

**MECHATRONICS
(AEIE 5131)**

Time Allotted: 3 hrs

Full Marks: 70

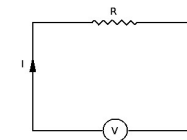
Figures out of the right margin indicate full marks.

*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 a
practicable.*

**Group - A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1=10**

- (i) The basic low pass filter resembles
 - (a) a multiplier
 - (b) a divider
 - (c) an integrator
 - (d) a differentiator.
- (ii) An Air muscle has a power-to-weight ratio of
 - (a) 16:1
 - (b) 64:1
 - (c) 200:1
 - (d) 400:1.
- (iii) Gap between high level languages and computer hardware is kno
 - (a) generation Gap
 - (b) symantec gap
 - (c) semantic Gap
 - (d) energy gap.
- (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) Derivative of momentum with respect to time results in
 - (a) acceleration
 - (b) velocity
 - (c) force
 - (d) pressure.
- (vi) What is the transfer function of the electrical system given below?



- (a) I: Current
(c) R: Resistance
- (b) V: Voltage
(d) none of the above.
- (vii) External electronic commutation circuitry is required for
(a) stepper Motor
(c) shunt Motor
- (b) BLDC Motor
(d) servo Motor.
- (viii) An electrical actuator used to protect an electrical circuit from damage caused by overload or short circuit is :
(a) safety switches
(c) circuit breaker
- (b) relay
(d) none of the above.
- (ix) Under dark condition, a photoresistor exhibits
(a) few hundred ohms resistance
(c) short circuit
- (b) few MΩ resistance
(d) none of above.
- (x) In a 3-way pneumatic actuator, an important safety feature is that
(a) the valve vents the downstream components each time it is turned off.
(b) the valve vents the downstream components each time it is operated.
(c) the valve stores the downstream components each time it is actuated.
(d) none of the above.

Group - B

2. (a) What do you mean by Scanning Laser Vibrometry? What are the basic difference between DVRT (Differential Variable Reluctance Transducers) and LVDT for displacement measurement?
(b) Explain the working principle of a piezoelectric accelerometer. How does a photo-resistor work?
3. (a) State the Disciplinary Foundations of Mechatronics. What do you mean by the key elements of mechatronics? Give a few examples on each key element.
(b) Explain the terms multi-disciplinary, cross-disciplinary and inter-disciplinary. Briefly explain various evolution stages of mechatronics.

$(2 + 2 + 2) + (3 + 3) = 12$

Group - C

4. (a) Explain the working principle of a hall effect transducer, with proper diagram.

- (b) What do you mean by single acting and double acting hydraulic cylinders? Write down the operating specifications for hydraulic cylinders. How does the electromechanical actuator work?
5. (a) What are the uses of microcomputer in mechatronics? Draw the basic block diagram of a microcomputer.
(b) State how an inductive transducer can be used as a proximity sensor.

$6 + (2 + 2 + 2) = 12$

$(2 + 5) + 5 = 12$

Group - D

6. (a) How can CMRR be improved by using Instrumentation amplifier in signal conditioning circuitry?
(b) Describe the building blocks of data acquisition system. What are the most important criteria for evaluating sensors?
7. (a) Design a BP filter of 1st order having lower cut off frequency 2 KHz and higher cut off frequency 100 KHz.
(b) A parallel plate capacitive transducer uses plates with 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 0.02 mm. Take the air as dielectric medium with a permittivity of 8.85×10^{-12} F/m.

$5 + (4 + 3) = 12$

$6 + 6 = 12$

Group - E

8. (a) Write in brief the basic differences between Lateral and Transverse comb drive microactuator.
(b) Define Pull-in instability in electrostatic actuator. What happens to a parallel plate capacitor when the applied voltage is gradually increased?
9. (a) What is the full form of SMA? Describe the mechanism of Stress Free Shape Recovery of SMA.
(b) What do you mean by power cylinder? Define the advantages of such a pneumatic actuator. Explain the working principle of a circuit breaker.

$5 + (3 + 4) = 12$

$(1 + 5) + (2 + 2 + 2) = 12$