



**NATIONAL OPEN UNIVERSITY OF NIGERIA**  
**PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA**  
**FACULTY OF SCIENCES**  
**DEPARTMENT OF PHYSICS**  
**2025\_1 EXAMINATION**

**COURSE CODE:** PHY313  
**COURSE TITLE:** MATHEMATICAL METHODS FOR PHYSICS II  
**CREDIT UNIT:** 3  
**TIME ALLOWED:** (3 HRS)  
**INSTRUCTION:** *Answer question 1 and any other three questions*

**QUESTION 1**

- (A) Using Argand plane, describe the concept of (i) modulus [3 marks]  
(ii) Argument of complex number. [3 marks]  
(B) Find the modulus of  
(i)  $\frac{1-i}{1+i}$  [6 marks]  
(ii)  $\left(\frac{2+i}{3-i}\right)^2$  [6 marks]  
(C) Express  $f(z) = 4x^2 + i4y^2$  by a formula involving the variable  $z$  and  $\bar{z}$  [8 marks]

**QUESTION 2**

- (A) Explain the pole of a complex number [3 marks]  
(B) Solve the complex variable  $z$  in term of  $x$  and  $y$   
(i)  $\operatorname{Re}(\sin z)$  [6 marks]  
(ii)  $\cos z$  [6 marks]

**QUESTION 3**

- (A) What is harmonic function? [3 marks]  
(B) Prove that the function  $U(x, y) = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$  satisfy the Laplace equation and determine the function  $f(z) = u + iv$  [12 marks]

**QUESTION 4**

- (A) Explain the residue of a complex number [3 marks]  
(B) Determine the residue of the function  $f(z) = \frac{z^2}{(z-2)(z^2+1)}$  [12 marks]

**QUESTION 5**

- (A) Using the Cauchy integral, solve  $\oint_C \frac{z}{(2z+1)} dz$ , such that  $C$  is a simple closed curved enclosing  $z=1$  [7 marks]  
(B) Given that  $f(z) = u + iv$ , use Cauchy–Riemann equation to deduced that  $\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} |f(z)|^2 = 4|f'(z)|^2$  [8 marks]

**QUESTION 6**

- Evaluate the integral  $\int_{-\infty}^{\infty} \frac{\sin x}{x} = \frac{\pi}{2}$  [15 marks]