CS/M.Tech(MC. ENGG.)/SEM-2/ME-204/09
APPLICATION OF MECHATRONIC SYSTEM (SEMESTER - 2)

1. ....
Signature of Invigilator

2. ....
Signature of the Officer-in-Charge

Reg. No.

Roll No. of the Candidate

CS/M.Tech(MC. ENGG.)/SEM-2/ME-204/09
ENGINEERING & MANAGEMENT EXAMINATIONS, JULY – 2009

APPLICATION OF MECHATRONIC SYSTEM (SEMESTER - 2)

Time : 2 Hours]   [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.

2. You have to answer the questions in the space provided marked 'Answer Sheet'. Write on both sides of the paper.

3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.

4. Read the instructions given inside carefully before answering.

5. You should not forget to write the corresponding question numbers while answering.

6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.

7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**

8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.

9. Rough work, if necessary is to be done in this booklet only and cross it through.

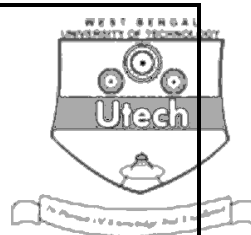### No additional sheets are to be used and no loose paper will be provided

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Marks Obtained

Question Number										Total Marks	Examiner's Signature
Marks Obtained											

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Head-Examiner/Co-Ordinator/Scrutineer

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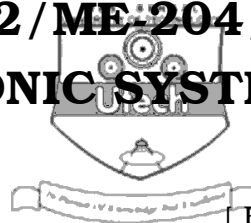
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SEMESTER - 2

Time : 2 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* questions.   5 × 14 = 70

1. a) Define robotics according to robotics industries association.   3

    b) Show the main components of a robot manipulator with neat sketch.   5

    c) Write three main functions of a robot controller.   3

    d) Name two examples of sensors for measurement of each of the three quantities (i) position (ii) force (iii) proximity in the field of robotics.   3

2. a) Define number of degrees of freedom of a robot.   3

    b) Show the cylindrical configuration of robot using graphic representation.   3

    c) Distinguish between repeatability and accuracy with diagram.   3

    d) Explain the working principle of a servo controlled robot using control loop diagram.   5

3. a) Distinguish between tool and gripper of a robot.   4

    b) Explain the gear-and-rack actuation method for actuating mechanical gripper.   4

    c) Name five examples of tools used as robot end effectors.   3

    d) Write three advantages of magnetic robot grippers.   3

4. a) Distinguish between stiffness and compliance of actuator.   4

    b) A set of reduction gears with a reduction ratio of N, a load with inertia I_l is connected to a motor with inertia I_m. Derive the expression of the total inertia felt by the motor due to load.   5

    c) Explain the working principle of a stepper motor with neat sketch.   5
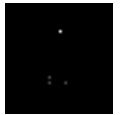
5.   a)
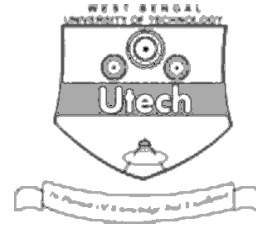
Fig.

A special three degree of freedom spraying robot has been designed as shown in Figure.

i)   Assign the coordinate frames based on Denavit-Hartenberg convention.   3

ii)   Fill out the D-H parameter table.   2

iii)   Write the matrices $^0A_1$, $^1A_2$, $^2A_3$.   4

iv)   Write the $^0T_3$ matrix in terms of the A-matrices.   3

   b)   Define inverse kinematics in robotics.   2

6.   a)   Mention four different parameters which are measured in the area of mechatronics.   2

   b)   Explain the principle of operation of a magnetic tachometer with a neat diagram. 4

   c)   Define gauge factor of a strain gauge. How strain gauge can be used for measuring force in a robotic gripper ? Explain with a schematic diagram.   5

   d)   Describe a proximity detector for sensing metallic object.   3
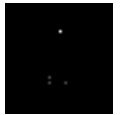
7. a) What are the different functions required for operation of a vision system ?   2

    b) What is camera calibration ?   2

    c) Explain with a neat diagram, the basic model of image formation process in perspective transformation.   5

    d) How this model is used in stereo-imaging process ?   5

8. a) Explain the following terms in relation with image processing :   3 × 2

        i) Thresholding

        ii) Region growing

        iii) Edge detection.

    b) Consider a vision system which provides one frame of 256 lines every $\frac{1}{2}$ S. The system is a raster scan system. Assume that the time for the electron beam to move from one line to the next takes 15% of the time to scan a single line. Determine the sampling rate for the system, if it is specified that there will be 320 pixels on each line.   5

    c) Classify robot programming languages and differentiate between them.   3

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END