ANALYTICAL SOLUTION OF UNSTEADY MHD FREE CONVECTION FLOW OF CASSON FLUID THROUGH A VERTICAL CHANNEL

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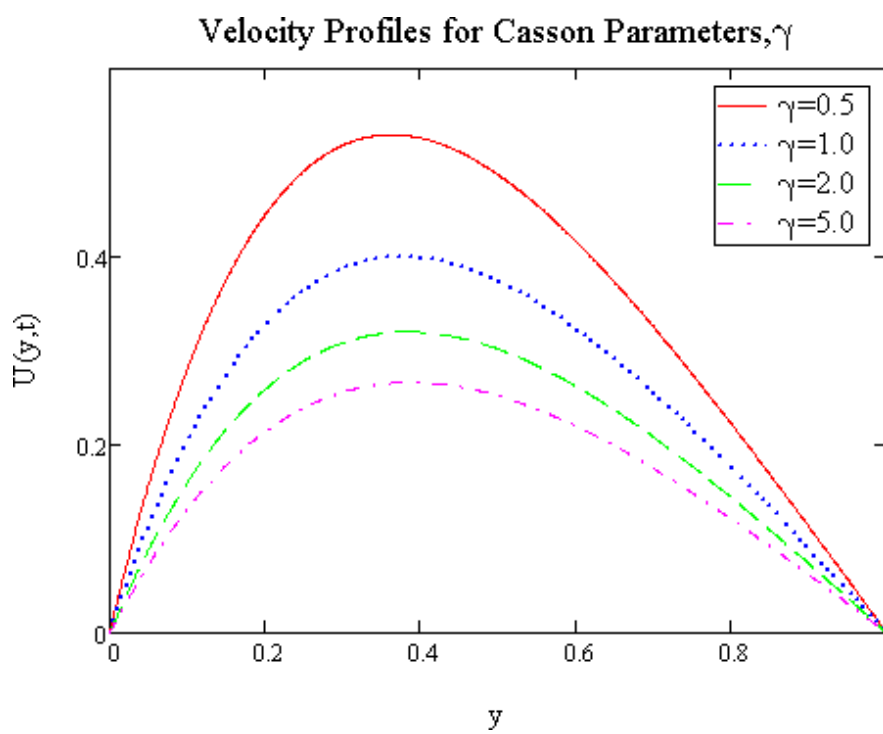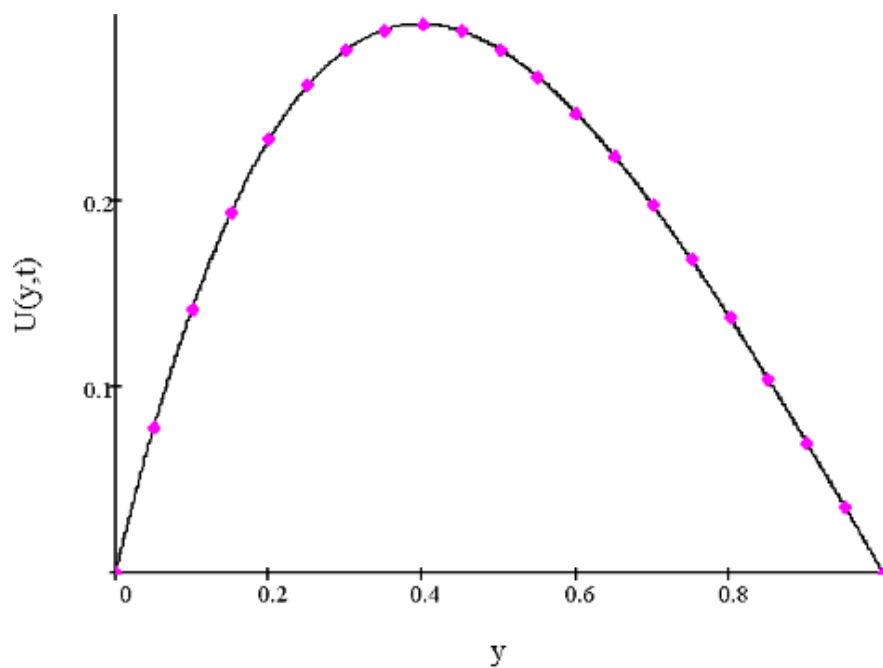
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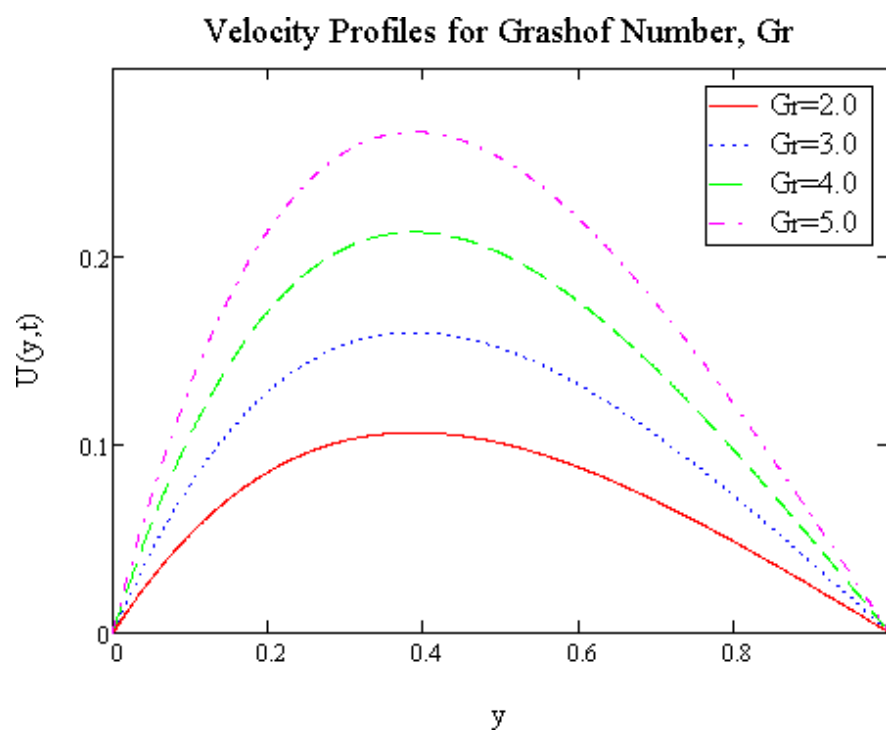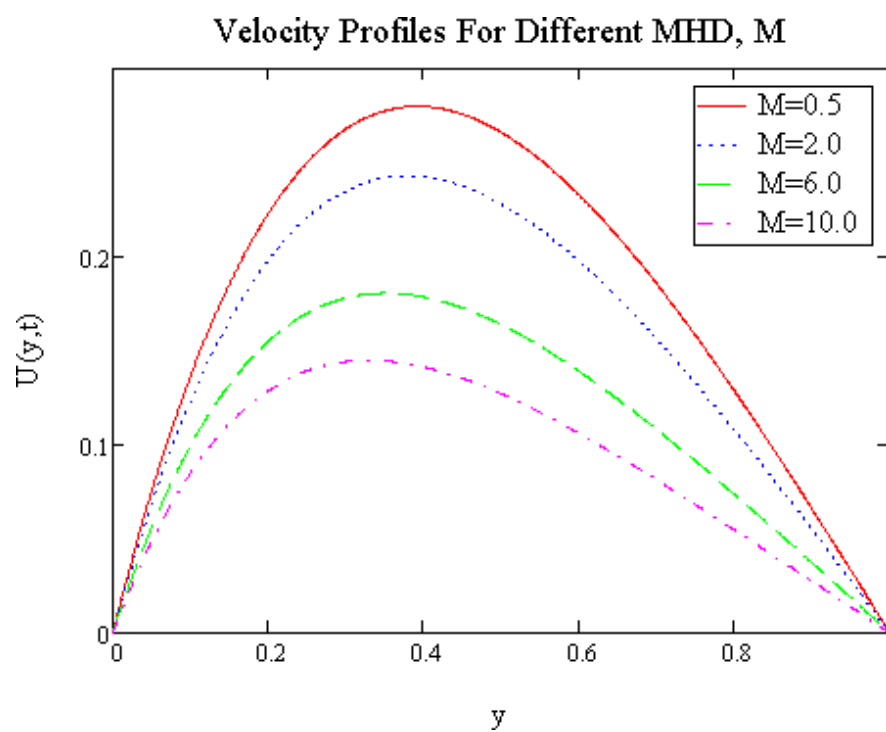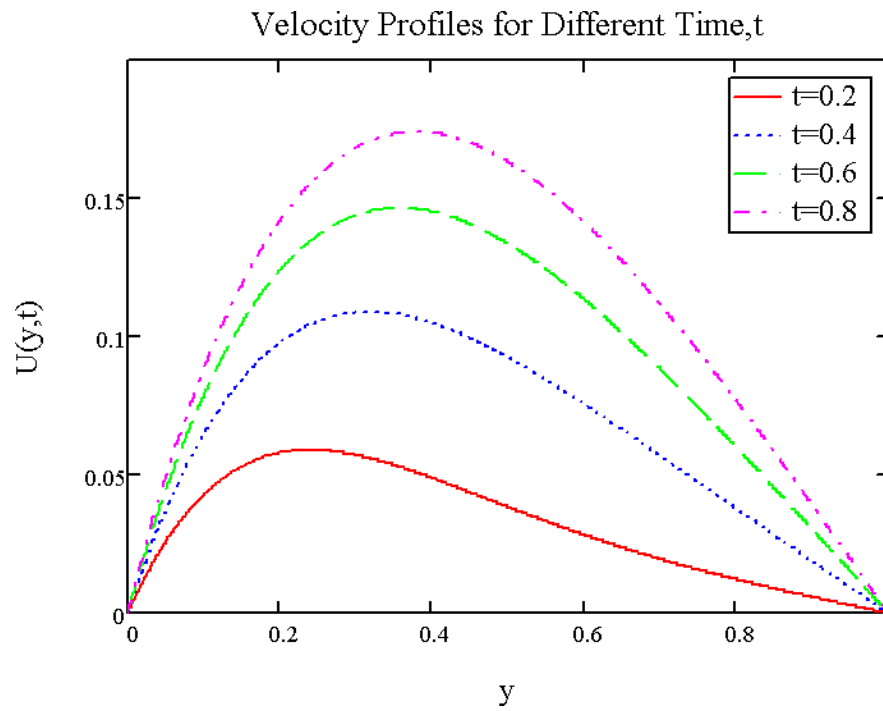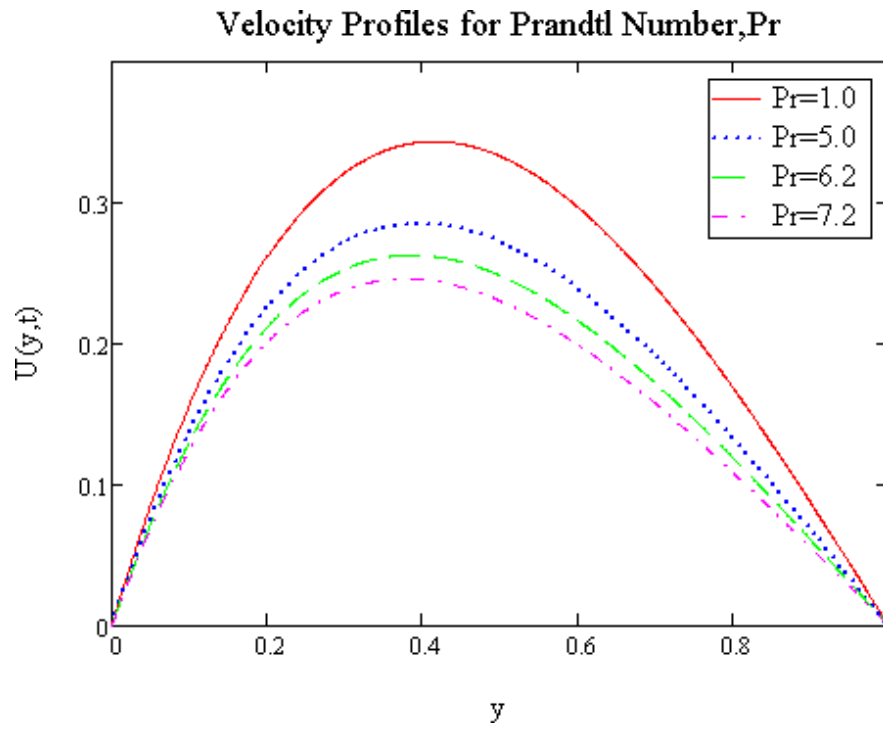
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Abstract

Unsteady flow of Casson fluid past through a vertical channel has been studied by some researchers due to its importance applications in science and technology. Therefore, the main purpose of this paper is to obtain exact solutions for unsteady free convection flows of Casson fluid with effects of magnetohydrodynamics (MHD) past through vertical channel. Dimensional governing equations are converted into dimensionless forms by using appropriate dimensionless variables. Dimensionless parameters are obtained through dimensionless process such as Casson fluid, time, Prandtl number, Grashof number and magnetic field. Laplace transform method is used to solve the dimensionless equations with associated initial and boundary conditions. Solutions for velocity and temperature profiles are obtained. Skin friction and Nusselt number are also calculated. The obtained analytical results for velocity and temperature are plotted graphically to discuss the influence of dimensionless parameters on profiles. It is observed that fluid velocity increases with increases of Grashof number, Gr and time, t whereas it decreases with increases of Casson parameter, γ, magnetic field parameter, M and Prandtl number, Pr. Besides that, it is found that temperature profiles decrease with high value of Prandtl number, Pr while increases with high value of time, t. In order to validate the results, the obtained results in limiting cases are compared with the published results and it is found to be in a mutual agreement.
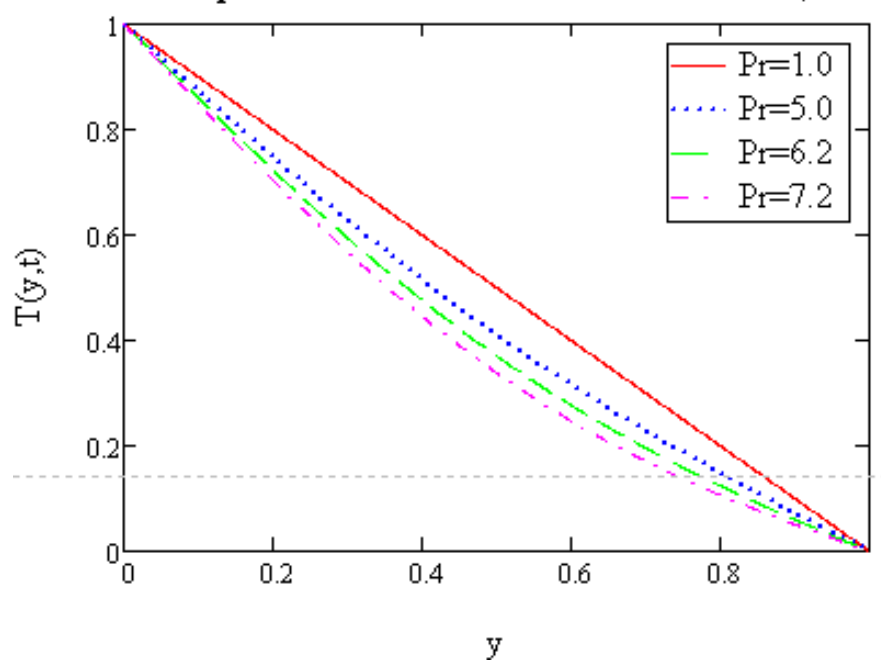
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Velocity Profiles for Casson Parameters, γ

Velocity Profiles For Different MHD, M

Velocity Profiles for Grashof Number, Gr

Velocity Profiles for Prandtl Number,Pr

Velocity Profiles for Different Time,t

Temperature Profiles for Prandtl Number,Pr

Temperature Profiles for Different Time,t