Linear Stability Analysis of Triple Diffusive Convection in a Saturated Anisotropic Porous Layer

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Abstract : The impacts of mechanical anisotropic parameter and anisotropic thermal parameter on triple-diffusive convection in a Maxwell liquid soaked anisotropic permeable layer is contemplated diagnostically utilizing linear stability investigation and normal mode procedure. The liquid layer is viewed as heated and soluted from underneath. The impact of anisotropy parameters, Vadasz number, solute Rayleigh numbers and porosity on the stability of the framework is explored systematically and results are portrayed graphically. The adequate conditions for the non-presence of over-stability are likewise determined.

***IndexTerms* – Linear Stability, Triple Diffusive, Porus Layer, Anisotropic**

I. INTRODUCTION

The beginning of convection in a non-Newtonian liquid layer in a permeable media has gotten the extraordinary significance amid the most recent couple of decades because of the expansive requests of such differing fields as bio-rheology, geophysics, and oil ventures. The issue on the heat convection in a viscoelastic liquid was talked by numerous researchers [1-2]. In two-fold diffusive convection, liquid contains two parts with various atomic diffusivities. The vital part of two-fold diffusive convection is that notwithstanding settling generally thickness angle can destabilize the framework when the thickness slopes brought about by individual segments are contradicted. It is seen that when the two individual diffusing segments are restricted, salt fingers happen when the segment with the littler diffusivity is destabilizing, while oscillatory convection happens when the quicker diffusing part is destabilizing [3]. A few authors [4-5] looked into broadly the two-fold diffusive convection with and without permeable media. It is important to call attention to that the principal viscoelastic rate type show, which is as yet utilized generally, is because of Maxwell. The solidness examination of two-fold diffusive convection in a Maxwell liquid immersed permeable medium is considered by Wang and Tan [6]. There are few investigations accessible on the beginning convection in an immersed isotropic permeable layer. As of late, Yoon et al. [7] have examined the issue of the beginning of oscillatory convection in a level permeable layer soaked with viscoelastic fluid. The stability investigation of two-fold diffusive convection of Maxwell liquid in a permeable medium is examined by Wang and Tan [8] while the beginning of convection in a parallel viscoelastic liquid soaked permeable layer has been considered by Malashetty et al. [9]. Consequently, a couple of more examinations are accessible on the convection stream in permeable medium [10-14].

In the above distributed work, permeable medium is considered as isotropic and homogeneous however in numerous physical circumstances, thermal and mechanical properties exists in permeable lattice. Anisotropy is commonly a result of particular introduction of deviated geometry of permeable network or strands and is showed up in a few frameworks in industry and in nature. Likewise, in certain circumstances, such as pelletting utilized in substance building procedure and fiber material utilized in protecting reason, counterfeit permeable framework anisotropy can be made. Castinel and Combarnous [15] have given the main investigation in a soaked anisotropic permeable layer. As of late, the impact of anisotropy on the beginning of convection in a permeable layer is considered by numerous researchers [16-19]. As opposed to two-fold diffusive convection, there are numerous circumstances where multiple parts are included like the hardening of liquid combinations, geothermally warmed lakes, magmas and their research center models and ocean water. In this way, triple-diffusive convection is increasingly practical when contrasted with two-fold diffusive convection. As of late, Shivakumara and Kumar [3] have examined the weakly nonlinear triple diffusive convection in a couple stress liquid layer while Zhao et al. [20] examined the linearly the triply diffusive convection in a Maxwell liquid soaked permeable layer.

Remembering the uses of anisotropic permeable material and triple-diffusive convection, an endeavor has been made to think about the linear stability examination of the triple-diffusive convection in a viscoelastic liquid soaked anisotropic permeable layer. To the best of my insight, this issue is uninvestigated up until now. In this paper, my point is to consider the impact of anisotropy parameters and different parameters on the stability criteria for triple diffusive convection.

II. MATHEMATICAL STATEMENT OF THE PROBLEM

Here, we consider a horizontal infinite anisotropic permeable layer of an incompressible Maxwell liquid, kept between two parallel planes arranged at $z=0$ and $z=d$ with the vertical descending gravity field $\mathbf{g}$ following up on it. A Cartesian edge of reference is picked with the end goal that the starting point lays on the lower plane and the z-hub as vertically upward. Likewise, we expect that the liquid layer is moving through anisotropic permeable material. Every limit divider is thought to be flawlessly thermally directing. The temperature and solute focuses at the base and top surfaces $z=0$, $z=d$ are $T_0+\Delta T$ and T_0; $C_0^{(1)}+\Delta C^{(1)}$, $C_0^{(1)}$ and $C_0^{(2)}+\Delta C^{(2)}$, $C_0^{(2)}$, individually. All through the investigation, we think about that temperature contrast and concentration contrasts and are kept up among the lower and upper limits. The Oberbeck-Bousssinesq approximation is expected to represent the impact of density variations. At the point when liquid courses through a permeable medium, the gross impact is spoken to by Darcy's law, the conditions of continuity and movement for a Maxwell liquid take the structure as;

$$\nabla\cdot\mathbf{q}=0, \quad (1)$$

$$\frac{\rho_0}{\varepsilon}\left(1+\bar{\lambda}\frac{\partial}{\partial t}\right)\frac{\partial\mathbf{q}}{\partial t}=\left(1+\bar{\lambda}\frac{\partial}{\partial t}\right)\left(-\nabla p+\rho\mathbf{g}\right)-\nu\,\mathbf{K}.\mathbf{q}, \quad (2)$$

$$(\rho c)_m\frac{\partial T}{\partial t}+(\rho c)_f\left(\mathbf{q}\cdot\nabla\right)T=(\rho c)_m\nabla\cdot\left(\mathbf{k_T}\cdot\nabla T\right), \quad (3)$$

$$\varepsilon\frac{\partial C^{(1)}}{\partial t}+(\mathbf{q}\cdot\nabla)C^{(1)}=\varepsilon k_{C_1}\nabla^2C^{(1)}, \quad (4)$$

$$\varepsilon\frac{\partial C^{(2)}}{\partial t}+(\mathbf{q}\cdot\nabla)C^{(2)}=\varepsilon k_{C_2}\nabla^2C^{(1)}. \quad (5)$$

Here, $\mathbf{q},\varepsilon,p,\bar{\lambda},\nu,\mathbf{K}=K_x^{-1}(\mathbf{ii}+\mathbf{jj})+K_z^{-1}(\mathbf{kk})$ and $\mathbf{k_T}=k_{Tx}(\mathbf{ii}+\mathbf{jj})+k_{Tz}(\mathbf{kk})$ denote the Darcian (filter) velocity, medium porosity, pressure, relaxation time, kinematic viscosity, inverse permeability tensor and heat diffusivity tensor, respectively. Also, we ignore the solute anisotropy since penetrability is most emphatically anisotropic than solute diffusivity and tragically; we have no experimental help for this since estimation of anisotropic diffusivity is deficient. Also, $t,\ \nu,\ k_T,\ k_{C_1},\ k_{C_2},(\rho c)_f$ and $(\rho c)_m=(1-\varepsilon)(\rho c)_s+\varepsilon(\rho c)_f$ are the time, kinematic consistency, viable thermal diffusivity and compelling solute diffusivities of the medium, volumetric warmth limit of the liquid, volumetric warmth limit of permeable network, separately. The thermal capacities with respect to liquid and strong network are spoken to by c_f and c_m, respectively. Following Boussinesq approximation, the equation of state for the Maxwell fluid layer is given by

$$\rho=\rho_0[1-\alpha_T(T-T_0)+\alpha_{C_1}(C-C_0^{(1)})+\alpha_{C_2}(C-C_0^{(2)})]. \quad (6)$$

The temperature and solute limit conditions are given as

$$T=T_0+\Delta T;\ C^{(1)}=C_0^{(1)}+\Delta C^{(1)};\ C^{(2)}=C_0^{(2)}+\Delta C^{(2)},\quad at\ z=0$$
$$T=T_0;\ \ C^{(1)}=C_0^{(1)};\ \ C^{(2)}=C_0^{(2)},\quad at\ z=d. \quad (7)$$

Here, $\rho,\rho_0,\alpha_T,\alpha_{C_1}$ and α_{C_2} indicate the liquid thickness, reference thickness, warm and dissolvable coefficients of development, separately.

III. Basic and perturbation state

We expected that the viscoelastic fluid has loosened up enough time; commonly 1s is sufficient for weaken polymeric suspensions. Hence the essential state is thought to be quiescentand is given by

$$\mathbf{q}=(0,0,0),\ T=T_b(z),\ p=p_b(z),\ C^{(1)}=C_b^{(1)}(z),\ C^{(2)}=C_b^{(2)}(z),\ \rho=\rho_b(z), \quad (8)$$

which satisfy the following conditions

$$\frac{dp_b}{dz}=-\rho_b g,\ \varepsilon k_{C_1}\frac{d^2C_b^{(1)}}{dz^2}=0,\ \varepsilon k_{C_2}\frac{d^2C_b^{(2)}}{dz^2}=0,\ k_{Tz}\frac{d^2T_b}{dz^2}=0. \quad (9)$$

Then the steady state solution is given by

$$T_b=T_0+\Delta T(1-z/d),\ C_b^{(1)}=C_0^{(1)}+\Delta C^{(1)}(1-z/d),\ C_b^{(2)}=C_0^{(2)}+\Delta C^{(2)}(1-z/d). \quad (10)$$

To utilize linearized stability hypothesis and typical mode strategy, we accept little annoyances on the fundamental state arrangement. Give us a chance to expect $\mathbf{q}(u,v,w)=0+\mathbf{q}(u',v',w')$, $\rho=\rho_b+\rho'$, $p=p_b+p'$, $T=T_b+T'$, $C^{(1)}=C_b^{(1)}+C^{(1)}{'}$ and $C^{(2)}=C_b^{(2)}+C^{(2)}{'}$ mean the irritations in the liquid speed, thickness, pressure and temperature and concentration, separately. The linearized perturbations equations can be composed as

$$\nabla\cdot\mathbf{q}'=0, \qquad (11)$$

$$\frac{\rho_0}{\varepsilon}\left(1+\bar{\lambda}\frac{\partial}{\partial t}\right)\frac{\partial\mathbf{q}'}{\partial t}=\left(1+\bar{\lambda}\frac{\partial}{\partial t}\right)\left[-\nabla p'-g\rho_0\left(\alpha_T T'-\alpha_{C_1}C^{(1)}{}'-\alpha_{C_2}C^{(2)}{}'\right)\right]-\nu\mathbf{K}.\mathbf{q}', \qquad (12)$$

$$(\rho c)_m\frac{\partial T'}{\partial t}+(\rho c)_f\,w'\frac{dT_b}{dt}=(\rho c)_m\,\nabla\cdot(\mathbf{k_T}\cdot\nabla T'), \qquad (13)$$

$$\varepsilon\frac{\partial C^{(1)}{}'}{\partial t}+w'\frac{dC_b^{(1)}}{dz}=\varepsilon k_{C_1}\nabla^2C^{(1)}{}', \qquad (14)$$

$$\varepsilon\frac{\partial C^{(2)}{}'}{\partial t}+w'\frac{dC_b^{(2)}}{dz}=\varepsilon k_{C_2}\nabla^2C^{(2)}{}'. \qquad (15)$$

Here primes show the perturbed amounts. Taking out pressure term from the force condition and presenting the accompanying non-dimensional amounts:

$$(x,y,z)=(x^*,y^*,z^*)d,\ t=\frac{d^2}{k_{Tz}}t^*,\ q'=\frac{\varepsilon k_{Tz}}{d}q'^*,\ T'=(\Delta T)T'^*,\ C^{(1)'}=\left(\Delta C^{(1)}\right)C^{(1)'}*,$$
$$C^{(2)'}=\left(\Delta C^{(2)}\right)C^{(2)'}*. \qquad (16)$$

Utilizing the above non-dimensional factors in the conditions (12) to (15) and taking out reference marks, we get the accompanying conditions

$$\left(1+\lambda\frac{\partial}{\partial t}\right)\left[\frac{1}{Va}\frac{\partial}{\partial t}(\nabla^2w')-Ra\nabla_1^2\left(T'-N_1C^{(1)'}-N_2C^{(2)'}\right)\right]+\nabla_1^2w'+\frac{1}{\xi}\frac{\partial^2w'}{\partial z^2}=0, \qquad (17)$$

$$\left(\frac{\partial}{\partial t}-\eta\nabla_1^2-\frac{\partial^2}{\partial z^2}\right)T'-\phi w'=0, \qquad (18)$$

$$\frac{\partial C^{(1)'}}{\partial t}-w'=\tau_1\nabla^2C^{(1)'}, \qquad (19)$$

$$\frac{\partial C^{(2)'}}{\partial t}-w'=\tau_2\nabla^2C^{(2)'}. \qquad (20)$$

Here, $\lambda=\bar{\lambda}k_{Tz}/d^2$ signifies the relaxation number (otherwise called Deborah number), $Da=k_z/d^2$ is the Darcy number, $\Pr=\nu/k_{Tz}$ speaks to the Prandtl number, $\phi=\varepsilon(\rho c)_f/(\rho c)_m$ is the standardized porosity, $Va=\varepsilon\Pr/Da$ speaks to the Vadasz number, $Ra=g\alpha_T\Delta Tdk_z/\varepsilon\nu k_{Tz}$ is the warm Rayleigh number, $N_1=\alpha_{C_1}\Delta C^{(1)}/\alpha_T\Delta T$ indicates the proportion of buoyancy, $N_2=\alpha_{C_2}\Delta C^{(2)}/\alpha_T\Delta T$ means the proportion of analogous buoyancy, $\tau_1=k_{C_1}/k_T$, $\tau_2=k_{C_2}/k_T$ signify the diffusivity proportions, $\xi=K_x/K_z$ speaks to the mechanical anisotropy parameter, $\eta=k_{Tx}/k_{Tz}$ means the warm anisotropy parameter. It is expected that the limit of the framework is isothermal and isosolutal. Subsequently, the limit conditions for irritation variable are given by

$$T'=C^{(1)'}=w'=C^{(2)'}=0\quad\text{at}\quad z=0,1 \qquad (21)$$

IV. PROCEDURE OF NORMAL MODE TECHNIQUE

Here, we talk about the direct solidness investigation. As per the normal mode examination, convective movement is accepted to show even periodicity. At that point the perturbed amounts can be thought to be periodic waves of the structure:

$$[T',C^{(1)'},w',C^{(2)'}]=[\Theta(z),\Gamma(z),W(z),\Psi(z)]\exp[ia_xx+ia_yy+nt] \qquad (22)$$

where a_x and a_y are the wave numbers in x and y headings, individually, $a^2=a_x^2+a_y^2$ is the resultant wave number of proliferation and n is the development rate. Small perturbations of the rest state may either soggy or develop contingent upon the estimation of the parameter n. Substituting condition (22) in conditions (17) to (21), we acquire

$$(1+\lambda n)\left[\frac{n}{Va}(D^2-a^2)W+a^2Ra\left(\mathrm{Q}-N_1\mathrm{G}-N_2\mathrm{Y}\right)\right]+\left(\frac{1}{\xi}D^2-a^2\right)W=0, \quad (23)$$

$$\left(n-\left(D^2-\eta a^2\right)\right)\mathrm{Q}-\phi W=0, \quad (24)$$

$$\left(n-\tau_1(D^2-a^2)\right)\mathrm{G}-W=0, \quad (25)$$

$$\left(n-\tau_2(D^2-a^2)\right)\mathrm{Y}-W=0. \quad (26)$$

Presently the limit conditions moves toward becoming

$$\Theta=\Gamma=W=\Psi=0 \text{ at } z=0,1 \quad (27)$$

To fulfill the limit condition (27), we expect the arrangement of conditions (23) to (26) in the structure

$$[\Theta(z),\Gamma(z),W(z),\Psi(z)]=[\Theta_0,\Gamma_0,W_0,\Psi_0]\sin m\pi z \ \ (m=1,2,3....) \quad (28)$$

It has been seen that the key mode i.e. $m=1$ is the most unsteady mode. In this way, we take $m=1$ in equation (28). Substituting the above expression into equation (23) to (26), we get

$$(1+\lambda n)\left[\frac{n}{Va}\left(\pi^2+a^2\right)W_0-a^2Ra\left(\mathrm{Q}_0-N_1\mathrm{G}_0-N_2\mathrm{Y}_0\right)\right]+\left(\frac{\pi^2}{\xi}+a^2\right)W_0=0, \quad (29)$$

$$\left(n+\left(\pi^2+\eta a^2\right)\right)\mathrm{Q}_0-\phi W_0=0, \quad (30)$$

$$\left(n+\tau_1\left(\pi^2+a^2\right)\right)\mathrm{G}_0-W_0=0, \quad (31)$$

$$\left(n+\tau_2\left(\pi^2+a^2\right)\right)\mathrm{Y}_0-W_0=0. \quad (32)$$

Above conditions can be composed as in matrix structure as

$$\begin{pmatrix} \dfrac{n\delta^2}{Va}+\dfrac{\delta_1^2}{(1+\lambda n)} & -a^2\,Ra & N_1a^2\,Ra & N_2a^2\,Ra \\ -\phi & n+\delta_2^2 & 0 & 0 \\ -1 & 0 & n+\tau_1\delta^2 & 0 \\ -1 & 0 & 0 & n+\tau_2\delta^2 \end{pmatrix}\begin{pmatrix} W_0 \\ \mathrm{Q}_0 \\ \mathrm{G}_0 \\ \mathrm{Y}_0 \end{pmatrix}=0. \quad (33)$$

Here, $\delta^2=\left(\pi^2+a^2\right),\ \delta_1^2=\left(\dfrac{\pi^2}{\xi}+a^2\right)$ and $\delta_2^2=\left(\pi^2+\eta a^2\right)$. For the non-insignificant solution of the above arrangement of homogeneous conditions, we get

Here $Ras_1=RaN_1/\tau_1,\ Ras_2=RaN_2/\tau_2$ represents different solute Rayleigh numbers.

Since the growth rate n is a complex constant so we have $n=n_r+in_i$, if $n_r<0$ then system is stable and the system is unstable for $n_r>0$. For neutral stability $n_r=0$, we set $n=in_i$ in equation (34), we get

$$Ra_T=\Delta_1+in_i\Delta_2, \quad (35)$$

where

$$\Delta_1=\frac{1}{\phi}\left[\frac{1}{a^2}\left\{\frac{\left(\delta_1^2\delta_2^2+\lambda n_i^2\delta_1^2\right)Va-\left(1+\lambda^2n_i^2\right)n_i^2\delta_2^2}{Va\left(1+\lambda^2n_i^2\right)}\right\}+\frac{\left(\delta^2\tau_1^2\delta_2^2+n_i^2\tau_1\right)Ras_1}{\left(n_i^2+\delta^4\tau_1^2\right)}+\frac{\left(\delta^2\tau_2^2\delta_2^2+n_i^2\tau_2\right)Ras_2}{\left(n_i^2+\delta^4\tau_2^2\right)}\right], \quad (36)$$

$$\Delta_2=\frac{1}{\phi}\left[\frac{\delta_2^4}{a^2Va}+\frac{\left(\delta_1^2-\lambda\delta_1^2\delta_2^2\right)}{a^2\left(1+\lambda^2n_i^2\right)}+\frac{\left(-\tau_1\delta_2^2+\delta^2\tau_1^2\right)Ras_1}{\left(n_i^2+\delta^4\tau_1^2\right)}+\frac{\left(-\tau_2\delta_2^2+\delta^2\tau_2^2\right)Ras_2}{\left(n_i^2+\delta^4\tau_2^2\right)}\right], \quad (37)$$

Since Ra_T is a physical amount, it must be genuine (real). Consequently, from condition (35), it pursues that either $n_i = 0$ for which principle of exchange of stabilities is valid or $\Delta_2 = 0$ ($n_i \neq 0$, oscillatory onset, overstability).

V. Stationary Convection

For the legitimacy of principle of exchange of stabilities, we have $n = 0$. At that point the articulation for the stationary Rayleigh number progresses toward becoming

$$Ra_T^{st} = \frac{\left(\pi^2 + \eta a^2\right)}{a^2 \phi}\left[\left(\frac{\pi^2}{\xi} + a^2\right) + \frac{a^2 Ras_1}{\left(\pi^2 + a^2\right)} + \frac{a^2 Ras_2}{\left(\pi^2 + a^2\right)}\right]. \quad (38)$$

From above condition obviously viscoelastic parameter does not influence the stationary convection. Hence, the stationary Rayleigh number for the triply diffusive convection in a viscoelastic liquid is same as the one for the triple-diffusive convection in a thick Newtonian liquid. Consequently, to the extent the stationary convection is worried, there is no qualification between viscous liquid and viscoelastic liquid.

The wave number $a = a_c$, for which the basic estimation of the stationary Rayleigh number is given by (38), fulfills the condition

$$b_0\left(a_c^{\,2}\right)^4 + b_1\left(a_c^{\,2}\right)^3 + b_2\left(a_c^{\,2}\right)^2 + b_3 a_c^{\,2} + b_4 = 0. \quad (39)$$

Here, $b_0 = \xi\eta,\ b_1 = 2\pi^2\xi\eta,\ b_2 = \pi^2\xi(\eta - 1)\left(Ras_1 + Ras_2\right) + \pi^4\left(\xi\eta - 1\right),\ b_3 = -2\pi^6,\ b_4 = -\pi^8.$

VI. Oscillatory Convection

In case of oscillatory convection $\Delta_2 = 0$ ($n_i \neq 0$), we obtain

$$a_0\left(n_i^{\,2}\right)^3 + a_1\left(n_i^{\,2}\right)^2 + a_2 n_i^{\,2} + a_3 = 0. \quad (40)$$

Here, $a_0 = a^2\lambda^2\delta_2^4$,

$$a_1 = \left\{\begin{array}{l} a^2 Va\delta_1^2\left(1 - \lambda\delta_2^2\right) + \delta_2^2\left(a^2\delta^4\lambda^2\delta_2^2\left(\tau_1^2 + \tau_2^2\right) + a^2\delta_2^2\right) + a^4\lambda^2 Ras_1 Va\tau_1\left(\delta^2\tau_1 - \delta_2^2\right) \\ + a^4\lambda^2 Ras_2 Va\tau_2\left(\delta^2\tau_2 - \delta_2^2\right) \end{array}\right\},$$

$$a_2 = \left\{\begin{array}{l} a^4 Ras_1 Va\tau_1\left(\delta^2\tau_1 - \delta_2^2\right)\left(1 + \delta^4\lambda^2\tau_2^2\right) + a^4 Ras_2 Va\tau_2\left(\delta^2\tau_2 - \delta_2^2\right)\left(1 + \delta^4\lambda^2\tau_1^2\right) \\ + a^2\delta^4\delta_2^4\left(\tau_1^2 + \tau_2^2 + \delta^4\lambda^2\tau_1^2\tau_2^2\right) + a^2\delta^4\delta_1^2 Va\left(1 - \lambda\delta_2^2\right)\left(\tau_1^2 + \tau_2^2\right) \end{array}\right\},$$

$$a_3 = \left\{\begin{array}{l} a^2\delta^8\delta_1^2\tau_1^2\tau_2^2 Va\left(1 - \lambda\delta_2^2\right) + a^4\delta^4 Ras_2 Va\tau_1^2\tau_2\left(\delta^2\tau_2 - \delta_2^2\right) + a^4\delta^4 Ras_1 Va\tau_1\tau_2^2\left(\delta^2\tau_1 - \delta_2^2\right) \\ + a^2\delta^8\delta_2^4\tau_1^2\tau_2^2 \end{array}\right\}.$$

Now equation (35) with $\Delta_2 = 0$, gives

$$Ra_T^{osc} = \frac{1}{\phi}\left[\begin{array}{l} \frac{1}{a^2}\left\{\frac{\left(\delta_1^2\delta_2^2 + \lambda n_i^2\delta_1^2\right)Va - \left(1 + \lambda^2 n_i^2\right)n_i^2\delta_2^2}{Va\left(1 + \lambda^2 n_i^2\right)}\right\} + \frac{\left(\delta^2\tau_1^2\delta_2^2 + n_i^2\tau_1\right)Ras_1}{\left(n_i^2 + \delta^4\tau_1^2\right)} \\ + \frac{\left(\delta^2\tau_2^2\delta_2^2 + n_i^2\tau_2\right)Ras_2}{\left(n_i^2 + \delta^4\tau_2^2\right)} \end{array}\right], \quad (41)$$

We locate the oscillatory marginal solution from condition (41) where $n_i^{\,2}$ is given by condition (40). It continues as pursues: First decide the quantity of positive arrangements of condition (40). In the event that there is none, at that point no oscillatory insecurity is conceivable. On the off chance that there are three qualities, at that point the minimum of Ra_T^{osc} from condition (41) gives the oscillatory marginal Rayleigh number. From a closed observation of equation (40), we conclude that oscillatory instability is not possible if $1 > \lambda\delta_2^2,\ \delta^2\tau_1 > \delta_2^2,\ \delta^2\tau_2 > \delta_2^2$. Along these lines, the adequate conditions for the non-presence of overstability are $\lambda\delta_2^2 < 1,\ \delta^2\tau_1 > \delta_2^2,\ \delta^2\tau_2 > \delta_2^2$.

VII. Results and Discussions

In this segment, the numerical calculation has been completed. Utilizing the straight security hypothesis and typical mode method, we have determined the beginning criteria for stationary convection. The outflows of stationary Rayleigh number and oscillatory Rayleigh number are given by the conditions (38) and (41), separately. The negligible strength bends in plane for stationary convection are shown through different figures for fixed estimations of the different parameters for example solute Rayleigh number $Ras_1 = 100$, analogous solute Rayleigh number $Ras_2 = 350$, standardized porosity $\phi = 0.5$, mechanical anisotropy parameter $\xi = 0.5$, thermal anisotropy parameter $\eta = 0.5$. Figure-1 demonstrates the examination between negligible soundness bends of Rayleigh number for stationary convection in the event of two-fold diffusive convection and triple diffusive convection (present investigation). From the figure, obviously expansion of additional salt settles the framework. It appears that expansion of an additional salt builds the liquid layer focus which retains heat from the framework and framework gets balance out. The impact of mechanical anisotropic parameter on the minor strength bends for stationary convection is appeared by figure-2. We find that the basic Rayleigh number for the stationary modes diminishes with an expansion of ξ which demonstrates that impact of mechanical anisotropy parameter is to destabilizes the framework. Figure-3 demonstrates the impact of thermal anisotropy parameter η on the minor dependability bends for stationary convection. It is obvious from assume that an expansion in warm anisotropy parameter builds Rayleigh number for the stationary modes showing that warm anisotropy parameter has balancing out impact on the beginning of stationary convection. In the above talk, it is intriguing that the impact of the mechanical anisotropy parameter is inverse to that of the warm anisotropy parameter. The impact of standardized porosity parameter on the minimal strength bends for stationary convection is appeared in figure-4. Unmistakably as the standardized porosity parameter expands, the stationary Rayleigh number abatements which implies that standardized porosity parameter destabilizes the beginning of triple-diffusive convection. As porosity of the medium is proportion of void space to the all out space and in this manner, we can say that the more noteworthy void space well make the framework precarious.

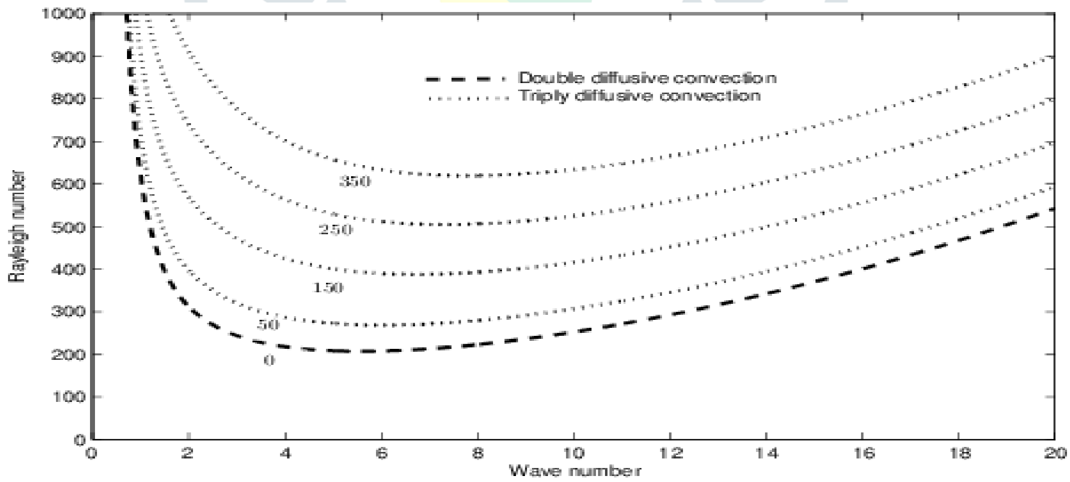

Fig. 1: Double diffusive and triple diffusive convection for $Ras_2 = 0, 50, 150, 250, 350$.

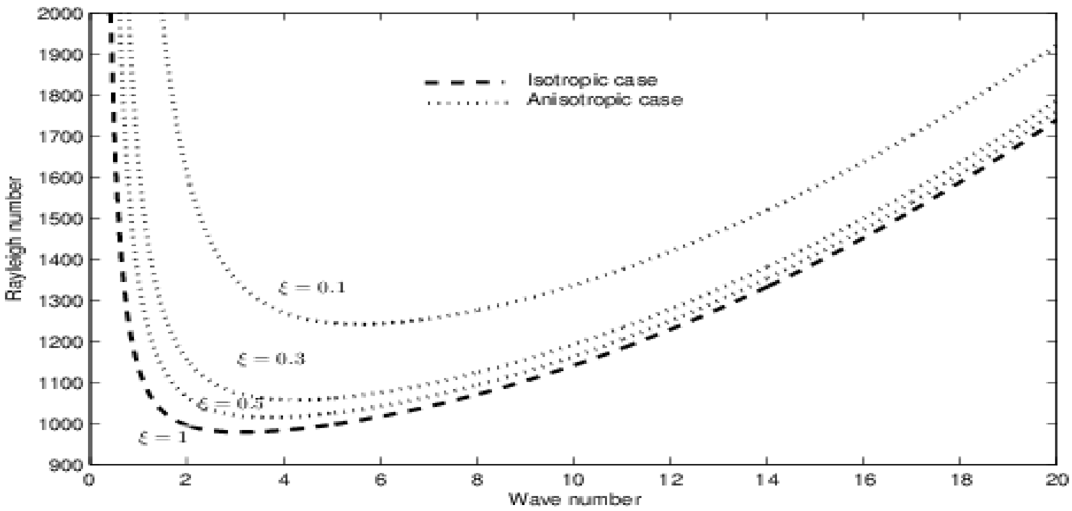

Fig. 2: Mechanical anisotropy parameter effect on stationary convection for $\xi = 0.1, 0.3, 0.5, 1$.

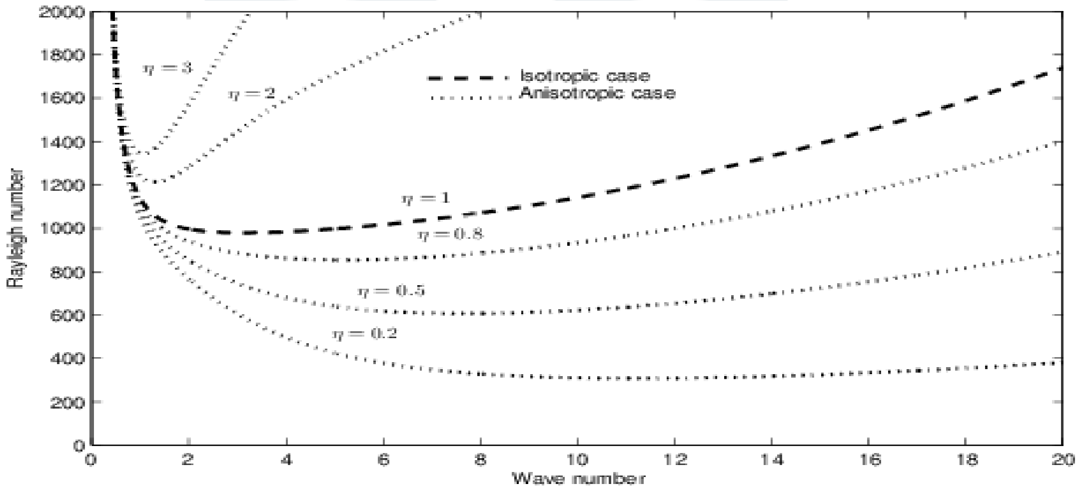

Fig. 3: Thermal anisotropy parameter effect on stationary convection for $\eta = 0.2, 0.5, 0.8, 1, 2, 3$.

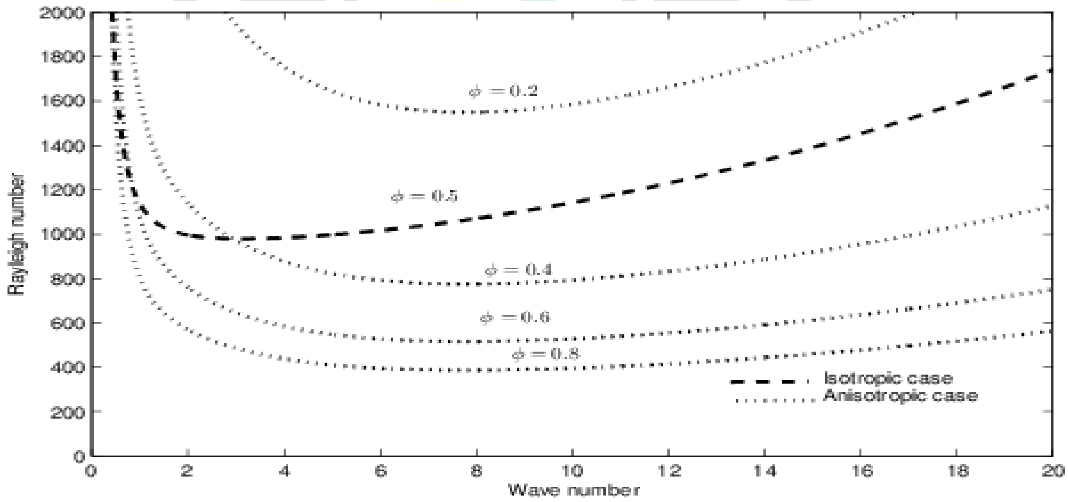

Fig. 4: Standardized porosity effect on stationary convection for $\phi = 0.2, 0.4, 0.6, 0.8$.

VIII. Conclusions

The beginning of triple diffusive convection in a Maxwell viscoelastic liquid soaked anisotropic and homogeneous permeable layer is examined utilizing linear stability examination and normal mode strategy. The dispersion relationship overseeing the impacts of different parameters is acquired. The primary ends are:

I. Vadasz number has no impact on stationary convection while solute Rayleigh numbers upgrade the dependability in stationary mode.
II. The mechanical anisotropy parameter destabilizes the framework for the instance of stationary convection.
III. The warm anisotropy parameter has balancing out impact on the beginning of stationary convection. In the above talk, it is fascinating that the impact of the mechanical anisotropy parameter is inverse to that of the warm anisotropy parameter.
IV. The standardized porosity parameter destabilizes the framework for the instance of stationary convection.
V. The oscillatory Rayleigh number is additionally acquired and given by the condition (41).
VI. The adequate conditions for the non-presence of overstability are $\lambda\delta_2^2 < 1,\ \delta^2\tau_1 > \delta_2^2,\ \delta^2\tau_2 > \delta_2^2$

REFERENCES

1. Takashima, M. (1970). The effect of magnetic field on thermal instability in layer of Maxwell fluid. *Physics Latter A 33*, 371-372.
2. Sokolov, M. & Tanner, R. I. (1972). Convective stability of a general viscoelastic fluid heated from below. *Phys. Fluids 15*, 534-539.
3. Shivakumara, I. S. & Kumar S. B. N. (2014). Linear and weakly nonlinear triple diffusive convection in a couple stress fluid layer. *Int. J. Heat Mass Transfer 68*, 542–553.
4. Sharma, R.C. & Rani, N. (1989). Double-diffusive convection with fine dust. *Czech. J. Phys. B 39*. 710-716.
5. Gaikwad, S. N., Malashetty, M. S. & Prasad, K. R. (2009). Linear and nonlinear double diffusive convection in a fluid saturated anisotropic porous layer with cross diffusion effects. *Transp. Porous Media 80*, 537.
6. Wang, S. and Tan, W. (2011). Stability analysis of soret-driven double-diffusive convection of Maxwell fluid in a porous medium. *Int. J. Heat Fluid Flow 32*, 88–94.
7. Yoon, D. Y., Kim, M. C. & Choi, C. K. (2004). The onset of oscillatory convection in a horizontal porous layer saturated with viscoelastic liquid, *Transp. Porous Media. 55*, 275.
8. Wang, S. W. & Tan, W. C. (2008). Stability analysis of double-diffusive convection of Maxwell fluid in a porous medium heated from below, *Phys. Lett. A 372*, 3046.
9. Malashetty, M. S., Swamy, M. & Heera, R. (2009). The onset of convection in a binary viscoelastic fluid saturated porous layer. *Z. Angew. Math. Mech. 89*, 356.
10. Kim, M. C., Lee, S. B., Kim, S. & Chung, B. J. (2003). Thermal instability of viscoelastic fluids in porous media. *Int. J. Heat Mass Transfer 46*, 5065.
11. Kumar, V. & Kumar, P. (2015). Thermosolutal convection in a viscoelastic dusty fluid with hall currents in porous medium. *Egyptian Journal of basic and applied sciences 2*, 221-228.
12. Sharma, P. K., Malik, H. Kumar, V. & Kumar, P. (2014). Triply-diffusive magneto Convection in viscoelastic fluid through porous medium. *International Transactions in Applied Sciences 6(4)*, 495-510.
13. Kumar, V. (2011). Stability of stratified couple-stress dusty fluid in the presence of magnetic field through porous medium. *Applications and Applied Mathematics: An International Journal, 6(2)*, 510-521.
14. Tyagi,V. K., Agrawal, S. C. & Agrawal, J. (2013). The onset of stationary and oscillatory convection in a horizontal porous layer saturated with viscoelastic liquid heated and soluted from below: effect of anisotropy. *Applications and Applied Mathematics: An International Journal, 8(1)*, 227 - 248
15. Castinel, G. & Combarnous, M. (1974) Critère d'apparition de la convection naturelle dans une couche poreuse anisotrope horizontal. *C.R. Acad. Sci. B 278*, 701-704.
16. Malashetty, M. S. & Biradar, B. S. (2011). The onset of double diffusive reaction-convection in an anisotropic porous layer. *Phys. Fluids 23*, 064102.
17. Bhadauria, B. S., Kumar, A., Kumar, J., Sacheti, N. C. & Chandran, P. (2011). Natural convection in a rotating anisotropic porous layer with internal heat generation. *Transp. Porous Med. 90*, 687–705.
18. Bhadauria, B. S. (2012). Double-diffusive convection in a saturated anisotropic porous layer with internal heat source. *Transp. Porous Med. 92*, 299-320.
19. Capone, F., Gentile, M. & Hill, A. A. (2011). Double-diffusive penetrative convection simulated via internal heating in an anisotropic porous layer with through-flow. *Int. J. Heat and Mass Transfer 54*, 1622-1626.
20. Zhao, M., Wang, S. & Zhang, Q. (2014). Onset of triply diffusive convection in a Maxwell fluid saturated porous layer. *Applied Mathematical Modelling 38*, 2345–2352.