

(FOR THE CANDIDATES ADMITTED
DURING THE ACADEMIC YEAR 2024-2025 ONLY)

SUBJECT CODE **24 UPS 304**

REG.NO. :

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI
END-OF-SEMESTER EXAMINATIONS : NOVEMBER – 2025
B.Sc. – PHYSICS
SEMESTER : III
MAXIMUM MARKS: 75
TIME : 3 HOURS

PART – III
MATHEMATICAL PHYSICS

SECTION – A (10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS. (K1)

1. Divergence of a solenoidal vector field is always _____.
 (a) zero (b) constant (c) infinite (d) unity
2. A matrix equal to its transpose is called a ____ matrix.
 (a) Hermitian (b) Skew-symmetric (c) Symmetric (d) Diagonal
3. The Laplace transform of 1 is _____.
 (a) 1/s (b) s (c) 0 (d) 1
4. The value of $\Gamma(1)\Gamma(1)$ is:
 (a) 1 (b) 0 (c) ∞ (d) e
5. Newton-Raphson method uses _____.
 (a) first derivative (b) second derivative
 (c) no derivative (d) none of the above

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES. (K2)

6. Define gradient of a scalar field with an example.
7. What is the characteristic equation of a matrix?
8. Define Laplace transform.
9. State Dirichlet's conditions.
10. What is known as Bisection method?

SECTION – B (5 X 5 = 25 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.

(K3)

11. a) Write the physical significance of curl of a vector function.

(OR)

- b) State and prove Gauss divergence theorem.

12. a) Find eigenvalues and eigenvectors of the matrix

$$\begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$$

(OR)

- b) Show that the product of two Hermitian matrices is Hermitian if and only if they commute.

(CONTD 2)

13. a) State and prove the first shifting property of Laplace transform.
(OR)
b) Prove and illustrate the convolution theorem with an example.
14. a) Prove the relation $\Gamma(n+1)=n\Gamma(n)$.
(OR)
b) Evaluate $B(1/2,1/2)$.
15. a) State the difference between algebraic and transcendental equations.
(OR)
b) Solve $dy/dx = x + y$ with initial condition $y(0) = 1$ using Euler's method for $x = 0.1$.

SECTION – C (5 X 8 = 40 MARKS)
ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.
(K4 (Or) K5)

16. a) Prove Stokes' theorem and apply it to evaluate a surface integral.
(OR)
b) Derive the expression for divergence and curl in spherical polar coordinates.
17. a) Verify Cayley-Hamilton theorem for a 2×2 matrix and find its inverse.
(OR)
b) Discuss the properties of Hermitian matrices with examples.
18. a) Find the inverse Laplace transform of $\frac{1}{S(S+1)}$.
(OR)
b) Solve the differential equation $y''+y = \sin t$ using Laplace transform.
19. a) Expand $f(x)=x$ in the interval $(-\pi, \pi)$ as a Fourier series.
(OR)
b) Establish the relation between Beta and Gamma functions.
20. a) Derive the formula for trapezoidal rule and apply it to evaluate $\int_0^1 e^x dx$.
(OR)
b) Solve the ODE $dy/dx = x^2 + y^2$, $y(0) = 1$ using Runge-Kutta second order method for $h = 0.1$.