VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act 1956)

REG. NO.:

SLOT: D2+TD2+TDD2

SCHOOL OF ADVANCED SCIENCES
DEPARTMENT OF MATHEMATICS
FALL SEMESTER 2025–2026

Continuous Assessment Test – II

| | | |
|---|---|---|
| Programme Name & Branch | : | B. Tech |
| Course Code & Course Name | : | BMAT201L (Complex variables and Linear Algebra) |
| Class Number(s) | : | Common question paper for this slot |
| Faculty Name(s) | : | Common question paper for this slot |
| Date of Examination | : | 08-10-2025 |
| Exam Duration | : | 90 Minutes |

Maximum Marks : 50

**General Instruction(s):**

- Answer ALL Questions.
- Non-programmable calculator is permitted.
- M - Max mark; CO Course Outcome; BL Blooms Taxonomy Level (1 Remember, 2 Understand, 3 Apply, 4 Analyse, 5 Evaluate, 6 Create)
- Course Outcomes
  CO 3 : Evaluate real integrals using techniques of contour integration.
  CO 4 : Use the power of inner product and norm for analysis.
  CO 5 : Use matrices and transformations for solving engineering problems.

| Q. No. | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 1. | a). Discuss the nature of the singularity of the function $f(z) = \dfrac{5z - \sin z}{z^3}$. | 5 | 3 | 2 |
| | b). Evaluate $\displaystyle\int_C \frac{3z^3 + 2}{(z-1)(z^2+4)}\,dz$ where $C$ is the circle with radius 2 and centered at $(2, 0)$, using Cauchy's integral formula. | 5 | 3 | 2 |
| 2. | Evaluate $\displaystyle\int_{-\infty}^{\infty} \frac{x \sin ax}{(x^2+4)}\,dx$ using the Cauchy's Residue theorem. | 10 | 3 | 3 |
| 3. | Let $A = \begin{pmatrix} 2 & 4 & 1 \\ 3 & 2 & 2 \\ 1 & -1 & 4 \end{pmatrix}$. Use Cayley Hamilton theorem to find constants $a, b, c$ such that $A^4 = aA^2 + bA + cI$, where $I$ is the identity matrix of order 3. Also find $A^{-1}$. | 10 | 5 | 2 |

<table>
<tr><th>Q. No.</th><th>Questions</th><th>Marks</th><th>CO</th><th>BL</th></tr>
<tr><td>4.</td><td>A construction project manager needs to decide how many units of Excavation , Concreting , Masonry , and Finishing to schedule. Each activity consumes different amounts of material, labor, machinery time, and budget. The total available resources are limited. The per-unit resource requirements and the total available resources are summarized in the table below:<br><br>
<table>
<tr><th>Activity</th><th>Material</th><th>Labor</th><th>Equipment</th><th>Budget</th></tr>
<tr><td>Excavation</td><td>1</td><td>2</td><td>1</td><td>3</td></tr>
<tr><td>Concreting</td><td>2</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>Masonry</td><td>1</td><td>2</td><td>3</td><td>1</td></tr>
<tr><td>Finishing</td><td>3</td><td>1</td><td>2</td><td>1</td></tr>
<tr><td>Total Available</td><td>20</td><td>18</td><td>17</td><td>19</td></tr>
</table>
<br>Determine the number of units for Excavation, Concreting, Masonry, and Finishing so that all resource constraints are exactly satisfied.</td><td>10</td><td>5</td><td>3</td></tr>
<tr><td>5.</td><td>a). Let $\mathbb{R}^3$ be a vector space over a field $\mathbb{R}$ and $W = \{(a, b, c) \in \mathbb{R}^3 \mid a = b - c,\ 2a + 3b - c = 0\}$. Verify whether $W$ is a subspace of $\mathbb{R}^3$.<br><br>b). Let $\mathbb{R}^3$ be a vector space over a field $\mathbb{R}$ and $S = \{(1, 1, 0), (1, 0, 2), (1, 1, 1)\}$ be the subset of $\mathbb{R}^3$. Verify whether $S$ is a basis of $\mathbb{R}^3$.</td><td>5<br><br>5</td><td>4<br><br>4</td><td>3<br><br>3</td></tr>
</table>

**********