Course Title: PhD Coursework (Syllabus) in Mathematics

Department Of Mathematics, Rabindranath Tagore University (RTU), Hojai, Assam

Fluid dynamics Credit 4

Unit 1: Hydro Dynamics: (Marks-20)

General Orthogonal curvilinear coordinate, gradient of scalar point function, Divergent and curl of vector point function in orthogonal curvilinear coordinate system with deduction in different coordinate system, Eulerian and Lagrangian methods of describing fluid motion, Material , local and convective derivative, differential equations of stream liner and path lines, Euler and Lagrange equation of continuity , Physical significant of equation of continuity.

Unit2: Navier Stokes Equation: **(Marks-20)**

Similarity Principle and dimensional analysis, with applica- tions, Physical importance of non-dimensional Parameters, important non-dimensional co-eff icients in the dynamics of viscous fluids, Lubrication theory, Idea of singular and regular Pertu- rbation, Method of multiple scales adopted in solving singular Perturbation problems.

Unit-3: **Heat transfer in fluid**: **(Marks-20)**

Idea of thermal boundary layer, fee and forced convection energy equations, theory of similarity in heat transfer the thermal boundary layer equation in two dimensional flow, Exact

solutions for the problem of temperature distribution in a viscous flow (Coutte flow, Poiseuille flow through channel with flat walls and Poiseuille flow through circular pipe). Effect of Prandll number free convection from a hot vertical plate, thermal energy integral equation.

Unit-4 : Magneto-hydrodynamics: (Marks-20)

Introduction, Maxwell's Electromagnetic field equation. Equation of motion of a conducting fluid. Rate of flow of charge. The magnetic Reynolds number, Alfven's theorem. The magnetic body force, Laminar flow of a Viscous conducting fluid between parallel walls in transverse magnetic field. Hartmann problem, Equation of continuity of charge, Magnetic Induction Equation.

Text Books:

1. Laminar boundary layers . edited by l. Rosenhead.
2. Boundary layer theory by H. Schlichting, McGraw-Hill pub Co.
3. Perturbation technique, in fluid Mechanics by Milton Von Dyke, Academic press.
4. A text Book of Fluid Dynamics by F. Charlton, CBS.
5. Fluid Dynamics, 3rd edition, Schaum's Series.
6. Fluid Dynamics by M.D. Raisinghnia S. Chand.

Paper Name: Dynamical Systems

Total Credit: 4

Total Marks: 100 (Internal Assessment 20+ Final 80)

Unit-1: Continuous Dynamical Systems **Marks 20**

Continuous Dynamical Systems, The existence and uniqueness theorem, Fixed point of a system, Analysis of one dimensional flow, Conservative and Dissipative dynamical system, Plane Autonomous system, Phase Plane Analysis, Local stability of two dimensional linear systems, Linearization at a fixed point, The Linearization Theorem, Limitation of linearization.

Unit-2: Stability theory and Oscillations **Marks 20**

Stability of linear systems, Methods for stability analysis, Stability of linearized systems, Oscillatory solutions, Periodic solutions, Limit cycles, Poincare-Bendixson theorem, Applications in infectious diseases, Predator-Prey systems, Competitive species**.**

Unit-3: Bifurcation Theory **Marks 20**

Bifurcations in one and two-dimensional systems: Saddle-Node Bifurcations, Transcritical Bifurcation, Pitchfork Bifurcation, Hopf Bifurcation, Homoclinic and Heteroclinic Bifurcations, Lorenz System and Its Properties.

Unit-4: Discrete Dynamical System **Marks 20**

Maps and flows, Orbits, Phase portraits, Fixed points, Stable and unstable fixed points, Basin of attraction and basin of boundary, Linear stability analysis, Cobweb diagram, Periodic points, Periodic cycle, Stability of periodic points and periodic cycle, Discrete logistic model.

Text Books:

1. G.C. Layek, An Introduction to Dynamical System and Chaos, Springer, 2015.
2. M.W. Hirsch, S. Smale, R. L. Devaney, Differential Equations, Dynamical Systems & An Introduction to Chaos, Second Edition, Elsevier Academic Press.

Reference Books:

1. D. K. Arrowsmith and C.M. Place. Dynamical Systems, Differential Equations, Maps and chaotic Behaviour – Chapman and Hall, London.