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Recent development in fluid-flow problems: A brief review

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Abstract

This particular article is a collection of some recent research articles on fluid flow problems. The present article summarizes the recent research developments regarding the experimental and theoretical examination about thermal conductivity of different nanofluids. The current investigate analyzes several factors those strongly affecting thermal conductivity of nanofluids include temperature, solid volume fraction, particle type, particle size, particle shape, magnetic field, different base fluids, pH, ultrasonic time and surfactant. Other than, different justifiably attractive models contributing enlargement of thermal conductivity of nanofluids are invoked. Lastly, major heat transfer mechanisms namely Brownian motion, thermophoresis, nanoclustering, interfacial nano-layer and osmophoresis responsible for remarkable role in upgrade the thermal conductivity. Hence the heat transfer characteristics of nanofluids are considered.

Keywords: Heat transfer; Nano-fluid; MHD boundary layer; Stretching/shrinking sheet; Heat source/sink.

1. Introduction

Aldabesh et al. [1] examined the free convection of a viscous electrically conducting fluid past a vertical stretching surface in the presence of a transverse magnetic field. The approximate analytical approach for the study of the steady two-dimensional flow of viscous fluid in the presence of the magnetic field is analyzed in the present investigation. Seth et al. [2] examined numerical solution of unsteady MHD natural convection flow of a viscous, incompressible, electrically conducting and heat absorbing fluid past an impulsively moving vertical plate with ramped temperature embedded in a porous medium in the presence of thermal diffusion is carried out. They conclude that magnetic field and heat absorption tend to retard fluid velocity whereas thermal buoyancy force and thermal diffusion have reverse effect on it and thermal diffusion tends to enhance fluid temperature whereas heat absorption has a reverse effect on it. Samantara et al. [3] have studied flow and heat transfer in a laminar plane wall jet in dusty fluid. They have used perturbation methods to solve the systems of differential equations and have observed that Nusselt number always increases with the increase of the parameters like, diffusion parameter, size of the particles and concluded that heat always transform from fluid to plate in all the cases. Bhukta et al. [4] was carried out analytical evaluation of energy dissipations, such as viscous, Joulian, and Darcy dissipation of viscoelastic flow phenomena over a deformable surface. The results serve as a guideline due to the process of transport properties as per the design requirement. Seth et al. [5] have discussed the effects of hall current and rotation on steady MHD Couette flow of Class-II of a viscous, incompressible and electrically conducting fluid in the presence of a uniform transverse magnetic field. Here also derived some expressions for shear stress at the lower and upper plates due to primary and secondary flows and mass flow rates in the primary and secondary flow directions. Seth et al. [6] have investigated the unsteady hydromagnetic Couette flow of a viscous, incompressible and electrically conducting fluid between two infinitely long parallel porous plates, taking hall current into account, in the presence of a transverse magnetic field. Seth at al. They have concluded that the Hall current tends to retard fluid flow in the primary flow direction throughout the channel and fluid flow in the secondary flow direction in the upper half of the channel. Magnetic field tends to accelerate fluid flow in both the primary and secondary flow

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directions. Samantara [7] have gone through the generation of electricity due to hitting of particles with each other and with the wall of the flow and its impact on motion of flow particles. The systems of equations representing the flow are solved by finite difference method. It concludes from outcome of computation that the particle velocity rises with rise of electricity generation and increasing size of particles. Ray et al. [8] have overdone the flow and heat transfer of dusty flow over a linear stretchable sheet. The effects of radiation and non-uniform heat source or sink have been studied. The formulation consists of systems of nonlinear PDEs which has been converted to a system of ODEs by taking suitable similarity transformations. Then the systems of ODEs have been solved by using Rungakutta method of 4th order. It is concluded that the presence of particles in fluid has some impact on different parameters in flow and heat transfer. The parameters like Eckert number, Fluid- particle interaction parameter, diffusivity parameter have remarkable effects of presence of particles. Pattnaik et al. [9] have considered (MHD) Nano-fluid flow (over a stretching permeable surface (using Buongiorno's Model)) where various parameters effects discussed. Mahato et al. [10] have considered MHD flow and heat transfer of nanofluid over a stretchable surface with melting, where chemical reaction effects discussed. Such nanofluid flows find applications in heat transfer processes, pharmaceutical processes, domestic refrigerators, heat exchanger, engine cooling, vehicle thermal management etc. Heat radiating, electrically conducting, incompressible, steady flow of a viscous and chemically reacting nano-fluid past a stretching sheet, with melting, in the presence of an applied transverse magnetic field, examined by Mahato et al. [11]. Das et al. [12] have gone through the radiation effects on the unsteady MHD free convection flow past in an infinite vertical plate with heat source. The governing equations are solved for the velocity field & temperature by using perturbation technique in terms of dimensionless parameters. Mishra et al. [13] have studied an analysis on flow and heat transfer with in a two-dimensional unsteady radiative boundary layer with fluid-particle interaction. The impacts of various parameters on the flow field have been discussed and determined the heat transfer characteristics. The stronger electric filed significantly enhances the temperature of both fluid and particle phase, which occurs more heat transfer on the surface. Pattnaik et al. [14] developed a non-Newtonian model by examine the flow of Newtonian Casson fluid over an expanding cylinder embedded in a porous medium which operate the combination of dissipative heat and the extra heat source that lift the heat transport phenomenon. They discover that the magnetic restriction and permeability enhance the shear rate coefficient, while the Casson parameter provided the contrasting influence and moreover the non-Newtonian Casson parameter hold up the fluid temperature. The impact of dissipative heat energy on the passage of an electrically conducting viscous fluid past a shrinking sheet is examined. They conclude that a higher suction is required to resist the fluid temperature and sinks as well as the dissipative heat energy favors enhancing the fluid temperature at all points in the flow domain by Acharya et al. [15]. Seth et al. [16] examined the unsteady MHD Couette flow of a viscous, incompressible and electrically conducting fluid between two parallel porous plates, taking Hall current into account, in the presence of a transverse magnetic field. They have concluded that fluid flow within the channel is induced due to accelerated movement of the lower plate of the channel and magnetic field is assumed to be fixed relative to the moving plate. Hall current tends to retard fluid flow in primary flow direction whereas it tends to accelerate fluid flow in secondary flow direction in the region near the stationary plate, also hall current tends to enhance primary shear stress at the moving plate whereas magnetic field has a reverse effect on it. Seth et al. [17] examined the effects of hall current and rotation on combined free and forced convection Couette-Hartmann flow of a viscous, incompressible and electrically conducting fluid in the presence of a uniform transverse magnetic. They have concluded that hall current and rotation tend to enhance fluid temperature, magnetic field tends to reduce fluid temperature, thermal buoyancy force tends to reduce fluid temperature when the walls of the channel are heated and it has reverse effect on fluid temperature when the walls of the channel are cooled. Thermal diffusion tends to reduce fluid temperature whereas viscous dissipation has reverse effect on it. Magnetic field and rotation tend to enhance both the primary and secondary shear stress at the moving plate. Tripathy et al. [18] have analyzed flow and heat transfer mixed convective boundary layer particle laden flow past an exponentially stretchable permeable surface. The flow was originated due to the surface stretched exponentially. A two-phase radiative transfer equation (RTE), considering radiation by both fluid and particle phase is considered for formulation of the problem. The heat transfer is significantly influenced with the combined effect of thermal conductivity, buoyancy force and radiation by both fluid and particle phases. Kanungo et al. [19] have gone through a parametric study to investigate the impact of electrification and radiation inside a thermal particulate boundary layer, where the flow is due to an unsteady stretching sheet in presence of non-uniform heat source/sink.it is concluded that the presence of particles in fluid has greater impacts on flow and heat transfer profiles. Jena et al. [20] enlarged a mathematical model and a survey made for flow of Casson fluid a non-Newtonian model over a cylinder in a porous medium. They conclude that Casson fluid parameter improved cutis friction coefficient yet slow up momentum and temperature distributions also Nusselt number. Jena et al. [21] scrutinized the steady boundary layer MHD stagnation-point flow past a stretching sheet through porous media with heat source /sink. They conclude that the existence of magnetic field produces a Lorentz force of electromagnetic origin, which is a drag force, hence the velocity decreases. Mahatha et al. [22] have considered MHD stagnation point nanofluid flow over a stretchable melting surface where thermal radiation, chemical reaction, viscous and Joule dissipative effects discussed. Various type of heat transfer processes, heat exchangers, engine cooling, vehicle thermal management etc. are the applications of these nano-fluid flows. Mahatha et al. [23] have considered MHD stagnation point nano-fluid flow (Over a stretchable melting surface) where radiation and dissipative effects examined. They concluded that velocity of nanofluid increased by radiation, velocity ratio parameter and magnetic field and decreased by thermal diffusion, thermophoretic diffusion, Brownian diffusion, viscous dissipation and melting of the sheet. Mishra et al. [24] have gone through the flow and heat transfer of dusty flow over a linear stretchable sheet has been analyzed. The effects of radiation and non-uniform heat source or sink.it is concluded that the presence of particles in fluid has some impact of different parameters in flow and heat transfer. The parameters like Eckert number, Fluid- particle interaction parameter, diffusivity parameter have remarkable effects of presence of particles. Kanungo et al. [25] have studied particle laden boundary layer flow with existence of electrification of particles has been studied over an inclined permeable stretching sheet. it was concluded that the presence of particles in fluid has greater impacts on flow and heat transfer profiles. Recently, Mahato et al. [26] studied "Radiative and Convective Heat Transfer on MHD Stagnation point Nanofluid Flow past a Stretchable Surface with Melting". In the presence of thermal stratification, the impact of thermal radiation and Joule heating due to the magnetohydrodynamic (MHD) flow of nanofluid against a nonlinearly stretching sheet with variable thickness are investigated by Pattnaik et al. [27]. Samantara et al. [28] have studied the impact of electrification of suspended particles in a fluid flow and heat transfer. It is concluded that electrification of particles reduces the numerical value of velocity of fluid and temperature of fluid and particles. So, it reduces heat transfer and skin friction. Further the increase of Prandtl number (Pr) results in the decrease in temperature distribution. Qasim et al. [29] examined about mass and heat transfer in nanofluid over an unsteady stretching sheet using Buongiorno's model, where the Nusselt number is increased the temperature at the surface decreases with the Prandtl number. By increasing the Prandtl number the thermal limit layer thickness decreases. The axial velocity is strong in the hydromagnetic boundary layer while the magnetic field is absent, and vice versa. Mahanthesh et al. [30] investigated MHD three-dimensional flow of nanofluids with slip and thermal radiation over a nonlinear stretching sheet. For the influence of mixed convection, the response of x- and y-components at the momentum boundary layer thickness is qualitatively opposite. Temperature at the boundary layer decreases with an increase in the mixed convection parameter. Transverse velocities and influence on axial of stretching ratio parameter is opposite. Verma et al. [31] have examined numerically a steady 2-D viscous Cu-water and Ag-Water nanofluid in a porous medium. A mathematical model and calculation to analyze simultaneously 3-models for rate of viscous flow, heat transfer including other effects has been studied in this problem.

2. Conclusion

A specific review on fluid flow in different flow geometries considering the effects of various flow parameters has been carried out. Some of the important outcomes of the present study is that, nanofluid shows a greater rate of heat transfer as compare to normal fluid. Temperature profiles are largely affected by different parameters like, convection (free and forced), radiation, Grashof number, Prandtl number etc. These fluid flow problems have their applications in many engineering as well as geophysical and astrophysical problems of interests. Present study may provide the readers a brief idea about the fluid flow and heat transfer problems.

Compliance with ethical standards

Disclosure of conflict of interest

There is no conflict of interest among the authors.

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