**14PHU17**

# PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

## BSc DEGREE EXAMINATION MAY 2019
(Fifth Semester)

Branch – **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 the curl $\vec{r} = 0$.
2 State Green's theorem in a plane.
3 Write the values of scale factors $h_1$,$h_2$ and $h_3$ for spherical polar coordinate system.
4 Give the expression for $\nabla^2$ in curvilinear co-ordinates.
5 Define covariant tensor.
6 What do you mean by symmetric tensor?
7 Define an analytic function of a complex variable.
8 If z=x+iy, show that sinz is analytic.
9 State Cauchy's rsidue theorem.
10 Evaluate $\int_i^1 (z+1)^2 dz$.

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

11 a State and prove Stokes theorem.

OR

b Show that $\nabla.\left(\frac{\vec{r}}{r^3}\right) = 0$.

12 a Express divergence of a vector function in curvilinear coordinates.

OR

b Obtain the expression for Laplacian in cylindrical coordinates.

13 a Explain contravariant tensors and mixed tensors with examples.

OR

b If $A_{\mu\nu}$, $B^{\mu}$ and $C^{\nu}$ are tensors, show that $A_{\mu\nu}B^{\mu}C^{\nu}$ is an invariant tensor.

14 a Show that the real and imaginary parts of an analytic function f(z) are harmonic.

OR

b Show that the real and imaginary parts of an analytic function f(z)=u(x,y)+iv(x,y) satisy Cauchy – Riemann equations at each point where f(z) is analytic.

15 a State and prove Cauchy's integral theorem.

OR

b Evaluate $\oint_c \frac{dz}{z^2 - 1}$ where c is a circle $x^2+y^2=4$.

Cont...

**SECTION - C (30 Marks)**

Answer any **THREE** Questions

**ALL** Questions Carry **EQUAL** Marks (3 x 10 = 30)

16 State and prove Gauss divergence theorem.

17 Obtain the expression for curl in curvilinear coordinated and hence obtain for the same in cylindrical coordinates.

18 a) Define Kronecker delta symbol and discuss its properties.

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

19 (i) Show that $f(z)=Z^{-1}$ is analytic.

(ii) Determine the analytic function whose real part is $x^3-3xy^2+3x^2-3y^2+1$.

20 State and prove Cauchy's integral formula.

Z-Z-Z END