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Code No. 8526 / CBCS/ Non-CBCS

FACULTY OF SCIENCE

M. Sc. I – Semester **(CBCS / Non-CBCS)** Examination, December 2013

Subject : Physics and Applied Electronics

Paper – I : Mathematical Physics

Time : 3 Hours Max. Marks: 80

Note : Answer all questions from Part–A and Part–B. Each question carries 4 marks in Part–A and 12 marks in Part – B.

PART – A (8 x 4 = 32 Marks)

(Short Answer Type)

1. Prove the recurrence relation
   $nP_n = (2n-1)x\ P_{n-1} - (n-1)\ P_{n-2}$ for Legendre's polynomials.
2. Define gamma function. Show that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$
3. Prove the recurrence relation
   $H_n'(x) = 2n\ H_{n-1}(x)$ for Hermite polynomials
4. Obtain Rodrigues formula for Hermite polynomial.
5. Show that the Fourier transform of f(at)= $\frac{1}{a} g\left(\frac{w}{a}\right)$.
   Where g(w) is the Fourier transform of f(t).
6. Find the Laplace transform of t sin at.
7. Show that every square matrix can be expressed as the sum of a Hermitian and Skew-Hermitian matrix.
8. Explain the inner product of two tensors.

PART – B (4 x 12 = 48 Marks)

(Essay Answer Type)

9 (a) Obtain the power series solution of Legendre's differential equation and show that

$$P_3(x)= \frac{1}{2}(5x^3 - 3x)$$

OR

(b) Obtain the polynomial solution of Bessel's differential equation and prove that
$J_n'(x)= nJ_n(x) - xJ_{n+1}(x)$.

10.(a) Set up the wave equation for the vibrations of a rectangular membrane and find its solution.

OR

(b) Show that the Hermite polynomials are generated by the function e^{2zx-z^2} and hence prove that

$$H_n(x)=(-1)^n\ e^{x^2}\frac{d^n}{dx^n}(e^{-x^2})$$

11.(a) What is Laplace and inverse Laplace transform of a function f(t). State and prove the convolution theorem for Laplace transform.

OR

(b) Find the Fourier transform of

(i) f(x) = $Ne^{-\alpha x^2}$; N and α are constants (ii) $e^{-|t|}$

12.(a) What are Christoffe's symbols of First and Second kind? Establish a relation between them.

OR

(b) What is the characteristic equation of a matrix? Find the eigen values and eigen vectors of the matrix.

$$\begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 2 & 3 & 6 \end{bmatrix}$$

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