

Code No. 3524 / CBCS / Non-CBCS

FACULTY OF SCIENCE

M. Sc. I - Semester (CBCS/Non-CBCS) Examination, December 2014

Subject: Physics / 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 Evaluate the value of Bessel's function $J_{5/2}(x)$.
- 2 Prove that the gamma function satisfies the relation $\Gamma_m - \Gamma_{1-m} = \frac{\pi}{\sin(m\pi)}$.
- 3 Briefly discuss the application of wave equation to a rectangular membrane.
- 4 Obtain the value of $H_3(x)$.
- 5 State and prove convolution theorem for Laplace transform.
- 6 Find the Fourier transform of the function $f(x) = Ne^{-\alpha x^2}$.
- 7 Define a contravariant tensor of rank two and write down the contravariant law for it.
- 8 State and prove the associative law of matrix multiplication.

PART – B (4 x 12 = 48 Marks)
(Essay Answer Type)

- 9 a) What are Legendre Polynomials? Establish the orthogonality property of the Legendre polynomials.
OR
b) Discuss the orthogonality property of Bessel's function of first kind. For the Bessel's function of first kind prove that $J_{n-1}(x) - J_{n+1}(x) = 2J_n(x)$.

- 10 a) Solve the Hermite differential equation using power series method. Derive the recurrent relation $2n H_{n-1}(x) = H_n'(x)$.

OR

- b) State and prove the Rodrigue's formula for Hermite polynomials. Show that $\int_{-\infty}^{+\infty} e^{-x^2} H_n(x) H_m(x) dx = 2^n n! \sqrt{\pi} \delta_{nm}$ for Hermite polynomials.

- 11 a) State Laplace and inverse Laplace transform of a function $f(t)$. State the linear, shifting and change of scale properties of Laplace transforms. Find the Laplace transform of $f(t) = t \sin at$.

OR

- b) State and prove the convolution theorem for Fourier transform. Find the cosine and sine transform of $f(x) = e^{-x}$.

- 12 a) Prove that the sum and difference of two tensors of the same rank results in a third tensor of the same rank. What are symmetric and antisymmetric tensors. Give some examples in physics for these two types of tensors.

OR

- b) What is a characteristic matrix equation? Define eigen values and eigen vectors. Determine the eigen values and eigen vectors of

$$A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$$
