U/D/TY

Reg. No: [redacted]

Final Assessment Test – April 2025

VIT Vellore Institute of Technology

Course: CSI3016 - Robotics: Machines and Controls

Class NBR(s): 2096/2100/2102 Slot: A1+TA1

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

Answer ALL Questions

(10 X 10 = 100 Marks)

1. After performing a successful soft landing in Moon, ISRO is planning to launch a mission to land a rover in Mars. The environment of Mars is unobservable. As a technical director of this mission, give a detailed note on any four AI technologies you will suggest to design and construct the rover by considering the geographical uncertainty caused by extreme temperature, dust storms, radiation etc.

2. Write the significance of automation in robots. List and explain various types of robotics automation systems with examples.

3.a) A point P (X, Y, Z) = $(0,5,2)^T$ is attached to a rotating frame. The frame performs following operations

Step 1: Rotates 30 Degree about Y-axis followed by translation of 4 units along Z- axis.

Step 2: Translate 6 units along Z-axis followed by rotation of 60 Degree along Y-axis.

Find the co ordinates of the point relative to the reference frame after the completion of the above transformations.

OR

3.b) In robot kinematics, the relationship between two coordinate frames will usually be represented using 6 parameters. But in Denavit- Hartenberg (DH) representation the coordinate frames have constraints which will lead to the reduction of parameters. Write the significance of this reduced number parameters and give general explanation of DH representation with final matrix with suitable example.

4. Define robots' degrees of freedom. Write an elaborate note on all the 6 degrees of freedom of a robot in 3D free space with diagrams.

5. Describe in brief the various types of drive systems used to actuate robot joints. Also give their advantages and limitations.

6. Explain the working principle of the following types of sensors used in robotics by mentioning one application under each type

   a. Proximity
   b. Vision
   c. Tactile

7. i. A CNC milling machine is using a 10 kW motor. If the machine operates at 80% efficiency, what is the actual power consumed by the motor in watts? [4]

ii. A CNC lathe is required to cut a part with a total length of 100 mm and a cutting feed rate of 150 mm/min. If the part requires two passes to complete the cut, what is the total cutting time? [3]

iii. A CNC machine is set to cut a part at a spindle speed of 1200 RPM and a feed per tooth of 0.05 mm. If the cutter has 4 teeth, what is the feed rate (mm/min)? [3]

8. Write the standard definition of Programmable Logic Controller (PLC) given by National Electrical Manufacturers Association (NEMA). Draw the architectural block diagram of PLC and explain its components in detail.

9. Give the prime objective of introducing a Proportional-Integral-Derivative (PID) controller in a closed loop control system. Derive a simple transfer function of a PID controller in parallel form for a given unit step input.

10.a) List and explain any five objectives of production control and planning in a robotic industry.

OR

10.b) What are the three basic elements of a automated systems? Write detailed notes on them with diagrammatic representation.

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