2015

UNSTEADY MHD FREE CONVECTION FLOW NEAR ON AN INFINITE VERTICAL PLATE EMBEDDED IN A POROUS MEDIUM WITH CHEMICAL REACTION,HALL CURRENT AND THERMAL RADIATION

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Abstract:*The purpose of this research paper is an unsteady free convection flow of an electrically conducting gray gas near equilibrium in the optically thin limit along an infinite vertical porous plate are investigated in the presence of strong transverse magneticfield imposed perpendicularly to the plate, taking hall currents and thermal radiation in to account. The similarly equations wereobtained using suitable transformations and the resulting non-linear coupled partial differential equations are solved by finite difference method. A parametric study illustrating the influence of different flow parameters on velocity, temperature and concentration fields are investigated. The effects of different flow parameters on these respective fields are discussed through graphs and results are physically interpreted.*

Keywords:*Chemical reaction, MHD, Thermal Radiation, Hall current, Finite difference method.*

1. INTRODUCTION

The growing need for chemical reactions in chemical and hydrometallurgical industries require the study of heat and mass transfer with chemical reaction. The presence of a foreign mass in water or air causes some kind of chemical reaction. This may be present either by itself or as mixtures with air or water. In many chemical engineering processes, a chemical reaction occurs between a foreign mass and the fluid in which the plate is moving. These processes take place in numerous industrial applications, for example, polymer production, manufacturing of ceramics or glassware and food processing. A chemical reaction can be codified as either a homogenous or heterogeneous process. This depends on whether it occurs on an interface or a single phase volume reaction.Aurang Zaïb and Sharidan Shafie [1] investigated the effects of thermal- diffusion and diffusion- thermo on an unsteady MHD free convection boundary layer flow with heat and mass transfer of an electrically conducting fluid over a stretching sheet in the presence of strong magnetic field with Hall current, thermal stratification, chemical reaction, heat generation, thermal radiation, Joule heating and viscous dissipation. The transformed nonlinear boundary layer equations are numerically solved by applying Keller-box method. An analytical solution of MHD free convective, dissipative boundary layer flow past a vertical porous surface in the presence of thermal radiation, chemical reaction and constant suction, under the influence of uniform magnetic field which is applied normal to the surface is studied by Raju et al. [2]. The governing equations are solved analytically using a regular perturbation technique.Heat and mass transfer effects on an unsteady flow of a chemically reacting micropolar fluid over an infinite vertical porous plate through a porous medium in the presence of a transverse magnetic field with Hall effect and thermal radiation are studied by Oahimire and Olajuwon [3]. The problem of magneto- micropolar fluid flow, heat and mass transfer with suction and blowing through a porous medium is analyzed numerically by Nasser Elgazery [4]. This problem was studied under the effects of chemical reaction, Hall, ion- slip currents, variable viscosity and variable thermal diffusivity. The governing fundamental equations are approximated by a system of non- linear ordinary differential equation. This system is solved numerically by using the Chebyshev pseudospectral method. The problem of steady, laminar, hydromagnetic, simultaneous heat and mass transfer by laminar flow of a Newtonian, viscous, electrically conducting and heat generating/absorbing fluid over a continuously stretching surface in the presence of the combined effect of Hall currents and mass diffusion of chemical species with first and higher order reactions is investigated by Salem and Mohamed Abd El- Aziz [5]. A two-

INFLUENCE OF THERMAL RADIATION ON UNSTEADY FREE CONVECTION FLOW OF WATER NEAR 4oC PAST A MOVING VERTICAL PLATE

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Abstract— The aim of this work is to study the influence of thermal radiation on unsteady free convection flow of water near 4_oC (Pr = 11.40) past a moving vertical plate. The effect of the suction/injection parameter at the plate on the velocity is considered. The governing dimensionalized non-linear coupled partial differential equations are solved using Finite element technique. The numerical solutions of velocity and temperature of the fluid are obtained and discussed through graphs and the physical aspects of the problem are highlighted and discussed. Comparisons with previously published work on special cases of the problem are obtained and are observed to be in accord.

Index Terms— Thermal radiation, Free convection, Water near $4_o C$, Finite element technique.

I. INTRODUCTION

From a technological point of view, free convection flows over an infinite vertical plate has an important applications in fluid mechanics. It becomes a more attractive problem when the fluid is water at 4°C which is electrically conductive, and the flow is focused to transverse and constant magnetic field. The steady mixed convective water flow at 4°C over a vertical porous plate was studied by Ling et al [1]. Michalis Xenos et al [2] studied the effect of constant uniform suction on unsteady MHD free convection flow of water at 4°C past an infinitely vertical moving plate with constant velocity. The unsteady free convection flow of water at 4°C in the laminar boundary layer over a vertical moving plate embedded in a porous medium was investigated by Raptis and Perdikis [3]. In this study, fourth-order Runge - Kutta scheme was used for solving momentum equations numerically. Siva Reddy Sheri and Srinivasa Raju [4] demonstrated the effect of thermal diffusion (Soret) on unsteady hydrodynamic free convection flow past a semi-infinite vertical plate in the presence viscous dissipation. Sivaiah and Srinivasa Raju [5] studied the effects of Hall current and heat source on unsteady magneto hydrodynamic free convective flow in presence of viscous dissipation, heat and mass transfer using finite element method.

The effect of thermal radiation on free convective flows have very important applications in space technology and design of pertinent equipments. Recent advances in nuclear power plants, gas cooled nuclear reactors, space vehicles, gas turbines and hypersonic flights have involved in this research field. The effects of thermal radiation and Heat source on magnetohydrodynamic free convective flow over an infinite

vertical porous plate in presence of Soret and Dufour using finite element method was studied by Srinivasa Raju et al [6]. The effects of thermal radiation on non-darcy mixed convection flow in the presence of magnetic field was studied by Srinivasacharya et al [7]. Srinivasacharya and Swamy Reddy [8] studied the effects of thermal radiation on natural convection in porous medium saturated with power-law fluid in the presence of chemical reaction. The effect of chemical reaction on mixed convection in magnetohydrodynamic micropolar fluid flow in presence of thermal radiation was studied by Srinivasacharya and Upendar Mendu [9].

The purpose of this paper is to study is the effect of thermal radiation on an unsteady free convection flow of water near $4_o C$ past a vertical moving porous plate. Finite element technique was used to solve dimensionalized non-linear coupled partial differential equations. Interesting findings are observed and were compared to the effects of thermal radiation reported by Raptis and Perdikis [3].

II. BASIC EQUATIONS

Let us consider a two dimensional laminar free convection flow of water near $4_o C$ past a moving vertical porous plate. The x' and y' axes are along and normal to the plate respectively. The flow governing equations of the problem are:

Continuity Equation:

$$\frac{\partial v'}{\partial y'} = 0 \tag{1}$$

Equation of Momentum:

$$\frac{\partial u'}{\partial t'} + v'\frac{\partial u'}{\partial y'} = \nu \frac{\partial^2 u'}{\partial y^2} + g\gamma (T' - T_\infty)_2 \tag{2}$$

Equation of Energy:

$$\frac{\partial T'}{\partial t'} + v'\frac{\partial T'}{\partial y'} = \frac{\kappa}{\rho C_p}\left[\frac{\partial^2 T'}{\partial y'^2} - \frac{\partial q_r}{\partial y'} \right] \tag{3}$$

The corresponding boundary conditions of the flow are:

$$t' \leq 0 : u' = 0, \ T' = T_\infty \text{ for all } y' \tag{4}$$

$$\left\{ u' = c't', v' = v'(t'), T' = T_w \text{ at } y' = 0 \right\}_{t' > 0}$$

$$u' \to 0, T' \to T_\infty \text{ as } y' \to \infty$$

Dynamics of Indian Stock Market – Role of Domestic Institutional Investors – A Causality Study

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ABSTRACT

Indian stock market being one among the top performing stock markets of the world has been attracting substantial amount of institutional investments from the last one decade. The increasing participation of institutional investors has assumed to have steadily controlled the investment scenario of the stock market. The present article examines the short-term and long-term causal relationship between Domestic Institutional Investors (DIIs) and Indian stock market. The study uses the monthly time series data on advances to declines ratio (ADR) of Bombay Stock Exchange (BSE) and National Stock Exchange (NSE), and purchases to sales ratio of DIIs. The sample period spans from April 2007 to December 2013. To attain the intent of the study, the article employs the empirical techniques such as Unit root tests, co-integration tests and VECM as part of research methodology. From the result of co-integrating relationship it is found that the variables understudy are co-integrated which holds that there is long run association between the variables. Moreover, the empirical results of VECM confirm a unidirectional long run causality running from DIIs to Indian stock market. Also, it is evident from the test results that there is no short-run bidirectional relationship running between DIIs and Indian stock market.

Introduction

Institutional investors are playing an increasingly important role in the development of Indian stock market. Existence of large numbers of institutional investors in the stock market tend to be less volatile and allocate resources and capital more efficiently to companies requiring funding. Institutional investors being highly specialized and managing substantial capital are better positioned to put pressure on corporations and their management to improve corporate governance and transparency. By pooling assets and employing high quality investment professionals, institutional investors can develop better investment strategies and build solid risk management systems, which

results in higher and more stable returns for investors. Hence there is a need for institutional investors and it is particularly important to create domestic institutional investors, as without these investors the flight to capital by foreigners in times of crisis and uncertainty will create even greater volatility in the stock market.

India being one of the favorite investment destinations for the foreign institutional investors attracted huge amount of funds from these investors. Indian stock market has been depending on the money flow from foreign financial institutions for sustainable rallies and FIIs have consistently dominated market and their investments are directly related to rise and fall of the Indian stock market. The FIIs in rush of maximizing their returns look for better investment destinations and shuffle their investments from one market to another. The withdrawal of investments by FIIs from the stock market tends to create pressure on selling side and increases volatility in the market, which the Indian stock market experienced in many occasions.

In a scenario of extreme pessimism surrounding the stock markets during the year 2008, it is the Domestic Institutional Investors (DIIs) who have kept faith in the market, while Sensex had lost 8,000 points