

**Course-6C: Partial differential equations & Fourier series**

(Skill Enhancement Course (Elective), 5 credits)

**1. Learning Outcomes:**

Students after successful completion of the course will be able to

1. Classify partial differential equations, formation of partial differential equations and solve Cauchy's problem for first order equations.
2. Solve Lagrange's equations by various methods, find integral Surface passing through a given curve and Surfaces orthogonal to a given system of Surfaces.
3. Find solutions of nonlinear partial differential equations of order one by using Char pit's method.
4. Find solutions of nonlinear partial differential equations of order one by using Jacobi's method.
5. Understand Fourier series expansion of a function  $f(x)$  and Parseval's theorem.

**II. Syllabus:** (Hours: Teaching: 75 (incl. unit tests etc.05), Training: 15)

**Unit – 1: Introduction of partial differential equations** (15h)

1. Partial Differential Equations, classification of first order partial differential equations, Rule I, derivation of a partial differential equations by the elimination of arbitrary constants
2. Rule II, derivation of a partial differential equation by the elimination of arbitrary function  $\phi$  from the equations  $\phi(u, v) = 0$  where  $u$  and  $v$  are functions of  $x$ ,  $y$  and  $z$ .
3. Cauchy's problem for first order equations

**Unit – 2: Linear partial differential equations of order one** (15h)

1. Lagrange's equations, Lagrange's method of solving  $Pp+Qq=R$ , where  $P$ ,  $Q$  and  $R$  are functions of  $x$ ,  $y$  and  $z$ , type 1 based on Rule I for solving  $\frac{dx}{p} = \frac{dy}{Q} = \frac{dz}{R}$ , type 2 based on Rule II for solving  $\frac{dx}{p} = \frac{dy}{Q} = \frac{dz}{R}$ .
2. Type 3 based on Rule III for solving  $\frac{dx}{p} = \frac{dy}{Q} = \frac{dz}{R}$ , type 4 based on Rule IV for solving  $\frac{dx}{p} = \frac{dy}{Q} = \frac{dz}{R}$ .
3. Integral Surface passing through a given curve, the Cauchy problem, Surfaces orthogonal to a given system of Surfaces.

**Unit – 3: Non-linear partial differential equations of order one-I****(15h)**

1. Complete integral, particular integral, singular integral and general integral, geometrical interpretation of integrals of  $f(x, y, z, p, q) = 0$ , method of getting singular integral from the PDE of first order, compatible system of first order equations.
2. Charpit's method, Standard form I, only  $p$  and  $q$  present.
3. Standard form II, Clairaut equations.

**Unit – 4: Non-linear partial differential equations of order one-II****(15h)**

1. Standard Form III, only  $p$ ,  $q$  and  $z$  present.
2. Standard Form IV, equation of the form  $f_1(x, p) = f_2(y, q)$ .
3. Jacobi's method, Jacobi's method for solving partial differential equations with three or more independent variables, Jacobi's method for solving a non-linear first order partial differential equations in two independent variables.

**Unit – 5: Fourier series****(15h)**

1. Introduction, Euler's formulae for Fourier series expansion of a function  $f(x)$ , Dirichlet's conditions for Fourier series, convergence of Fourier series.
2. Functions having arbitrary periods. Change of interval, Half range series.
3. Parseval's theorem, illustrative examples based on Parseval's theorem, some particular series.

**III. Reference Books:**

1. Dr.M.D.Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
2. Dr. S.Sreenadh, S.Ranganatham, Dr.M.V.S.S.N.Prasad, Dr. V.Ramesh Babu, Fourier Series and Integral Transforms, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.
3. Prof T.Amaranath, An Elementary Course in Partial Differential Equations Second Edition, Narosa Publishing House, New Delhi.
4. Fritz John, Partial Differential Equations, Narosa Publishing House, New Delhi, 1979.
5. I.N.Sneddon, Elements of Partial Differential Equations by McGraw Hill, International Edition, Mathematics series.
6. Web resources suggested by the teacher and college librarian including reading material.