BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: **I.M.Sc.** **SEMESTER: III**
BRANCH: **PHYSICS** **SESSION: MO/2023**

SUBJECT: PH213 MATHEMATICAL PHYSICS-II

TIME: **3 Hours** **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

CO BL

Q.1(a) What is the need for Fourier Series? Describe its complex notation. [5] 1 2
Q.1(b) Obtain the Fourier series form of a full-wave sinusoidal rectifier signal. [5] 1 5

Q.2(a) Define when two functions are said to be orthogonal. Give an example. [2] 2 1
Q.2(b) Using Frobenius method, solve the Bessel equation: [8] 2 3

$$x^2y'' + xy' + (x^2 - n^2)y = 0$$

Q.3(a) From the generating function of Legendre polynomial construct the following recursion relation: [5] 3 6

$$lP_l(x) = xP_l'(x) - P_{l-1}'(x)$$

Q.3(b) Write the generating function of Bessel functions of first kind and obtain $J_0(x)$ and $J_1(x)$ from the generating function. Show that $2J_1(x) = x[J_0(x) + J_2(x)]$ [5] 3 3

Q.4(a) Making use of a suitable definition of beta function $B(p,q)$, evaluate the definite integral, [5] 3 3

$$I = \int_0^{\pi/2} \cos^5\theta \sin^3\theta \; d\theta$$

Q.4(b) Explain the method of least square fit. Given below are the measured values of current through a resistance and voltage across it. [5] 4 5

I (in mA)	0	10	20	30	40	50
V (in volt)	0	2.8	5.3	8.0	11.0	13.4

Determine the value of resistance using least-square fit method.

Q.5(a) Write 1-D heat equation and solve it using the method of separation of variables. [5] 5 3
Q.5(b) Inspect whether the function $u(x,t) = A_0\exp[-(kx - \omega t)^2]$ is a valid solution of 1-D wave equation given by [5] 5 4

$$\frac{\partial^2 u}{\partial t^2} = c^2\frac{\partial^2 u}{\partial x^2}$$

Does this function represent a physically acceptable solution?

:::::24/11/2023 E:::::