MATHEMATICAL METHODS – PAPER II

Unit-I

Laplace Transforms – Inverse Laplace Transforms – Error functions – Application to boundary value problems(Heat Equations-Laplace equation) – Fourier transform – Fourier integral formula – Finite & Infinite Fourier sine and cosine transforms – Application to integral equations and Boundary Value problems – Hankel Transform.

Unit-II

Special function: Bessel functions: Recurrence relations for the Bessel co-efficient – Series expansions for Bessel co-efficient – Integral expression for the Bessel co-efficient. The additions formula for the Bessel co-efficient – Legendre's equations – Orthogonal properties of Legendre's polynomials – Hermite polynomials.

Unit-III

Numerical solution of partial differential equations – Introduction – Finite difference approximations to derivatives – Finite difference methods – Laplace's equation – parabolic equations – Cranice – Nicholson Method – Jacobi method – Gauss Siedel method.

Unit-IV

Finite Element Methods – Integral formulation and variational methods : Need for weighted-integral forms – Some mathematical concepts and formulas – Boundary, initial and Eigen value problems – Integral relations – Functionals – The variational symbol – Weak formulation of Boundary value problems – Weighted-Integral and Weak formulations – Linear and Bilinear forms and Quadratic functional – examples. Variational methods of approximation – The Rayleigh – Ritz Method – Petrov-Galerkin method.

Unit-V

Variational principles – Euler's equations – Euler – Legrange equation- Lagrange Multipliers, Variable end points, Sturm-Liouville problems, integral equations: Introduction, Relations between Differential and Integral Equations, The Green's function, alternative definition of the Green's function, Linear equations in Cause and Effect – The influence function.

References :

1. **Integral Transforms –** Goyal and Gupta
2. **Introductory Methods of Numerical Analysis –** S.S.Sastry
3. **Methods of Applied Mathematics –** Francis B. Hildebrand, PHI Limited
4. **Special functions of Mathematical physic and Chemistry –** I.N.Sneddon

Differential Equations – Elsgoltz

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Model question Paper

Max. Marks : 100 **Time : 3 hours**

Note : 1. Answer any FIVE Questions

2. Each Question carries 20 Marks.

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Q.No.1.

(a) Find the finite Fourier Sin & Co Sin of f(x)=x(π-x) in 0<x <π

(b) State and Prove the Orthogonality of Bessel Functions

(c) Using Modified Euler's Method find y(0.2) and y(0.4) given

$$\frac{dy}{dx} = y + e^x, \qquad y(0) = 0$$

Q.No.2

a) Evaluate $L\left[\frac{1-\cos t}{t^2}\right]$

b) Using Convolution Theorem solve $L^{-1}\left(\frac{s}{(s^2+a^2)^2}\right)$

Q.No.3

Using Laplace Transform methods solve the D.E.

$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 5y = e^{-t}\sin t\ , y(0) = 0, y^1(0) = 1$

Q.No.4

Apply the Fourth order RK-Method to find y(0.1) and y(0.2) given $\frac{dy}{dx} = xy + y^2,\ y(0) = 1$

Q.No.5

Explain about the Rayleigh-Ritz Method

Q.No.6

a) If a displacement field is described by $u = (-x^2 + 2y^2 + 6xy)10^{-4}$

$$v = (3x + 6y - y^2)10^{-4}$$

Determine $\varepsilon_x, \varepsilon_y, \gamma_{x,y}$ at the point x = 1, y = 0

b) In a plane strain problem, we have

$$\sigma_x = 20000\,psi, \sigma_y = -10000\,psi$$

$$E = 30x10^6\ psi, v = 0.3$$

Determine the value of the stress σ_z

Q.No.7

Explain about Cranice – Nicholson Method to solve a partial differential equation.

Q.No.8

Explain about the Sturm-Liouville problem of boundary value problem involving linear ordinary differential equations.