H.T.No. | | | | | | | | | | |

Code No: ME1542 **GEC-R14**

IV B. Tech I Semester Regular Examinations, November 2017

ROBOTICS

(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 60**

Note: All Questions from **PART-A** are to be answered at one place.
Answer any **FOUR** questions from **Part-B.** All Questions carry equal Marks.

PART-A

6 × 2 = 12M

1. Define an Industrial Robot.
2. a) In a variable reluctance stepper motor, the number of steps required n = 200. What is the step angle?
   A) 1.8^0 B) 18^0 C) 3.6^0 D) 36^0
   b) Which of the following is a velocity sensor?
   A) AC Servomotor B) DC tachometer C) Brushless DC motor D) Stepper motor
3. List four processing operations which can be automated by robot.
4. With reference to DH notation, what is a joint angle? Explain with a sketch.
5. a) Jacobian relates the velocities of joints to the velocities of_________ [ ]
   A) Tool point B) Manipulator C) Joint D) None of the above
   b) If KE is kinetic energy, and PE is potential energy, then what is Lagrangian Function L? [ ]
   A) KE + PE B) KE - PE C) KE ÷ PE D) PE ÷KE
6. Distinguish between manual lead through and power lead through programming.

PART-B

4 × 12 = 48M

1. a) Distinguish between the functions of "body and arm assembly" and wrist assembly. (4M)
   b) A part weighing 8 kg is to be held by a gripper using friction against two opposing fingers. The coefficient of friction between the fingers and the part is estimated to be 0.3. The orientation of the gripper will be such that the weight of the part will be applied in a direction parallel to the contacting finger surfaces. A fast work cycle is anticipated so that the g factor to be used in force calculations should be 3. Compute the required gripper force for the specifications given. (8M)
2. a) With neat sketch explain the working principle of a stepper motor. (6M)
   b) Describe working of an absolute encoder with a neat sketch. (6M)
3. Describe non-manufacturing applications of robots in detail. (12M)

4. The joint link parameters for a 3-DOF spherical arm are given in the following table. Obtain a general solution for inverse kinematics. (12M)

Link i	a_i	α_i	d_i	Θ_i
1	0	90^0	0	Θ_1
2	0	-90^0	0	Θ_2
3	0	0	d_3	0

5. Determine the manipulator Jacobian matrix for a 3-DOF articulated arm. The link transformation matrices are as follows: (12M)

$$ {}^{0}T_1 = \begin{bmatrix} C_1 & 0 & S_1 & 0 \\ S_1 & 0 & -C_1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad {}^{1}T_2 = \begin{bmatrix} C_2 & -S_2 & 0 & L_2C_2 \\ S_2 & C_2 & 0 & L_2S_2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad {}^{2}T_3 = \begin{bmatrix} C_3 & -S_3 & 0 & L_3C_3 \\ S_3 & C_3 & 0 & L_3S_3 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

6. a) With reference to motion planning of a robot, explain the following terms. (6M)

   i) Trajectory   ii) Knot points   iii) Path update rate

   b) Explain the motion commands used to programme the robot. (6M)

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