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**Pages: 2**



Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech Degree S7 (S, FE) / S7 (PT) (S, FE) Examination December 2023 (2015 Scheme)

**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) | Explain the principles of thermocouples and thermistors | (4) |
| | b) | Explain any one method of increasing the sensitivity of thermocouples. | (3) |
| | c) | Explain the construction and working of RTDs | (3) |
| 2 | a) | Differentiate static and dynamic characteristics of a thermocouple. | (6) |
| | b) | What are the factors responsible for the response time of a thermocouple | (4) |
| 3 | a) | Explain two examples where, single acting and double acting pneumatic cylinders are used for actuation. | (5) |
| | b) | Draw the schematic diagram for a double acting pneumatic cylinder with variable cushioning. | (2) |
| | c) | Draw a schematic diagram for a hydraulic power pack. | (3) |
| 4 | a) | Explain the working of a balanced vane pump with a sketch | (6) |
| | b) | Draw the schematics for i) 2/3 way pilot operated valve ii) accumulator | (4) |

## PART B

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

| | | | |
|---|---|---|---|
| 5 | a) | Explain the fabrication steps of a MEMS pressure sensor with piezo resistive sensing elements | (10) |
| 6 | a) | Distinguish CVD from Epitaxy | (4) |
| | b) | Explain the working of a transverse comb MEMS accelerometer | (6) |
| 7 | a) | Explain the use of aerostatic guideways. | (3) |
| | b) | Explain the working of recirculating ball screw and distinguish tensile and compression preloading with sketches | (7) |
| 8 | a) | Explain LM guide ways used in CNC machines. | (4) |

b) Explain Stick-slip phenomenon in guideways and methods to avoid it (4)

c) What are the coating materials used in friction guideways (2)

## PART C

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

9 a) Explain the working of a hybrid stepper motor. Why teeth are provided on the stator and rotor poles. (6)

b) Explain the characteristics used to specify a stepper motor (4)

10 a) Derive the mathematical expression for temperature variation of an iron box of mass M, heated by an electric coil of power W. The heat loss from the iron box is Q. Assume uniform temperature in the iron box and it has an overall specific heat capacity Cp. (10)

11 a) Sketch and explain the schematics of an MPFI engine management system showing the importance of various sensors and actuators (10)

12 a) Distinguish between histogram stretching and histogram sliding. (4)

b) Explain the applications of robotic vision (6)

13 a) Explain the working of a CCD camera (6)

b) Explain segmentation and thresholding as applied to image processing (4)

14 a) Design a PLC based pick and place robot, that picks parts from a conveyor and puts in to a bin after checking the size of the part and rejects are put into another bin. (10)

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