UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	INSTRUMENTATION & MEASUREMENT
COURSE CODE	:	BEJ 10702
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2020
DURATION	:	4 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS.
		OPEN BOOK EXAMINATION

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

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Q1   (a) **Figure Q1(a)** shows a measurement process between the plant floor and control room.

   (i)   List down **THREE (3)** factors to observe during measurement process

(3 marks)

   (ii)   Explain the usage of information received after measurement

(2 marks)

(b) A resistive transducer with a resistance of 5000 Ω and a shaft stroke of 50 cm is used in the arrangement as **Figure Q1(b)**. Potentiometer R_3R_4 is also 5000 Ω, and $V_T = 5$ V. The initial position to be used as a reference point is such that $R_1 = R_2$ (shaft is at midstroke). At the start of the test, potentiometer R_3R_4 is adjusted so that the bridge is balanced ($V_E = 0$). Assuming that the object being monitored will move a maximum distance of 5 cm toward A.

   (i)   Calculate the new value of V_E.

(3 marks)

   (ii)   Form a table indicating the relation between R_1, R_2, V_E with corresponding distance, X.

(4 marks)

   (iii)   Generate V_E versus X graph from the table indicating the linear formula

(3 marks)

(c) The impedances of the AC bridge in **Figure Q1(c)** are given as follows:

$$Z1 = 200 \ \Omega \angle 30°$$
$$Z2 = 150 \ \Omega \angle 0°$$
$$Z3 = 250 \ \Omega \angle -40°$$
$$Zx = Z4 = \text{unknown}$$

Determine the impedance of the unknown arm during balance condition.

(10 marks)

Q2   (a) The worktable of a positioning system as shown in the **Figure Q2(a)** is driven by a ball screw whose pitch is 25mm. The ball screw is connected to the shaft of a stepper motor through a gearbox. An incremental encoder of 100 pulses/rev is connected to the end of the ball screw. The table must move a distance of 250mm from its present position.

   (i)   Sketch the connection of an incremental encoder for the use of detecting forward and reverse motions with the help of diagram
   (4 marks)

   (ii)   Calculate the resolution of the encoder
   (3 marks)

   (iii) Calculate how many pulses of the encoder are to be read to identify that the table is moved to the specified distance.
   (3 marks)

(b) A measurement of temperature using a sensor that outputs 6.5mV/°C must measure up to 100°C. A 6-bit ADC with a 10-V reference is used.

   (i)   Determine the required gain that need to develop a circuit to interface the sensor and the ADC.
   (5 marks)

   (ii)   Sketch the circuit.
   (5 marks)

   (iii) Find the temperature resolution
   (5 marks)

- END OF QUESTIONS –

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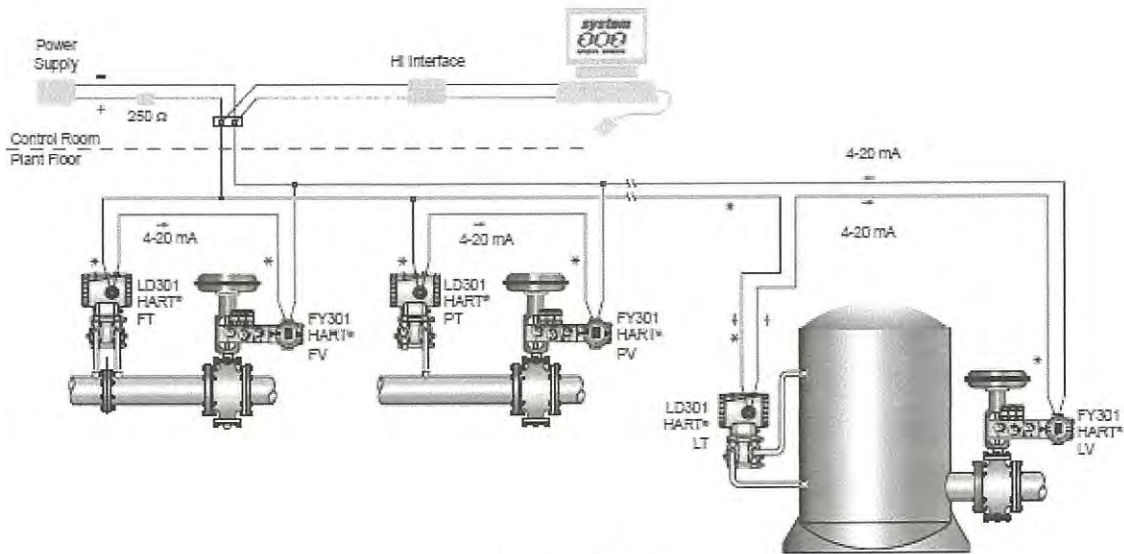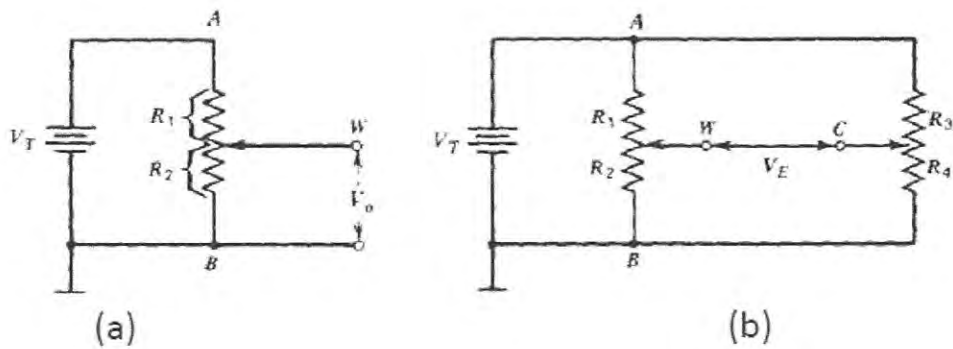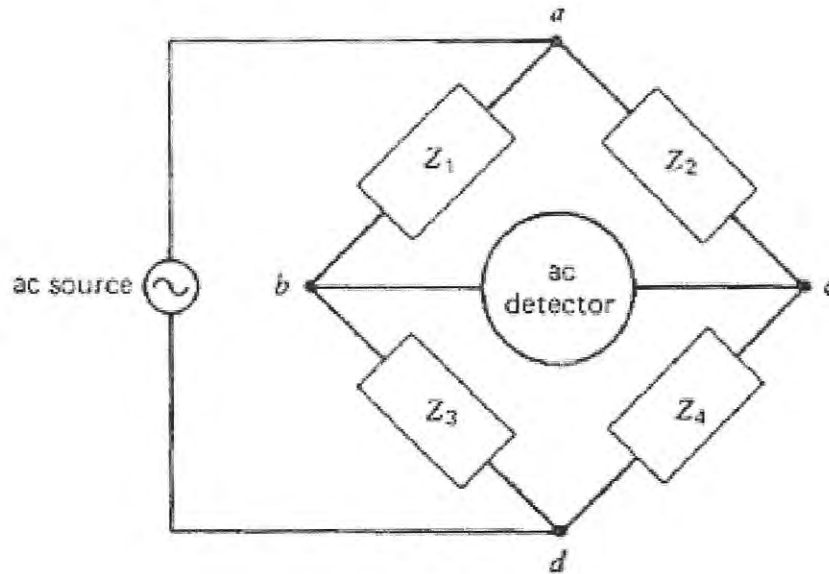COURSE NAME   :   INSTRUMENTATION AND   COURSE CODE   :   BEJ10702
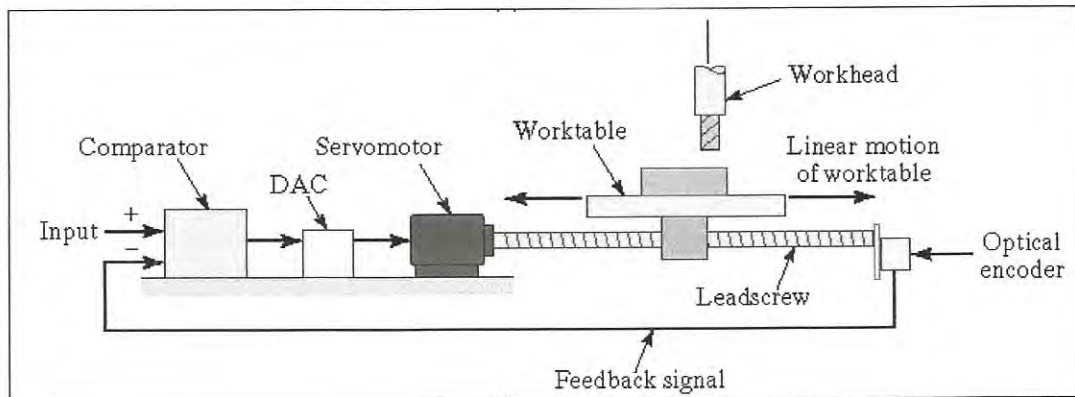   MEASUREMENT

Figure Q1(a)

(a)   (b)

Figure Q1(b)

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Figure Q1(c)

Figure Q2(b)

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