Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH (ME)/SEM-2/ME -201/2011

2011
APPLICATION OF MECHATRONIC SYSTEMS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* of the following. 5 × 14 = 70

1. a) Why is sensor needed in mechatronic systems ? 2

   b) Mention the name of a sensor for measuring each of the following parameters.

      i) Angular position

      ii) Force

      iii) Torque

      iv) Touch

      v) Slip 5

   c) What are the different types of encoders used in robotics ? Which one is more advantageous and why ? 4

   d) Describe a proximity detector for sensing metallic object. 3

2. a) Explain with a block diagram the functions of a robot vision system. 5

b) Explain two different applications of robot vision system. 4

c) Classify robot programming languages and differentiate between them. What are 'joint interpolated motion' and 'straight line motion' instructions ? 5

3. a) Mention different sensors used in a washing machine. 2

b) What type of motors are used in such a system ? What type of control technique is used for those motors ? 2

c) Explain with a neat block diagram the sequence of operation of a microprocessor controlled washing machine. 6

d) Draw a detailed block diagram of an automatic camera. What are the different sensors used in such a system ? 4

4. a) State the first law of Robotics given by Isaac Asimov. 2

b) Name the elements of robot controller. 4

c) Define degrees of freedom of a robot. 3

d) Show two configurations of manipulator including arm portion and wrist portion by graphic representation. 5

5. a) Draw spherical co-ordinate robot using graphical symbol along with the workspace. 4

   b) Explain the control loop of a servo-controlled robot using a neat diagram. 5

   c) Define repeatability of a robot. 2

   d) Show the vertical stroke and horizontal stroke of a manipulator with neat sketch. 3

6. a) Name four types of kinematic device used to actuate the finger movement. 2

   b) Show the working principle of cam actuated gripper with a neat sketch. 3

   c) Give four examples of robot tool. 2

   d) Explain the use of grinder as a tool for removing rough edges from castings. 3

   e) Distinguish between compliance and stiffness of actuator. 4

7. a) Show the main parts of a hydraulic actuation system with neat sketch. 4

   b) Name four applications in machine loading and unloading. 2

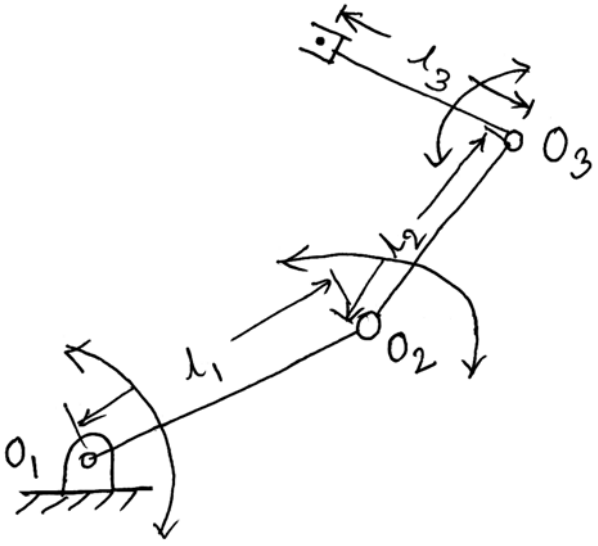
   c) Explain the application of robot in die-casting. 3

   d) Define numerical control machine tools. 2

   e) Explain the closed loop control of CNC with a neat diagram. 3

8. a) Define robot kinematics. 2

b) Consider a planar three-link manipulator with three rotary joints and parallel jaw gripper as the end effector. All the joint axes are parallel and are pointing out of the paper.



i) Assign all co-ordinate frames using Denavit-Hartenberg convention.

ii) Calculate the homogenous transformation matrices ${}^0A_1$, ${}^1A_2$, ${}^2A_3$

iii) Derive the forward kinematics ${}^0T_3$. 2 + 5 + 2

c) Define the term trajectory planing. 3