MECHATRONICS & CONTROL SYSTEMS
(MECH 3232)

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) Sensors that require external power source to create an output are known as a/an _____ sensor.
(a) active (b) passive
(c) variable (d) thermo

(ii) The ratio of change in output value of a sensor to the per unit change in input value that causes the output change is known as the sensor's _____
(a) accuracy (b) nonlinearity
(c) resolution (d) sensitivity.

(iii) Actuators are used to
(a) sense an object (b) activate a chemical
(c) make a mechanical movement (d) all of the above.

(iv) Which among the following fluid parameters are not controlled by the control valves?
(a) Pressure (b) Rate of flow
(c) Speed (d) Direction of flow.

(v) The fluid power devices that convert the energy of a pressurised fluid into mechanical energy to do work are called
(a) activators (b) actuators
(c) accumulators (d) converters.

(vi) MOV A, R1 will
(a) Copy R1 to the accumulator
(b) Copy the accumulator to R1
(c) Copy the contents of memory whose address is in R1 to the accumulator
(d) Copy the accumulator to the contents of memory whose address is in R1.

(vii) _____ of a sensor indicates the limits between which the input can vary.
(a) Span (b) Accuracy
(c) Range (d) Resolution

(viii) An ideal operational amplifier will gave the following characteristics
(a) Infinite open loop gain (b) Zero output impedance
(c) Infinite input impedance (d) All of the above.

(ix) The instructions like MOV or ADD are called as _____
(a) OP-Code (b) Operators
(c) Commands (d) None of the mentioned.

(x) Error signal in a closed loop control system is
(a) reference signal (b) output signal-reference signal
(c) reference signal-feedback signal (d) feedback signal-output signal.

Group- B

2. (a) What are the advantages, disadvantages and use of recirculating ball-screw-nut system? *[(CO1)(Understand /LOCQ)]*
(b) Explain with the help of a neat hydraulic circuit diagram, the operation of a Pneumatic cylinder for forward and reverse motion using a manually operated DC valve. *[(CO1)(Understand/LOCQ)]*

6 + 6 = 12

3. (a) With a neat sketch, explain the working principle of BLDC motor. *[(CO1)(Understand/LOCQ)]*
(b) Explain the working principle of a electrical relay with a suitable diagram. *[(CO1)(Understand/LOCQ)]*

6 + 6 = 12

Group - C

4. (a) What are the different types of displacement and position sensors? Explain anyone with a suitable diagram. *[(CO2)(Understand /LOCQ)]*
(b) What are the advantages, disadvantages and application of LVDT? *[(CO2)(Understand/LOCQ)]*

6 + 6 = 12

5. (a) Explain with a circuit diagram, how op-amp can be used as summing amplifier for three voltage input. *[(CO3) (Apply/IOCQ)]*
(b) An inverting amplifier is used to amplify the signal which is coming from a sensor in the range of 0 to -50 mV to an output range of 0 to 5 V. Find the maximum gain of the amplifier. Also, if the amplifier is to be made using operational amplifier, find the resistance that are to be connected. Use minimum of 3 kΩ resistance. Assume op-amp to be an ideal op-amp. *[(CO3)(Apply/IOCQ)]*

6 + 6 = 12

Group - D

6. (a) What are the differences between open loop and closed loop control systems? *[(CO4)(Understand /LOCQ)]*

(b) Determine the transfer function for the following system shown in Fig.1.

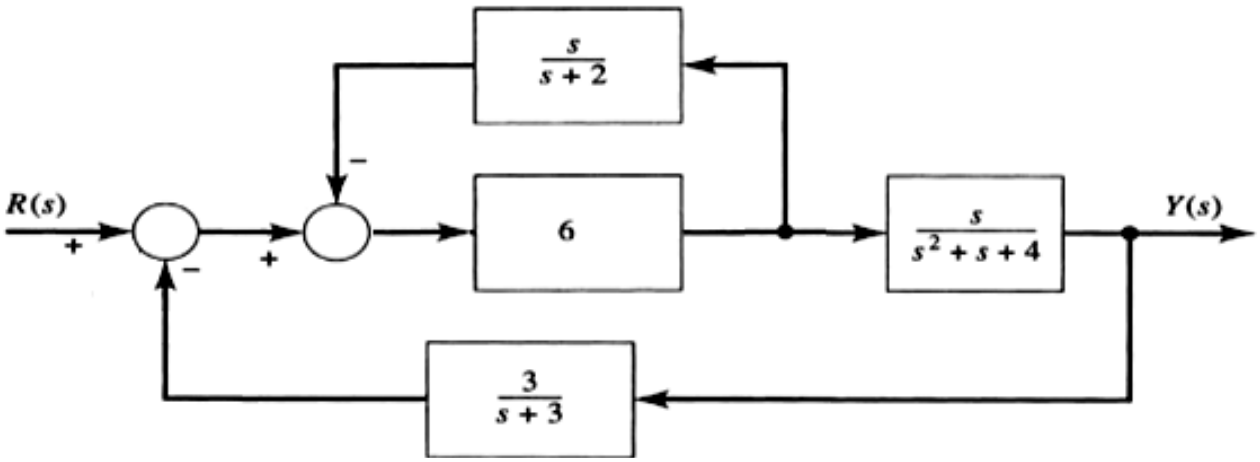

Fig.1

[(CO4)(Analyze/IOCQ)]

(c) What do you mean by steady state error of a system? *[(CO4)(Understand/LOCQ)]*

4 + 6 + 2 = 12

7. (a) A first order system has transfer function G(s)=2/(s+4). Calculate the time constant and final value. Also find the inverse Laplace transform for unit step input. *[(CO4)(Analyze/IOCQ)]*

(b) What is PID controller? What are the advantages and disadvantages of PID controller over On-Off controller? *[(CO4)(Understand/LOCQ)]*

6 + 6 = 12

Group - E

8. (a) Write an assembly language program to divide A7H by 1EH and store the quotient and remainder at R5 and R6, respectively. *[(CO5)(Analyze/IOCQ)]*

(b) Explain the main components of a PLC with a suitable block diagram. *[(CO6)(Understand/LOCQ)]*

6 + 6 = 12

9. (a) Draw the ladder diagram using timing block to turn on a motor after the delay of 5 seconds after pressing the start switch. The Motor should be off after a delay of 3 seconds when stop switch is pressed. *[(CO6)(Create/HOCQ)]*

(b) Compare between Microprocessor and Microcontroller. *[(CO5)(Understand/LOCQ)]*

6 + 6 = 12

Cognition Level	*LOCQ*	*IOCQ*	*HOCQ*
Percentage distribution	*62.5*	*31.25*	*6.25*

Course Outcome (CO):

At the end of the course, a student will be able to

CO1: Identify different types of drive system for implementation in engineering applications
CO2: Identify suitable sensors for an engineering system
CO3: Apply the concept of signal processing and signal conditioning for industrial applications
CO4: Explain, analyze and evaluate different control systems
CO5: Describe the basic knowledge of microcontroller and write program for industrial applications
CO6: Explain the basics of PLC and write program for industrial applications

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*