Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY ME – SEMESTER III (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2730808

Subject Name: Robotics Engineering

Time: 10:30 am to 01:00 pm

Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q.1 (a) Define degree of freedom. Describe with the help of a neat sketch the four 07 basic arm configurations that are used in robotic manipulators.
 - (b) Enlist the various factors considered in selection and design of grippers. 07
- Q.2 (a) What are the parameters for a link for kinematic modeling? Which of these 07 parameters are variable and which are constant for (a) revolute joint (b) Prismatic joint?
 - (b) Determine the time-history of the position, velocity and acceleration of the 07 end-effector of a 5-DOF manipulator, which moves from start to goal point via two intermediate points. The desired end effector motion is specified in table below.

End effector	Path point			
	1	2	3	4
Position(rad)	0	3П/2	-П/2	2П
Velocity(rad/s)	0	-П/2	П	0
Traversal time (s)	0	3	5	2
OR				

(b) Describe design considerations on trajectories. Explain 4-3-4 trajectory. 07

- Q.3 (a) Explain with the help of an algorithm the assignment of frames and 07 determination of DH- parameters for each link of n-degree of freedom manipulator.
 - (b) Explain Direct and inverse Kinematics with a suitable example.

OR

Q.3 (a) For the PUMA robot as shown below construct: (i) Table for Joint 07 parameters (ii) The component of the ${}^{5}T_{0}$.



Figure 1

Total Marks: 70

Date:03/05/2016

1

07

- (b) What do you understand by robot workspace? Explain the following 07 performance measuring indices:(a) Condition Number (b) Manipubality Index.
- Q.4 (a) Explain the Lagrange- Euler formulation to derive dynamic model of a 07 manipulator.
 - (b) Determine the Equation of motion for a 2-DOF planar manipulator using 07 Lagrange- Euler formulation.



- Q.4 (a) Explain Newton- Euler formulation to derive the dynamic model of a 07 manipulator.
 - (b) Determine the Equation of motion for a 2-DOF planar manipulator (figure 2) using Newton- Euler formulation.
- Q.5 (a) Differentiate between open loop and close loop control systems. 07
 - (b) Describe the working of Independent joint PID control with a neat block 07 diagram.

OR

- Q.5 (a) Classify robotic control system. Explain any one in detail. 07
 - (b) For the development of coordinated movement of an end effector from **07** point 1 to point 2, explain the following cases
 - 1. Variable speed control.
 - 2. Constant speed control.
