Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE	:	ELECTRONIC INSTRUMENTS AND MEASUREMENT
COURSE CODE	:	BEF 24002
PROGRAMME	:	BACHELOR OF ELECTRICAL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	DECEMBER 2015 / JANUARY 2016
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FOUR** (4) QUESTIONS ONLY.

THIS PAPER CONSISTS OF **FIVE** (5) PAGES

Q1 (a) Show in tabular form the differences between analog and digital measuring instruments.

(4 marks)

(b) Illustrate, with the aid of sketches, what is meant by static and dynamic performance characteristics of an electronic measuring instrument.

(6 marks)

(c) Following are the excerpts from the specifications of an electronic measuring instrument:

(i) Measurement range: -100°C to + 300 °C
(ii) Resolution: 0.1°C
(iii) Linearity: 1% Full Scale
(iv) Response time: 0.15ms

Explain the meaning of each term.

(4 marks)

(d) A first-order instrument is to measure signals with frequency content up to 100 Hz with amplitude inaccuracy of 5 %.

(i) Determine the maximum allowable time constant.

(5 marks)

(ii) Determine the phase shift at 50 Hz.

(1 mark)

Q2 (a) Explain the importance of matching the impedance of a sensor to the input impedance of the input amplifier.

(5 marks)

(b) A certain instrument has an input impedance of 50 Ω and is rated for a maximum input of 10 dBm. Determine the maximum voltage that can be applied to the instrument.

(5 marks)

(c) Describe the physical origins of intrinsic electrical noise in electronic components.

(5 marks)

(d) Calculate the noise voltage across a 100 kΩ resistor at a room temperature of 290°K for a bandwidth of 100 kHz.

(5 marks)

Q3 (a) A measurement signal has a frequency less than 1 kHz, but there is unwanted noise at about 1 MHz.

(i) Design a low-pass filter that attenuates the noise to 1 %.

(7 marks)

(ii) Calculate the effect on the measurement signal at its maximum of 1 kHz.

(5 marks)

(b) In the Wheatstone bridge circuit shown in **Figure Q3(b)**, R_T is a resistive temperature sensor, while R_1, R_2, are standard resistors and R_3 a variable resistor. Suppose the resistance R_T of the temperature sensor is related to the temperature T, in °C, by the equation

$$R_T = (1500 + 25T)\ \Omega$$

The bridge is balanced by adjusting R_3 until $R_3 = 250\ \Omega$. Find the value of the temperature.

(8 marks)

Q4 (a) Show in tabular form the differences between passive and active transducers.

(2 marks)

(b) Explain what a thermocouple is and how it can be used to measure temperature.

(4 marks)

(c) Define gauge factor of a strain gauge.

(4 marks)

(d) A strain gauge is bonded to a steel beam of 0.1 m length and 4 cm^2 cross section. The modulus of beam material (steel) is 207 x 10^6 N/rn^2. The strain gauge has initial resistance of 240 Ω and a gauge factor of 2.2. When a load is applied the resistance of the strain gauge changes by 0.013 Ω. Calculate

(i) change in the length of the beam, and

(5 marks)

(ii) force applied to the beam.

(5 marks)

Q5 (a) Show, with the aid of a diagram, the key components and their interconnection in a digital multimeter. Explain what determines the measurement performance of the instrument.

(5 marks)

(b) Compare 1X and 10X oscilloscope probes from the point of view of source loading and compensation to reduce signal distortion. Explain which probe would be the probe of choice in most applications.

(5 marks)

(c) Illustrate, with the aid of sketches, the differences between electrostatic and electromagnetic interference.

(4 marks)

(d) List and explain four methods for reducing electromagnetic interference.

(6 marks)

END OF QUESTIONS

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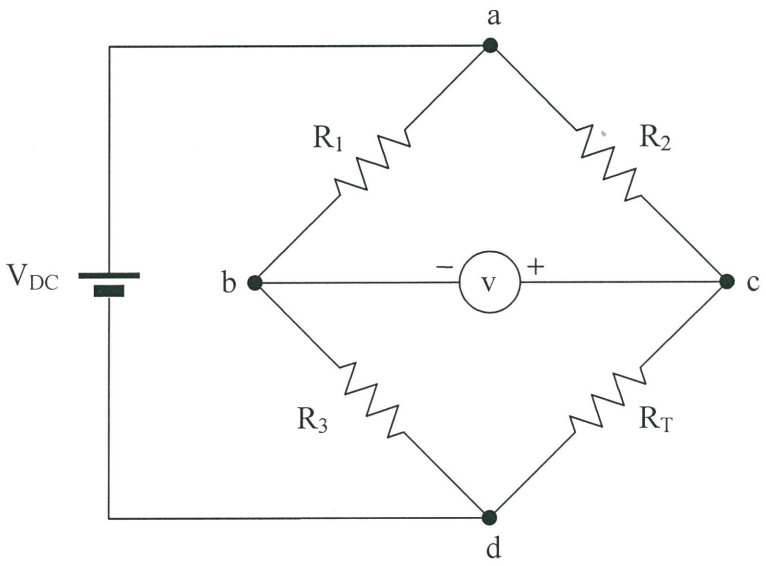

FIGURE Q3(b)