Q/K/TY

Reg. No:

Final Assessment Test – November 2025

VIT
Vellore Institute of Technology

Course: **BMAT201L - Complex Variables and Linear Algebra**

Class NBR(s): **0662 / 0688 / 0691 / 0693 / 0696 / 0698 / 0700 / 0764 / 0768 / 0916 / 0918 / 2396 / 2397 / 2401 / 2417 / 2421 / 2434 / 2441 / 2447 / 2449 / 4384 / 4392**

Slot: **A1+TA1+TAA1**

Time: **Three Hours**

Max. Marks: **100**

- **KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

COs	CO Statements
CO1	Able to construct analytic functions and find complex potential of fluid flow and electric fields.
CO2	Able to find the image of straight lines by elementary transformation and to express analytic functions in power series.
CO3	Able to evaluate real integrals using techniques of contour integration.
CO4	Able to use the power of inner product and norm for analysis.
CO5	Able to use matrices and transformations for solving engineering problems.

BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)

Answer ALL Questions
(10 X 10 = 100 Marks)

1. Verify $\psi = 3x^2y + x^2 - y^2 - y^3$ Can represents the stream function of an incompressible fluid flow. Find the corresponding velocity potential and hence the complex potential $f(z) = \varphi + i\psi$. CO1 BL2

2. If $f(z)$ is a regular function of z, prove that CO1 BL2
$$\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}\right)\left(Re\ f(z)\right)^2 = 2|f'(z)|^2 .$$

3. Find the image in the w-plane of the region of the z-plane bounded by the lines $x = 0, y = 0, x = 2, y = 1$ under the transformation CO2 BL3
(i) $w = z + 2 - i$. (ii) $w = (1 + 2i)z + (1 + i)$.

4. Find the bilinear transformation that maps the points $z_1 = 0$, $z_2 = -i$ and $z_3 = -1$ into the points $w_1 = i$, $w_2 = 1$, and $w_3 = 0$ and also find the image of $|z| = 2$ under this transformation. CO2 BL3

5.a) Find the Laurent's series expansion of the function $f(z) = \frac{1}{z(1-z)}$ which are valid in (i) $1 < |z + 1| < 2$. (ii) $|z + 1| > 2$. (iii) $|z + 1| < 1$. CO3 BL2

OR

5.b) Evaluate $\int_0^\infty \frac{x\sin x}{x^2+1}\,dx$, by contour integration. CO3 BL2

6. Find the basis and dimension of row space, column space and null space of CO5 BL3

$$A = \begin{bmatrix} 1 & 2 & 0 & 2 & 5 \\ -2 & -5 & 1 & -1 & -8 \\ 0 & -3 & 3 & 4 & 1 \\ 3 & 6 & 0 & -7 & 2 \end{bmatrix}.$$

7.a) Let $T : R^3 \to R^2$ be the linear transformation defined by CO5 BL3

$$T(x;\ y;\ z) = (3x - y + 4z;\ 7x + 8y - z)$$

Find $[T]_\alpha^\beta$, for $\alpha = \{(1,1,0),(1,1,0),(1,0,0)\}$ and $\beta = \{(-2,4),(-7,5)\}$.

OR

7.b) Find a basis and dimension of R_T and N_T for the linear transformation $T: R^3 \to R^3$, defined by $T(x_1, x_2, x_3) = (x_1 - x_2 + 2x_3,\ 2x_1 + x_2,\ -x_1 - 2x_2 + 2x_3)$. CO5 BL3

8. Apply the Gram–Schmidt orthogonalization process to find an orthogonal basis and then an orthonormal basis for the subspace W of R^4 spanned by the set of vectors $\{(1,1,1,1),(1,2,0,1),\ (2,2,4,0)\}$. CO4 BL3

9. Find the Eigen values and Eigen vectors of the matrix CO4 BL2

$$A = \begin{pmatrix} 2 & -2 & 2 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{pmatrix}$$, hence find the Eigen values of $A^{-1},\ A^T and\ A^4$.

10. Using Gauss-Jordan method, solve the system of equations CO4 BL2

$x + y + z + w = 2$,

$x + y + 3z - 2w = -6$,

$2x + 3y - z + 2w = 7$,

$x + 2y + z - w = -2$.

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