## **Question Paper**

Exam Date & Time: 16-Nov-2018 (02:00 PM - 05:00 PM)



## MANIPAL ACADEMY OF HIGHER EDUCATION

## END SEMESTER QUESTION PAPER ELEMENTS OF MECHATRONICS SYSTEMS IMET 231

ELEMENTS OF MECHATRONICS SYSTEMS [IMET 231]

Marks: 100

## Answer 5 out of 8 questions.

- <sup>1)</sup> What are the factors that determine the classification of <sup>(10)</sup> sensors? Classify the types of sensors used in Mechatronics systems in detail and describe the functioning of any one.
  - <sup>B)</sup> Machine Learning was born from pattern recognition and <sup>(4)</sup>
    <sup>i</sup> the theory that computers can learn without being programmed to perform specific tasks; researchers interested in Artificial Intelligence wanted to see if computers could learn from data. Why has Machine Learning and AI become a buzz word today?
    - <sup>ii</sup> Consider the figures shown below. What does figure A represent? What kind of Machine Learning is it? What does figure B represent and what kind of learning is it? How are the two different from each other?





Figure A

Duration: 180 mins.

(6)



Figure B

2)

A)

(10)Since its commercial introduction more than 60 years ago, the LVDT linear position sensor has evolved from its initial use as a laboratory tool to becoming the preferred technology for critical and reliable linear displacement measurements in industrial, military, aerospace, subsea, downhole drilling, nuclear power and process control applications. Through microcontroller-based electronics and innovative construction materials and techniques, modern LVDT technology is now competitive with other displacement sensing technologies in terms of price, performance, and durability. What is an LVDT? Describe its working with suitable diagrams to support your answer.

- B) What is a Thermocouple. Elaborate on the laws governing (5) the design of a Thermocouple. i
  - ii With the aid of a suitable diagram, describe the functioning <sup>(5)</sup> principle of a Hall Effect sensor.
- 3) Write a PLC ladder logic diagram for the following (4)expression. A) i

OUTPUT = AB + B'CD + ABC' + E

- With a neat diagram, explain the construction and working <sup>(6)</sup> ii of an Inductive sensor. List down 3 applications of the same.
- In the given figure, the cost function  $J(\theta 0, \theta 1)$  has been plotted (4) B) i against 00 and 01, as shown in 'Plot 2'. The contour plot for the same cost function is given in 'Plot 1'. Based on the figure, what can you deduce about points A, B, C and P? Point P on plot 2 corresponds to which point of plot 1?





- <sup>ii</sup> What is a Contour plot? With suitable steps describe the <sup>(6)</sup> generation of a Contour plot for a Linear Regression model.
- Describe in detail the construction and functioning of a <sup>(10)</sup> Photoelectric sensor.
  - Discuss in detail about the construction and working of an <sup>(5)</sup> <sup>i</sup> Optical encoder.
    - <sup>ii</sup> With a neat block diagram illustrate and explain the <sup>(5)</sup> functioning of an Actuating system.
- <sup>5)</sup> Consider the following diagram of using a simple switch for  $^{(4)}$  switching on a lamp and an NPN transistor for the same action.



What is the benefit of using a transistor for switching operations when a normal ON/OFF switch would be sufficient for the operation? Describe in detail.

- <sup>ii</sup> Elaborate on the construction and working of the two types <sup>(6)</sup> of Solenoids.
- <sup>B)</sup> What is the valve shown below?

4)

B)

(4)



<sup>ii</sup> With the aid of suitable diagrams, explain the difference <sup>(6)</sup> between a Single acting cylinder and Double acting cylinder.

What is the principle of operation of a CRO? Use a diagram  $^{\rm (4)}$  to support your answer.

<sup>ii</sup> Consider the figure shown below. For the appearance of such a wave on the CRO screen what would be the input waveforms given to the horizontal and vertical plates of the CRO?



<sup>B)</sup> What is a Lissajous pattern? Describe the kinds of input <sup>(10)</sup> waves to be given to a CRO in order to produce a Lissajous pattern of:

i. A Line ii. A Circle iii. An Ellipse Use suitable graphs/ figures to support your answer.

<sup>7)</sup> With a suitable circuit diagram and supporting graphs
 <sup>(5)</sup> describe the construction of a Positive and Negative clamper circuit using the 741 Op-amp.

<sup>ii</sup> Describe how an Adder-Subtractor can be created using an <sup>(5)</sup> Adder circuit and a Subtractor circuit. Use the 741 Op-amp.

6)

A)

Consider the following figure. This corresponds to which <sup>(4)</sup> <sup>i</sup> type of filter? Support your answer with suitable reasons.



- <sup>ii</sup> What are the conditions to be satisfied by an Ideal Op- <sup>(6)</sup> amp? How is the operation of an Ideal Op-amp altered due to the addition of a feedback (positive/ negative).
- Describe the various elements of Mechatronics which are <sup>(10)</sup>
  used in the construction of a Manufacturing system.
  - <sup>B)</sup> Describe the various elements of Mechatronics which are <sup>(10)</sup> used in an Aircraft.

-----End-----

8)