Question Paper

Exam Date & Time: 19-Dec-2022 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

THIRD SEMESTER B.TECH END SEMESTER EXAMINATIONS, DEC 2022

SENSORS AND TRANSDUCERS [ICE 2155]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

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

A)

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 conditions of load and also find the accuracy and loading error , when the voltmeter has a resistance of 100 kΩ. [CO1 PO1-3 BL3] (3)

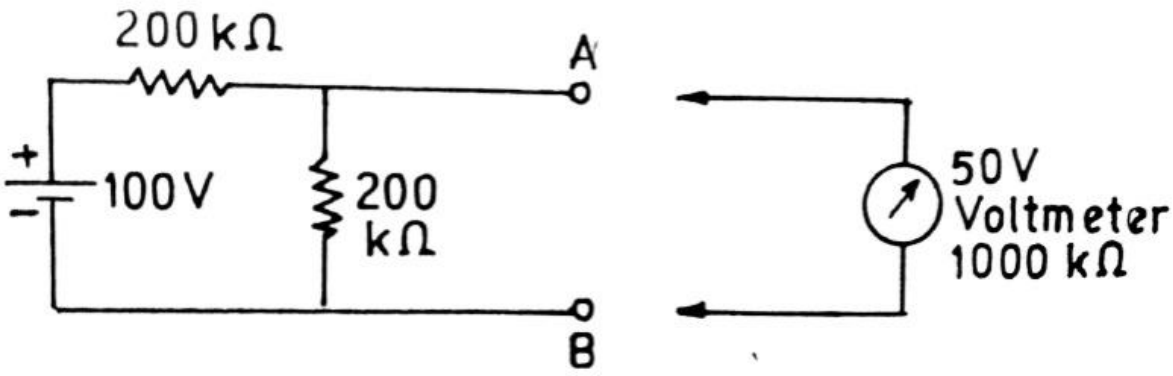

Fig:1

C) Plot the input output characteristics of capacitive transducer and indicate the salient feature. [CO2 PO1-3 BL3]. (4)

2) Describe the construction of strain gauge. Derive the equation of gauge factor of strain gauge. [CO3 PO1-3 BL2]. (4)

A)

B) Explain with neat sketch and mathematical expressions, the operation of LVDT with core position is at ES1 = ES2. [CO2 PO1-3 BL3]. (3)

C) With the help of a neat diagram, explain how the Helipot type potentiometer transducer used for displacement measurement. [CO2 PO1-3 BL2]. (3)

3) With the help of a table, explain the standard binary encoding of the optical absolute encoder when, the number of distinct positions of the shaft is 2^3. [CO5 PO1-4 BL3]. (3)

A)

B) Design an electrochemical sensing system with two 8B pencils and a silver wire for detection of dopamine in sweat. Draw the layout of the system, design the electronics, write down the reactions and draw the expected output waveforms. [CO4 PO1-4 BL6]. (3)

C) A setting of 50 scans to average and integration time of 100 ms is used to acquire a first order binding event of time constant 1 second at a wavelength of 530 nm. Draw the absorbance response likely to be observed and comment on the settings used. If the absorbance value at t=0 is 1 and at t=10s is 2, determine the ratio of initial intensity (at t=0) to final intensity (at t=10). [CO5 PO1-4 BL4] (4)

4) Describe the practical utility of artificially sensing smell for estimation of quality of agricultural produce. [CO5 PO1-4 BL4]. (3)

A)

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^2 (3)

d_{31} = 2.3*10^{-12} C/N, d_{32} = -0.67*10^{-12} C/N,

E = 4.5, E_0=8.85*10^{-12} F/N, resistivity = 8*10^{11} Ωm,

ρ = 2.65 x10^3 kg/m^3, Y = 80*10^9 Nm^{-2} ,

Max Safe Stress = 98*10^6 Nm^{-2}. [CO3 PO1-4 BL6]

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

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

parameters for any given system. [CO1 PO1-4 BL3]

A)

B) What is the electrode potential for a half-cell consisting of a cadmium electrode immersed in a solution that is 0.015 M in Cd^{2+} Given E^o = - 0.403 V. [CO4 PO1-4 BL3] (4)

C) With a neat block diagram, illustrate the building blocks of an optical sensing system. Which are the sources of noise in such systems. [CO5 PO1-4 BL2] (2)

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