## Electives –III (Any One) COMPUTATIONAL METHODS IN THERMAL ENGINEERING

Introduction: Concepts of consistency, stability, and convergence of numerical schemes. Various finite difference and finite element methods and their applications to fundamental partial differential equations in engineering and applied sciences. Case studies selected from fluid mechanics and heat transfer. ; Finite Difference Method: Classification, Initial and Boundary conditions, Forward, Backward difference, Uniform and non-uniform Grids, Grid Independence Test. Basic finite difference schemes. Boundary treatments. Fourth order RK methods and Predictor-corrector methods and Nachsheim-Swigert iteration with applications to flow and heat transfer. ; Parabolic and hyperbolic problems: Model problems and stability estimates. Examples of the methods of lines. The Lax-Richtmyer equivalence theorem. Stability analysis. Discrete Fourier series. Von- Neumann stability analysis. Consistency, convergence and error estimates. Keller Box and Smith's method with applications to thermal boundary layers. ; Convection dominated problems: The failure of standard discretization, Upwinding and Higher order methods.

## Books:

- K.Muralidhar and T.Sundararajan, "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi1995.
- P.S., Ghoshdasdidar, "Computer Simulation of flow and heat transfer" TMH Ltd., 1998.
- S.V. Patankar, "Numerical heat transfer fluid flow", Hemisphere Publishing Co, 1980.
- **4.** D.A. Anderson, I.I. Tannehill, and R.H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Hemishphere Publishing Corporation, New York, USA, 1984.
- **5.** C.A.J. Fletcher, ,"Computational Techniques for Fluid Dynamics
- 6. Fundamental and General Techniques, Springer-Verlag, 1987.
- 7. T.K. Bose, "Numerical Fluid Dynamics" Narosa Publishing House, 1997.