Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME SEMESTER– • EXAMINATION – WINTER 2014

Subject Code:734702 **Date: 27/11/2014**

Subject Name:Robotic Engineering

Time:2.30 to 5.00 **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** What is robotics? Explain robot anatomy and its application in mechatronics. **07**

(b) Explain importance of degree of freedom in robotics and also Explain RPP, RRP configuration of robot. **07**

Q.2 **(a)** Define following with respect to robotics. **07**

Load carrying capacity, work volume, end effectors, resolution, dexterity

(b) A 3 degree of freedom roll pitch-yaw wrist having following configurations. Obtain direct kinematic model. Where ai Ŭi di ⍰i are usual D-H parameters. **07**

Link i	ai	Ŭi	di	⍰i
1	0	90 °	0	⍰1
2	0	90 °	0	⍰2
3	0	0	0	⍰3

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OR

(b) 4 Degree of freedom RPPR manipulator , the link joint transformation matrices with joint variables ⍰1,d2 ,d3 and ⍰4 are. Using inverse transformation find unknown joint variables .Where ai Ŭi di ⍰i are usual D-H parameters. **07**

Link i	ai	Ŭi	di	⍰i
1	5	90 °	0	⍰1
2	0	90 °	D2	0
3	0	0	D3	0
4	0	0	0	⍰4

End effector 4 x 4 transformation matrix is given as under.

$$T_E = \begin{matrix} -3.5 & 0.4 & -0.8 & -90 \\ 0.4 & -0.8 & -0.5 & -46 \\ -0.8 & -0.5 & 0 & 50 \\ 0 & 0 & 0 & 1 \end{matrix}$$

Q.3 **(a)** Define following with respect to robotics. **07**

Load carrying capacity, work volume, end effectors, resolution

(b) Differentiate robotic end effectors. And give design procedure for gripper design **07**

OR

Q.3 **(a)** What is inverse kinematics ? Explain guideline to get close form solution for inverse kinematics **07**

(b) Which are robot programming methods? Explain any one in brief. **07**

Q.4 **(a)** Explain optical encoders with their working and application in robotics **07**

	(b)	Explain force sensor and torque sensors.	**07**

OR

Q.4	**(a)**	Explain static force analysis for robotics. Explain that how Jacobean is useful in static analysis.	**07**
	(b)	List the methods used for dynamic analysis of robot. Explain any one method in detail.	**07**
Q.5	**(a)**	Explain steps in robotic trajectory planning with atleast one example.	**07**
	(b)	What is cubic polynomial trajectory in robot? Derive its mathematical formulation	**07**

OR

Q.5	**(a)**	Explain mathematical formulation for a trajectory having a linear function with parabolic blend.	**07**
	(b)	For a SCARA manipulator find cubic polynomial to generate smooth trajectory for following data. Ū=40 to 160 degree in 6 seconds. What is maximum velocity for this trajectory?	**07**

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