Cooling problems assume growing importance in the development of high speed vehicles. It is well known that part of the power which is necessary to overcome the drag of the vehicle is converted into heat by internal friction within the boundary layer which surrounds the vehicle. This heat flows partially from the air layer into the surface of the vehicle by an amount which increases rapidly with the increase of vehicle speed. As a consequence cooling problems arise in almost every component of the space vehicle. The basis for any calculation in engineering-design, the aim of which is to determine the cooling requirements, is always a determination of the convective heat transfer from the heated boundary layer into the skin of the space vehicle. Engineering processes in which a fluid supports an exo-thermic chemical or nuclear reaction are very common today, and the process design requires accurate correlations for the heat transfer coefficients at the boundary surfaces. Free convection is a phenomenon often occurring in nature and also in industrial processes, wherever heated surfaces immersed in fluids are involved. If the fluid be already in motion due to other external causes such as a pressure gradient or the motion of the solid surface, the flow is frequently referred to as due to
combined free and forced convection and has been quite an interesting subject of study. The phenomenon of heat transfer is encountered in almost all branches of technology. The MHD aspect of heat transfer in channel flow has been discussed by many researchers. MHD channel flows have a number of important applications such as MHD power generators, electromagnetic flowmeter and electromagnetic accelerators. The last device is used extensively in connection with nuclear power reactor to pump liquid sodium as a coolant. In this thesis, an attempt is made to study the temperature distribution in various configurations of the flow of a viscous, incompressible and slightly conducting fluid.

CHAPTER 1: MHD COMBINED FREE AND FORCED CONVECTION FLOW THROUGH TWO PARALLEL POROUS WALLS

In this chapter we have studied the combined effects of free and forced convection on the flow of an incompressible viscous conducting fluid between two horizontal insulated parallel walls, one of which is at rest and the other moving parallel to itself with a linear axial temperature variation, under the uniform transverse magnetic field. We have evaluated the velocity and temperature distributions, the coefficients of skin friction and the rates of the heat transfer coefficients at both the walls. We have investigated the effects of magnetic field, Grashoff number, Brinkman
number and the suction Reynolds number on the above mentioned physical quantities.

TO APPEAR IN "ACTA MECHANICA" (1982)

CHAPTER II: HYDROMAGNETIC CHANNEL FLOWS UNDER PERIODIC RATE OF HEAT GENERATION WITH HALL EFFECTS

In this chapter the flow of an electrically conducting viscous incompressible fluid between two insulated parallel flat plates at a distance 2h in the presence of uniform transverse magnetic field is considered. Temperature distributions are derived with the conditions that the plates situated at $y = \pm h$ (i) have zero initial temperatures and (ii) are always being kept at zero temperatures. Effects of viscous dissipation are taken into account and the rate of heat generation per unit volume is taken to vary periodically with time. The effects of Hall and magnetic parameters and Reynolds number R are investigated on velocity and temperature distributions and also on heat transfer coefficients. We have also investigated the effect of Prandtl number $P_r$ on temperature distribution and on the rate of heat transfer.

TO APPEAR IN "REGIONAL JOURNAL FOR ENERGY, HEAT AND MASS TRANSFER", Vol. 3(2)
CHAPTER III: HYDROMAGNETIC UNSTEADY FLOW THROUGH A
POROUS MEDIUM IN A CONSTRUCTED CHANNEL

In this chapter, unsteady flow of viscous incompressible and conducting fluid through a porous medium in a constricted channel under the influence of uniform transverse magnetic field, is studied. Velocity, the coefficient of skin friction and temperature distribution and the rate of heat transfer are evaluated. The effects of porosity parameter $K$ and the magnetic parameter $M$ on the above said physical quantities are investigated.

COMMUNICATED TO "ACTA MECHANICA"

CHAPTER IV: HALL EFFECTS ON MHD FLOW THROUGH A
POROUS STRAIGHT CHANNEL

In this chapter, the effect of Hall currents on the flow of a viscous incompressible slightly conducting fluid through a porous straight channel under a uniform transverse magnetic field is considered. The pressure gradient is taken as constant quantity and the case of steady flow is obtained by taking the time since the start of the motion to be infinite. We have evaluated skin friction at both the plates, the temperature distribution and the coefficients of heat transfer at both the plates. We have investigated the effects of Hall parameter, magnetic parameter and Reynolds number on the above physical quantities. We have
also evaluated velocity distribution when the pressure
gradient (i) varies linearly with time and (ii) decreases
exponentially with time.

COMMUNICATED TO "DEFENCE SCIENCE JOURNAL"

CHAPTER V: HYDROMAGNETIC TRANSIENT FLOW OF VISCOELASTIC
FLUID DOWN AN INCLINED PLANE

In this chapter, we have discussed the flow of
viscoelastic fluid of Maxwell type down an inclined plane
under the influence of uniform transverse magnetic field.
The fluid is supposed to be flowing through two heated
parallel planes which are inclined. The lower plate is
fixed and the upper plate is moving with a transient
velocity. We have evaluated velocity, liquid discharge
per second, drag, temperature distribution and heat transfer.
We have investigated the effects of magnetic field,
relaxation time and Prandtl number on the above physical
quantities.

PRESENTED IN 51st CONFERENCE OF "NATIONAL ACADEMY OF
SCIENCES", INDIA.
CHAPTER VI: MAGNETOHYDRODYNAMIC FREE CONVECTION LAMINAR FLOW OF AN INCOMPRESSIBLE VISCOELASTIC FLUID

In this chapter, we have studied the hydromagnetic free convection effects on laminar flow of an incompressible conducting viscoelastic fluid. The main motivation of this work is to find how the flow past an infinite vertical flat plate in the free convection currents is affected by the variable suction under the influence of uniform transverse magnetic field. The method of solution is the one suggested by Lighthill [1], Stuart [7] and Massiha [2]. We have found the velocity distribution, its fluctuating parts, skin friction its amplitude and phase, temperature distribution, its fluctuating parts, transient temperature and the rate of heat transfer coefficient, its amplitude and phase. The flow phenomena have been characterised by the non-dimensional numbers magnetic parameter $M$, Prandtl number $Pr$, Grashoff number $C$ and viscoelastic parameter $S_e$. We have investigated the effects of these parameters on the above said physical quantities for both constant and variable suction.

COMMUNICATED TO "APPLIED SCIENTIFIC RESEARCH".