Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 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. A Cartesian robot has a slide with a total range of 1.5m and it is desired that it will have a control resolution of 0.58cm on this axis. Determine the bit storage capacity which the control memory must possess to accommodate this level of precision. **02**

1B. Discuss the working of a CCD camera with suitable diagram? Give any 2 comparison between CCD and Vidicon camera. **05**

1C. List and explain the general considerations of joint interpolated trajectory. **03**

2A. List the difference between capacitive proximity sensor and inductive proximity sensors with suitable diagram. **04**

2B. Define the following :

i. Spatial Resolution
ii. Flexible automation
iii. Compliance
iv. Repeatability

04

2C. Determine the homogeneous transformation matrix to represent a rotation of robot wrist about OP axis by $30^0$and a translation of -9 units along OB axis of the mobile frame. **02**

3A. Mobile body reference frame OPQR is rotated 75^0 about OA-axis of the fixed base reference frame OABC. If $X_{abc}=(4,16,36)^T$ and $Y_{abc}=(9,25,49)^T$ are the coordinates with respect to OABC plane, what are the corresponding coordinates of X and Y with respect to OPQR. **02**

3B. Elaborate on Harmonic drives with a suitable diagram by stating its application in robotics. **04**

3C. A stepper motor actuates a arm of pick and place robot. The step angle of the motor is 32^0 . for each pulse received from the pulse train source, the motor rotates through a distance of one step angle .

i) How many pulses are required to rotate the motor through four complete revolutions? **04**

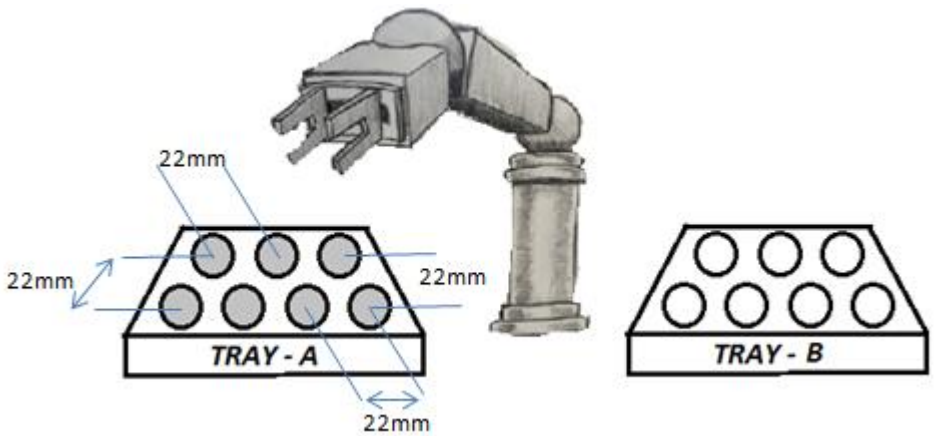
ii) What is the resolution of stepper motor?

iii) What is the controle resolution and accuracy of rotation?

iv) If it is desired to rotate the motor at a speed of 55 rpm , what must be the pulse rate generated by the controller?

4A. List any two advantage and disadvantages of the grounded and isolated junction thermocouples with its neat sketch. **03**

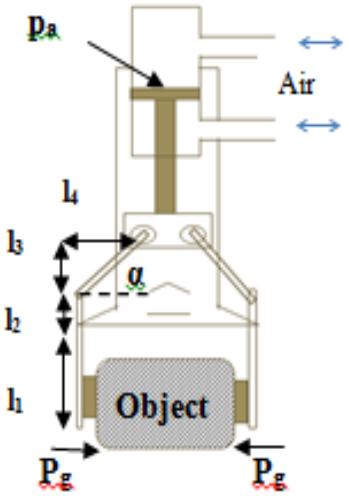
4B. Consider Tray – A and Tray – B as shown below, where Tray-A consists 7 objects in it which should be transferred to tray-B of same size. Write a VAL program to do pick and place action of the objects by a robot arm from Tray-A to Tray-B. **05**



4C. The mechanism connecting the wrist assembly is a twisting joint which can be rotated through 7.5 revolution from the start to end position. It is desired to have control resolution of rotation of ±0.34º at least. What is the number of bit storage capacity to achieve this resolution? **02**

5A. The mechanical gripper uses friction to grasp a part weighing 18N. the co-efficient of friction between the part and the gripper pad shown in fig. is 0.25. the gripper is accelerating down with an acceleration = 9.81m/s^3. The diameter of the piston of pneumatic cylinder is 58mm. assume a factor of safety=1.1 and lengths L1=63mm, L2=31mm, L3=15mm, L4=43mm.

Calculate : i) Gripping force ,
ii) Actuation force,
iii) Power required,
iv) Air Pressure needed
v) Hinge force
vi) Linkage force



06

5B. A gear box has an input speed of 1500 rev/min clockwise and an output speed of 300 rev/min anticlock wise. The input power is 20KW and efficiency is 70%. Determine gear ratio, input torque , output power, output torque. **04**