

### **MA 20103 Partial Differential Equations (PDE)( 3-0-0 3)**

1. Why 2<sup>nd</sup> order ODEs, Bessel functions and Legendre polynomials? Application areas where these occur frequently; 2<sup>nd</sup> order ODEs-classification of regular and singular points.
2. Power series solution of 2<sup>nd</sup> 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 1<sup>st</sup> 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. Parabolic equation: 1-dimensional heat conduction equation, separation of variable solution for homogeneous equations;
16. Hyperbolic equation: 1-dimensional wave equation, characteristics, d'Alembert's solution, separation of variable solution for homogeneous equations;
17. 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

#### **Text Books:**

#### **Units 1-4 only:**

Advanced Engineering Mathematics – Erwin Kreyszig, Wiley

#### **Units 5 – 18:**

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

**Reference Books:**

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

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

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

**Evaluation:**

10 marks: attendance + assignments + surprise tests

10 marks: a pre-declared class test

30 marks: a pre-declared mid-examination

50 marks: a pre-declared end examination

Class test: 30<sup>th</sup> August 2017

Mid-examination: 15 – 25 September 2017   End examination: 20 – 28 November 2017

**Slot:** (3 lectures: MON: 10:00 – 10:55; WED: 8:00 – 9:55)