C3.3 Differential equations-II and Mechanics

Theory Paper, Full Marks: 100, Total Credit:6=5+1(Th+Tutorial), No. of classes per week:6(=5+1)
Paper Code: HMTCR3071T

Module-I: Differential Equations-II (39 classes)

Course Objective: *To learn the analysis of solutions of non-linear second order ODE, the system of first order ODE, Sturm-Liouville methods and its applications. To learn various methods of solving first order quasi-linear PDE specially the method of characteristics.*

Non-linear second order ode: Equilibrium points, Interpretation of the phase plane, Critical points and their classification. Prey- predator model and its analysis, Epidemic model of influenza and its analysis, Battle model and its analysis.

Sturm-Liouville problems and its application in bending moment.

Total differential equations: conditions of integrability, exactness and techniques of solving them.

Partial Differential Equations – Basic concepts and Definitions, Mathematical Problems. First Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining general Solution of quasi linear equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.

NOTE: Teaching aid would be given if time & equipment constraints (like available software) permit**.**

References:

(1) S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004**.**
(2) T. Amarnath --An elementary course in Partial Differential Equations,2nd Ed.,Narosa.
(3) Mac Owen: Methods and Applications of Partial Differential Equations.
(4) Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.
(5) Martha L Abell, James P Braselton, Differential Equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.
(6) T. Amarnath --An elementary course in Partial Differential Equations,2nd Ed.,Narosa.
(7) Walter Kelley & Allan Peterson ,Difference equations: An Introduction with Applications , (Academic press,1991)
(8) R. Kent Nagle, Edward B. Saff, Arthur David Snider --Fundamentals of Differential Equations   (8 th Ed.),Pearson

Module-II : Mechanics (39 Classes)

Course objective: *One dimensional motion is aimed to be studied for simplest cases. Mainly the course is designed so as to exemplify the applications of first and second order differential equations. Vectors algebra recapitulation is motivated so that the forces in 2D and 3D in Statics can be given a general treatment (Vectorial treatment is encouraged).*

Recapitulation of Vector Algebra [8], One dimensional motion [SHM with and without damping, Variable forces, Motion under gravity in a resisting medium, Conservation of linear momentum & conservation of energy.] [18]

Coplanar forces : resultant force and resultant couple, Line of action of resultant force, Astatic Equilibrium.[6]

Forces in 3D- resultant force and resultant couple, Line of action of resultant force, Poinsot's central axis.[7]

References:

(1) Analytical Statics- Sinha & Pradhan
(2) Vector and Tensor Analysis- U. Chatterjee & N. Chatterjee.
(3) Dynamics of a Particle- S. L. Loney