

25073 (OR)

M.Sc. DEGREE EXAMINATION, APRIL 2015.

SECOND SEMESTER

Physics

Paper III — MATHEMATICAL PHYSICS

Time : Three hours

Maximum : 75 marks

(No additional sheet will be supplied)

PART A — (5 × 3 = 15 marks)

Answer any FIVE questions.

Each question carries 3 marks.

Each answer should not exceed 1 page.

1. Define Beta and Gamma functions and show that  $\beta(x, y) = \frac{\Gamma(x)\Gamma(y)}{\Gamma(x+y)}$ .
2. Define Bessel function. Show that  $J_{-n}(x) = (-1)^n J_n(x)$ .
3. Find the Fourier sine transform of  $\frac{e^{-ax}}{x}$ .
4. Find the Laplace transform of  $\sin at$ .
5. Find the solution for two dimensional wave equation by variable separable method.
6. What are contravariant, covariant and mixed tensors and explain with examples?
7. What is analytic function? Show whether  $f(z) = \bar{z}$  is analytic or not?
8. State and prove Residue theorem.

PART B — (4 × 15 = 60 marks)

Answer ALL questions.

Each question carries 15 marks.

Each answer should not exceed 6 pages.

9. (a) Prove the generating function of Hermite polynomial.  
(b) Show that  $H_{n+1}(x) = 2xH_n(x) - 2nH_{n-1}(x)$  at  $n \geq 1$  and  $H_1(x) = 2xH_0(x)$ .

Or

10. (a) Prove the orthogonal property of Legendre polynomial.  
(b) Show that  $(x^2 - 1)P_l'(x) = l_x P_{l+1}(x) - lP_{l-1}(x)$ .

11. (a) Find the solution for square wave using Fourier series.  
(b) Find the Fourier transform for impulse function.

Or

12. (a) Find the inverse Laplace transform of  $\left[ \frac{5s-2}{s^2(s+2)(s-1)} \right]$ .  
(b) Using Laplace transform find the solution for the flow of current in LCR circuit.
13. (a) Find the solution for two dimensional steady flow of heat in a long cylinder.  
(b) Find the solution for vibration of circular membrane using partial differential equation.

Or

14. (a) If  $A^{pq}$  and  $B_{rs}$  are antisymmetric tensors, show that their products  $C_{rs}^{pq}$  is symmetric tensor.  
(b) Explain Piezoelectricity in a crystal using tensors.
15. (a) Explain various types of singular points with examples.  
(b) Find the residue of  $f(z) = \frac{z^2 - 2z}{(z+1)^2(z^2+4)}$  at all points in a finite plane.

Or

16. (a) State and prove Taylor's theorem.  
(b) Expand  $f(z) = \ln(1+z)$  in a Taylor's series at  $z=0$ .