MECHATRONICS
(AEIE 5141)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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 instrumentation amplifier is preferred for
                 (a) high gain   (b) infinite bandwidth
                 (c) high CMRR   (d) low CMRR

     (ii)   Data acquisition is the process in which, physical variables from the real world are
                 (a) converted into electrical signals
                 (b) modified and converted into a digital format for processing
                 (c) converted into mechanical signals
                 (d) converted into pneumatic signal

     (iii)   Gap between high level languages and computer hardware is known as
                 (a) generation Gap   (b) symantec gap
                 (c) semantic Gap   (d) energy gap

     (iv)   Derivative of momentum with respect to time results in
                 (a) acceleration   (b) velocity
                 (c) force   (d) pressure

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

     (vi)   ADC's performance is measured of by
                 (a) resolution   (b) input impedance
                 (c) sampling rate   (d) conversion time

     (vii)   The 3/2 Solenoid Valve has
                 (a) 3 ports and 2 states   (b) 2 ports and 3 states
                 (c) 3/2 ports and 0 states   (d) 3 states only.

(viii) For broad frequency bandwidth (typically 0.2 – 5 kHz), the recommend accelerometer is
(a) piezoelectric type
(b) capacitive type
(c) electromechanical type
(d) piezoresistive type.

(ix) Higher order polynomial indicates that the filter is
(a) of practical type
(b) of falling slope
(c) of ideal type
(d) easier to design.

(x) The most suitable LVDT for measurement of vibration is
(a) guided armature
(b) captive armature
(c) spring-extended armature
(d) unguided armature

Group - B

2. (a) Contrast on the drawbacks related to traditional product realization paradigm.
[(CO4) (Understand/LOCQ)]
(b) Explain using sequential product realization the various steps in designing a mechanical system plant. [(CO2) (Evaluate/HOCQ)]
(c) Compare based on functionality the four key elements of mechatronics.
[(CO1) (Analyze/IOCQ)]

3 + 6 + 3 = 12

3. (a) List a few issues that purely mechanical systems inherently suffer from.
[(CO1) (Analyze/IOCQ)]
(b) Why are modelling/simulation in design of mechatronic system so important?
[(CO1) (Remember/LOCQ)]
(c) Assess the role of control computing hardware in a modern mechatronic system.
[(CO1) (Evaluate/HOCQ)]

5 + 4 + 3 = 12

Group - C

4. (a) Interpret the importance of pull-in instability in electrostatic actuators.
[(CO3) (Evaluate/HOCQ)]
(b) Identify three artificially manufactured piezoelectric crystals.
[(CO6) (Apply/IOCQ)]
(c) Outline few applications of piezoelectric actuators in real life.
[(CO3) (Understand/LOCQ)]

3 + 5 + 4 = 12

5. (a) Construct a suitable actuation system for position control with proper justification. [(CO4) (Create/HOCQ)]
(b) Analyze the Shape Memory Effect. [(CO2) (Analyze/IOCQ)]
(c) How does a circuit breaker work? [(CO1) (Remember/LOCQ)]

3 + 5 + 4 = 12

Group - D

6. (a) How can CMRR be improved by using Instrumentation amplifier in signal conditioning circuitry? [(CO3) (Remember/LOCQ)]
   (b) Compare instrumentation amplifier with conventional differential amplifiers. [(CO2) (Analyze /IOCQ)]
   (c) Estimate the percentage error in output voltage due to finite CMRR of 60 dB, when the inputs are V1=1.0 volt and V2= 1.01volt for the OpAmp. [(CO5) (Evaluate/HOCQ)]

   4 + 6 + 2 = 12

7. (a) "Ideal filter, sometimes called a 'brickwall' Filter"—Justify. [(CO2) (Evaluate/HOCQ)]
   (b) Demonstrate the working of a second order band stop filter with a suitable circuit diagram. [(CO3) (Understand/LOCQ)]
   (c) Contrast why Schmitt trigger is also referred as regenerative comparator with suitable circuit diagram and voltage hysteresis loop. [(CO1)(Analyze/IOCQ)]

   2 + 4 + 6 = 12

Group - E

8. (a) Examine the importance of microcomputer in mechatronics systems. [(CO4) (Analyze/IOCQ)]
   (b) Outline the uses of microcomputer in mechatronics? [(CO2) (Understand/LOCQ)]
   (c) Interpret with a basic block diagram the various parts of a micro-computer. [(CO1) (Evaluate/HOCQ)]

   4 + 5 + 3 = 12

9. (a) Summarise with a brief description on the building blocks of data acquisition system. [(CO4) (Remember/LOCQ)]
   (b) Construct a suitable transducer system for measurement of vibration in machinery. [(CO2) (Apply/IOCQ)]
   (c) Design an acquisition circuitry required for the suggested transducer applicable for the afore-mentioned system. [(CO1) (Create/HOCQ)]

   4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	30.2%	40.6%	29.1%

Course Outcome (CO):
After the completion of the course students will be able to:
1. Understand a real time mechatronics system.
2. Identify the key elements of mechatronics systems and its representation in terms of block diagram.

3. Gain knowledge of different types of Sensors required for developing mechatronics systems.
4. Learn the functions of different types of actuators and identify their application areas.
5. Understand concept of signal conditioning and use of interfacing systems such as comparator, filters, amplifiers, etc.
6. Learn the hardware and software interfacing for embedded systems

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

Department & Section	Submission Link
AEIE	https://classroom.google.com/c/NDA2MDk2MDE2NTEy/a/NDY0MTg1NTM5MDU3/details