



NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PHYSICS
2025_2 EXAMINATIONS.

COURSE CODE: PHY312
COURSE TITLE: MATHEMATICAL METHODS FOR PHYSICS I
CREDIT UNIT: 2
TIME ALLOWED: (2 HRS)
INSTRUCTION: Answer question 1 and any other three questions

QUESTION 1

- (A) i. What is partial differential equation [3marks]
(ii) Explicitly, write out type of expression for second order linear PDE [4marks]
(B) i. Mention and state the condition for the types of PDE [9marks]
(C) Consider a function of separable variable $U(x, t) = X(x) T(t)$ such that wave equation is given as $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 v}{\partial x^2}$. Establish the general solution for $X(x)$ dependent for the three identified cases [9marks]

QUESTION 2

- (A) Explain the concept of Half range Fourier series [6marks]
(B) Find the half range expansion of

$$f(t) = \begin{cases} \frac{2k}{l}t, & 0 < t < \frac{l}{2} \\ \frac{2k}{l}(l-t), & \frac{l}{2} < t < l \end{cases} \quad [9marks]$$

QUESTION 3

- (A) Write out the generalised expression for Legendre polynomial $P_n(\mu)$. [3 marks]
(B) Find the series Legendre polynomial
(i) $P_1(\mu)$ [4 marks]
(ii) $P_3(\mu)$ [4 marks]
(iii) $P_5(\mu)$ [4 marks]

QUESTION 4

- (A) Write out the expression for orthogonality of Legendre's polynomial. [5 marks]
(B) Show that $\int_{-1}^1 x P_n(x) P_{n-1}(x) dx = \frac{2n}{4n^2 - 1}$ [10 marks]

QUESTION 5

- (A) Define the following terms
i. Periodic function ii. Odd function iii. Even function [6marks]
(B). Solve the equation $\frac{\partial^2 y}{\partial x^2} = 12x^2(t + 1)$ given that at $t = 0$, $u = \cos zt$ and $\frac{\partial y}{\partial x} = \sin t$ [9 marks]

QUESTION 6

Using the Recurrence formula, prove that $J_{\frac{1}{2}}(x) = \sqrt{\left(\frac{2}{\pi x}\right)} \sin x$ [15 marks]