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]**