



III BRAC University

Department of Mathematics and Natural Sciences

Total Points: 150

Assignment - 01

Course Code: MAT215

Complex Variables & Laplace Transform

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Section: 12

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Assigned by

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Question 1

Find all possible values of z satisfying

$$z^7 = 64 + 64\sqrt{3}i.$$

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 $|z - 6i| - |z + 6i| = 10$ on the complex plane.

 Solution:

Question 3

Describe the region $\left| \frac{z+6i}{z-6i} \right| \geq 6$ on the complex plane.

 **Solution:**

? Question 4

Solve the equation

$$e^{7z} = 9i$$

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

$$\operatorname{sech}^{-1} z = 8 - 5i$$

 Solution:

? Question 7

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

 Solution:

Question 8

Using L'Hôpital's rule, evaluate

$$\lim_{z \rightarrow 0} \left(\frac{\tan z}{z} \right)^{\frac{5 \sin(9z)}{z - \sin z}}$$

 Solution:

Question 9

Consider the function

$$f(z) = \frac{\tan 7z}{5z}.$$

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

$$f(z) = 4z^2 + 3z - 6$$

is differentiable at all points. Also find the derivative.

 Solution:

? Question 11

Using the definition, find the derivative of $f(z) = \frac{2z - 9}{9z + 8i}$ at $z = i$.

 Solution:

Question 12

Consider the function

$$f(z) = 4 \sinh(8z) - 4 \cos(8z).$$

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

 Solution:

Question 13

Consider the function

$$f(z) = 3|z|^2 + 3z - 9\bar{z}.$$

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

 Solution:

? Question 14

Show that the function

$$v(x, y) = 7e^{-4x} \cos(4y) - 6e^{3y} \sin(3x) + 24x^2y - 2x^2 - 8y^3 + 2y^2$$

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

 Solution:

Question 15

Show that the function

$$v(x, y) = 3xe^{-2x} \cos(2y) + 3ye^{-2x} \sin(2y)$$

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

 **Solution:**