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HERITAGE INSTITUTE OF TECHNOLOGY

M.Tech 1st Semester Examination. 2014 Session : 2014-2015

Discipline : AEIE

Paper Code : AEIE5131 Paper Name : MECHATRONICS

Time Allotted : 3 hrs Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: 10 x 1=10

(i) Derivative of momentum with respect to time results in
(a) Acceleration (b) Velocity
(c) Force (d) Pressure

(ii) _____ accepts a small control signal to produce a large effect in the system output
(a) Controller (b) Actuator
(c) Signal conditioner (d) Sensor

(iii) External electronic commutation circuitry is required for
(a) Stepper Motor (b) BLDC Motor
(c) Shunt Motor (d) Servo Motor

(iv) AC LVDTs
(a) have wider operating temperature range
(b) have external signal conditioning circuitry
(c) deliver DC output in the secondary coils
(d) none of these

(v) An Air muscle has a power-to-weight ratio of
(a) 16:1 (b) 64:1
(c) 200:1 (d) 400:1

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(vi) ODEs are result of
(a) Distributed parameter processes
(b) Lumped parameter processes
(c) Manipulated variables
(d) Control signal modelling

(vii) Dummy strain gauge is used to compensate
(a) Pressure (b) Strain
(c) Temperature (d) Force

(viii) Low pressure positioner is operated by
(a) electrical and magnetic forces (b) pneumatically generated forces
(c) hydraulically generated forces (d) electrostatic forces

(ix) In AC synchronous motor, we make use of
(a) carbon brushes (b) rotating coil
(c) rotating magnet (d) none of these

(x) Under dark condition, a photoresistor exhibits
(a) few hundred ohms resistance (b) few MΩ resistance
(c) short circuit (d) none

Group - B

2.(a) What are the important elements of mechatronics? Explain with a suitable block diagram.

(b) Describe the process flow chart followed to realize Mechatronic systems. Give examples of two Mechatronic systems. (4 + 2) + 6 = 12

3.(a) Define thermopile. What do you mean by T, K and J type thermocouples?

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(b) What is thermistor? Explain its operating principle. What do you mean by piezoelectricity? (2 + 3) + (4 +3)= 12

Group - C

4.(a) Explain briefly the working principle of hydraulic actuator. Specify the term "stroke" in case of hydraulic cylinders.

(b) How do you define air-muscle? The bottom diameter and piston diameter of a hydraulic cylinder are 4.5 mm and 2.5 mm respectively. The pressure at bottom side is 5 psi while pressure measured at head side of the cylinder is 3 psi. Calculate the pulling force. (4+2) + (2+4) = 12

5.(a) Explain the working principle of electrostatic type micro actuator. What happens to a parallel plate capacitor type micro-actuator when the applied voltage is gradually increased?

(b) What is comb drive?
A parallel plate capacitive transducer uses plate's area 100 mm2 which are separated by a distance 0.2 mm. Calculate the value of the change in capacitance if by a linear displacement reduces the separation distance of 0.02 mm. Take the air as dielectric medium with a permittivity of 8.85x10-12 F/m. (4+2) + (3+3) = 12

Group - D

6.(a) What do you mean by Shape memory effect? Name one application area of SMA.

(b) Define embedded system with one suitable example.

(c) In what type of processes programmable logic controllers are used? What is ladder diagram? 4+ 4 +4 = 12

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7.(a) Explain briefly the working principle of a stepper motor. Define the important factors for selection of a motor.

(b) State the advantages of Brushless DC motor over brushed DC motor. How does a relay work? (4 + 2)+ (3 + 3) = 12

Group - E

8.(a) How can CMRR be improved by using Instrumentation amplifier in singal conditioning circuitry?

(b) Design a typical active bandpass filter. The CMRR of an opamp is 60 dB. The inputs are V_1=1.0 volt and V_2= 1.01volt. Find the percentage error in output voltage due to finite CMRR. 5 + (4 + 3) = 12

9.(a) Describe the building blocks of data acquisition system.

(b) What is data logger?

(c) Differentiate between data acquisition system and data logger.

(d) What different types of ADCs are normally used in data acquisition system? 4 + 2+ 4+2 = 12