CONCLUSION

The thesis entitled, 'Numerical/analytical solutions of generalized Crane's problems involving continuous moving surface', considered the two-dimensional boundary layer flow of an incompressible fluid, obeying the power-law model past a non-linear stretching sheet coinciding with the plane y =0. The flow is generated by the action of two equal and opposite forces along the x-axis so that the wall is stretched and y-axis being normal to the flow. Temperature dependent fluid properties namely, the fluid viscosity and the fluid thermal conductivity are assumed to vary with temperature. The governing time dependent boundary layer equations are transformed to coupled, non-linear ordinary differential equations with power-law index, unsteady parameter, film thickness, magnetic parameter, injection parameter, variable thermal conductivity parameter, thermal radiation parameter, the Prandtl number and the Eckert number. These coupled non-linear equations are solved numerically by an implicit, finite difference scheme known as the Keller box method. The numerical solutions are helpful to understand the heat flow and mass transfer mechanisms of the power law fluid and would find many applications in technological and material processing industries such as polymer extrusion, wire and fiber coating, food stuff processing. Some of the interesting results are as follows:

1. The effect of increasing values of power-law index is to decrease the velocity profile as well as the thermal boundary layer thickness.
2. The effect of increasing values of velocity exponent parameter is to reduce the horizontal velocity and the temperature profile.
3. The increasing value of temperature exponent parameter and modified Prandtl number is to decrease the temperature profile.
4. The effect of increasing values of variable viscosity parameter is to reduce the velocity boundary layer thickness, whereas to enhance the thermal boundary layer thickness. This observation holds for all values of the power-law index.
5. The effect of increasing values of the unsteady parameter S is to reduce the velocity as well as the thermal boundary layer thickness, even in the presence of variable fluid parameters.

6. The effects of heat source/sink parameter and the Eckert number are to enhance; whereas the effect of the Prandtl number is to reduce the thermal boundary layer thickness for all values of the power-law index.
7. The effect of increasing values of thermal Grashoff number Gr leads to enhance the horizontal velocity profile.
8. The combined effects of increasing the values of thermal Grashoff number Gr, the mass Grashof number (modified Grashof number) Gc, is to reduce the temperature profile significantly on the boundary sheet.
9. An increase of the reaction rate parameter and wall concentration parameter reduces the thickness of the species distribution. This holds good for all values of the power-law index.
10. The effect of increasing values of material parameter is to increase the velocity and hence enhances the boundary layer thickness. This phenomenon holds for all values of injection parameter namely, suction, impermeability and the blowing of an elastic sheet.
11. The effect of increasing values of heat source/sink parameter is to decrease the wall temperature gradient in PST case whereas its effect is to increase the wall temperature in PHF case.
12. The effect of increasing values of unsteady parameter S is increases the horizontal boundary layer thickness as well as thermal boundary thickness and for a given value of S, the pseudo plastic (shear thinning fluids) film is thinner and exhibits a greater surface velocity than a Newtonian film, while quite reverse behavior is true for shear thickening (dilatant) fluids.
13. The effect of increasing values of the magnetic parameter is to increase the thermal boundary thickness. This is due to the fact that, the introduction of transverse magnetic field to an electrically conducting fluid gives rise to a resistive force known as the Lorentz force. This force, forces the fluid to experience a resistance by increasing the friction between its layers, and due to this there is an increase in the temperature. This behavior holds for all types of fluids considered, namely, pseudo plastic, Newtonian, and dilatant fluids.
14. The temperature distribution is lower throughout the boundary layer for zero values of thermal conductivity parameter as compared with non-zero values

of ε. This is due to the fact that the presence of temperature-dependent thermal conductivity results in reducing the magnitude of the transverse velocity by a quantity. This behavior holds for all types of fluids.

For the validation of the numerical procedure, numerical results are obtained for Newtonian fluid (i.e., when n = 1) and are compared with the available results in the literature (*Aziz et al.* [2011], *Wang* [2006], *Noor et al.* [2010], *Grubka and Bobba* [1977], *Chen* [1988], *Ali* [2006], *Andersson and Kumaran* [2006] and *Prasad et al.* [2009]) and found to be in excellent agreement. Some of the limiting cases to the problems are mentioned below:

- For a Newtonian fluid flow over a linearly stretching sheet n = 1, m =1 and r = 1, the equation (3.10) and (3.11) are reduces to those of *Gupta and Gupta* [1977] and *Grubka and Bobba* [1985]. For $n \neq 1$ and when there is no heat transfer the equation (3.10) reduces to *Andersson and Dandapat* [1991].
- For a Newtonian fluid with constant thermal conductivity $n = 1, \varepsilon = 0$, $S = 0$ and $\theta_r \to \infty$, the equations (4.19) and (4.20) reduce to those of *Anjali Devi and Thyagarajan* [2006]. However, for the non-Newtonian power-law fluids, when there is no heat transfer, the equations (4.20) reduce to that of *Andersson et al.* [1992]. Further, when the unsteady parameter and the Eckert number are absent, and $\theta_r \to \infty$, equations (4.20) and (4.21) are similar to the ones studied by earlier researchers for Newtonian fluid case.
- In the absence of mass transfer when $Gr = 0$ and $Gc = 0$ equations (5.11) and (5.12) reduce to those of *Hassanien et al.* [1998], while for a Newtonian fluid (n = 1) in the presence of mass transfer, the equations reduce to those of *Andersson et al.* [1994]. Also, in the presence of thermal buoyancy for the power-law fluid flow, without mass transfer, the equation (5.11) and (5.12) reduces to those of *Prasad et al.* [2009].
- For n = 1, $\varepsilon = 0$ and $\mathrm{Nr} = 0$, the equations (7.19) and (7.20) reduce to those of *Abel et al.* [2009]. However, in the presence of a non-Newtonian power-law fluids and when there is no heat transfer, equation (7.19) reduces to that of *Andersson et al.* [1996]. Further, when the unsteady parameter and the Eckert number are absent,

equations (7.19) and (7.20) are similar to the ones studied by *Datti et al.* [2004] for Newtonian fluid case.

- Similar to the above, for Newtonian fluid with constant thermo-physical properties i.e., $n = 1$, $\varepsilon = 0$ and as $\theta_r \to \infty$, the equations (8.20) and (8.21) reduce to those of *Subhas Abel et al*.[2009]. However, for the power law fluids, when there is no heat transfer, equation 8.20) reduces to that of *Andersson et al.*[2000].
- Further, for Newtonian fluid, constant thermal conductivity, absence of nano particles and without mass transfer ($n = 1, \varepsilon_1 = 0, N_b = N_t = 10^{-5}$) and in the absence of thermal radiation, the equations (9.16)-(9.18) reduce to those of *Subhas Abel et al*. [2009]. However, in the presence of a non-Newtonian power-law fluids and when there is no heat transfer, equation (9.16) reduces to that of *Andersson et al*. [1996]. Further, when the unsteady parameter, nano particles and mass transfer are absent, equations (9.16)-(9.18) are similar to the ones studied by *Datti et al*. [2004] for Newtonian fluid case.