Continuous Assessment Test(CAT) – I – January 2025

Programme	:	B.Tech	Semester	:	Win-24-25
Course Code & Course Title	:	BMAT201L & Complex Variables and Linear Algebra	Slot	:	A1+TA1+TAA1
Faculty	:	Dr. R. Jayagopal, Dr. S. Balaji, Dr. A. Manivannan, Dr. Amit Kumar Rahul, Dr. P. Vijay Kumar, Dr. P. Durgaprasad, Dr. R. Pavithra, Dr. Pulak Konar, Dr. Soumendu Roy, Dr. Prosenjit Paul	Class Numbers	:	CH2024250500921, 922, 923, 925, 927, 928, 929, 930, 931, 932
Duration	:	1 hour 30 Mins	Max. Marks		50

General Instructions:
- Write only your registration number on the question paper in the box provided and do not write other information
- Only non-programmable calculator without storage is permitted

Answer all questions

Q. No	Sub Sec.	Description	Marks
1		Show that $u = x^2 - y^2$ and $v = \dfrac{-y}{x^2+y^2}$ are harmonic, but $u + iv$ is not an analytic function.	10

2		If $\omega = \phi + i\psi$ represents the complex potential for an electric field and if $\phi = e^{x^2-y^2}\cos(2xy)$ can represent the equipotential,
		  i. Find the complex potential ω.
		  ii. Find the lines of force ψ.
			10

3	a	Make use of Cauchy-Riemann equations, verify the function $f(z) = \left(r + \frac{1}{r}\right)\cos\theta + i\left(r - \frac{1}{r}\right)\sin\theta$ is analytic or not. Also, verify the harmonicity of $v(r, \theta)$.	5
3	b	Expand $f(z) = \frac{1}{1-z}$ in Taylor series about $z = 2i$ and determine the radius of convergence.	5
4	a	Find the image of the rectangular region R bounded by the lines $x = 0, y = 0,$ $x = 2, y = 1$ under the mapping $w = \sqrt{2}\, e^{\frac{\pi i}{4}} z + (1 - 2i)$. Sketch the region R in z-plane and its image in w-plane.	5
4	b	Find a bilinear transformation that maps $z_1 = 1, z_2 = i, z_3 = -i$ onto $w_1 = -i, w_2 = i, w_3 = \infty$. Hence find the images of $z = 0$ and $z = \infty$ under this bilinear transformation.	5
5		Find the image of the region bounded by the straight lines $y = 2x,\ x + y = 6$ and $y = 0$ under the mapping (a) $w = \frac{1}{z}$ and (b) $w = z^2$. Hence sketch the images in w-plane.	10