



VIT

Vellore Institute of Technology

Final Assessment Test - November 2023

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

Class NBR(s): 0667 / 0676 / 0679 / 0684 / 0715 / **0720** / 0733 / 0757 / 0783 / 0785 / 0787 / 0789 / 7387

Slot: **C2+TC2+TCC2**

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)

- 6 Show that $\psi = e^{-x}[2xy \cos y + (y^2 - x^2) \sin y]$ can represent the stream function in an incompressible fluid flow. Also find the corresponding velocity potential and complex potential. CO1 BL2
- Determine the analytic function $f(z) = u + iv$ given that $3u + 2v = y^2 - x^2 + 16xy$. CO1 BL3
- 8 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 $w_3 = -i$. CO2 BL3
- 11 Find and sketch, the image of the strip $2 < x < 3$ and the circle $|z - 3i| = 3$ under the mapping $w = \frac{1}{z}$. CO2 BL3
- a) Find the Laurent's series expansion of the function $f(z) = \frac{-1}{(z-1)(z-2)}$ which are valid in range (i) $1 < |z| < 2$ (ii) $|z| < 1$ and $|z| > 2$. CO3 BL5

OR

- b) Evaluate $\int_0^{2\pi} \frac{\cos 3\theta d\theta}{5 - 4\cos\theta}$, by contour integration. CO3 BL5
- 4 Find the basis and dimension of row space, column space and null space of $A = \begin{bmatrix} 1 & -1 & 2 & 1 & 0 \\ 2 & 0 & 1 & -1 & 3 \\ 5 & -1 & 3 & 0 & 3 \\ 1 & 3 & -4 & -5 & 6 \\ 4 & -2 & 5 & 1 & 3 \end{bmatrix}$. CO4 BL3

- 7.a) Let $G : R^3 \rightarrow R^3$ be the linear mapping defined by CO4 BL2
 $G(x, y, z) = (x + 2y - z, y + z, x + y - 2z)$ Find a basis and the dimension of (i) The image of G , (ii) The kernel of G .

OR

- 7.b) Let $T : R^3 \rightarrow R^2$ be the linear transformation defined by CO4 BL2
 $T(x, y, z) = (3x + 2y - 4z, x - 5y + 3z)$. Find $[T]_{\alpha}^{\beta}$, for $\alpha = \{(1, 1, 1), (1, 1, 0), (1, 0, 0)\}$ and $\beta = \{(1, 3), (2, 5)\}$.

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

9. ¹¹⁸ Find the eigen values and eigen vectors of the matrix $A = \begin{pmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{pmatrix}$, CO5 BL2
 hence find the eigen values of A^{-1} .

10. ⁷¹⁶ Solve the system of equations CO5 BL3
 $2x - 6y + 8z = 24$, $5x + 4y - 3z = 2$, $3x + y + 2z = 16$ by Gauss-Jordan elimination method.

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