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**B. Sc. (Hons.) (Mathematics) 5th
Semester Examination – March, 2021**

METHODS OF APPLIED MATHEMATICS

Paper : BHM-355

Time : Three Hours]

[Maximum Marks : 60

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt five questions in all, selecting one question from each Unit. Question No. 9 is compulsory. All questions carry equal marks.

UNIT – I

- (a) To find the displacement of the vibrating string of length L whose ends are fixed. Given that $f(x)$ is initial displacement and initial velocity is zero.
(b) Solve three dimensional wave equation in cylindrical polar coordinates.
- (a) A string of length L is initially at rest in its equilibrium position and each of its points is given

the velocity $\left(\frac{\partial u}{\partial t}\right)_{t=0} = 40 \sin^3\left(\frac{\pi x}{L}\right)$ where $0 < x < L$. find the displacement function $u(x, t)$.

- (b) Obtain the solution of Laplac's equation in cylindrical polar coordinates.

UNIT – II

- (a) Write the solution for :

$$\frac{\partial u}{\partial t} = 4 \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right) \text{ for } 0 < x < 2, 0 < y < 3, t > 0$$

with conditions that :

$$u(x, 0, t) = u(x, 3, t) = 0 \text{ for } 0 < x < 2, t > 0$$

$$u(0, y, t) = u(2, y, t) = 0 \text{ for } 0 < y < 3, t > 0$$

$$\text{and } u(x, y, 0) = x^2 (2 - x) \sin(y) (3 - y)$$

- (b) Solve the problem $\frac{\partial u}{\partial t} = k \frac{\partial^2 u}{\partial x^2}$ for $-\infty < x < \infty, t > 0$ and $u(x, 0) = e^{-4|x|}$ for $-\infty < x < \infty$.

- (a) Solve wave equation for semi-infinite string.
(b) Solve the following B. V. P. :

$$\frac{\partial^2 u}{\partial r^2} + \frac{1}{r} \frac{\partial u}{\partial r} = \frac{1}{a^2} \frac{\partial u}{\partial t} \text{ with boundary conditions } u(b, t) = 0 \text{ and } u(r, 0) = f(r).$$

UNIT - III

5. (a) Find the n th order Hankel Transform of $f(r) = r^n H(a-r)$.
- (b) Find the solution of the Laplace equation for the steady temperature distribution $u(r, z)$ with a steady and symmetric heat source $Q_0 q(r)$.
6. (a) Find the Fourier cosine transform of e^{-x^2} .
- (b) Using the Fourier sine transform, solve the partial differential equation $\frac{\partial u}{\partial t} = k \frac{\partial^2 u}{\partial x^2}$ with the boundary condition :
- (i) $u = u_0$ when $x = 0, t > 0$ and the initial condition.
- (ii) $u = 0$ when $t = 0, x > 0$.

UNIT - IV

7. (a) State and prove parallel axes theorem.
- (b) Find the M. I. of a rigid circular solid cone of mass M , height h and radius a of base about its axis.
8. (a) Prove that principal axis are mutually orthogonal.
- (b) Show that two systems are equimomental iff :
- (i) they have same total mass,
- (ii) they have same centroid,
- (iii) they have same principal moments of inertia at centroid and same principal axis.

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(P-4)(Q-9)(21) (3)

P. T. O.

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(P-4)(Q-9)(21) (3)

UNIT - V

9. (a) A square of side 'a' has particle of masses in, 2m, 3m, 4m at its vertices. Find the M. I. and P. I. at the centre of square.
- (b) Write solution of $P^2 R'' + PR' + m^2 P^2 R = 0$.
- (c) Write Laplace's equation in spherical polar coordinates.
- (d) State perpendicular axis theorem.
- (e) Obtain the zero order Hankel Transforms $r^{-1} \exp(-ar)$.
- (f) Find the Fourier cosine transform of $2e^{-5x}$.

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