

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MARCH 2020

**Course Code: ME407**  
**Course Name: MECHATRONICS**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer any three full questions, each carries 10 marks.*

Marks

- |   |                                                                                                                                                                |     |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1 | a) Suggest a method of sensing temperature using a non-contact method. Explain the method with suitable sketches.                                              | (4) |
|   | b) Distinguish between the features of synchro and resolver.                                                                                                   | (4) |
|   | c) List any two active sensors.                                                                                                                                | (2) |
| 2 | a) Describe the working of piezoelectric vibration sensor.                                                                                                     | (6) |
|   | b) Describe the working principle and applications of acoustic emission sensor system.                                                                         | (4) |
| 3 | a) Explain the working of the elements of a hydraulic power supply unit.                                                                                       | (6) |
|   | b) Sketch the standard symbols for (i) 4/3 DC Valve (ii) Push Button operated poppet valve (iii) Pressure relief valve (iv) Unidirectional valve               | (4) |
| 4 | a) Develop a standard circuit for a hydraulic shaper in which the backward motion of linear actuator is quicker than the forward motion. Describe the working. | (8) |
|   | b) Suggest two applications for pneumatic circuits in industrial automation.                                                                                   | (2) |

**PART B**

*Answer any three full questions, each carries 10 marks.*

- |   |                                                                                    |      |
|---|------------------------------------------------------------------------------------|------|
| 5 | a) Illustrate the use of sacrificial layer in MEMS fabrication.                    | (4)  |
|   | b) Describe LIGA process to develop a micro-gear in gold material                  | (6)  |
| 6 | a) List the factors influencing the micro-machining with wet etching.              | (2)  |
|   | b) Illustrate the construction and working of MEMS accelerometer.                  | (8)  |
| 7 | a) Describe the functioning of hydrostatic and aerostatic linear motion guideways. | (4)  |
|   | b) Illustrate the working of recirculating ball screws.                            | (6)  |
| 8 | Explain the types of adaptive control systems used in CNC machine tools.           | (10) |

**PART C**

*Answer any four full questions, each carries 10 marks.*

- 9 a) Describe the working of permanent magnet stepper motor. (6)  
b) Describe the terms pull-in torque, pull-out torque, slew range and step angle for stepper motor. (4)
- 10 a) List the basic building blocks to mathematically model a mechanical system. (2)  
b) A hot plate having capacitance  $C$  and temperature  $T$  cools in a large room having temperature  $T_r$ . Consider the thermal resistance for the system as  $R$ . Develop a mathematic model to represent change in the temperature of the hot plate with time. (8)
- 11 a) Explain one application of pulse width modulation (PWM) (2)  
b) Describe the configuration, working and features of harmonic drive. (8)
- 12 a) Discuss the features of CCD and CID cameras. (6)  
b) Describe one application of thresholding using histogram. (4)
- 13 a) Discuss the functioning of a robotic vision system (8)  
b) Suggest one application for histogram sliding (2)
- 14 In a car park system, a horizontal bar barrier is to be lifted to vertical position when a vehicle reaches nearby and pay the parking fees. The barrier remains in vertical position for 10 seconds to allow the vehicle to pass and comes back to horizontal position. This sequence is to be repeated for every vehicle. The position of barrier is to be sensed by proximity sensor and its movement is controlled by a pneumatic circuit. Develop a PLC ladder program for the sequence and pneumatic circuit for the actuation. (10)

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