ISSN: 2338-0128
VOLUME: 6

PROCEEDING

BaSIC 2016

THE 6th BASIC SCIENCE INTERNATIONAL CONFERENCE

Basic Science International Conference 2016

2nd - 3rd MARCH 2016

ATRIA HOTEL & CONFERENCE, MALANG, EAST JAVA
INDONESIA

ORGANIZED BY
FACULTY OF MATHEMATICS & SCIENCES
BRAWIJAYA UNIVERSITY

PROCEEDINGS OF THE 6th ANNUAL BASIC SCIENCE INTERNATIONAL CONFERENCE

"Enhancing Innovation in Science for Sustainable Development"
ATRIA HOTEL AND CONFERENCE, MALANG, INDONESIA
March, 2nd – 3rd 2016

Please cite the proceeding as "Proceeding of Annual Basic Science International Conference Vol. 6" with the following abbreviation:
Proc. Basic Sci., **6**

Issued on **June 7th, 2016**

FOREWORD

The 6th Annual Basic Science International Conference (BaSIC 2016) had been successfully held on 2 – 3 March 2016 at Atria Hotel, in Malang, Indonesia. The conference theme this year is "*Enhancing Innovation in Science for Sustainable Development*". The conference is aimed at promoting scientific research activities by fellow scientists in Indonesia and overseas, in the hope of building and strengthening networks and collaborations. Additionally, the conference is also designed to bring experts as well as students together from different disciplines related to basic sciences, to stimulate the formation of new collaborations. So, it is an event where new generation of scientists will coalesce with the senior and experienced ones.

We do thank all participants for their contributed talks, the keynote speakers, as well as the invited speakers for coming and sharing their knowledge with us. The presenters actively contributed in sending their articles to be published in this proceeding. We also thank Brawijaya University and Faculty of Sciences in particular, the organizing team from the Department of Mathematics, Faculty of Sciences, Brawijaya University, as well as all members of the scientific committee.

We are delighted that the proceeding of the 6th Annual Basic Science International Conference (BaSIC 2016) had been completed. It is a book containing papers that had been presented in the BaSIC conference. Moreover, the articles in this proceeding are divided into a breath of the conference subjects of Material Science and technology, Science and Technology Education, Environmental Science and Technology, Molecular and Health Science, Mathematics, Statistics, and Modeling, Instrumentation and Measurement, as well as Energy. The proceeding is aimed at collecting and sharing any useful information that had been gathered during the BaSIC conference.

The editorial team has made some editing and correction needed in some cases. Most of the editing correction are conducted and concentrated in the organization of the paper based on the guideline and the language. Some figures and tables were corrected, and placed accordingly. In addition, the language is the most time-consuming work; hence on behalf of the committee we apologize for the late publishing of this book and for any inconvenience as a result of the delay.

We give our gratitude to the reviewing and editing team for their hard work and for making the publication of this proceeding happen. We again thank all participants and presenters for the kindness to be part of the BaSIC conference. We hope the readers of this book could gain new knowledge, information, and idea for a research and further research collaboration, particularly in the topics or subjects related to basic sciences.

Best regards,

Achmad Efendi, PhD
Chairman of BaSIC 2016

WELCOME MESSAGE

On behalf of the Dean of Faculty of Mathematics and Natural Sciences, we are very pleased to welcome you in the proceeding of the Sixth Annual Basic Sciences International Conference 2016. This proceeding is one of the continuation for the conference. Based on these papers, hopefully more collaboration can be initiated or should be followed up.

I would like to express my gratitude to all of the contributed papers, also keynote and invited speakers. Many thanks also goes to the reviewers and the editorial team for the big effort in supporting this proceeding.

Last but not least my big appreciation to the steering and organizing committees, in realizing this proceeding.

Faculty of Mathematics and Natural Sciences,

Dean,

Prof. Dr. Marjono, M.Phil.

TABLE OF CONTENTS

Proceeding of The 6th Annual Basic Science International Conference
Published online, on June 7, 2016.

Viscous Fluid Flow With Presence of Magnetic Field Past An Elliptical Cylinder

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Abstract – In this study, we consider a magnetohydrodynamics (MHD) problem of unsteady and incompressible boundary layer flow of viscous fluid past an elliptical cylinder. The effect of magnetic field that acts on viscous fluid causes the separation of flow delay. Dimensional Governing Equations are formulated from the physical phenomena and reduced by using boussinesq approximation and boundary layer theory. These dimensional boundary layer further are converted into non-dimensional form by substituting several non-dimensional variables. Further, those non-dimensional equations are transformed into similar equations and solved numerically by using Keller-Box method. Numerical results for the flow quantities show that temperature profiles decrease when both of magnetic parameter and convective parameter increases.

1. INTRODUCTION

Magnetohydrodynamics (MHD) is the study of the motion of electrically conducting fluids under magnetic fluids. MHD flow is an important research area due to its potential applications in engineering and industrial fields. Nowadays, the heat transfer and magnetic field on a fluid flow, regardless Newtonian or non-Newtonian fluids, are widely used in engineering for several processes [9]. In this paper, we used viscous fluid, that one of type of Newtonian fluid. Newtonian fluid is a fluid which has the viscous stresses arising from its flow, at every point, are linearly proportional to the local strain state. The Newtonian fluid isthe simplest mathematical model of fluid that accounts for viscosity. One of the MHD effect is when the values of magnetic parameter or Hartmann number are increased, the thicness of boundary layer are decreased[8].

In this paper, we assume convective of heat transfer that happened on the fluid is forced convection flow. Theconvective of heat transfer is a heat transfer from one place to another through the intermediary of a fluid caused by temperature difference. Forced convection is also called as heat advection, fluid moves due to external forces [7]. In this paper, we also assume that unsteady viscous fluid. In general, unsteady viscous fluid play an important role in reentry of space vehicles. Unsteady viscous flows have been studied quite widely and all the characteristic features of unsteady effects are now more of less familiar to fluids mechanics.

Many researchers had been working on elliptical cylinder problem. A study on steady forced convection was conducted by D'Alessio *et al*[5]. Cheng had been working on the effect of temperature dependent viscosity [4]. In this study focuses on the unsteady forced convective on the viscous fluid flow past an elliptic cylinder.

2. METHODS

2.1 PROCEDURES

Dimensional Governing Equations are formulated from the physical phenomena and reduced by using boussinesq approximation and boundary layer theory. These dimensional boundary layer further are converted into non-dimensional form by substituting several non-dimensional variables. Further, those non-dimensional equations are transformed into similar equations and solved numerically by using Keller-Box method.

2.2 PROBLEM FORMULATION

We consider unsteady MHD forced convection boundary layer flow past a elliptical cylinder in a viscous fluid. Fig. 1 illustrates the physical model and the coordinate system of theelliptical cylinder. Consider a laminar flow starts impulsively at rest in an incompressible, electrically-conducting, viscous fluid past a non conducting elliptical cylinderwith ambient velocity of fluid U_∞ and uniform temperatureT_∞. The governing equations are developed from mass, momentum, and energy conservation, as follows:

Continuity equation:

$$\frac{\partial \bar{u}}{\partial \bar{x}} + \frac{\partial \bar{v}}{\partial \bar{y}} = 0 \tag{1}$$

Momentum equation:

$$\rho\left(\frac{\partial \bar{u}}{\partial \bar{t}} + \bar{u}\frac{\partial \bar{u}}{\partial \bar{x}} + \bar{v}\frac{\partial \bar{u}}{\partial \bar{y}}\right) = -\frac{\partial p}{\partial \bar{x}} + \mu\left(\frac{\partial^2 \bar{u}}{\partial \bar{x}^2} + \frac{\partial^2 \bar{u}}{\partial \bar{y}^2}\right) - \sigma B_0^2 \bar{u} - (\rho - \rho_\infty) g \sin A \tag{2}$$

$$\rho\left(\frac{\partial \bar{v}}{\partial \bar{t}} + \bar{u}\frac{\partial \bar{v}}{\partial \bar{x}} + \bar{v}\frac{\partial \bar{v}}{\partial \bar{y}}\right) = -\frac{\partial p}{\partial \bar{y}} + \mu\left(\frac{\partial^2 \bar{v}}{\partial \bar{x}^2} + \frac{\partial^2 \bar{v}}{\partial \bar{y}^2}\right) - \sigma B_0^2 \bar{v} + (\rho - \rho_\infty) g \cos A \tag{3}$$

Energy equation:

$$\rho C_p\left(\frac{\partial \bar{T}}{\partial \bar{t}} + \bar{u}\frac{\partial \bar{T}}{\partial \bar{x}} + \bar{v}\frac{\partial \bar{T}}{\partial \bar{y}}\right) = c\left(\frac{\partial^2 \bar{T}}{\partial \bar{x}^2} + \frac{\partial^2 \bar{T}}{\partial \bar{y}^2}\right) \tag{4}$$

2.3 NON-DIMENSIONAL EQUATIONS

These dimensional boundary layer equation on (1)-(4) are transformed into non-dimensional governing equation by substituting non-dimensional variables. The non-dimensional variables as follows:

$$x = \frac{\bar{x}}{a}, \qquad y = Re^{1/2}\frac{\bar{y}}{a}, \qquad t = \frac{U_\infty \bar{t}}{a}, u = \frac{\bar{u}}{U_\infty},$$

$$v = Re^{1/2}\frac{\bar{u}}{U_\infty}, p = \frac{\bar{p}}{\rho U_\infty^2}, T = \frac{\bar{T} - T_\infty}{T_W - T_\infty},\ r(x) = \frac{\bar{r}(\bar{x})}{a} \tag{5}$$

By substituting the non-dimensional variables on (5) into dimensional governing equations (1)-(4), we obtain the non-dimensional equation i.e.:

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0 \tag{6}$$

$$\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} = -\frac{\partial p}{\partial x} + \frac{1}{Re}\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} - Mu + \alpha T \sin A \tag{7}$$

$$\frac{1}{Re}\left(\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y}\right) = -\frac{\partial p}{\partial y} + \frac{1}{Re^2}\frac{\partial^2 v}{\partial x^2} + \frac{1}{Re}\frac{\partial^2 v}{\partial y^2} - \frac{\alpha}{Re^{1/2}} T \cos A - \frac{M}{Re} v \tag{8}$$

$$\frac{\partial T}{\partial t} + u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \frac{1}{\Pr}\left(\frac{1}{Re}\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}\right) \tag{9}$$

2.4 STREAM FUNCTION

In order to connect the flow velocity u in x- direction, and the flow velocity v in y- direction, the stream function is introduced. The stream function is introduced as follow:

$$u = \frac{\partial \psi}{\partial y} \text{and} v = -\frac{\partial \psi}{\partial x} \tag{10}$$

By substituting (10) into (6)-(9), we get:

$$\frac{\partial \psi^2}{\partial x \partial y} = \frac{\partial \psi^2}{\partial y \partial x} \tag{11}$$

$$\frac{\partial^2 \psi}{\partial t \partial y} + \frac{\partial \psi}{\partial y}\frac{\partial^2 \psi}{\partial x \partial y} - \frac{\partial \psi}{\partial x}\frac{\partial^2 \psi}{\partial y^2} = u_e\frac{\partial u_e}{\partial x} + \frac{\partial^3 \psi}{\partial y^3} - M\left(\frac{\partial \psi}{\partial y} - u_e\right) + \alpha T \sin A \tag{12}$$

$$\frac{\partial T}{\partial t} + \frac{\partial \psi}{\partial y}\frac{\partial T}{\partial x} - \frac{\partial \psi}{\partial x}\frac{\partial T}{\partial y} = \frac{1}{\Pr}\frac{\partial^2 T}{\partial y^2} \tag{13}$$

2.5 SIMILARITY VARIABLES

The similarity variables are introduced as bellow:

$$\psi = t^{\frac{1}{2}} u_e(x) f(x, \eta, t), T = s(x, \eta, t), \eta = y / t^{\frac{1}{2}} \tag{14}$$

By applying similarity variableson (14) into stream function governing equations (11)-(13) are obtained

$$\frac{\partial^3 f}{\partial\eta^3}+\frac{\eta}{2}\frac{\partial^2 f}{\partial\eta^2}+t\frac{\partial u_e}{\partial x}\left[1-\left(\frac{\partial f}{\partial\eta}\right)^2+f\frac{\partial^2 f}{\partial\eta^2}\right]+Mt\left(1-\frac{\partial f}{\partial\eta}\right)=t\frac{\partial^2 f}{\partial\eta\partial t}+tu_e\left(\frac{\partial f}{\partial\eta}\frac{\partial^2 f}{\partial\eta\partial x}-\frac{\partial f}{\partial x}\frac{\partial^2 f}{\partial\eta^2}\right)-\alpha ts\frac{\sin A}{u_e} \quad (15)$$

$$\frac{\partial^2 s}{\partial\eta^2}+\frac{\Pr\eta}{2}\frac{\partial s}{\partial\eta}+\Pr t f\frac{\partial u_e}{\partial x}\frac{\partial s}{\partial\eta}=\Pr t\, u_e\left(-\frac{\partial f}{\partial\eta}\frac{\partial s}{\partial x}+\frac{\partial f}{\partial x}\frac{\partial s}{\partial\eta}\right)+\Pr t\frac{\partial s}{\partial t} \quad (16)$$

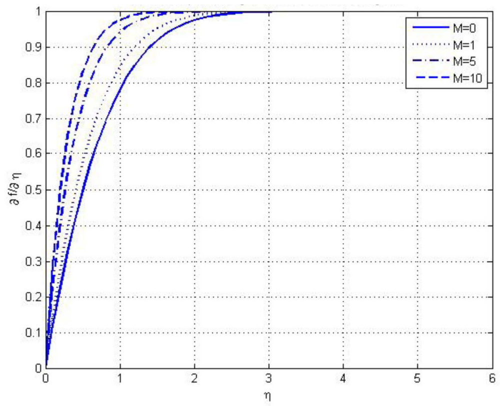
Subjected to boundary conditions:

$$t<0: f=\frac{\partial f}{\partial\eta}=s=0 \text{ for each } x,\eta$$
$$t\geq 0: f=\frac{\partial f}{\partial\eta}=0, s=1 \text{ at } \eta=0$$
$$\frac{\partial f}{\partial\eta}=1, s=0 \text{ at } \eta\to\infty$$

3. RESULTS AND DISCUSSION

This problem is then solved numerically by using Keller-Box method. The method has the following four main steps:

(i) Reduce those equation to a first order equations
(ii) Write the difference equations using central differences
(iii) Linearize the resulting algebraic equation by Newton's Method and write in matrix-vector form
(iv) Use the block tridiagonal elimination technique to solve the linear system [4]



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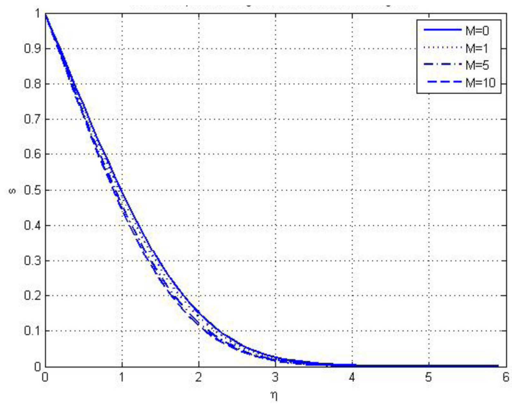
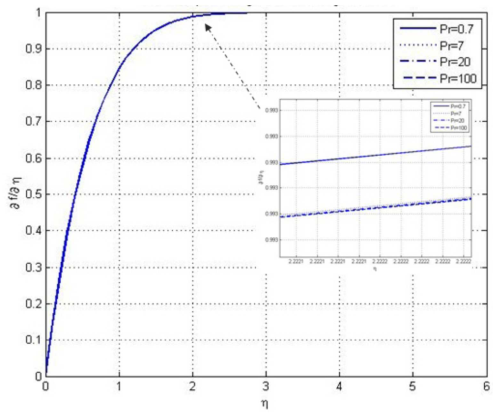


b

Figure 1a.(Velocity profiles with variation of magnetic parameter) 1.b (Temperature profiles with variation of magnetic parameter)



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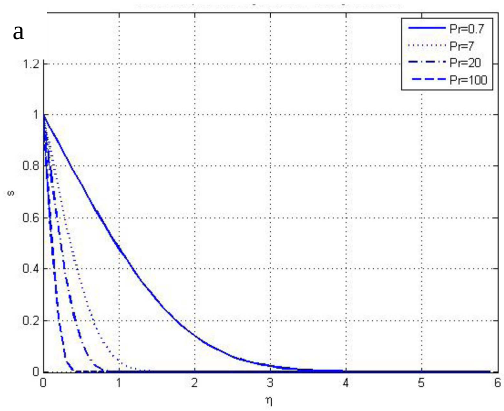

b

Figure 2a. (Velocity profiles with variation of Prandtl Number) 2b. (Temperature profiles with variation of Prandtl Number)

The numerical results obtained including velocity profile and temperature profile near the forward stagnation point for slender orientations. Figure 1a.shows the velocity profiles with variation of magnetic parameter. In this figure, the magneticparameter is 0, 1, 5 and 10. The results show that velocity profiles in Figure 1a. increase when the magnetic parameter increases, there is no values of velocity in negative. Meanwhile the temperatur profile are decreased when magnetic parameter increased, Figure 1b. These result show that the magnetic field on the viscous fluid making the velocity of fluid flow increasing and the temperature decreasing.

In Figure 2a. and Figure 2b. show the velocity and temperature profiles with variation of Prandtl number, respectively.In these figure, the Prandtl number is 0.7 (gas), 7 (water), 20 and 100. Figure 2a. shows that the velocity of fluid at stagnation point decreasing unsignificantly when the Prandtl number increasing. And Figure 2b. shows that the temperature of fluid decreasing when the Prandtl number increasing.

4. CONCLUSION

This paper considers the unsteady Magnetohydrodynamic (MHD) forced convective boundary layer flow and heat transfer of viscous fluid past a elliptic cylinder. From the analysis and discussion of the result, the following conclusions are:

1. The governing equations are developed from continuity, momentum, and energy conservation. Further, those equations are transformed into boundary layer equations and transformed into a non-dimensional form. The resulting nonlinear system of partial differential equations are solved numerically using the Keller-Box method.
2. This research has revealed how the magnetic parameter affect the flow and heat transfer characteristics. The velocity distributions increase and the temperature distributions decrease when the value of magnetic parameter (M) increase. And the velocity distributions decrease unsignificantly and the temperature decrease when the value of Prandtl number increses.

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