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

DEPARTMENT OF PURE AND APPLIED SCIENCE

SEPTEMBER 2020_1 EXAMINATION

COURSE CODE: **PHY 312**
COURSE TITLE: **MATHEMATICAL METHODS FOR PHYSICS II**
CREDIT UNIT **3**
TIME ALLOWED **(2½ HRS)**

INSTRUCTION: Answer questions one and any other four questions

Question 1

(i) Define partial differential equation. (2marks)

(ii) When is a partial differential equation said to be linear? (2marks)

(iii) Write down the equation that expresses the Legendre's differential equation. (3marks)

(iv) What is the Rodrigues formula for Legendre polynomials? (2marks)

(v) What is the generating function for Legendre polynomials? (3marks)

(vi) Write down the Bessel's differential equation. (2marks)

(vii) Find the Fourier cosine series for $f(x) = e^x$ on $(0, \pi)$. (4marks)

(viii) Given that

$$J_{-n}(x) = \sum_{r=0}^{\infty} \frac{\left(x/2\right)^{-n+2r}}{r!\,\Gamma(-n+r+1)}$$

determine the value of $J_{-\frac{1}{2}}(x)$. (4marks)

SECTION B

Question 2

(a) Write down the general form of a second order linear partial differential equation in two independent variables *x* and *y*. (4 marks)

(aii) When is the equation said to be (i) homogeneous (1mark) (ii) non-homogeneous (1 mark)

(b) Solve the equation

$$\frac{\partial^2 u}{\partial x^2} - 7\frac{\partial^2 u}{\partial x \partial y} + 6\frac{\partial^2 u}{\partial y^2} = 0 \quad \text{(6 marks)}$$

Question 3

Find the period of tanx. (12marks)

Question 4

The equation

$$L_n(x) = \sum_{r=0}^{n} (-1)^n \frac{n!}{(n-r)!\,(r!)^2} x^r \; with \; L_n(0) = 1$$

expresses the Laguerre polynomial. Use this to find the first Laguerre polynomials. (12marks)

Question 5

Write down the important linear partial differential equations of second order each for one-dimensional (i)wave and(ii) heat equations, two-dimensional (iii) Laplace and (iv) Poisson equations and (v) Three-dimensional Laplace equation. (12marks)

Question 6

Find the Fourier integral of $(x) = x^2$, $\quad -\pi \leq x \leq \pi$ (12marks)