

**Avinashilingam Institute for Home Science and Higher Education for Women
Coimbatore-641043.**

Continuous Internal Assessment Test II April 2025

I Semester

Class : I PG
Major : Physics

Time: 2 hours
Max. Marks: 60

23MPHC10Mathematical Physics II

Course Learning Outcomes:

1. Solve first order, second order homogeneous and non-homogeneous equations
2. Deliver mathematical modeling for Physics problems involving partial differential equations
3. Solve differential equations using Laplace transforms
4. Arrive at a solution for partial differential equation employing Fourier transform
5. Apply special functions in solving integral functions

Part A

6 x 1 = 6

Choose the correct answer

1. Which of the following is Poisson's Equation? CO2K1
a. $\nabla^2 \phi = -\frac{1}{\epsilon_0}$ b. $\nabla^2 \phi = -\frac{\rho}{\epsilon_0}$ c. $\rho \nabla^2 \phi = \epsilon_0$ d. $\nabla^2 \phi - \frac{\partial^2 \phi}{\partial t^2} = \frac{\rho}{\epsilon_0}$
2. Laplace's equation may be used in the study of CO2K1
a. Gravitational potential in region containing no matter
b. Gravitational potential in region containing matter
c. Gravitational potential in region containing matter
d. Magnetic potential in region containing matter
3. In Fourier series a function said to be even if $f(-x) =$ CO4K1
a. $f(-x)$ b. $f(x)$ c. zero d. $f(x)^2$
4. Fourier transform of function $f(t) = e^{-t+1}$ is CO4K1
a. 0 b. $\frac{2}{1+s}$ c. $\frac{2}{(1+s^2)}$ d. 1
5. $\Gamma(2) =$ CO5K1
a. 1 b. 2 c. 0 d. ∞
6. $P_3(-1) =$ CO5K4
a. 6/2 b. 3/2 c. 1 d. -1
7. Error function $\text{erf}(x) =$ CO5K2
a. $\frac{2}{\pi} \int_0^\infty e^{-t^2} dt$ b. $\frac{2}{\sqrt{\pi}} \int_0^\infty e^{-t^2} dt$ c. $\frac{2}{\pi} \int_0^x e^{-t^2} dt$ d. $\frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$

Part B

Answer all the questions.

3 x 6 = 18

Each answer should not exceed 200 words or one page

- 7a. Deduce div and Laplacian in terms of orthogonal curvilinear coordinates. CO2K1
(OR)
- 7b. Deduce Green's function. Explain the use of Green's function. CO2K1
- 8a. $f(x) = K$ if $0 < x < a$ CO4K3
 $= 0$ if $x > a$, Find the Fourier Cosine transform
(OR)
- 8b. State and Prove the properties of Fourier's Transform. CO4K2
- 9a. Write a short note on Dirac delta functions. CO5K1

(OR)

9b. Derive the relation between gamma and beta function for m and n greater than zero.

CO5K1

Part C

3 x 12= 36

Answer ALL the questions.

Each answer should not exceed 600 words or three pages

10a. Solve Laplace's equation in Cartesian coordinates.

CO2K2

(OR)

10b. Find the Fourier Cosine transform of e^{-x^2}

CO4K2

11.a Find the Fourier series of the function $f(x) = x \sin x$ in the range $-\pi < x < \pi$.

And deduce $\frac{\pi}{4} = \frac{1}{2} + \frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7}$

CO4K1

(OR)

11. b. An alternating current after passing through a rectifier has the form

CO4K3

$$\begin{aligned} I &= I_0 \sin \omega t & 0 < \omega t < \pi \\ &= 0 & \pi < \omega t < 2\pi \end{aligned}$$

Find the Fourier series of the function.

12a. Solve the Lagurre's differential equation

CO5K2

(OR)

12.b. State and Prove the Recurrence formulae of $J_n(x)$

CO5K2