



COLLEGE OF ENGINEERING, SCIENCE & TECHNOLOGY

SCHOOL OF ELECTRICAL & ELECTRONICS
ENGINEERING

CERTIFICATE IV IN BIOMEDICAL ENGINEERING

FINAL EXAMINATION –QUARTER III – 2019

QUESTION PAPER
EEC 451

INTRODUCTION TO MECHATRONICS

Maximum Marks: 100 (Time Allowed 2:10 mins)

Instructions

1. There are Three (3) sections (A , B & C). **All sections are compulsory.**
2. Write your **answers legibly** in the **answer booklet provided.**
3. A **time of Two (2) hours** is **allowed** to complete this paper. **Extra 10 minutes** allowed to read the paper.
4. You may use **blue or black ball pen** to write your answers.
5. **Insert all written foolscaps, graph paper, drawing paper, etc.** in their correct sequence and secure with string provided.
6. Write your **student identification** number on each page used.
7. **Begin each answer on a fresh new page** and **use both sides** of the sheets.
8. **No GSM mobiles or smartphones allowed** during the examination

SECTION A **MULTIPLE-CHOICE**

[30 MARKS]

- 1) The sensors are classified on the basis of
 - (A) Functions
 - (B) Performance
 - (C) Output
 - (D) All of the above

- 2) Which of the following form the basis of Electrical domain?
 - (A) Current
 - (B) Resistance
 - (C) Inductance
 - (D) All of the above

- 3) Which of the following is not covered under Mechanical energy domain?
 - (A) Distance
 - (B) Force
 - (C) Latent heat
 - (D) Size

- 4) Type of sensor used to detect both metallic and non-metallic objects
 - (A) Inductive
 - (B) Thermocouple sensor
 - (C) Capacitive sensor
 - (D) pH Sensor

- 5) A sensor is a device that converts:
- (A) Physical quantity into measurable signals
 - (B) Physical quantity into mechanical signal
 - (C) Electrical signal into physical quantity
 - (D) Physical quantity into electric signal only
- 6) The ability to give same output reading when same input value is applied repeatedly is known as
- (A) Stability
 - (B) Repeatability
 - (C) Accuracy
 - (D) Sensitivity
- 7) It is the ability of the sensor to indicate the same output over a period of time for a constant input.
- (A) Stability
 - (B) Resolution
 - (C) Error
 - (D) Impedance
- 8) It is the time required to come to an output value within the specified error level.
- (A) Response time
 - (B) Rise time
 - (C) Settling time
 - (D) None of the above
- 9) What are the functions of Encoder?
- (A) Senses mechanical motion
 - (B) Provides information regarding position & velocity and direction
 - (C) Converts analog into digital information
 - (D) All of the above

10) Following is not an example of transducer.

- (A) Analogue voltmeter
- (B) Thermocouple
- (C) Photo electric cell
- (D) Pneumatic cylinder

11) The following is (are) type(s) of Hall Effect sensors.

- (A) Linear Hall Effect sensor
- (B) Threshold Hall Effect sensor
- (C) Both (A) and (B)
- (D) None of the above

12) Following is (are) true for Hall Effect sensors.

- (A) They can operate as switches of high frequency
- (B) They cost less than electromechanical switches
- (C) They are free from contact bounce problem
- (D) All of the above

13) A Piezo-electrical crystal generates voltage when subjected to ____ force.

- (A) Electrical
- (B) Mechanical
- (C) Gravity
- (D) All of the above

14) Hall Effect sensors are used in

- (A) Flow meter
- (B) Fuel level indicator
- (C) Both (A) and (B)
- (D) None of the above

15) The poles of the function is at:

$$F(s) = \frac{s + 1}{(s + 2)(s + 3)(s + 4)}$$

- (A) -4, -3 & -2
- (B) -3 & -2
- (C) -2 & -4
- (D) -1

16) Following is (are) the type(s) of Light sensor(s)

- (A) Photo sensor
- (B) Photo transistors
- (C) Photo conductors
- (D) All of the above

17) Following type of sensors are used to generate information in object grasping and obstacle avoidance.

- (A) Hall Effect sensor
- (B) Proximity sensor
- (C) Light sensor
- (D) Optical sensors

18) Inductive proximity sensors can be effective only when the objects are of _____ materials.

- (A) Ferro magnetic
- (B) Diamagnetic
- (C) Paramagnetic
- (D) All of the above

19) Following acts as detector in Optical sensor

- (A) Light emitting diode
- (B) Photo diode
- (C) Transistor
- (D) All of the above

20) Angular momentum is:

- (A) The sum of moment of inertia and angular velocity
- (B) The product of moment of inertia and angular velocity
- (C) The square root of angular velocity
- (D) The difference of angular velocity and momentum.

21) What is the LOAD of the lever as you stand on your tiptoes?

- (A) Your ankle
- (B) Your whole body
- (C) Your calf muscles
- (D) Your arms

22) The energy absorb by brake is always kinetic.

- (A) No, potential
- (B) Potential
- (C) Kinetic or potential
- (D) Strain Energy

23) Pneumatic brakes are same as electrical brakes.

- (A) Yes both deals with electricity.
- (B) Yes, both are concerned with electricity
- (C) Yes, both deals with pressure
- (D) No, one deals with pressure and other with electricity

24) When the time period of observation is large, the type of error is

- (A) Steady state error
- (B) Transient error
- (C) Half-power error
- (D) Position error constant

25) When is artificial intelligent.

- (A) Putting more memory into a computer.
- (B) Making a machine intelligent
- (C) Playing game
- (D) Putting your intelligence into computer.

26) The process of converting the analog sample into discrete form is called.

- (A) Modulation.
- (B) Quantization
- (C) Multiplexing
- (D) Sampling

27) The sequence of operations in which PCM is done is.

- (A) Sampling, quantizing, encoding
- (B) Quantizing, encoding, Sampling,
- (C) Quantizing, Sampling, encoding,
- (D) None of the above.

28. The variable s in the Laplace transform $H(s)$ is called

- (A) Complex frequency
- (B) Transfer function
- (C) Zero
- (D) Pole

29) A micro controller at-least should consist of:

- (A) RAM, ROM, I/O devices, serial and parallel ports and timers
- (B) CPU, RAM, I/O devices, serial and parallel ports and timers
- (C) CPU, RAM, ROM, I/O devices, serial and parallel ports and timers
- (D) CPU, ROM, I/O devices and timers

30) The zero of the function is at:

$$F(s) = \frac{s + 1}{(s + 2)(s + 3)(s + 4)}$$

- (A) -4
- (B) -3
- (C) -2
- (D) -1

SECTION B SHORT ANSWER QUESTIONS

[55 Marks]

Question 1.

[10 marks]

- a) Describe the key elements of mechatronics? (5 marks)
- b) Describe the role of mechatronics in industries? (2 marks)
- c) What are the important advantage of using mechatronics system? (2 marks)
- d) Describe the use of mechatronics in Biomedical? (2 marks)

Question 2.

[10 marks]

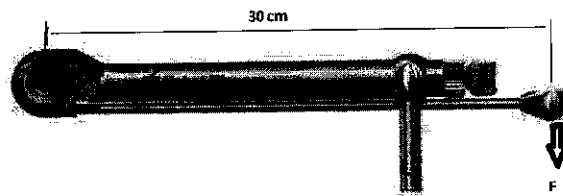
- a) Explain the terms Accuracy and Precision? (2 marks)
- b) With aid of diagram briefly explain the structure and operation of capacitive sensor. (4 marks)
- c) Explain the following terms
 - 1. Span (2 marks)
 - 2. Calibration (2 marks)

Question 3.

[10 marks]

a) A coin and a ring, each having the same mass and radius are placed at the top of an incline. If both objects are released at the same time, which object will reach the bottom of the incline first? Why? (2 marks)

b) A dentist uses a Dental Torque wrench to tighten implant screw on a patient's gum. Calculate the maximum force he should apply to archive a maximum torque of 60Nm? (3 marks)



c) Briefly, describe how these three terminologies are related, neural network; fuzzy systems and neuro fuzzy system. (5 marks)

d) State some applications of Neuro-Fuzzy System. (4 marks)

Question 4.

[15 marks]

- a) Define the following terms (3 marks)
- i. Plant:
 - ii. Feedback control system:
 - iii. Control elements:
- b) Explain the relation between microprocessor and microcontroller. (2 marks)
- c) With the help of block diagram illustrate closed loop system and state the difference between open and close loop system. (6 marks)
- d) Draw Transfer control block diagram of a system (2 marks)
- e) With the help of diagram represent a sampled signal (2 marks)

Question 5.

[10 marks]

- a) Illustrate a schematic representation of medical imaging in a mechatronics system (3 marks)
- b) Write down the four parameters that directly affects the ultrasound image. (4 marks)
- c) State and Describe six uses for robots in the field of medicine today. (3 marks)

Section C

Calculation

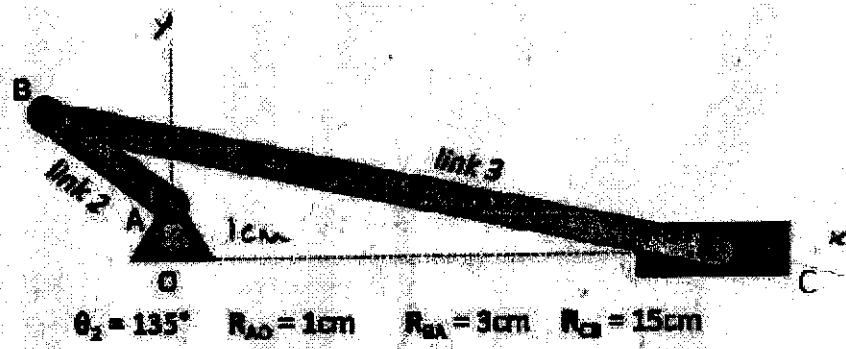
[15 Marks]

Question 1.

[10 marks]

The offset slider-crank mechanism is driven by rotating crank (link 2).

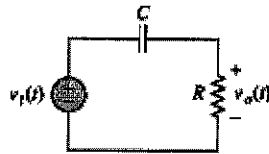
- a) Determine the position of the slider R_c .
- b) Determine the liner velocity of block C, algebraically, if link 2 turns counter-clockwise at an angular velocity of 30 rev/min.



Question 2.

[5 marks]

For the given RC circuit below, find:



- a) The equivalent differential equation. (2 marks)

- b) The transfer function V_o/V_i (2 marks)

Good Luck.

*****THE END*****