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CRITERION 3- RESEARCH, INNOVATIONS & EXTENSION

3.5.1. The number MOUs, Collaborations/linkages for Faculty exchange, Internship, Field Project, On-the-job training, research and other academic activities during the last five years

Activity Reports

2020-21

Collaborative Activities
2020-21

Sr. No.	Title of the collaborative activity	Name of the collaborating agency with contact details
1	Optimization of Aluminium Doping Concentration in Titanium Dioxide Nanoparticles Photo Anode for Enhancing Efficiency of Dye-Sensitized Solar Cell	Crystal growth research Laboratory, Milliya College, Beed
2	Integrity in linear and nonlinear optical properties of L-tyrosine doped bis thiourea cadmium acetate single crystal	Crystal growth research Laboratory, Milliya College, Beed
3	Role of dopant L-Methionine concentration in modifying optical properties of parent Zinc Thiourea Sulphate Nonlinear crystal	Crystal growth research Laboratory, Milliya College, Beed
4	Focusing Nonlinear Optical Traits of Parent & L-Tryptophan Doped Bis Thiourea Cadmium Acetate (TR-BTCA) Crystal for NLO	Crystal growth research Laboratory, Milliya College, Beed
5	Inter Loan Facility (Library)	Milliya College, Beed
6	Thermodyanamic studies of transition metal Ions with Sciff base in 50% (V/V) Ethanol-Water system.Journal of research and Development, Volume 10, Special Issue 02 (2020).	Milliya College Beed
7	Thermodyanamics of the formation of divalent Copper complexes carrying novel Schiff bases in mixed solvent media; Journal of Interdiciplinary Cyclic Research Volume XIII, Issue-IV, Page No. 53-61, ISSN: 0022-1945, April/2021.	ACTRA, Milliya College Beed
8	Studies of complexation of trivalent rare earth metal ion Cerium with novel Schiff bases:Thermodynamic Aspect; The International Journal of analytical and experimental modal analysis, Vollume XIII, Issue IV, Page No 74-80; ISSN: 0886-0367; April/2021.	ACTRA, Milliya College Beed
9	Rotating Fluid Magneto Hydrodynamics flow Past an impulsively Started Infinite Vertical Plate	R. B. Attal College, Gevrai & Dept. of Mathematics, Swa. Sawarkar Mahavidyalaya, Beed

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Optimization of Aluminium Doping Concentration in Titanium Dioxide Nanoparticles Photo Anode for Enhancing Efficiency of Dye-Sensitized Solar Cell

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Well crystallized Aluminium (Al) doped Titanium dioxide (TiO_2) nanoparticles with various doping concentration (0, 0.05 M, 0.07 M, 0.09 M and 0.11 M) were synthesized successfully by sol–gel route to develop the photo anode of Dye Sensitized Solar Cell (DSSC). Anatase crystalline nature of TiO_2 nanoparticles was confirmed using X-ray diffraction (XRD) and Raman spectrophotometer. The Atomic Force Microscopy (AFM) was used to investigate the morphology of the photo anode (Al-doped TiO_2 nanoparticles). The photovoltaic performance of the DSSC in terms of Current, Voltage and efficiency was investigated with a standard illumination of AM1.5G having an irradiance 100 mW/cm^2. Optimized values of Short Circuit Current density (I_{sc}), Open Circuit Voltage (V_{oc}) and efficiency (η) obtained was 247.62 μA/cm^2, 359 mV and 0.02456%, respectively for 0.07 M Al doping concentration. Eco-friendly Eosin

Dept. of physics 2020-21

Collaborative publication

(2)

FERROELECTRICS
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Integrity in linear and nonlinear optical properties of L-tyrosine doped bis thiourea cadmium acetate single crystal

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ABSTRACT

The slow evaporation technique was adopted for the growth of L-tyrosine doped Thiourea (Bis) Cadmium Acetate (CTA) single crystal. The doped crystals were characterized by powder X-ray diffraction, FT-IR analysis, SHG Studies, UV-vis and Vickers microhardness studies. The UV-visible absorption spectrum is found to have improved optical parameters than pure CTA. The optical study revealed that the doped CTA crystal has high transmission with low cut off wavelength of 290 nm. The optical band gap was found to be 4.14 eV. The Second harmonic generation efficiency measured using Nd-YAG laser is 3.64 times higher than pure CTA.

ARTICLE HISTORY
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KEYWORDS
Crystal growth; FT-IR; Kurtz-Perry powder technique; nonlinear optical materials

1. Introduction

The organic crystals are used in the crystal growth due to its crystalline structure and fascinating optical properties. The organic crystal plays important role to enhance the nonlinear optical (NLO) properties [1, 2]. The NLO property depends on the donor and acceptor properties of charges and delocalization among the crystal. The non-centrosymmetric is the fundamental technique to elaborate the NLO property. The thiourea produces non-centrosymmentric behavior in the crystals when combines with metal compounds. The large dipole moment and ability to form hydrogen bonding network of thiourea helps to improve nonlinearity in the crystal. The physicochemical stability and breaking of ligands into the crystal plays important role in improving NLO properties [3]. Now a day's different techniques developed to grow crystals with remarkable enhancement in different properties to be used in the technological application in optical communication mechanism [4–6]. The Semi organic material possesses high second and third order nonlinear intensity, integral laser damage threshold factor, better thermal stability and holds good microhardness coefficient [7]. L-tyrosine contains the proton donor carboxyl acid (COO) group and the proton acceptor amino (NH_2) group present in the amino acids improves linear and nonlinear scales of the crystal [8, 9]. In recent year amino acid doped in different materials enhances the second and third order properties and shows better electrical, photonic and thermal properties. The Effects of the addition of L-lysine monohydrochloride dihydrate on the growth and various properties of ADP single-crystal studied and grown crystal by using slow evaporation method have been studied. The effect of doping was

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Role of dopant L-Methionine concentration in modifying optical properties of parent Zinc Thiourea Sulphate Nonlinear crystal

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Abstract: The recent investigation was aimed to explore the influence of varying concentration of amino acid L-methionine on decisive optical properties of zinc thiourea sulphate (ZTS) crystal. The traditional slow solvent evaporation technique has been adapted to grow L-methionine zinc thiourea sulphate (LM-ZTS) crystal at room temperature. The influence of 0.2 M% &0.3M % L- Methionine on optical transparency and optical constants of ZTS crystal in range of 200-900 nm has been ascertained by means of UV visible spectral analysis, to discuss the technological impetus of mixed crystal for optical devices. The optical study revealed that 0.2 M % LM-ZTS crystal has higher transmission with lower cut off wave length. The extinction coefficient, refractive index, reflectance and polarizability of 0.2 M % LM-ZTS found to belower than 0.3 M % LM-ZTS crystal. Also the direct band gap determined by the Tauck's plot method of 0.2 M % LM-ZTS is wider than 0.3 M % LM-ZTS. All these parameters show the usability of LM- ZTS crystal for various opto-electronic device applications.

Keywords: crystal growth, extinction coefficient, optical constant.

1. INTRODUCTION:

In past decade many research groups have done extensive research on semi organic thiourea metal complexes. Among thiourea metal complex pure and doped zinc thiourea sulphate outstands as a potential candidate that seeks huge demand in technologies like high power lasers, opto-electronics, frequency conversion, high speed information processing [1-3]. Amino acid play a vital role in the field of NLO crystal as they exhibit natural chiral properties and crystallize in the non-Centro symmetric space group, which are an essential criteria for nonlinearoptical device applications. The enhancement in different characteristics properties of ZTS crystals has been evident from literature due to addition of L-cysteine, L-serine, Nd^{3+}, urea [4-7]. Thus in order to imitate foresaid desirable properties amino acid L-methionine is doped in different concentration in ZTS crystal by employing UV visible spectral analysis and its detail optical parameters to confirm its superiority for various opto-electronics applications.

2. EXPERIMENTAL PROCEDURE:

Zinc thiourea sulphate (ZTS) salt was synthesized by gradually dissolving merck made analytical reagent (AR) grade zinc sulphate and thiourea in double distilled water in the molar ratio of 1:3. The recrystallization of technique has been used to enhance the purity of ZTS salt. Amino acid L- methionine with 0.2 mole% and 0.3mole% was added into the super saturated solution of ZTS with constant stirring for 4 hours. The 0.2 mole% and 0.3mole% LM-ZTS solution was filtered using whatmans filter paper in a beaker and kept for slow evaporation at ambient temperature. The grown crystalsof 0.2 mole% and 0.3mole% LM-ZTS were obtained within a period of 20 days as shown in **Fig.1.**

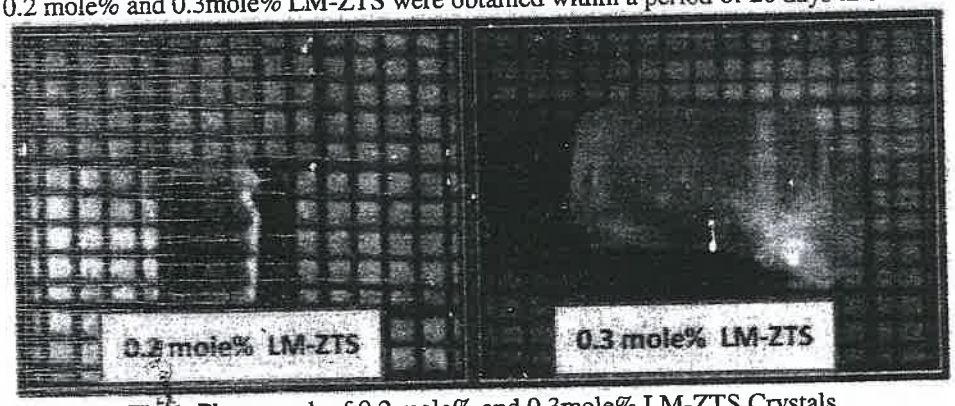

Fig.1. Photograph of 0.2 mole% and 0.3mole% LM-ZTS Crystals.

Dept. of physics 2020-21
Collaborative publication

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Focusing Nonlinear Optical Traits of Parent & L-Tryptophan Doped Bis Thiourea Cadmium Acetate (TR-BTCA) Crystal for NLO Applications

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ABSTRACT

Recent scenario deals with the requirement of good quality crystals for the nonlinear optical (NLO) device applications. Hence present manuscript explores the growth of parent & L-Tryptophan doped Bis Thiourea Cadmium Acetate (TR-BTCA) Crystal by conventional slow evaporation solution growth method. Paper demonstrates the study of comparative nonlinear optical properties such as optical conductivity, extinction coefficient, reflectance and refractive index of parent & L-Tryptophan doped Bis Thiourea Cadmium Acetate (TR-BTCA) Crystal. The evaluated nonlinear optical parameters confirmed the superiority of L-Tryptophan doped Bis Thiourea Cadmium Acetate (TR-BTCA) Crystal over parent Bis Thiourea Cadmium Acetate (BTCA) crystal for application in laser assisted NLO applications.

Keywords: Crystal growth, Extinction coefficient, optical conductivity,Reflectance, Refractive index

1. INTRODUCTION

Nonlinear optical (NLO) crystals seek large demand for developing the cutting edge technological accessories utilized in data storage, digital communication systems, optical switching, laser fusion, photonics, optoelectronics and laser frequency conversion device applications [1–3]. Designing, engineering and growth of perfect nonlinear optical crystals delivering extraordinary characteristics has become a challenging task for researchers in the current scenario. All optical device applications concurrently desire excellent optical (UV–visible), SHG efficiency, luminescence, third order nonlinear optical), crystalline perfection, thermal stability and electrical (dielectric) properties [4]. Tremendous efforts have been taken since past few decades for designing a new class of organo-metallic nonlinear optical crystals. In organometallic crystals a large variety of thiourea metal complex crystals have been reported [5,6] amongst which the Bis thiourea Cadmium acetate (BTCA) deserves more attention due to its orthorhombic crystal structure, appreciable linear-nonlinear optical properties, hardness, electrical and thermal properties as evident in literature. With the aim of achieving improved quality CTA crystal; several researchers attempted a technique of doping additives Zn, Mn(II), NMU, Glycine, Alanine, Valine, Cystein [7-16].

L-tryptophan contains an α amino group, and α carboxylic acid group with 1five membered ring with a nitrogen atom bounded to a benzene ring called as in dole ring present in side chain of molecule making it an non polar aromatic amino acid . L tryptophan exhibits non exponential fluorescence decay in aqueous solution and this has been explained by the emission from non interconnecting rotamers which has different life times due to different rate of intermolecular charge transfer [17].

Hence present study aimed to grow the parent bis thiourea cadmium acetate (BTCA) and L-tryptophan doped bis thiourea cadmium acetate (TR-BTCA) crystal by slow evaporation solution growth technique and thus to study the effect of amino acid L- tryptophan on nonlinear optical properties of BTCA.

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2020-21

Dept. of Chemistry

Journal of Research and Development | Volume 10, Special Issue 02
Title : Innovative Ideas in Chemical Science and Environment Science for Sustainable Development-2020

Thermodynamic Studies of transition Andrare Earth Metal Ions With Schiff Base In 50 % (V/V) Ethanol-Water Mixture.

Vishal Naiknaware[1], and Sahebrao Naikwade[2], Shailendrasingh Thakur[*3]
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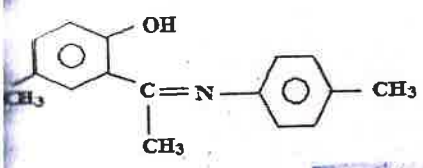
:
constant ofschiff base2-hydroxy-5-methylacetophenone-N-(4-methylphenyl)imine with divalent ions Cu^{2+}, Ni^{2+}, Cd^{2+}, Co^{2+}, Mn^{2+}, Zn^{2+} and trivalent lanthanide metal ions La^{3+}, Ce^{3+}, Pr^{3+}, Nd^{3+}, Sm^{3+}, Eu^{3+}, Dy^{3+} and Ho^{3+} using apH metric titration technique in 50% (v/v) ethanol-water mixture atthree different 25°C, 35°C and 45°C at an ionic strength of 0.1M $NaClO_4$ were studied. The Calvin-Bjerrum method as ing-Rossotti has been employed to determine metal-ligand stability constant log K values. The trend in the nstants for transition metal ions follows the order: $Cu^{2+}>Zn^{2+}>Cd^{2+}>Co^{2+}> Ni^{2+} >Mn^{2+}$ and for lanthanide $La^{3+}<Ce^{3+}<Pr^{3+}<Nd^{3+}<Sm^{3+}<Eu^{3+}>Gd^{3+}<Tb^{3+}<Dy^{3+}> Ho^{3+}$ and shows a break at gadolinium. The mic parameters such as, Gibb's free energy change (ΔG), entropy change (ΔS) and enthalpy change (ΔH) th the complexation reactions were calculated.

ords : Stability constant, transition metal, lanthanide, schiff base, pH metry, thermodynamic parameteretc.

duction :

titration technique is a powerful and analytical technique for determination of nstants. Metal complexes of schiff bases play ole in the development of coordination Most of the d-block and f-block elements exes. There are different kinds of ligands mplexation. For the present investigation, we ected schiff base2-hydroxy- 5-phenone- N- (4-methylphenyl) imine lecular formula $C_{16}H_{17}ON$.

mination of our earlier work[1-16] and after rvey it was thought of interest to study the mperature on thermodynamic parameters bb's free energy change ΔG, enthalpy change opy change ΔS of complexes of 2-hydroxy-cetophenone-N-(4-methylphenyl)imine with ion metal ions Cu^{2+},Ni^{2+},Cd^{2+},Co^{2+}, Mn^{2+}, n rare earth metal ions La^{3+}, Ce^{3+}, Pr^{3+}, Nd^{3+}, Gd^{3+}, Tb^{3+}, Dy^{3+} and Ho^{3+} using pH in 50 % (v/v) ethanol-water mixture.



e:2-hydroxy-5-methylacetophenone-N-(4-methylphenyl)imine

2. Experimental :

2.1 Materials and Solution :

All transition metal, rare earth metal, NaOH, $NaClO_4$, $HClO_4$ are of AR grade. The solutions used in the pH metric titration were prepared in double distilled CO_2free water. The NaOH solution was standardized against oxalic acid solution and standard alkali solution was again used for standardization of $HClO_4$. The measurements were made at temperatures 25°C, 35°C and 45°C in 50 % (v/v) ethanol-water mixture at constant ionic strength (0.1M $NaClO_4$).Water thermostat is used to maintain the temperature constant and the solutions were equilibrated in the thermostat for about 10-15 minutes before titration. The pH measurement was made using a digital pH meter model Elico L1-120 in conjunction with a glass and reference calomel electrode. The instrument was calibrated at pH 9.18, 7.00 and 4.00 using the standard buffer solutions.

2.2 pH metric procedures :

To calculate the protonation constant of the ligand and the formation constant of the complexes in 50% (v/v) ethanol-water mixture with different metal ions the following sets of solutions were prepared (total volume 50 ml) and titrated pH metrically against standard NaOH solution at temperature 25°C, 35°C and 45°C.

i. Free Acid $HClO_4$
ii. Free Acid $HClO_4$ + Ligand (schiff base)

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Thermodynamics of the formation of divalent Copper complexes carrying novel Schiff bases in mixed solvent media

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Abstract : The stability constant of seven Schiff bases 4-hydroxy-3-(1-((5-phenyl)-1,3,4-thiadiazol-2 yl) imino) ethyl)-2H-chromen-2-one[S_1], 4-hydroxy-3-(1-((5-(p-tolyl)-1,3,4-thiadiazol-2-yl)imino)ethyl)-2H-chromen-2-one[S_2], 4-hydroxy-3-(1-((5-(4-nitrophenyl)-1, 3, 4-thiadiazol-2-yl) imino) ethyl)-2H-chromen-2-one [S_3], 4-hydroxy-3-(1-((5-(4-flurophenyl)-1,3,4-thiadiazol-2 yl) imino) ethyl)-2H-chromen-2-one[S_4], 4-hydroxy-3-(1-((5-(4-chlorophenyl)-1,3,4-thiadiazol-2 yl) imino) ethyl)-2H-chromen-2-one[S_5], 4-hydroxy-3-(1-((5-(4-bromophenyl)-1,3,4-thiadiazol-2 yl) imino) ethyl)-2H-chromen-2-one[S_6] and 4-hydroxy-3-(1-((5-(4-iodophenyl)-1,3,4-thiadiazol-2 yl) imino) ethyl)-2H-chromen-2-one[S_7] with divalent transition metal ion Cu^{2+} using a pH metric titration technique in 80%(v/v) ethanol-water mixture at three different temperatures 25°C, 35°C & 45°C at an ionic strength of 0.1M $NaClO_4$ were studied. The Calvin-Bjerrum method as adopted by Irving-Rossotti has been employed to determine metal-ligand stability constant logK values. The thermodynamic parameters such as, Gibb's free energy change (ΔG), entropy change (ΔS) and enthalpy change (ΔH) associated with the complexation reactions were calculated.

Keywords: stability constant, transition metal ion, Schiff bases, pH metry, thermodynamic parameter etc.

1. Introduction:

Metal complexes of Schiff bases play a central role in the development of coordination chemistry. pH metric titration technique is a powerful and simple electro analytical technique for determination of stability constants. Most of the d-block elements form complexes. There are different kinds of ligands used for complexation. For the present investigation, we have selected a series of seven Schiff bases.

After a review of literature and in continuation of our earlier work with complexation of Schiff bases and medicinal drugs[1-7], it was thought of interest to study the effect of

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Studies of complexation of trivalent rare earth metal ion Cerium with novel Schiff bases : Thermodynamic Aspect

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Abstract : **In the present work we have investigated the stability constant of seven Schiff bases 4-hydroxy-3-(1-((5-phenyl)-1,3,4-thiadiazol-2 yl) imino) ethyl)-2H-chromen-2-one[S_1], 4-hydroxy-3-(1-((5-(p-tolyl)-1,3,4-thiadiazol-2-yl)imino)ethyl)-2H-chromen-2-one[S_2], 4-hydroxy-3-(1-((5-(4-nitrophenyl)-1, 3, 4-thiadiazol-2-yl) imino) ethyl)-2H-chromen-2-one [S_3], 4-hydroxy-3-(1-((5-(4-fluorophenyl)-1,3,4-thiadiazol-2 yl) imino) ethyl)-2H-chromen-2-one[S_4], 4-hydroxy-3-(1-((5-(4-chlorophenyl)-1,3,4-thiadiazol-2 yl) imino) ethyl)-2H-chromen-2-one[S_5], 4-hydroxy-3-(1-((5-(4-bromophenyl)-1,3,4-thiadiazol-2 yl) imino) ethyl)-2H-chromen-2-one[S_6] and 4-hydroxy-3-(1-((5-(4-iodophenyl)-1,3,4-thiadiazol-2 yl) imino) ethyl)-2H-chromen-2-one[S_7] with trivalent rare earth metal ion Ce^{3+} using a pH metric titration technique in 80%(v/v) ethanol-water mixture at three different temperatures 25°C, 35°C & 45°C at an ionic strength of 0.1M $NaClO_4$. The Calvin-Bjerrum method as adopted by Irving-Rossotti has been employed to determine metal-ligand stability constant logK values. The thermodynamic parameters such as, Gibb's free energy change (ΔG), entropy change (ΔS) and enthalpy change (ΔH) associated with the complexation reactions were calculated.**

Keywords: rare earth metal ion, Schiff bases, stability constant, pH metry, thermodynamic parameter etc.

1. Introduction:

Metal complexes are widely used in various fields, such as biological processes pharmaceuticals, separation techniques, analytical processes etc.To understand the complex formation ability of the ligands and the activity of complexes, it is essential to have the knowledge about solution equilibria involved in the reactions. The extent to which the ligand binds to metal ions is normally expressed in terms of stability. Metal complexes of Schiff bases play a central role in the development of coordination chemistry. pH metric titration technique is a powerful and simple electro analytical technique for determination of stability constants. Most of the f-block elements form complexes. There are different kinds of ligands used for complexation. For the present investigation, we have selected a series of seven Schiff bases.

After a review of literature and in continuation of our earlier work with complexation of Schiff bases and medicinal drugs[1-5], it was thought of interest to study the effect of temperature on thermodynamic parameters such as Gibb's free energy change ΔG, enthalpy change ΔH and entropy change ΔS of complexes of seven Schiff bases with rare earth metal ion Ce^{3+} pH metrically in 80% (v/v) ethanol-water mixture.

2. Synthesis of Schiff bases:

Synthesis of all seven Schiff bases was done by reported methods. The compounds 3-acetyl-4-hydroxy-2H-chromen-2-one and 2-amino thiadiazole derivatives were the intermediates for preparing novel Schiff bases 4-hydroxy-3-(1-((5-substitutedphenyl)-1,3,4-thiadiazol-2-yl)imino)ethyl)-2H-chromen-2-one. The ketone, 3-acetyl-4-hydroxychromen-2-one was prepared from 4-hydroxy coumarin and acetic acid in presence of $POCl_3$ by refluxing for 30 minutes[6]. The aromatic amine, 5-(4-

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Rotating Fluid of Magneto Hydrodynamics Flow Past An Impulsively Started Infinite Vertical Plate

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Abstract :

This paper present an exact solution to the a rotating fluid of magneto hydrodynamics flow past an impulsively stated infinite vertical plate. Dimensionless governing equation are solved by Laplace-transform technique. Expressions of axial and transfer component of velocity, skin friction are derived. It is demonstrated that both axial and transverse components of velocity decrease due to increasing t. The axial component of skin-friction increases with increasing M but the transverse component of skin friction decrease with increasing M.

Keywords : MHD flow, Laplace transform, Rotating fluid.

Nomenclature:

Cp: Specific heat at constant pressure. EK: Ekman number

Gr : Grashof number

g: Acceleration due to gravity K: Thermal conductivity

Pr: Prandtl number

T': Temperature of the fluid near the plate T'W: Temperature of the plate

T'∞: Temperature of the fluid far away from the plate

t': Time

Uo: Reference velocity (Eq 2.5)

G': Angular speed

(uu, vu):Velocity components along x, and y, axis respectively

z': Coordinate normal to x',y', plane

Greek Symbols :

ν : Kinematic viscosity

β : Coefficient of volume expansion þ* : Coefficient of species expansion ρ : Density

μ: Viscosity

Introduction:

If the plate is given motion in a rotation fluid, how the motion takes place? This has been discussed by Batchelor (1967). Many papers were published on this topic by different authors. The fluid assumed was stationary. Flow of a viscous incompressible fluid past an impulsively started infinite vertical plate, on taking into account the presence of free convection currents was studied by Soundalgekar (1977) and presented an exact solution to coupled linear partial differential equation by the Laplace transform technique. The effects of transversely applied

$$\frac{\partial v'}{\partial t'} + 2\Omega u' = v\frac{\partial^2 v'}{\partial z'^2} - \frac{\sigma B_0^{\,2}}{\rho}v' \qquad (3)$$

$$\rho C_p \frac{\partial T'}{\partial t'} = k\frac{\partial^2 T'}{\partial z'^2} \qquad (4)$$

All the physical variables are defined in the notation. The initial and boundary conditions are

$$u' = 0, \quad v' = 0, \quad T' = T'_\infty \quad for\ all\ z', t' \le 0$$
$$u' = U_0, \quad v' = 0, \quad T' = T'_w \quad at\ z = 0, t' > 0$$
$$u' = 0, \quad v' = 0, \quad T' = T'_\infty \quad as\ z' \to \infty, t' > 0 \qquad (5)$$

In equations (1) -(5) and we have

$$\frac{\partial q}{\partial t} + 2iE_K q = \theta + \frac{\partial^2 q}{\partial z^2} - Mq \qquad (6)$$

$$Pr\frac{\partial \theta}{\partial t} = \frac{\partial^2 q}{\partial z^2} \qquad (7)$$

where $q = u + iv$

with the following initial and boundary conditions :

$$q = 0, \quad \theta = 0, \quad for\ all\ \ z, t \le 0$$
$$q = 1, \quad \theta = 1 \quad at\ z = 0, t > 0$$
$$q = 0, \quad \theta = 0 \quad as\ z \to \infty, t > 0 \qquad (8)$$

The solutions to these coupled linear systems can be derived by the usual Laplace- transform technique and it is as follows:

$$q = \frac{1}{2}\left(1 - \frac{1}{b}\right)\left\{e^{-2\eta\sqrt{bt}}erfc\left(\eta - \sqrt{bt}\right) + e^{2\eta\sqrt{bt}}erfc\left(\eta + \sqrt{bt}\right)\right\} + \frac{e^{at}}{2b}\left\{e^{-2\eta\sqrt{(a+b)t}}erfc(\eta - \sqrt{(a+b)t}) + e^{2\eta\sqrt{(a+b)t}}.erfc\left(\eta\sqrt{(a+b)t}\right)\right\} + \frac{1}{b}erfc\left(\eta\sqrt{Pr}\right) - \frac{e^{at}}{2b}\left\{2^{-2\eta\sqrt{aPrt}}.erfc\left(\eta\sqrt{Pr} - \sqrt{at}\right) + e^{2\eta\sqrt{aPrt}}.erfc\left(\eta\sqrt{Pr} + \sqrt{at}\right)\right\}$$

Where $a = \frac{b}{Pr-1}$, $\qquad b = 2iE_K + M \qquad (9)$

And $\eta = \frac{z}{2\sqrt{t}}$

we have carried out numerical computation for u. v and 8. In order to gain physical insight into this problem However, for Pr=0.71, the argument of erfc function becomes complex and hence we have to separate these into real and imaginary parts.

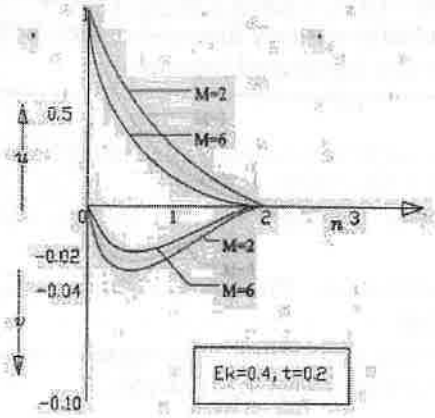

FIG.2: AXIAL AND TRANSVERSE VELOCITY PROFILES,Pr=0.71

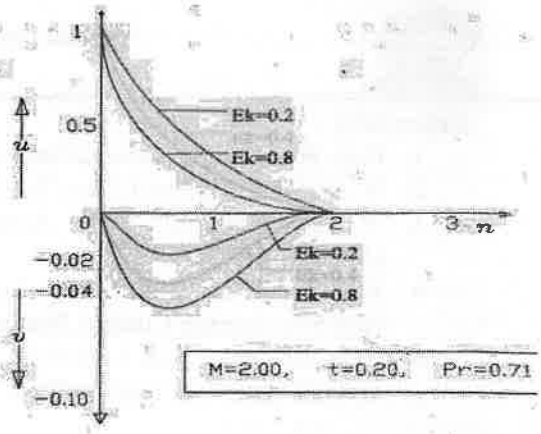

FIG.3: AXIAL AND TRANSVERSE VELOCITY PROFILES

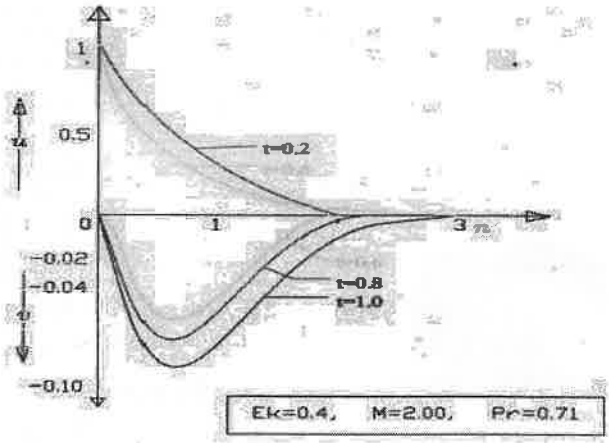

FIG.4: AXIAL AND TRANSVERSE VELOCITY PROFILES,EFFECT OF TIME

Conclusions.

(i) By increasing the Ekman number , the axial as well as transverse components of velocity decrease.

(ii) By increasing time t, the axial as well as transverse components of velocity decrease.

(iii) Due to increasing M, the axial component of velocity decreases But the transverse component of velocity increases.

(iv) Due to increase in time t. the axial as well as transverse components of skin friction increases

(iv)The Axial component of skin friction increases with increasing M or Ek

(v) The transverse component of skin friction decrease with increasing M and increase owing to an increase in the Ek.

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As per the agreement between *Swa. Sawarkar Mahavidyalaya, Beed* and *R.B. Attal College, Georai,* there has been collaborative research activity between Faculty of the Department of Mathematics,Swa. Sawarkar Mahavidyalaya, Beed and Faculty of the Department of Mathematics,R.B. Attal College, Georai. The details of the collaborative research activities are as follows:

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2	Dr. Vijay Sangale	Mathematics	R.B. Attal College, Georai

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