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M. Sc. (Physics) (Semester – 1st)
MATHEMATICAL PHYSICS
Subject Code: MPHYS1103
Paper ID: [18220703]

Time: 03 Hours **Maximum Marks: 60**

Instruction for candidates:

1. Section A is compulsory. It carries 16 marks. It consists of 4 questions of 4 marks each.
2. Section B consist of 4 questions of 8 marks each. The student has to attempt any 3 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A **(4 marks each)**

Q1. If V is a vector space of real valued continuous functions over R, then show that the set W of solutions of differential equation $2y'' - 9y' + 2y = 0$ is a subspace of V.

Q2. Find the finite sine transform of x^3.

Q3. Solve Laplace equation in two dimensions which satisfies the conditions: $u(0, y) = u(l, y) = u(x, 0) = 0$ and $u(x, a) = sin\frac{n\pi x}{l}$.

Q4. Express $f(x) = x^3 - 5x^2 + x + 2$ in terms of Legendre's polynomials.

Section – B **(8 marks each)**

Q5. State and prove Cayley Hamilton Theorem with example.
(b) Find the eigen values and eigen vectors of the matrix $[- 2\ 2\ - 3\ 2\ 1\ - 6\ - 1\ - 2\ 0]$

Q6. Obtain half-range cosine series for $f(x) = \{kx : \quad 0 \le x \le \frac{l}{2}\ k(l - x): \quad \frac{l}{2} \le x \le l \}$

Q7. (a) State and prove convolution theorem for Laplace transforms.
(b) Find the inverse Laplace transforms of $\frac{1}{s^2(s^2+a^2)}$

Q8. (a) State and prove orthogonality of Legendre polynomials.
(b) Prove that $\int J_3(x)dx = - J_2(x) - \frac{2}{x}J_2(x)$

Section – C **(10 marks each)**

Q9. (a) Solve $z_{xx} - z_{xy} = sinx \cos cos\, 2y$
(b) Use Gauss Jordan method to find rank of matrix $[2\ 1\ - 1\ 0\ 2\ 1\ 5\ 2\ - 3]$

Q10. (a) Solve with the help of Laplace transform $y'' - 3y' + 2y = 4t + e^{3t}$ subjected to the conditions $y(0) = 1,\ y'(0) = - 1$.
(b) State and prove relation between Beta and Gamma function.

Q11. (a) Write one dimensional heat conduction equation and find its solution.
(b) Solve $r - 4s + 4t = e^{2x+y}$.