



**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

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

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

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

### Question 3

Find the period of  $\tan x$ . (12marks)

### Question 4

The equation

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

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  $(x) = x^2$ ,  $-\pi \leq x \leq \pi$  (12marks)