NATIONAL OPEN UNIVERSITY OF NIGERIA OF NIGERIA
JABI, ABUJA
FACULTY OF SCEINCE

SEPTEMBER/OCTOBER 2016 EXAMINATION

COURSE CODE: **PHY 312**
COURSE TITLE: **MATHEMATICAL METHODS IN PHYSICS**
TIME ALLOWED **(3 HRS)**
INSTRUCTION: **Answer any 5 questions**

QUESTION 1

a) State which of the following is an "even" function.

i. t^2
ii. t^2+4t
iii. $\sin(2t) +3t$
iv. t^3+6 (8 Mrks)

b)

a) Solve the equation :

$$\frac{\partial^2 u}{\partial^2 x} - 7\frac{\partial^2 u}{\delta x \delta y} + 6\frac{\partial^2 u}{\partial^2 y} = 0$$ (6 Mrks)

QUESTION 2

a.The Bessel function $J_n(x)$is given by the series expansion:

$$J_n(x) = \frac{\sum(-1)^k (x/2)^{n+2k}}{k!\Gamma(n+k+1)}$$

Show that: $\frac{d}{dx}[x^n J_n(x)] = x^n J_{n-1}(x)$ (11 Mrks)

b. Determine the value of $J_{-1/2}(x)$ (3 Mrks)

QUESTION 3

a. i. State the generating function for the Hermite polynomials (2 Mrks)

ii. Given that: $Z = Ae^{pt} \sin px$

Show that: $\frac{\partial^2 Z}{\partial t^2} + \frac{\partial^2 Z}{\partial x^2} = 0$

(6 Mrks)

b). For Laguerre's polynomials, show that that $L_n(0) = n!$. Assume the generating function:

$$\frac{e^{\frac{-xs}{(1-s)}}}{1-s} = \sum_{n=0}^{\infty} \frac{L_n(x)s^n}{n!}$$ (6 Mrks)

Hint: Put x = 0,

QUESTION 4

Find the Fourier series of the periodic function defined by:

$$f(x) = 0, \ if - \pi \leq x \leq 0$$
$$f(x) = \pi, \quad if \ 0 \leq x \leq \pi$$

(14 Mrks)

QUESTION 5

a. Solve the equation $\frac{\partial^2 u}{\partial x \partial y} = \sin x \cos y$, subject to the boundary conditions that at $y = \frac{\pi}{2}, \frac{\partial u}{\partial x} = 2x$ and at $x = \pi,\ u = 2 \sin y$ (11 Marks)

b.

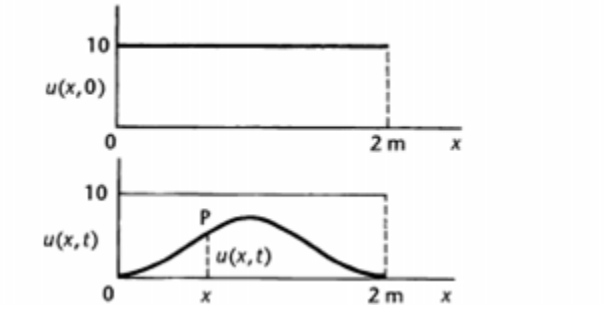
i. State the Laguerre polynomial that is a solution of the Laguerre's equation. (2Mrks)

ii. Find $L_1(x)$ (1Mrk)

QUESTION 6

A bar of length 2m is fully insulated along its sides. It is initially at a uniform temperature of 10 °C and at t = 0 the ends are plunged into ice and maintained at a temperature of 0°C. Determine an expression for the temperature at a point P a distance x from one end at any subsequent time t seconds after t=0. (14 Mrks)

Hint: Use the heat equation with boundary equations



QUESTION 7

a.

Define the term periodic function. (2 Mrks)

b.

Evaluate the integral (12 Mrks)

$$\int x^4 J_1(x)$$