



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 minutesMaximum Marks: 50**General instruction(s):**

Answer all the Questions

5X10=50

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

CAT-1AI+TAI KEY

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

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

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

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

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

$$f'(0) = \lim_{r \rightarrow 0} \frac{(1+i) - r^3(-i)}{(1+ri)(1+r^2)} \quad \text{depends on its value}$$

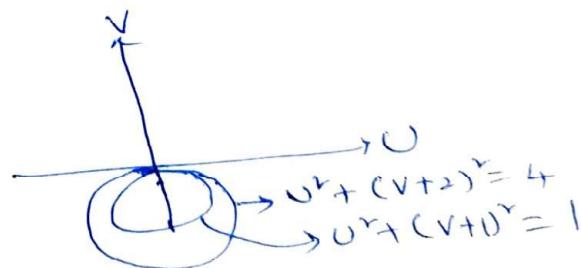
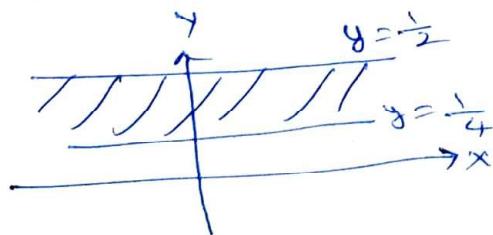
$f'(0)$ doesn't exists: $f'(0)$ is not regular

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

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

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

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



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 $1 < |z| < 4$

$$f(z) = 1 - \frac{1}{z} \left[1 - \frac{1}{z} + \frac{1}{z^2} - \dots \right] - \left[1 - \frac{z}{4} + \frac{z^2}{16} - \dots \right]$$