

(7 pages)

Reg. No. :

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M.Sc. (CBCS) DEGREE EXAMINATION,
APRIL 2016.

Second Semester

Physics

MATHEMATICAL PHYSICS — II

(For those who joined in July 2012 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Products of orthogonal matrices are

- (a) Unit matrix
- (b) Hermitian matrix
- (c) Transpose matrix
- (d) Orthogonal matrix

2. Transpose of a matrix is denoted by A^T , then $(\lambda A)^T =$

- (a) λA^T
- (b) $\lambda^T A^T$
- (c) $\lambda * A^T$
- (d) $\lambda^T A$

3. Complex functions that satisfy Cauchy — Riemann differential equation is called _____ function.

- (a) real
- (b) imaginary
- (c) analytic
- (d) complex

4. In Taylor's series when we put $Z_0 = 0$, the series become

- (a) Lauren's series
- (b) Special Taylor's series
- (c) Maclaurin series
- (d) Ordinary series

5. The relation between $J_{-n}(x)$ and $J_n(x)$ is

- (a) $J_{-n}(x) = (-1)^n J_n(x)$
- (b) $J_{-n}(x) = (-1)^n J_n(-x)$
- (c) $J_{-n}(x) = (-x)^n J_n(x)$
- (d) $J_{-n}(x) = (-x)^n J_n(-x)$

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6. The value of $J_{-1/2}(\pi/2)$ is
- (a) 1 (b) 0
(c) π (d) $\pi/2$
7. Fourier Transform of $f(at)$ is $(1/a)g(\omega/a)$ called
- (a) similarity theorem
(b) linearity theorem
(c) convolution theorem
(d) parsevals theorem
8. The inverse Laplace Transform (Theory) is also called
- (a) Cauchy Integral Theorem
(b) Fourier Integral Theorem
(c) Fourier Mellin Integral Theorem
(d) Hankel Integral Theorem
9. What is the order of error in Simson's formula?
- (a) h (b) h^2
(c) h^3 (d) h^4

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10. Which of the following formula is particular case of Runge — Kutta formula of second kind
- (a) Taylor's formula
(b) Picard's formula
(c) Euler's modified formula
(d) Milne's predictor formula

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Show that every square matrix can be uniquely expressed as the sum of symmetric and anti symmetric matrix.

Or

- (b) Define Hermitian matrix, and show that the given matrix $\begin{bmatrix} 1/\sqrt{2} & i/\sqrt{2} \\ -i/\sqrt{2} & -1/\sqrt{2} \end{bmatrix}$.

12. (a) Derive the harmonic function of a complex variable, using Cauchy — Riemann condition.

Or

- (b) Derive Cauchy's integral formula for a complex variable function.

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[P.T.O.]



13. (a) Prove the Recurrence relation for Bessel function, $\frac{d}{dx} [x^{-n} J_n(x)] = -x^{-n} J_{n+1}(x)$.

Or

- (b) Derive the generating function for associate Laguerre polynomials.
14. (a) Explain the Fourier Transform of a derivative.

Or

- (b) Derive the Laplace Transform of Integral.
15. (a) Derive the Trapezoidal rule for solving numerical integrations.

Or

- (b) Solve the equation $\frac{dy}{dx} = 1 - y$ with the initial condition $x = 0, y = 0$, using Euler's algorithm and tabulate the solutions by Euler's modified method at $x = 0.1, 0.2, 0.3, 0.4$.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Find the eigen values and normalized eigen

vectors of the matrix, $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$.

Or

- (b) Find the characteristic equation of the following matrix and verify the Cayley —

Hamilton theorem. $\begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & 1 \end{bmatrix}$

17. (a) Define and explain Cauchy's integral theorem, and discuss the multiple connected regions.

Or

- (b) Evaluate the definite integral, $I = \int_0^{2\pi} \frac{d\theta}{1 + \varepsilon \cos \theta}, |\varepsilon| < 1$, using the residue theorem.



18. (a) Derive the generate function of Bessel polynomials.

Or

- (b) Derive the Rodrigue's formula for Laguerr polynomials.

19. (a) State and prove Parsevals theorem in Fourier transform.

Or

- (b) Obtain the Laplace transform of half wave

rectifier function
$$F(t) = \begin{cases} \sin \omega; & 0 < t < \frac{\pi}{\omega} \\ 0; & \frac{\pi}{\omega} < t < \frac{2\pi}{\omega} \end{cases}$$

20. (a) Apply the Taylor series method, to find the values of $y(1.1)$, $y(1.2)$ and $y(1.3)$ correct to three decimal places given that $y' = xy^{1/3}$, $y(1) = 1$, taking the first three terms of the Taylor series expansion.

Or

- (b) Apply the fourth order Runge — Kutta method, to find an approximate value of y when $x = 0.2$, given that $y' = x + y$, $y(0) = 1$.

