



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

DEPARTMENT OF PHYSICS

2024 1 EXAMINATION

COURSE CODE: PHY 313  
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) Solve the complex number
- (i)  $(2 + 3i) + (4 + 7i)$  [3marks]  
(ii)  $(2 + 3i)(4 + 7i)$  [3marks]
- (B) Established the analyticity of the following complex variable
- (i)  $|z|$  [4marks]  
(ii)  $\text{Re}(z)$  [4marks]
- (C) Evaluate  $z = (1 + i\sqrt{3})^8 + (1 - i\sqrt{3})^8$  [11marks]

**QUESTION 2**

- (A) Given the complex function  $U(x, y) = x^2 + 2axy + by^2$ . Find  $a$  and  $b$  [9marks]
- (B) Test if the function  $\frac{1}{z}$  is analytic [6marks]

**QUESTION 3**

- (A) Given the complex function  $w = \sin z$ , obtain the real complex part of  $\frac{dw}{dz}$  [7marks]
- (B) Using Cauchy integral, Solve  $\int_c \frac{\cos z}{z - \pi}$  [8 marks]

**QUESTION 4**

- (A) Explain the concept of monogenic function [3marks]
- (B) Given that a function  $f(z) = U(x, y) + iV(x, y)$  is analytic in domain  $D$  and  $U(x, y) = x^4 - 6x^2y^2 + y^4$ . Determine the harmonic conjugate of  $U(x, y)$  [12marks]

**QUESTION 5**

(A) Find the pole and residue of  $f(z) = \frac{z+1}{z^2-2z}$  [7marks]

(B) Show that the transformation  $w = \frac{2z+3}{z-4}$  changes the circle  $x^2 + y^2 - 4x = 0$  into a straight line  $4u + 3 = 0$  [8 marks]

**QUESTION 6**

(A) Solve for the principal root of  $(-8i)^{\frac{1}{3}}$  [8 marks]

(B) If  $e^z = w$ , show that  $\text{Log } w = z \pm 2p\pi i$  [7 marks]

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