22PHU517/N20PHU17

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION MAY 2025
(Fifth Semester)

Branch – **PHYSICS**

MATHEMATICAL PHYSICS

Time: Three Hours Maximum: 50 Marks

SECTION-A (5 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (5 x 1 = 5)

1 What is the gradient of a scalar field?
(i) Vector quantity (ii) Scalar quantity
(iii) Tensor quantity (iv) Unitless quantity

2 Which is included in the gradient of spherical coordinates?
(i) Cartesian coordinates only
(ii) Radial, azimuthal, and polar components
(iii) Cylindrical components
(iv) Both cartesian and cylindrical

3 Choose the characteristic equation of a matrix.
(i) $|A| = 1$ (ii) $|A + \lambda I| = 0$
(iii) $|A - \lambda I| = 0$ (iv) $|A| = 0$

4 Which of the following is a property of Fourier transform?
(i) Scaling (ii) Linearity
(iii) Time shifting (iv) All of the above

5 Indicate the process which is proved using Morera's theorem.
(i) Analyticity of a function (ii) Differentiability of a function
(iii) Integration of a function (iv) Nullification of a function

SECTION - B (15 Marks)
Answer **ALL** Questions
ALL Questions Carry **EQUAL** Marks (5 x 3 = 15)

6 a. Explain the physical significance of curl.
OR
b. State tensors and give an example of a second-rank tensor.

7 a. Outline the need for coordinate transformation and its applications.
OR
b. Describe the physical significance of divergence and curl in coordinate systems.

8 a. State an orthogonal matrix and give an example.
OR
b. Show that the determinant of an orthogonal matrix is ±1.

Cont...

9 a. State and prove the linearity property of the Fourier transform.

OR

b. State and explain the finite Fourier transform.

10 a. Show the derivation of the Cauchy-Riemann equations.

OR

b. State and prove Liouville's theorem.

SECTION -C (30 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 x 6 = 30)

11 a. Derive and explain Stokes' theorem with its physical significance.

OR

b. State and derive Christoffel symbols of 3 index.

12 a. Examine how arc length and volume elements are derived in different coordinate systems.

OR

b. Discuss the significance of curl, divergence, and gradient in different coordinate systems with examples.

13 a. Explain the significance of the Cayley-Hamilton theorem with an example.

OR

b. State and prove the diagonalization theorem.

14 a. Outline the derivation of the Fourier sine and cosine transforms of a function f(x).

OR

b. Examine and prove the convolution theorem for the Laplace transform.

15 a. Point out the proof of Cauchy's integral formula and explain its significance.

OR

b. State and prove Laplace equation.

Z-Z-Z END