NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES

DEPARTMENT OF PURE AND APPLIED SCIENCE

2021_2 EXAMINATIONS

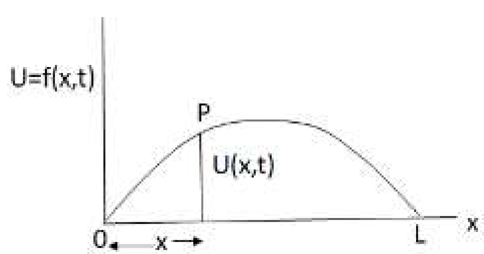
COURSE CODE: **PHY312**

COURSE TITLE: **MATHEMATICAL METHODS FOR PHYSICS II**
CREDIT UNIT: **3**
TIME ALLOWED: **(2½ HRS)**

INSTRUCTION: ***Answer question 1 and any other four questions***

QUESTION 1

A (i). Consider a perfectly flexible elastic string stretched between two points at x=0 and x=l (see Figure below) with uniform tension T. If the string is displaced slightly from its initial position of rest and released, with the end point remaining fixed, then the string will vibrate. The position of any point P in the string will then depend on its distance from one end and on one instant in time. Given that its displacement u=f(x,t); where x is the distance from the left hand, write the equations of motion in terms of X and T using the separation of variables approach. [6 marks]



(ii). If a wave equation is given as $\nabla^2 u = \frac{1}{v^2}\frac{\partial^2 u}{\partial t^2}$; what are the physical parameters represented by u and v? [2marks]

(iii). Find the complete solution of $pq = xy$ [5marks]

B. Evaluate the integral $\int \frac{dx}{6x^2-5x+1}$ [5marks]

C. Solve the equation $(X^2 - 4XX^I + 3X^{I2})b = 0$ [4marks]

QUESTION 2

A. Solve the equation $\frac{\partial^2 u}{\partial x \partial y} = \sin(x + y)$ given that at $y = 0$, $\frac{\partial u}{\partial x}$=1 and at x=0 u=$(y - 1)^2$

[7marks]

B. Solve $\frac{\partial z}{\partial x} = Sinx$, for z(x,y) [5marks]

QUESTION 3

A. Find the complete integral of the equation $P^2x + q^2y = Z$ using Jacobis method. [6marks]

B(i). Give one advantage of using Jacobis method for solving integration. [2marks]

(ii). Determine the inverse Laplace transform of $\frac{1}{(S-2)(S^2+1)}$. [4marks]

QUESTION 4

A. Find the tenth (a_{10}) Fourier coefficient of the Fourier series: $f(x) = \frac{a_o}{2} + \sum_{n=1}^{\infty}(a_n Cosnx + b_n Sinnx)$ [6marks]

B (i). State Bessel's differential equation. [2marks]

(ii). Given that $J_{-n(x)}= \sum_{r=0}^{\infty} \frac{(\frac{x}{2})^{-n+2r}}{r!\Gamma(-n+r+1)}$; What is the value for $J_{-\frac{1}{2}(x)}$? [4marks]

QUESTION 5

A. Find the Fourier Cosine series for F(x)=e^x at (0, π) [5marks]

B. If solution y(x), of the differential equation $\frac{d^2y}{d^2} - 3\frac{dy}{dx} + 2y = 2e^{-x}$ is subjected to the boundary conditions y(0) = 2, y'(0) = 1 has the form y(x) = $Ae^{-x} + Be^{x} + Ce^{2x}$. Evaluate the value of A + B – C. [7marks]

QUESTION 6

A .Define a half-range Fourier series for a function f(x); obtain a Fourier Cosine series which respects an even periodic Function $F_1(t)$ of period T=2l. [7marks]

B (i). Laplace and Fourier transforms are useful in solving a variety of partial differential equations; what would guide the choice of the appropriate transform? [2mark]

(ii). List at least three periodic phenomena in nature [3marks]