Exam Date & Time: 30-Jan-2023 (09:30 AM - 12:30 PM)



## MANIPAL ACADEMY OF HIGHER EDUCATION

III Semester Make Up Examination

SENSORS AND TRANSDUCERS [ICE 2155]

Marks: 50

**Descriptive Questions** 

Answer all the questions.

Section Duration: 180 mins

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1) Explain the schematic diagram of output filtering of measurement system [CO1 PO1-3 BL 2]

(4)

A)

C)

A)

B)

C)

A)

B)

C)

A)

2

3)

B) A 50 V range voltmeter is connected across the terminals A and B of the circuit shown in Fig :1. Find the reading of the voltmeter under open circuit and under the (2) conditions of load and also find the accuracy and loading error, when the voltmeter has a resistance of 100 kΩ. [CO1 PO1-3 BL3].



- 4) Des
  - B) : Design a piezoelectric quartz crystal with a resonant frequency of 6 MHz When used as a QCM sensor, for a certain observation a frequency of 5.91 MHz is noted. Calculate the change in mass on the oscillating surface perpendicular to it. Some relevant information is provided as follows, others may be suitably assumed. Assume the area of cross section to be 1 cm<sup>2</sup>

 $d_{31} = 2.3^{*}10^{-12} \text{ C/N}, d_{32} = -0.67^{*}10^{-12} \text{ C/N}, \text{ E} = 4.5, \text{ E}_{0} = 8.85^{*}10^{-12} \text{ F/N}, \text{ resistivity} = 8^{*}10^{11} \Omega \text{m}, \rho = 2.65 \times 10^{3} \text{ kg/m}^{3}, \text{ Y} = 80^{*}10^{9} \text{ Nm}^{-2}, \text{ Max Safe Stress} = 98^{*}10^{6} \text{ Nm}^{-2}. \text{ [CO3 PO1-4 BL6]}$ 

C) Using any redox probe of your choice, analyse the concept of cyclic voltammetry. [CO4 PO1-4 BL3]

5) With the help of examples involving non-electrical measurements, illustrate the concept of reproducibility and precision. How do you improve these (4) parameters for any given system. [CO1 PO1-4 BL3]

(3)

- A)
- B) What is the electrode potential for a half-cell consisting of a cadmium electrode immersed in a solution that is 0.005 M in C<sup>2+</sup> Given E<sup>o</sup> = 0.403 V. (3) [CO4 PO1-4 BL3]
- C) With a neat block diagram, illustrate the building blocks of an optic fibre based sensing system. Which are the sources of noise in such systems. (3) [CO5 PO1-4 BL2]

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