

INTRODUCTION TO MECHATRONICS
AEIE 3111

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.

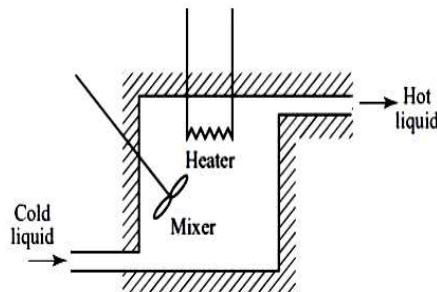
Group - A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The sensing principle used by gyroscopes is change in
(a) moment of inertia (b) linear acceleration
(c) Coriolis force (d) rotation speed leading to Coriolis force.
- (ii) The most important characteristics of an instrumentation amplifier is
(a) High common mode gain (b) High differential mode gain
(c) High common mode rejection ratio (d) Low common mode gain.
- (iii) The output circuit to input circuit in a relay is
(a) Mechanically isolated (b) Electrically isolated
(c) Electrically non-isolated (d) Mechanically non-isolated.
- (iv) The shaft torque in a DC motor is given by the following equation
(a) $J\ddot{\theta} = K_t i - b\dot{\theta}$ (b) $J\ddot{\theta} = K_t i - b\dot{\theta}$
(c) $Ri = V - K_e \dot{\theta} - L \frac{di}{dt}$ (d) $Ri = \dot{\theta} - L \frac{di}{dt}$
- (v) The first step in analog to digital conversion is
(a) Encoding (b) Quantizing
(c) Sampling (d) Linearization.
- (vi) The actuation principle used by micro-gripper is
(a) Thermal expansion of two dissimilar metals (b) Electrostatic force
(c) Electrical actuation (d) Mechanical actuation
- (vii) The performance of DAC is a measure of
(a) Resolution (b) Input impedance
(c) Conversion speed (d) both (a) and (c).
- (viii) Choose the correct piezoelectric material from the following
(a) TiNi (b) Quartz (c) Si₂N₃ (d) PolySilicon.

- (ix) In a standard block diagram of a control system, the block between the controller and plant is known as
 (a) Final control element (b) Sensor
 (c) Actuator (d) Both (a) and (c).
- (x) Which of the following is not an application area for Digital Signal Processors
 (a) Filtering (b) Spectral Analysis
 (c) Impedance matching (d) Synthesis.

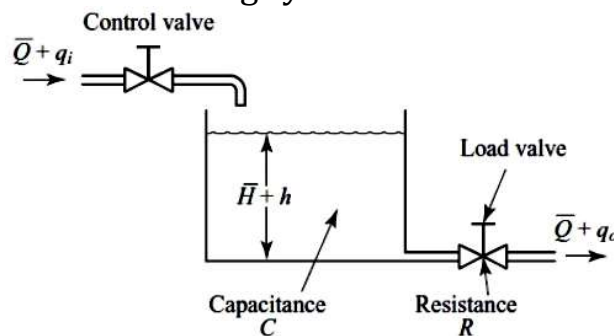
Group - B

2. (a) What do you understand by thermal resistance? What unit does thermal resistance have? Define thermal resistance for turbulent flow.
 (b) Derive the overall transfer function if the following system in terms of heat input rate (kcal/s) by the heater and steady state temperature of the in/out flowing fluid (°C).



(2 + 2 + 2) + 6 = 12

3. (a) What is used to represent capacitance in a fluid system? Derive the overall transfer function of the following system shown in the figure below.



- (b) What are the two assumptions made in case of thermal systems while modelling them? What do you understand by thermal capacitance?

(2 + 4) + (3 + 3) = 12

Group - C

4. (a) Explain the working principle of a relay. State a few application areas where relays are used.
 (b) What is the actuation principle of a linear micro motor? List a few points of difference between a DSP and a micro-processor.

(3 + 3) + (4 + 2) = 12

B.TECH/AEIE/5TH SEM/ AEIE 3111/2020

5. (a) What do you understand by secondary input/s to a MEMS pressure sensor? State names of a few such inputs.
- (b) Explain the working principle of a solenoid plunger. State a few application areas where solenoid plungers are used.
- (4 + 2) + (4 + 2) = 12**

Group - D

6. (a) State the principle of actuation in case of micro-cantilevers. Which material is used in micro-cantilever for actuation?
- (b) What is the sensing principle used by MEMS gyroscope? State the names of two different MEMS accelerometers based on construction of the sensing structure.
- (4 + 2) + (3 + 3) = 12**
7. (a) What do you understand by single acting pneumatic cylinders? State few differences between single and double acting pneumatic cylinders.
- (b) Explain the actuation principle of a MEMS cantilever beam using quartz as actuating element. What is the sensing principle used by MEMS accelerometers?
- (3 + 3) + (3 + 3) = 12**

Group - E

8. (a) What are Shape memory alloys? Give a one example of a Shape memory alloy. Where are Shape memory alloys used?
- (b) State the various programming languages described in the IEC 1131-3 standard for programming a PLC. What do you understand by a scan cycle in a PLC?
- (2 + 2 + 2) + (3 + 3) = 12**
9. (a) Explain with a neat circuit diagram the working of an R-2R type DAC. State the final out voltage expression of a 4-bit R-2R type DAC.
- (b) Implement the digital NOT logic using PLC ladder diagram. What are the major parts of PLC system, explain using neat block diagram.
- (3 + 3) + (4 + 2) = 12**

Department & Section	Submission link:
AEIE	https://classroom.google.com/c/MTIyNTUxMjk5MjQ4/a/MjcxMTEyOTU4MDMy/details