

Reg. No:

R/K/TY

Final Assessment Test – November 2025

Course: **BMAT201L - Complex Variables and Linear Algebra**
 Class NBR(s): **0663/ 0674/ 0690/ 0692/ 0695/ 0697/ 0699/ 0701/ 0767/ 0769/ 0917/ 0919/ 2398/ 2411/ 2437/ 2444/ 2446/ 2496/ 3476/ 4256/ 4368/ 4416**

Slot: **A2+TA2+TAA2**

Max. Marks: **100**

Time: **Three Hours**

- **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	Construct analytic functions and find complex potential of fluid flow and electric fields.
CO2	Find the image of straight lines by elementary transformations and to express analytic functions in power series.
CO3	Evaluate real integrals using techniques of contour integration.
CO4	Use the power inner product and norm for analysis.
CO5	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. If $f(z) = u + iv$ is an analytic function of z and $3u - 2v = 7x^2 - 7y^2 + 8xy$. **CO1 BL2**
Find $f(z)$ in terms of z . Also find the functions of u and v .
2. Verify $\phi(x, y) = x^4 - 6x^2y^2 + y^4$ is the Velocity potential function. Find the stream function ψ such that $f = \phi + i\psi$ is analytic function. **CO1 BL1**
3. Under the transformation $w = z + \frac{a^2 - b^2}{4z}$, find the image of the circle of radius and centre at the origin into the w -plane. **CO2 BL2**
4. Find the bilinear transformation which maps the points $z = 1, i, -1$ into $w = i, 0, -i$. Also find the image of $|z| < 1$. **CO2 BL2**
- 5.a) Expand $f(z) = \frac{z+3}{z(z^2-z-2)}$ the Laurent's series for the region **CO3 BL3**
 - (i) $|z| < 1$
 - (ii) $1 < |z| < 2$
 - (iii) $|z| > 2$.

OR

- 5.b) Evaluate $\int_0^\infty \frac{x^2}{x^6+1} dx$ by using Calculus of residues. **CO3 BL3**

6. Find the basis for column space and null space of $A = \begin{bmatrix} 1 & -2 & 0 & 0 & 3 \\ 2 & -5 & -3 & -2 & 6 \\ 0 & 5 & 15 & 10 & 0 \\ 2 & 6 & 18 & 8 & 6 \end{bmatrix}$. CO4 BL3

Hence, find the rank and nullity of A .

- 7.a) Let $T: \mathbb{R}^3 \rightarrow \mathbb{R}^3$ be a transformation defined as CO4 BL2
 $T(x, y, z) = (2x, 4x - y, 2x + 3y - z)$, show that T is invertible and find $T^{-1}(u, v, w)$. Also find the linear transformation $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$ is defined as $T(2, 3) = (4, 5)$ and $T(1, 0) = (1, 2)$.

OR

- 7.b) Let $T: R^3 \rightarrow R^3$ be the linear transformation defined by CO4 BL2
 $T(x_1, x_2, x_3) = (x_1 + 2x_2 + x_3, -x_2, x_1 + 4x_3)$. Let α be the standard basis, and let $\beta = \{(1, 0, 0), (1, 1, 0), (1, 1, 1)\}$ for R^3 . Find the associated matrix of T with respect to α and the associated matrix of T with respect to β . Are they similar?
8. Let $P_3(R)$ be the vector space of polynomials with the inner product CO4 BL2
 $\langle f, g \rangle = \int_{-1}^1 f(t)g(t)dt$, Apply Gram-Schmidt orthogonalization process on the basis $[1, t, t^2, t^3]$ of $P_3(R)$ to find an orthogonal basis.
9. Express the following system of equation in matrix form and solve then by Gauss Elimination method. CO5 BL3

$$\begin{aligned} 2x_1 + x_2 + 2x_3 + x_4 &= 6 \\ 6x_1 + 6x_2 + 6x_3 + 12x_4 &= 36 \\ 4x_1 + 3x_2 + 3x_3 - 3x_4 &= -1 \\ 2x_1 + 2x_2 - x_3 + x_4 &= 10. \end{aligned}$$

10. Find the characteristic equation of the matrix $A = \begin{pmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{pmatrix}$ and hence CO5 BL2
 compute A^{-1} . Also find the matrix represented by $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I$.

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