CHAPTER - 9

CONCLUSIONS AND SUGGESTIONS FOR FUTURE WORK
9.1. Conclusions

I have considered Sumudu transform methods. Homotopy perturbation Sumudu transform method, Sumudu decomposition method and homotopy analysis Sumudu transform method have been developed and applied to obtain the solutions of various nonlinear equations.

The solution of the problem of two-dimensional and axisymmetric unsteady flows due to normally expanding or contracting parallel plates by homotopy perturbation Sumudu transform method is discussed.

We have used a simple recursive algorithm based on the homotopy perturbation Sumudu transform method which produces the series solution of MHD boundary-layer equations for stretching sheet problem. It is observed that when magnetic parameter M, increases, the velocity profile is more and more far away from the wall, and the boundary layer thickness is more and more thicker.

A simple recursive algorithm based on the homotopy perturbation Sumudu transform method is presented. This method produces the series solution of the two-dimensional viscous flow due to shrinking sheet. The difficulty of the condition at infinity is overcome by the use of Padé approximants.

We have presented a simple recursive algorithm based on the homotopy perturbation Sumudu transform method, which produces the series solution of the two-dimensional viscous flow between slowly expanding or contracting walls with weak permeability.
The homotopy perturbation Sumudu transform method, the Sumudu decomposition method and the homotopy analysis Sumudu transform method are applied to find the approximate solutions of nonlinear equation governing the thin flow of a third grade fluid down an inclined plane. A graphical comparison of the numerical results obtained from these methods is also presented. It is shown that as we decrease the non-Newtonian parameter β the solution converge to the Newtonian case.

The homotopy perturbation Sumudu transform method is used to find velocity, heat transfer and pressure variation profiles of steady three-dimensional Walter’s B fluid in a vertical channel with porous wall. The effect of various Elastic number (S) on \( F(\eta) \) and \( F'(\eta) \) is shown.

Two analytical techniques namely the homotopy perturbation Sumudu transform method and homotopy analysis Sumudu transform method are presented to obtain the approximate solutions of nonlinear equation governing Jeffery-Hamel flow. It is observed that (i) When \( \alpha > 0 \) and steep of the channel is divergent, increase in the values of Reynolds number decreases the velocity when \( \alpha = 3^\circ \). (ii) When \( \alpha < 0 \) and the steep of the channel is convergent, the velocity increases with the increase in Reynolds number as depicted when \( \alpha = -5^\circ \). (iii) When Reynolds number is fixed, there is an inverse relation between divergence angle of the channel and the velocity of the fluid.
It is worth mentioning that the proposed techniques are capable of reducing the volume of the computational work as compared to the classical methods while still maintaining the high accuracy of the numerical result; the size reduction amounts to an improvement of the performance of the approach. Coupling of semi-analytical methods with Sumudu and Laplace transforms gives less time consuming consequences and less C.P.U time (Processor 2.65 GHz or more and RAM-1 GB or more) for solving nonlinear problems. It is shown that the techniques are very powerful and efficient in finding analytical as well as numerical solutions for wide classes of linear and nonlinear partial differential equations arising in science and engineering.

9.2. Suggestions for Future Work

On the basis of the present study and our current understanding of Newtonian and non-Newtonian fluid flows, the following recommendations are made with respect to future work:

1. In view of the importance of fluid dynamics, it is recommended to study the Newtonian and non-Newtonian fluid flows in different geometries, especially the flows past parallel plates, through channels etc. with heat and/or mass transfer and to study non-linearity caused by interdependence between the transport properties of a fluid and it’s, thermodynamic state. Laminar flow problems can be studied by taking the boundaries of the fluid domain porous/non-porous and the flow is caused by injection/suction/moving boundaries.
2. The governing equations of motion, the Navier-Stokes equations are highly non-linear. The class of flows, which admits exact analytical solutions of these Navier-Stokes equations, is extremely narrow. Thus one has to fall back upon either a numerical solution or an approximate analytical solution. Further even if one is able to obtain an exact analytical solution, it is likely to be extremely complicated. Hence it is highly desirable and natural to seek numerical and approximate solutions of the flow problems. The Sumudu transform techniques and numerical techniques can be used in anglicizing depending upon the model.

3. Further, programming languages is to be developed in Maple, Matlab and Mathematica for Sumudu transform techniques and numerical techniques to study the fluid flows in different geometries.