education in India. (excluding Legal and Medical).
- Foreign Universities in India : NEP has paved the way for foreign universities to set up campuses in India.

- Common entrance exam for University / College admission: The National Testing Agency will conduct entrance examination for admissions to universities across the country.

National Education Policy (2020): Digital Education Perspectives:

A plan for reforming the use of technology an its integration, online and digital education Indian educational system has been outlined in part III, chapters 23 and 24 of National Education Policy (NEP)- 2020, with an emphasis on technological integration, experiential learning, and holistic development. The NEP 2020 acknowledges the value of digital education and highlights the necessity of incorporating it within the academic programme.The National Education Policy-2020 endorses the emergence of the National Educational Technology Forum (NETF), an independent organisation that serves as a forum for the open sharing of ideas on how to use technology to improve teaching, learning, evaluation, planning, administration, and other areas in both higher education and the classroom. The NETF will act bridge the divide between the educational institutions, governmental organizations and the stakeholders; thus providing the basis for recent knowledge, innovations in the field of education, research and development, NETF will create avenues for consultation and extension by sharing knowledge on the vital components of digital developments, the best practices in technology based education. The NETF will carry out the following duties: provides impartial, fact- based guidance on interventions based on technology to State and National government bodies; to develop institutional and intellectual capabilities in the field of education technology; to provide guidelines for pedagogy, technology, and content for digital and online teaching and learning. States, Boards, Schools, Higher educational institutions, and others will be able to create e-learning guidelines with the use of these standards. To determine which technological interventions can be used to improve the teaching-learning and evaluation process, aid in the professional development of teachers, increase educational access, and optimize planning, leadership, and administration of education, including the admissions, attendance, and assessment

Digitalized Education System: The Way Forward

NEP-2020 aimed at conducting online degree certificate and skill development programmes offered in by UTA, NITA, CTET etc. National Educational Technology Forum (NETF) a functioning authority to enhance e-educations division works to boost the digital content development, its infrastructure and capacity building. Now the pilot study has been a success and full-fledged Certificate Diploma and Degree courses are offered by National Institutes. Based on NEP (2020) vision of developing digital infrastructure, rapid development had taken place and the systematic implementation across schooling from middle school to higher education AI, Machine learning and learning modes in the manner with collaborative learning, blended learning, use of Al tools for learning have been successfully incorporated and had become common practices in learning which is a major achievement on the part of digital initiatives. Further role of assistive tools and Learning Management Systems (LMS) have been adopted by the teachers and learners which had resulted in sweeping changes in the day-to-day educational activities.Digital Assessment practices through online modes has witnessed a revolution in the assessment process that is already in vogue that can be seen across the national examinations conducted through online across the nation. Digital initiatives have far- fetched the results in achieving the digital revolution in a short-span of time. National progress is visible and evident with the digital transcendence, creation and adoption of newer digital tools for education; in the present day context the progress is prompt and instant with the initiatives of the central and state governments.

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Conclusion:

The NEP-2020 possess huge potential for transforming the country's fortune in the near future. The 21st Century skills like creative thinking, problem solving research and creativity can be fostered and enhanced by integration of multidisciplinary in education. The digital tools are being widely used by students across all levels of education. Digital tools and applications, mobile learning platforms have opened up global accessibility for students ensuring access to educational resources. optimization of ICT resources through training across education sector by National Institutes have resulted in holistic adaptation of digital resources both by the teacher and the taught; further digital initiatives have opened by possibilities of involvement of India. Thus by taking forward the roadmap provided by NEP-2020 the higher educational institutions would make a lasting contribution to the development of a sustainable and dynamic knowledge society.

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