End Semester Examination, 2022

Semester - III

Physics

PAPER - CC-5T

Full Marks : 40

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.

Group - A

1. *Answer any <u>five</u> questions :* **5x2=10**

a) Check the singularity of the equation

$(1-x^2)\frac{d^2y}{dx^2}-2x\frac{dy}{dx}+l(l+1)y=0$ at $x=+1$ and $x=-1$. 2

b) Prove that, $P'_{n+1}(x)-P'_{n-1}(x)=(2n+1)Pn(x)$ 2

c) Write down the three dimensonal wave equation in cylindrical co-ordinates. 2

d) Show that, $\frac{d}{dx}\{x^nJ_n(x)\}=x^nJ_{n-1}(x)$ 2

e) What is the value of Fourier Series at the point of discontinuity ? 2

f) What is Dirichlet's condition ? 2

g) Express $7x^3+2x-3$ in terms of Legendre polynomials. 2

(Turn Over)

h) If $f = \frac{5x^3y^4}{z^5}$ and errors in x, y, z be 0.0001, compute the maximum proportional error when $x = 0.001$, $y = 0.01$ and $z = 0.1$. 2

Group - B

Answer any <u>four</u> of the following questions : ***4x5=20***

2. What are Bessel's functions ? Prove that the function $J_n(x)$ is the coefficient of Z^n in the expansion of $e^{\frac{1}{2}(z-\frac{1}{z})}$. 2+3

3. Solve the differential equation by power series solution :- $(1-x^2)\frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 0$ about $x = 0$. 5

4. i) State Normal law of errors.

   ii) By using the principle of least squares, find the equation of best fit straight line in the following data :-

$x \rightarrow$	0	5	10	15
$y \rightarrow$	12	15	17	22

   1+3

5. Using the method of seperation of variables, solve the spherical form of Laplace's equation. 5

6. Find half range cosine series of the function $f(x) = 1 + x \qquad 0 \le x \le 2$

   And hence prove that,

   $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots = \frac{\Pi^2}{8}$ 3+2=5

7. Find the relation between Beta and Gamma functions. 5

Group - C

Answer <u>any one</u> of the following : ***1x10=10***

8. Deduce generating functions of Hermite Polynomials and show that :

   $\frac{1}{e}Cosh2x = \sum_{n=0}^{\infty}\frac{1}{2n!}H_{2n}(x)$ 6+4

9. Find out the permanent temperature within a solid sphere of radius unity when one half of the surface of the sphere is kept at constant temperature 0^0c and the other half of the surface of the sphere is kept at 1^0c. 10