



BRAC University

Department of Mathematics and Natural Sciences

Total Points: 150

 **Assignment - 01**

Course Code: MAT215

Complex Variables & Laplace Transform

 **Name: OMER HOSSAIN**


 **Student ID: 22221137**

 **Section: 12**

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 **Submission Date: _____**

Assigned by


 **Partho Sutra Dhor**
Lecturer, Department of MNS
BRAC University

Question 1

Find all possible values of z satisfying


$$z^7 = -128.$$

Locate them on the complex plane. Show that they lie on a circle, and determine its radius. Also, find the angular distance between two adjacent roots.

 Solution:


Question 2

Describe the locus $|z - 8| - |z + 8| = 14$ on the complex plane.

 Solution:

Question 3

Describe the region $|z + 8| + |z - 8| \leq 19$ on the complex plane.


 Solution:

Question 4

Solve the equation

$$e^{9z} = \frac{7}{2} - \frac{7\sqrt{3}i}{2}$$


for z and express z as $x + iy$ where $x, y, \in \mathbb{R}$.

 Solution:

Question 5

Prove that


$$\cosh^{-1} z = \ln \left(z + \sqrt{z^2 - 1} \right),$$

 Solution:

Question 6


Solve for z where

$$\tanh^{-1} z = 5 - 9i$$

 Solution:

Question 7


Using the definition of a limit, show that $\lim_{z \rightarrow 0} \frac{\text{Im}\{z^2\}}{|z|^2}$ does not exist.

 Solution:

Question 8

Using L'Hôpital's rule, evaluate

$$\lim_{z \rightarrow 0} \left(\frac{\sin z}{z} \right)^{\frac{8 \sin(9z)}{z - \sin z}}$$


 Solution:

Question 9

Consider the function

$$f(z) = \frac{\tan 5z}{5z}.$$

Is $f(z)$ continuous at $z = 0$? If not, redefine f at $z = 0$ so that $f(z)$ becomes continuous. Also, find all the points of discontinuity of $f(z)$.


 **Solution:**

Question 10

Using the definition, show that


$$f(z) = 8z^2 + 4z - 4$$

is differentiable at all points. Also find the derivative.

 **Solution:**

Question 11

Using the definition, find the derivative of $f(z) = \frac{6}{z^2}$ at $z = 7 + 7i$.


 Solution:

Question 12

Consider the function

$$f(z) = 9 \sinh(9z) - 9 \cos(8z).$$

Using the Cauchy–Riemann equations, determine whether the function is analytic.


 **Solution:**

Question 13

Consider the function

$$f(z) = 3|z|^2 + 8z - 5\bar{z}.$$

Using the Cauchy–Riemann equations, determine whether the function is analytic.


 **Solution:**

Question 14

Show that the function

$$v(x, y) = 2e^{-2x} \cos(2y) - 6e^{8y} \sin(8x) + 24x^2y - 4x^2 - 8y^3 + 4y^2$$

is harmonic. Find the harmonic conjugate u of v such that $u + vi$ becomes analytic.


 **Solution:**

Question 15

Show that the function

$$u(x, y) = 3xe^{-8x} \cos(8y) + 3ye^{-8x} \sin(8y)$$

is harmonic. Find the harmonic conjugate v of u such that $u + vi$ becomes analytic.

 **Solution:**