



SCHOOL OF ADVANCED SCIENCES

CONTINUOUS ASSESSMENT TEST – I

FALL SEMESTER 2025-2026

SLOT: A1+TA1+TAA1

Programme Name & Branch : B. Tech (Common)
Course Code : BMAT201L
Course Name : Complex Variables and Linear Algebra
Class Number(s) : Common question paper for this slot

Exam Duration: 90 minutes

Maximum Marks: 50

General instruction(s):

Answer all the Questions

5X10=50

Q.No.	Question	Max Marks	CO	BL
1.	<p>Show that the function $f(z) = \begin{cases} \frac{x^3(1+i) - y^3(1-i)}{x^2 + y^2}, & z \neq 0 \\ 0, & z = 0 \end{cases}$</p> <p>is not regular at the origin, although C-R equations are satisfied at the origin.</p>	10	CO1	BL2
2.	<p>An incompressible fluid flowing over the xy-plane has the velocity potential $\phi = x^2 - y^2 + \frac{x}{x^2 + y^2}$. Examine if this is possible and find a stream function.</p>	10	CO1	BL3
3.	<p>Find the bilinear transformation that maps the points $2, i, -2$ into $1, i, -1$ respectively. Also find the invariant points.</p>	10	CO2	BL2
4.	<p>Find the image of the infinite strip $\frac{1}{4} \leq y \leq \frac{1}{2}$ in the z-plane under the transformations $w = \frac{1}{z}$</p>	10	CO2	BL2
5.	<p>Obtain the expansions for $f(z) = \frac{z^2 - 4}{z^2 + 5z + 4}$ which are valid when (i) $z < 1$ (ii) $1 < z < 4$</p>	10	CO2	BL2

CAT-1

AI+TAI KEY

1. $U(x,y) = \frac{x^3 - y^3}{x^2 + y^2}$; $V(x,y) = \frac{x^3 + y^3}{x^2 + y^2}$; $f(0) = 0$; $U(0,0) = V(0,0) = 0$

$(U_x)_{z=0} = \lim_{x \rightarrow 0} \frac{U(x,0) - U(0,0)}{x} = 1$; $(U_y)_{z=0} = -1$

$(V_x)_{z=0} = 1$; $(V_y)_{z=0} = 1$

$U_x = V_y$; $U_y = -V_x \Rightarrow$ C-R eq's are satisfied

$f'(0) = \lim_{z \rightarrow 0} \frac{(1+i) - m^3(1-i)}{(1+im)(1+m^2)}$ depends on m value

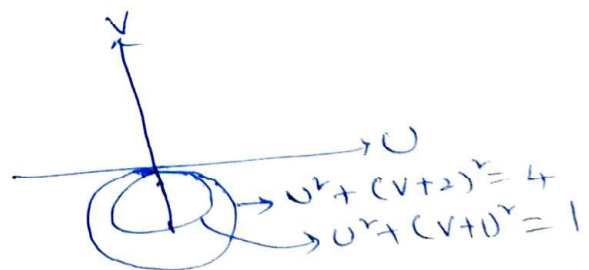
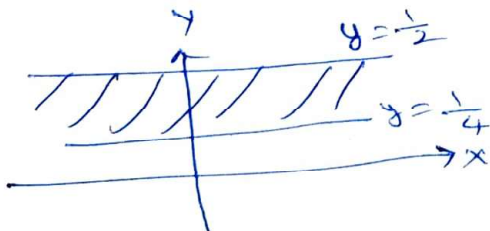
$f'(0)$ doesn't exist : $f'(0)$ is not regular

2. $\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = 0$

$f(z) = z^2 + \frac{1}{z} + i$; $\psi(x,y) = 2xy - \frac{y}{x^2 + y^2}$

3. $w = f(z) = \frac{3z + 2i}{iz + 6}$; $f(z) = z \Rightarrow \frac{3z + 2i}{iz + 6} = z \Rightarrow z = \underline{2i, i}$

4. $w = \frac{1}{z} \Rightarrow z = \frac{1}{w}$; $\therefore x = \frac{u}{u^2 + v^2}$; $y = \frac{-v}{u^2 + v^2}$



5. (i) when $|z| < 1$
 $f(z) = 1 - (1+z)^{-1} - (1+\frac{z}{4})^{-1} = 1 - (1-z+z^2-\dots) - (1-\frac{z}{4}+\frac{z^2}{16}-\dots)$

(ii) when $1 < |z| < 4$
 $f(z) = 1 - \frac{1}{z} + \frac{1}{z^2} - \dots - [1 - \frac{z}{4} + \frac{z^2}{16} - \dots]$