

MECHATRONICS
(AEI5141)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) In refrigerators, the sensor used for On-Off controlling of compressor is
(a) hydraulic type (b) pneumatic type
(c) bi-metallic strip (d) reed switch
- (ii) For lower frequency bandwidth (typically 0 – 800 Hz), the recommend accelerometer is
(a) piezoelectric type (b) capacitive type
(c) electromechanical type (d) piezoresistive type.
- (iii) In high-rise buildings, motion induced by earthquake or wind is amplified and this vibration can be reduced by
(a) Tuned mass damper (b) gyroscope
(c) strain gauge (d) electromagnetic flowmeter
- (iv) ‘Stents’ employed in angioplasty is an actuator of type
(a) electromechanical (b) electrostatic
(c) pneumatic (d) SMA
- (v) An air muscle has a power-to-weight ratio of
(a) 16:1 (b) 64:1 (c) 200:1 (d) 400:1
- (vi) In Schmitt trigger circuit, the nature of feedback is
(a) positive (b) negative (c) nil (d) imaginary
- (vii) To reject common mode noise, we prefer
(a) instrumentation amplifier (b) inverting amplifier
(c) integrating amplifier (d) summing amplifier
- (viii) The IC that works as a VCO in frequency modulation is
(a) 555 (b) 566 (c) 565 (d) 556

- (ix) The resolution of a Digital to Analog Converter is dependent on
 (a) number of bites (b) input impedance
 (c) sampling rate (d) conversion time
- (x) Gap between high level languages and computer hardware is known as
 (a) Generation Gap (b) Symantec gap
 (c) Semantic Gap (d) None of the above

Fill in the blanks with the correct word

- (xi) In robotics, the servomechanism is actuated by _____ motor.
- (xii) Photoresistors exhibit a _____ characteristics for incident optical illumination versus the resulting resistance
- (xiii) The Air _____ is an extraordinary actuator.
- (xiv) The filter that passes a single frequency is known as _____ filter.
- (xv) _____ is the distance that the piston travels through the cylinder.

Group - B

2. (a) Discuss the Mechanical elements of Mechatronics. Give a few examples on electromechanical elements of mechatronic system. [[CO1](Analyze/IOCQ)]
- (b) State the process of tracing the technological advances in design, manufacturing, and operation of engineering products/devices. Describe the benefits associated with Revolutions of Mechatronics as a Contemporary Design Paradigm. [[CO1](Apply/IOCQ)]
- (3 + 3) + (3 + 3) = 12**
3. (a) Define Mechatronics systems. [[CO1](Understand/LOCQ)]
- (b) How can you classify sensors based by considering transduction principle? [[CO1](Remember/LOCQ)]
- (c) Why are modelling/simulation in design of mechatronic system so important? [[CO1](Remember/LOCQ)]
- 2 + 6 + 4 = 12**

Group - C

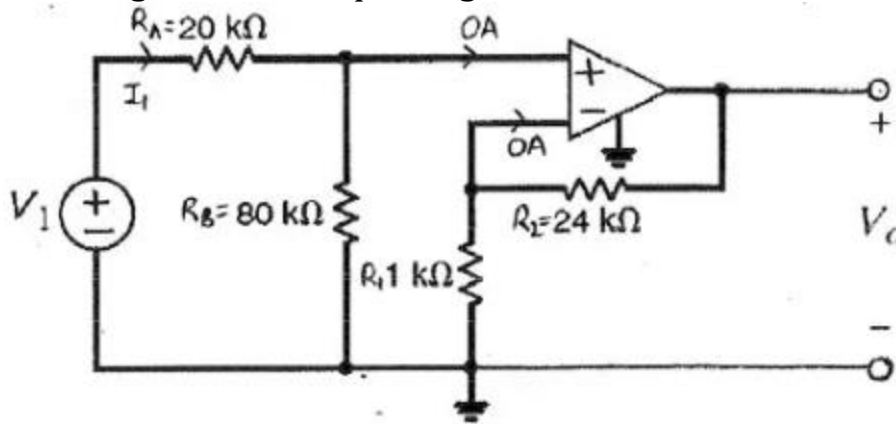
4. (a) How do you measure displacement in mm scale? Describe the transduction principle of the said transducer with I/O characteristics. [[CO1](Remember/LOCQ)]
- (b) Name three different types of commonly used LVDTs. Specify their applications in industry. [[CO2](Analyze/IOCQ)]
- (2 + 4) + (3 + 3) = 12**
5. (a) Compare single acting hydraulic cylinders with double acting. List down the operating specifications for hydraulic cylinders. [[CO3](Remember/LOCQ)]
- (b) Discuss the crystal structure transformations responsible for the shape memory effect. [[CO3](Understand/LOCQ)]
- (3 + 3) + 6 = 12**

Group - D

6. (a) Explain the significance of CMRR. [[CO4](Remember/LOCQ)]
 (b) How can common mode signal is rejected by using Instrumentation amplifier in signal conditioning circuitry? [[CO3](Remember/LOCQ)]
 (c) How does a Zero Crossing Detector work? [[CO3](Understand/LOCQ)]

4 + 4 + 4 = 12

7. (a) Why micro-actuators are part and parcel in medical surgery? Compare Lateral and Transverse comb drive microactuators. [[CO3](Remember/LOCQ)]
 (b) Calculate the gain of the amplifier given below.



[[CO3](Evaluate/HOCQ)]

(4 + 3) + 5 = 12

Group - E

8. (a) What do you mean by “Brickwall Filter”? How does the behaviour of a band pass filter change if we increase the order? [[CO5](Remember/LOCQ)]
 (b) Explain the operation of any one type of ADC. [[CO4](Remember/LOCQ)]

6 + 6 = 12

9. (a) Define resolution in Analog to Digital Converters. [[CO4](Remember/LOCQ)]
 (b) Calculate the number of comparators required to construct a 3 bit ADC. [[CO4](Analyze/IOCQ)]
 (c) Describe the operation of 4 bit Weighted resistor type DAC. [[CO3](Remember/LOCQ)]
 (d) State the disadvantages of such type DACs. [[CO3](Understand/LOCQ)]

2 + 4 + 4 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	75	20.83	4.17

