Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (MECHATRONICS ENGINEERING)

END SEMESTER MAKEUP EXAMINATIONS, JUNE/JULY 2016

SUBJECT: INTRODUCTION TO ROBOTICS [MTE 3283]

OPEN ELECTIVE

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- All calculations are to be shown.
- All sketches should be neat and labeled clearly.
- Missing data may be suitably assumed.

1A. Identify the following configurations and draw the appropriate work volume for the configuration as shown in fig.1 and also mention its joint notation scheme. **04**

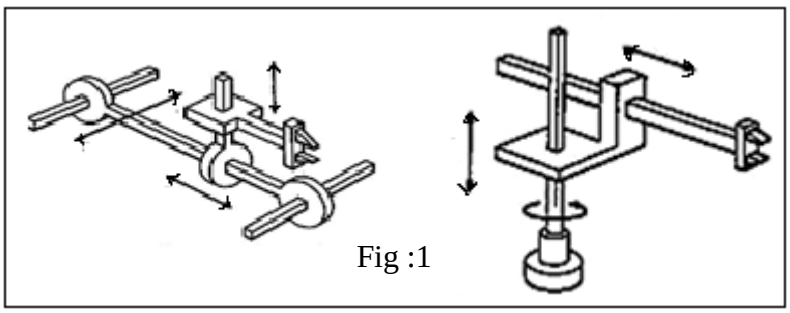

Fig :1

1B. Define Quantization. Consider the maximum voltage range for a 16bit capacity A/D converter to be 36v. calculate the quantization levels, quantization level spacing , and quantization error. **02**

1C. A six joint robotic manipulator equipped with a digital TV camera is capable of continuously monitoring the position and orientation of an object. the position and orientation of the object with respect to the camera is expressed by a matrix [T1], the origin of the robot's base co-ordinate with respect to the camera is given by [T2], and the position and orientation of the gripper with respect to the base co-ordinate frame is given by [T3]. **04**

Determine: (i). the position and orientation of the object with respect to the base coordinate,
(ii). the position and orientation of the object with respect to the gripper.

$$[T1]=\begin{bmatrix} 0 & 1 & 0 & 5 \\ 1 & 0 & 0 & 6 \\ 0 & 0 & -1 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}, [T2]=\begin{bmatrix} 1 & 0 & 0 & -20 \\ 0 & -1 & 0 & 10 \\ 0 & 0 & -1 & 12 \\ 0 & 0 & 0 & 1 \end{bmatrix}, [T3]=\begin{bmatrix} 1 & 0 & 0 & 8 \\ 0 & 1 & 0 & 6 \\ 0 & 0 & 1 & 6 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

2A. vision system uses a Vidicon tube. An analog video signal is generated for each line of the 1024 lines comprising the faceplate. The sampling capability of the A-D converter is 150 Nano seconds. This is the cycle time required to complete the A-D conversion process for 1 pixel. Using the American standard of 33.33 milliseconds (1/30 sec) to scan the entire faceplate consisting of 1024 lines, determine the number of pixels that can be processed per line. **02**

2B. What is cold junction compensation. Explain with suitable diagram. Also mention the combination of metals used for the construction of K-type & J-type thermocouple. **04**

2C. What is hall voltage. Elaborate on hall effect sensors with a suitable diagram by stating its application in robotics. **04**

3A. With a neat sketch, derive an expression for the frictional force analysis of a 2 finger mechanical gripper mechanism actuated through a double acting pneumatic cylinder. **06**

3B. Explain about the Lead through programming method and its types in brief. **04**

4A. Write a suitable flow chart for the following, with respect to a VAL program. Consider a SCARA robot arm used to carry out the Palletization action of 5 thin metal sheets continuously one after the other from a position ‘A’ to a position ‘B’ (both the positions are assumed accordingly). **03**

4B. Discuss the working of a Vidicon camera with suitable diagram ? Give any 2 comparison between CCD camera and Videcon camera. **05**

4C. A rastor scan system of vision has a frame of face-plate with 256 lines, having 1/3 sec. as the scanning rate. It may be assumed that the electron beam takes 10% of the scan time to move from one line to other line. If there are 256 pixels per line , determine the sampling rate. **02**

5A. Consider a robot arm with its end effector is located initially at the OPQR Plane. Determine the homogeneous transformation matrix after the following sequence of operations to reach OABC, and also draw the coordinate plane for the same.

05

i). Rotation of 90^0 about OR-axis.

ii). Translation of -22 units along OX- axis

iii). Rotation of 35^0 about OZ-axis.

iv). Translation of -7 units along OC-axis.

5B. Consider the following Gear train, where Gear A(20 teeth) is the output, Gear B (80 teeth) is connected to Gear C(40 teeth) through a shaft and the Gear D(120 teeth) is the input. Gear D rotates at 2500 rev/min clockwise.

i. Calculate the gear ratio & output speed.

ii. If input torque on D is 9Nm & efficiency is 55%, calculate output power.

iii. Calculate the input power & output torque.

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