U.G. 3rd Semester Examination - 2020

PHYSICS

Course Code : BPHSCCHC301

Course Title : Mathematical Physics II

Full Marks : 30 Time : 2 Hours

The figures in the right-hand margin indicate marks.

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

1. Answer any **ten** questions: $1\times10=10$

a) Write down the three dimensional wave equation.

b) Express ∇^2 operator in spherical polar coordinate.

c) What is the importance of Legendre transformation?

d) Write down Hamilton's canonical equation of motion.

e) Why we should observe symmetry pattern of the function while calculating its Fourier series?

f) Write down Parseval identity.

g) Define error function.

h) Write down the general linear differential equation of the n-th order. When it is called homogeneous?

i) What are the order and degree of the following differential equation?

$$\frac{\left[1+\left(\frac{dy}{dx}\right)^5\right]^{\frac{2}{5}}}{\frac{d^3y}{dx^3}}=C.$$

j) From the generating function of Legendre polynomials $\left(P_n(x)\right)$, find the value of $P_n(-1)$.

k) Write down Lagrange's equation of motion.

l) Write the expression of three dimensional heat flow equation in steady state. What is another name of the equation which you get?

m) What is ordinary point of a differential equation?

n) Write down Laguerre's differential equation.

o) State Parseval's formula.

2. Answer any **five** questions: $2\times5=10$

a) Show that the shortest curve joining two points in a plane is a straight line.

b) Write down Lagrangian for a spherical pendulum.

c) Write down differential equation describing simple harmonic oscillator. It is very similar to one of the standard differential equations, can you guess it?

d) Write down Laguerre differential equation and find out its singular points.

e) Find the value of $\Gamma\left(\frac{1}{2}\right)$.

f) Express $f(x)=x^4+3x^3-x^2+5x-2$ in terms of Legendre polynomials.

g) Prove that

$$(n+1)P_{n+1}(x)=(2n+1)xP_n(x)-nP_{n-1}(x).$$

h) Solve $\frac{d^2y}{dx^2}-4y=x\sinh x$.

3. Answer any **two** questions: $5\times2=10$

a) Write down Laplace's equation in plane polar coordinates. Find its solution by separation of variable technique, considering the separation constant is zero. What are cyclic coordinates? $1+3+1=5$

b) A string is stretched and fastened to two points l apart. Motion is started by displacing the string in the form $y=a\sin\left(\frac{\pi x}{l}\right)$ from which it is released at time t=0. Find the displacement of any point at a distance x from one end at time t.

c) Find the Fourier series expansion for the function, $f(x)=x^4-2\pi x^2$, $(-\pi\le x\le\pi)$.

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