U/K/TY

Reg. No:

Final Assessment Test - November 2025

VIT Vellore Institute of Technology

Course: BMAT201L - Complex Variables and Linear Algebra

Class NBR(s): 0664 / 0665 / 0669 / 0671 / 0672 / 0673 / 0677 / 0680 / 0683 / 0713 / 0718 / 0722 / 0724 / 0729 / 0731 / 0745 / 0753 / 0773 / 0774 / 0776 / 2379 / 2381 / 2386 / 2388 / 2507

Slot: C1+TC1+TCC1

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 transformations 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. Show that $\psi = x^2 - y^2 - 3x - 2y + 2xy$ can represent the stream function of an incompressible fluid flow. Also find the corresponding velocity potential ϕ and hence the complex potential $f(z) = \varphi + i\psi$. **CO1 BL2**

2. Determine the regular function $f(z) = P + iQ$, given that $P - Q = \frac{\sin 2x}{\cosh 2y - \cos 2x}$. **CO1 BL3**

3. Find the image of the triangle formed by the lines $y = x, y = -x$ and $y = 1$ under the transformation $w = z^2$. **CO2 BL3**

4. Find the bilinear transformation that maps the points $z_1 = 0$, $z_2 = 1$ and $z_3 = \infty$ into the points $w_1 = i$, $w_2 = -1$, and $w_3 = -i$ and also find its invariant points. **CO2 BL3**

5.a) Find the Laurent's series of $f(z) = \frac{z}{(z-1)(z-3)}$ valid in the region **CO3 BL5**
(i) $0 < |z - 1| < 2$,
(ii) $|z - 1| > 2$.

OR

5.b) Evaluate $\int_0^\infty \frac{x^2}{(x^2+1)(x^2+4)} dx$, by contour integration. **CO3 BL5**

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

$$A = \begin{bmatrix} 1 & -3 & 2 & -3 & 9 \\ 2 & 0 & 1 & 3 & 3 \\ -2 & -4 & 1 & -9 & 7 \\ 1 & 3 & -1 & 6 & -6 \end{bmatrix}.$$

7.a) Let $G : R^3 \to R^3$ be the linear mapping defined by CO5 BL3

$$G(x; y; z) = (x - y + 2z; 2x + y; -x - 2y + 2z)$$

Find a basis and the dimension of (i) the image of G, (ii) the kernel of G.

OR

7.b) Let $T : R^3 \to R^2$ be the linear transformation defined by CO5 BL2

$$T(x; y; z) = (2x + y - z; 3x - 2y + 4z)$$

Find $[T]_{\alpha}^{\beta}$, for $\alpha = \{(1,1,1), (1,1,0), (1,0,0)\}$ and $\beta = \{(1,3), (1,4)\}$.

8. Apply the Gram–Schmidt orthogonalization process to find an orthogonal basis and then an orthonormal basis for the subspace U of R^4 spanned by CO4 BL3

$v_1 = (2, 1, 3, -1)$, $v_2 = (7, 4, 3, -3)$ $v_3 = (5, 7, 7, 8)$.

9. Find the eigen values and eigen vectors of the matrix CO5 BL2

$$A = \begin{pmatrix} 2 & 2 & -7 \\ 2 & 1 & 2 \\ 0 & 1 & -3 \end{pmatrix}$$, hence find the eigen values of A^{-1}, A^T and A^4.

10. Using Gauss-elimination method, solve the system of equations CO5 BL3

$2x + 2y - z + w = 4$, $4x + 3y - z + 2w = 6$,

$8x + 5y - 3z + 4w = 12$, $3x + 3y - 2z + 2w = 6$.

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