PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
BSc DEGREE EXAMINATION DECEMBER 2019
(Fifth Semester)

Branche – **PHYSICS**

MATHEMATICAL PHYSICS

Time : Three Hours   Maximum : 75 Marks

SECTION-A (20 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks   (10 x 2 = 20)

1   Show that curl $\vec{r}$ = 0.

2   Find $\iint r.ds$ using Gauss divergence theorem.

3   What is curvilinear coordinates?

4   Derive the Laplacian form of spherical coordinates.

5   Define n-dimensional space.

6   Write note on Indical Convention.

7   What is an analytic function?

8   Write a short note on harmonic function.

9   Evaluate $\int_{i}^{1}(z+1)^2 dz$

10   Evaluate the integral $\oint_c \dfrac{d^2}{z^2+2}$

SECTION - B (25 Marks)
Answer **ALL** Questions
ALL Questions Carry **EQUAL** Marks   (5 x 5 = 25)

11   a   Show that the vector field $V = \dfrac{-x\,\vec{i} - y\,\vec{j}}{\sqrt{x^2 + y^2}}$ is a sink, give its physical

interpretation.

OR

b   State and prove Gauss's divergence theorem.

12   a   Obtain an expression for the divergence in cylindrical coordinates.

OR

b   If (q_1, q_2, q_3) are general orthogonal coordinates then show that $\dfrac{dr}{dr_i}$ and ∇r_i are

reciprocal system of vectors for i = 1,2,3

13   a   Derive the form of coordinate transformation.

OR

b   If $a_{\alpha\beta}\, x^{\alpha}\, x^{\beta} = 0$ for all values of the variables $x^1, x^2 \ldots x^n$, then show that $a_{\mu\nu} + a_{\nu\mu} = 0$.

14   a   Find whether the given function is analytic or not, f(2) = sin 2

OR

b   Determine the analytic function, whose real part is $x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$

15   a   List out the basic properties of the complex line integrals.

OR

b   State and prove Cauchy Integral theorem $\int f(2)dz = 0$.

SECTION - C (30 Marks)
Answer any **THREE** Questions
ALL Questions Carry **EQUAL** Marks   (3 x 10 = 30)

16   Using Gauss divergence theorem, Evaluate $\iint\limits_{S} (x^3 dxdz + y^3 dzdx + z^3 dxdy)$,

where S is the surface of the sphere $x^2+y^2+z^2 = a^2$.

17   Derive the conditions under which a generalized curvilinear coordinate system is orthogonal.

18   Analyze Kronecker delta symbol and explain the properties and generalized form of Kronecker delta.

19   If f(2) is analytic function of 2, prove that $\left(\dfrac{d^2}{dx^2}+\dfrac{d^2}{dy^2}\right)\left|f(2)\right|^2 = 4\left|f'(2)\right|^2$

20   Apply calculus of residues to show that $\displaystyle\int\limits_{0}^{2\pi} \dfrac{d\theta}{a + b\cos\theta} = \dfrac{2\pi}{\sqrt{a^2 - b^2}}, a > b > 0.$

Z-Z-Z   END