B.Sc. 1st Semester (Honours) Examinations, 2020-21

PHYSICS

Course ID:12411 **Course Code: SH/PHS/101/C-1**

Course Title: Mathematical physics - I

Time: 1hour 15 minutes **Full Marks: 25**

The figures in the margin indicate full marks

Candidates are required to give their answers in their own words as far as practicable

Section - I

***1.* Answer *any five* of the following questions:** **(1×5 = 5)**

a) Evaluate $\Gamma(-\frac{3}{2})$.

b) Write down the wronskian of a second order differential equation.

c) Write down the Dirichlet conditions related to Fourier series.

d) A force given by $\vec{F} = 3\hat{\imath} + 2\hat{\jmath} - 3\hat{k}$ is applied at the point (1,-2,3). Find the moment of $\vec{F}$ about the point (-2,1,4).

e) Show that $\vec{E} = \frac{\vec{r}}{r^2}$ is irrotational.

f) Write down two dimensional Laplace's equation in cylindrical co-ordinates(r,θ)

g) Show that J_{-n}(x) = $(-1)^n J_n$(x) , J_n(x) implies usual meaning.

h) For the Error function (Probability integral) prove that $erf(\infty)$ =1.

Please Turn Over

Section - II

Answer *any two* of the following questions: ***(5×2 = 10)***

2. Represent the vector $\vec{A} = 2y\hat{\imath} - z\hat{\jmath} + 3x\hat{k}$ in cylindrical coordinate system and determine A_ρ, A_Φ, A_z; symbols have their usual meaning. (2+3=5)

3. a) Prove that $\vec{A} = r^2\vec{r}$ is conservative and find the scalar potential .

b) Evaluate $\int_C \vec{A}.d\vec{r}$ $along\ the$ curve $x^2 + y^2 = 1, z = 1$ $in\ the$ positive direction from (0,1,1) to (1,0,1) if $\vec{A} = (yz + 2x)\hat{\imath} + xz\hat{\jmath} + (xy + 2z)\hat{k}$ (1+1 +3=5)

4. Solve the differential equation . $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = e^{e^x}$ 5

5. Find the Fourier series expansion of the function $f(x) = x + x^2$ for $-\pi < x < \pi$ **.**

From this expansion, show that, $\frac{\pi^2}{6} = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \ ......$ (4+1=5)

Section - III

Answer any one of the following questions: **(10×1 =10)**

6.a) State Stokes theorem in vector calculus.

b) Verify the divergence theorem for $\vec{A} = 2x^2y\hat{\imath} - y^2\hat{\jmath} + 4xz^2\hat{k}$ taken over the region in the first octant bounded by $y^2 + z^2 = 9$ and x = 2. (2+8=10)

7. a) Show that the Legendre polynomials can be represented by Rodrigue's formula:

$$P_n(x) = \frac{1}{2^n n!}\frac{d^n}{dx^n}(x^2 - 1)^n$$

bi) Evaluate $\int_0^1 \frac{dx}{\sqrt{1-x^n}}$

ii) Find out the relation between Beta and Gamma function. (4+2+4=10)
