FACULTY OF SCIENCE
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 (8x4 = 32 Marks)
[Short Answer Type]

1. Define Gamma and Beta functions.
2. Obtain the Generating function for Legendre's differential equation.
3. Prove that $H_n(x) - 2xH'_n(x) + 2nH_n(x) = 0$
4. Show that $(1+x)^n$ is a hyper geometric function.
5. Write note on applications of Fourier Transforms.
6. Find the Laplace transform of $e^{-at}$
7. Define symmetric, skew symmetric and hermition matrices.
8. Explain what is meant by covariant, contravariant and mixed tensors?

PART – B (4x12 = 48 Marks)
[Essay Answer Type]

9. a) Obtain the power series solution for Bessel function.
   OR
   b) Prove the following:
      i) $r(n+1) = nr(n)$
      ii) $\beta(m,n) = \frac{r(m)r(n)}{r(m+n)}$

10. a) Show that Hermite polynomials are generated by the function $e^{2xz-z^2}$.
    OR
    b) State and prove recurrence relations for Hermite polynomials.

11. a) Obtain the Fourier recurrence of the function
        $F(x) = \begin{cases} 0 & -\pi < x < 0 \\ 1 & 0 < x < \pi \end{cases}$
    OR
        b) Prove the Laplace transform of derivatives property and evaluate $L\left[\cos \sqrt{t}\right]$.

12. a) What do you mean by diagonal matrix? Show that the Eigen values of a Hermitian matrix are all real and its Eigen vectors corresponding to two distinct Eigen values are orthogonal.
    OR
    b) What are symmetric and anti symmetric tensors? Show that any tensor of rank '2' can be expressed as a sum of symmetric and an anti symmetric tensor both of rank '2'.

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