SLOT: F2+TF2

REG.NO.: 23BMM0042

VIT
Vellore Institute of Technology

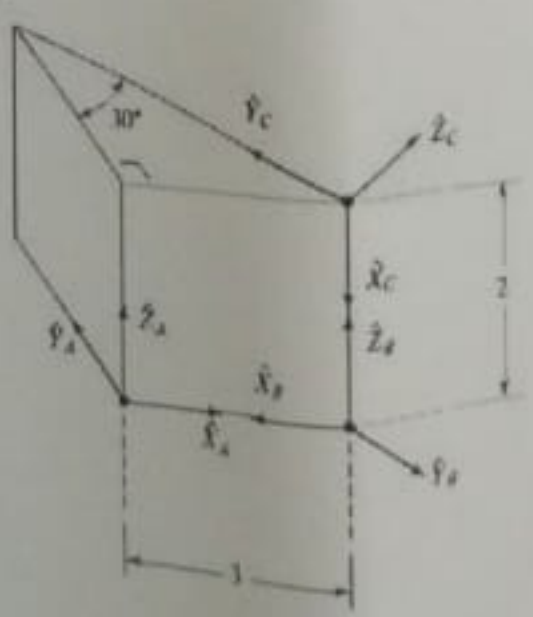
SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST (CAT) -I
WINTER SEMESTER 2025-2026

Programme Name & Branch	: B.Tech Mechanical Engineering
Course Code	: BMEE316E
Course Name	: Industrial Robotics
Faculty Name(s)	: Kalaiarassan G
Class Number(s)	: VL2025260503036
Date of Examination	: 01.01.2026
Exam Duration	: 90 minutes

Maximum Marks: 50

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes Statements:
  CO. 1: Specify various types of Robots for industrial applications with sound knowledge of the positioning system.
  CO. 2: Represent the rigid body motion and its transformation mathematically.

Q. No	Question	M	CO
1.	Determine the degrees of freedom (DOF) of a Stewart platform using the Grübler–Kutzbach criterion, and explain its anatomy with a suitable sketch.	10	01
2.	A DC servomotor drives the X-axis of a CNC milling table through an 8:1 gear-reduced ball screw of 7.5 mm pitch. An optical encoder (75 pulses/rev) is mounted on the ball screw. For a straight-line move at 300 mm/min from (202.5 mm, 35 mm) to (25 mm, 250 mm), determine for the X-axis: (a) Control resolution, (b) motor speed, (c) encoder pulse frequency, and (d) total pulses generated during the move.	10	01
3.	a) Refer to the following figure.1 and calculate the transformation matrix of ${}^{C}_{A}T$ and ${}^{A}_{C}T$  Figure. 1	05	02

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	b) A vector ${}^{A}P$ is rotated about $\hat{}Y_A$ by 30 degrees, then rotated about $\hat{}X_A$ by 45 degrees, and subsequently rotated about $\hat{}Z_A$ by 60 degrees. Give the rotation matrix that accomplishes these rotations in the given order.	05	
4.	Explain the three fundamental operators used in rigid body representation: translation, rotation, and transformation operators. Support your answer with relevant coordinate frame sketches and corresponding mathematical equations.	10	02
5.	Derive the equivalent rotational matrix, of ${}^{A}_{B}R_{XYZ}$ (γ, β, α) using the principle of fixed angle and Euler angle rotation with suitable frame descriptions.	10	02

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