NATIONAL OPEN UNIVERSITY OF NIGERIA
JABI, ABUJA
FACULTY OF SCEINCE

SEPTEMBER/OCTOBER 2016 EXAMINATION

COURSE CODE: **PHY 313**
COURSE TITLE: **MATHEMATICAL METHODS FOR PHYSICS II**
TIME ALLOWED: **(3 HRS)**
INSTRUCTION: **Answer any 4 questions**

QUESTION ONE

1. (a)What are the necessary conditions for a function $f(z)$ to be analytic at a point z_o in the region R of the z plane?

(b) Show that the function $\bar{z}$ is **not analytic** at any point.

(c) Show that $f(z): \rightarrow \mathbb{C}$ defined by $f(z) = e^z$ is analytic in $\mathbb{C}$ (ii) $\frac{de^z}{dz} = e^z$.

2.(a) Evaluate the integral $\int_C f(z) = (z-i)^2$ and C is a straight line joining

(b) Show that $\int_0^{\frac{\pi}{2}} e^{t+it} dt = \frac{1}{2}\left(e^{\frac{\pi}{2}} - 1\right) + \frac{i}{2}\left(e^{\frac{\pi}{2}} + 1\right)$

3.(a) $Write\ f(z) = z^4\ in\ the\ form\ f(z) = u(x,y) + iv(x,y)$

(b) Express $f(z) = 4x^2 + i4y^2$ by a formula involving the variables $z\ and\ \bar{z}$

(c) $f(z) = z^5 + 4z^2 - 6$ in polar form

4. (a) A circle in the z-plane has its centre at $z = 3$ and a radius 0f 2 units. Determine its image in the w-plane.

(b) The ellipse centered at the origin with a horizontal major axis of 4 units and vertical minor axis of 2 units. Obtain the the parametric equation that represents the ellipse.

(c) Show that the image of the right half plane $Re(z) = x > 1$ under the linear transformation $w = (-1 + i)z - 2 + 3i$ is the half plane $> u + 7$.

5. (a) Using Cauchy's formula for derivatives, evaluate:

$\int_C e^{5x}/(z + i)^4 dz$ where C $|z| = 3$

(b) $\int_C [(z^4)/(z + 1)(z - i)^2] dz$, where C is the ellipse $9x^2 + 4y^2 = 36$

6. (a) Expand $f(z) = \cos z$ in Taylor's series about $z = (\pi/3)$

(b) Find the Laurent series for $f(z) = [(z^2 - 1)/(z^2 + 5z + 6)]$ in the region $2 < |z| < 3$

7. (a) Find the principal part and the residues at the pole of the function

$f(z) = [(2z + 3)/(z + 2)^2]$

(b) Find the principal point and the residues for the function

$f(z) = [z/(z^4 + a^4)]$