MA 20103 Partial Differential Equations (PDE)

1. Why 2nd order ODEs, Bessel functions and Legendre polynomials? Application areas where these occur frequently; 2nd order ODEs-classification of regular and singular points.
2. Power series solution of 2nd order ODEs, Frobenius series solution.
3. Bessel equation and Bessel functions; Orthogonality properties and Recurrence relations;
4. Legendre equation and Legendre polynomials; Orthogonality properties and Recurrence relations;
5. Introduction to PDEs: Why PDEs? Application to real life problems; curves and surfaces; ideas on order, degree, linear, non-linear; elimination of arbitrary function to form a PDE; elimination of parameters to form a PDE;
6. Classification of 1st order PDEs (1 dependent variable and two independent variables) as Linear /quasi-linear/semi-linear/non-linear; integral surface-general solution.
7. Lagrange's method of solution, method of characteristics for solving these equations;
8. Integral surfaces through a given curve – Cauchy problem;
9. Classification of integrals as general solution, complete integral and singular solution, compatibility condition.
10. Non-linear PDEs, Charpit's method
11. Special types of first order PDEs
12. Second order Linear PDE with constant coefficients
13. Classification of second order PDEs (1 dependent variable and 2 independent variables)
14. Canonical forms for Linear second order PDEs with variable coefficients
15. Hyperbolic equation: 1-dimensional wave equation, characteristics, d'Alembert's solution, separation of variable solution for homogeneous equations;
16. Elliptic equation: 2-dimensional Laplace equation, Classification of boundary value problems with respect to Dirichlet, Neumann and Robin boundary conditions, separation of variable solution for (i) Dirichlet problem for a rectangle, (ii) Dirichlet problem for interior of a circle, (iii) Dirichlet problem for exterior of a circle (iv) Dirichlet problem in spherical coordinates
17. Parabolic equation: 1-dimensional heat conduction equation, separation of variable solution for homogeneous equations;
18. Duhamel's principle to obtain solution for non-homogeneous equations

Text Books

1. Advanced Engineering Mathematics – Erwin Kreyszig, Wiley

2. An Elementary course in Partial Differential Equations – T. Amarnath, Jones & Bartlett Learning (Foreign Ed.) / Narosa (Indian Ed.).

Reference Books

1. Elements of Partial Differential Equations- Ian N Sneddon, Dover Publications.

2. Linear Partial Differential Equations for Scientists and Engineers – Tyn Myint-U and Lokenath Debnath, Birkhauser.

3. Introduction to Partial Differential Equations, K Sankara Rao, PHI Learning Pvt. Ltd.