UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	INSTRUMENTATION AND MEASUREMENT
COURSE CODE	:	BEH20403
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JUNE/JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1. (a) Describe the function of Wheatstone Bridge.

(2 marks)

(b) Distinguish the advantages of Kelvin Bridge over Wheatstone Bridge.

(3 marks)

(b) Discuss the differences between Maxwell Bridge and Wein Bridge.

(5 marks)

(c) The Wien-bridge oscillator is shown in **Figure Q1(c)** as one of the most commonly used for audio oscillator which employs RC feedback networks. Given R1 = R2 = 10 kΩ, R3 = 15 kΩ and R4 = 20 kΩ, analyze the values of C1 and C2 that cause the circuit to oscillate at 15 kHz.

(15 marks)

Q2. (a) A inductive transducer as shown in **Figure Q2(a)**.

(i) List **THREE (3)** types of variation in inductive transducers that will change the electromotive(Voltage).

(3 marks)

(ii) Propose a solution to use a inductive transducer to measure the liquid flowmeter.

(7 marks)

(b) A resistive position transducer with a resistance of 10 kΩ and shaft stroke of 0.1m with a bridge circuit is used to measure the bumpiness of a roadway by moving it to the right as shown in **Figure Q2(b).**
(note: the initial position to be used as a reference point is when the shaft is at the middle of stroke).

(i) Illustrate the equivalent circuit of the system.

(5 marks)

(ii) Derive the formula for V_{out} in terms of the value resistor in the circuit.

(2 marks)

(iii) Determine the value of V_{out} when the shaft at initial position.

(2 marks)

(iv) Calculate the value of V_{out} when the shaft reached point A.

(6 marks)

Q3 (a) A Numerical Control (NC) worktable operates by closed-loop positioning as shown in **Figure Q3**. The lead screw has a pitch of 35 mm and is coupled to the motor shaft with a gear ratio of 15:1 (15 turns of drive motor for each turn of the screw). An incremental optical encoder generates 1000 pulses/rev of its output shaft. Determine:

(i) The resolution of the NC worktable.

(3 marks)

(ii) Number of encoder pulses should be received by the control system to verify if the table has moved exactly 350 mm.

(3 marks)

(iii) The encoder rate pulse/sec; if the table is to move at 60000 mm/min.

(3 marks)

(iv) The drive motor speed in term of revolution per minute (RPM) if the table is moved at the speed as specified at Q3(a)(iii).

(3 marks)

(b) Linear Variable Differential Transformer(LVDT) and Synchro can measure position and displacement of objects.

(i) Distinguish the differences of LVDT with Synchro.

(4 marks)

(ii) Describe the advantages of LVDT over linear potential meters.

(4 marks)

(c) A tachometer can be used to measure the rotational speed of a shaft. Differentiate between contact tachometry and optical tachometer.

(5 marks)

Q4 (a) List **TWO (2)** advantages and **TWO (2)** disadvantages of a digital instrument compared to analog instrument.

(4 marks)

(b) **Figure Q4(b)** shows a circuit for voltage to frequency converter.

(i) Describe the function of a voltage to frequency converter.

(2 marks)

(ii) Given $V_i = f/50$. Calculate the amplitude input voltage V_i of the voltage to frequency converter, if 600 pulses are passes by the AND gate during a 0.1 sec gating pulse.

(7 marks)

(c) **Figure Q4(c)** shows a block diagram of an Single-slope Analog to Digital Converter (ADC).

(i) Determine the component for "A" and "B" in **Figure Q4(c)**

(2 marks)

(ii) Sketch the output waveform of the circuit labeled 'Vio', 'Vc' and 'Pulse'.

(4 marks)

(iii) A Single-slope ADC as shown in **Figure Q4(b)** consists of a 1000 kΩ resistor and a 1 μF capacitor. The reference is 12 V. Calculate the conversion time for a 6.8 V analog input.

(6 marks)

- END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER / SESSION	: SEM II / 2017/2018	PROGRAMME CODE	: 3 BEJ
COURSE NAME	: INSTRUMENTATION AND MEASUREMENT	COURSE CODE	: BEH20403

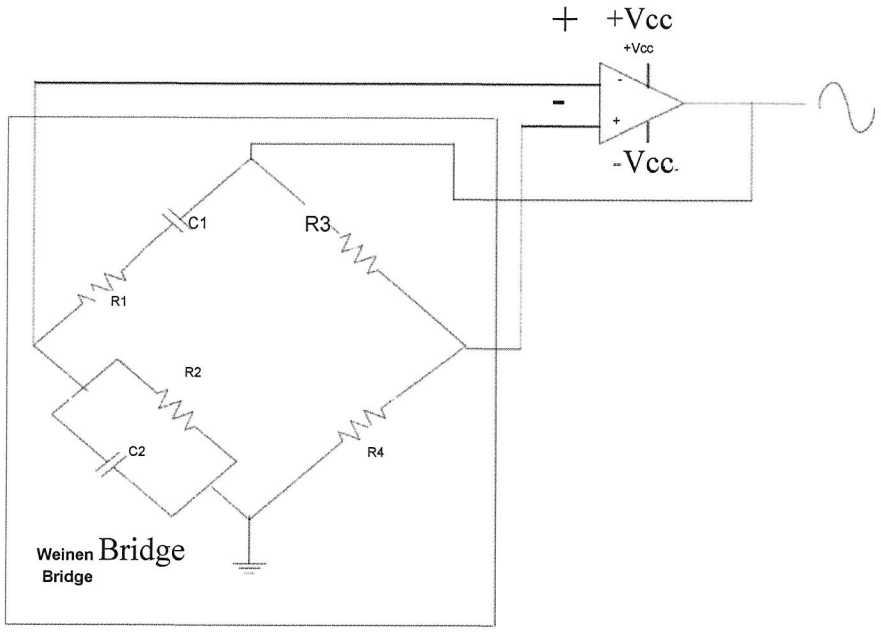

Figure Q1(c)

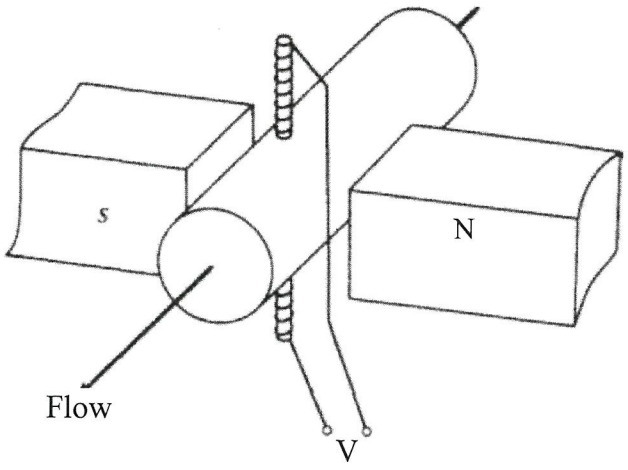

Figure Q2(a)

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2017/2018
COURSE NAME : INSTRUMENTATION AND MEASUREMENT
PROGRAMME CODE : 3 BEJ
COURSE CODE : BEH20403

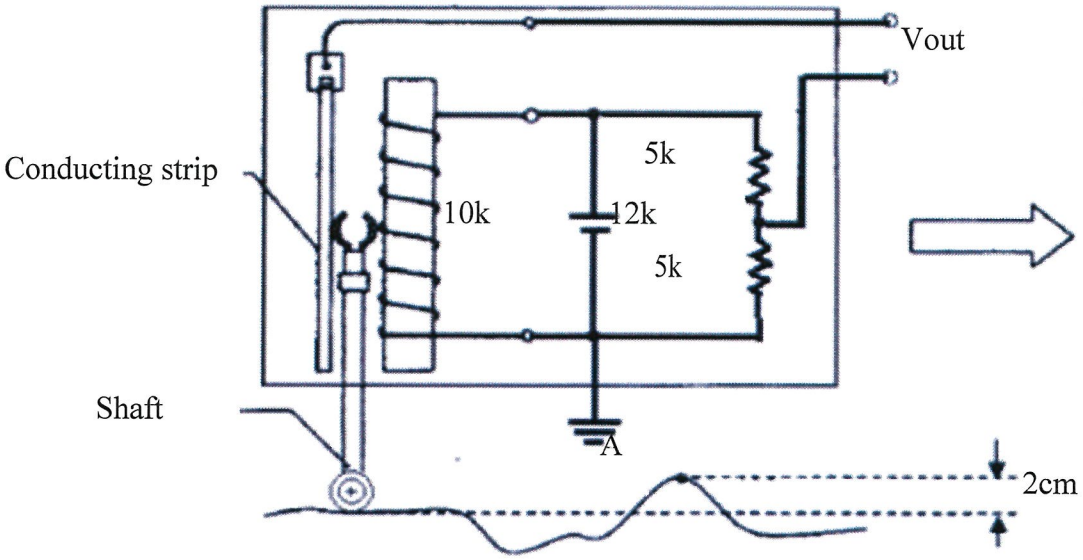

Figure Q2(b)

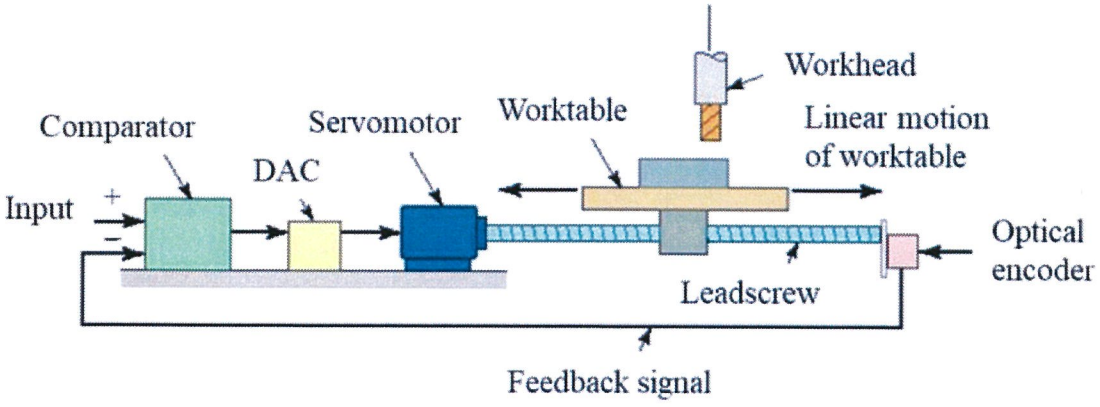

Figure Q3

FINAL EXAMINATION

SEMESTER / SESSION : SEM II / 2017/2018
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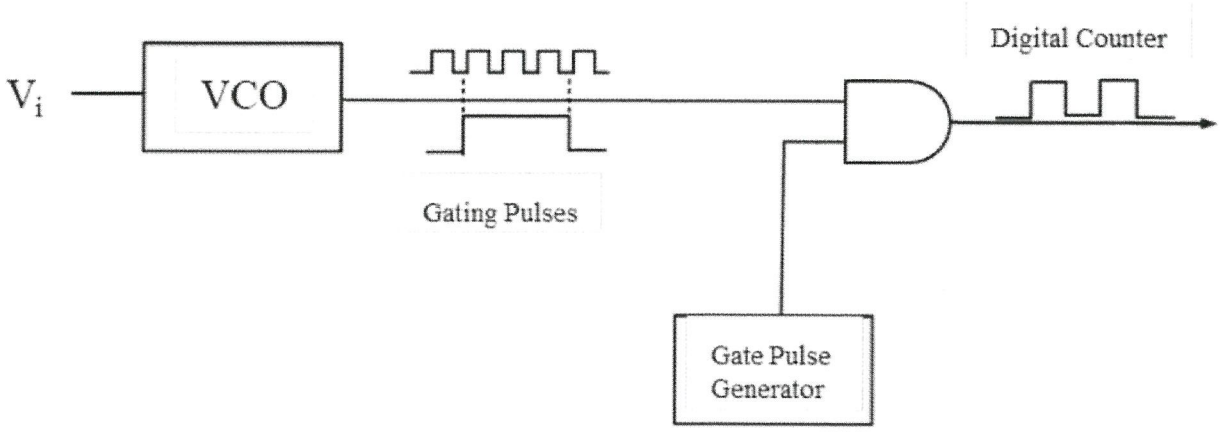

Figure Q4(b)

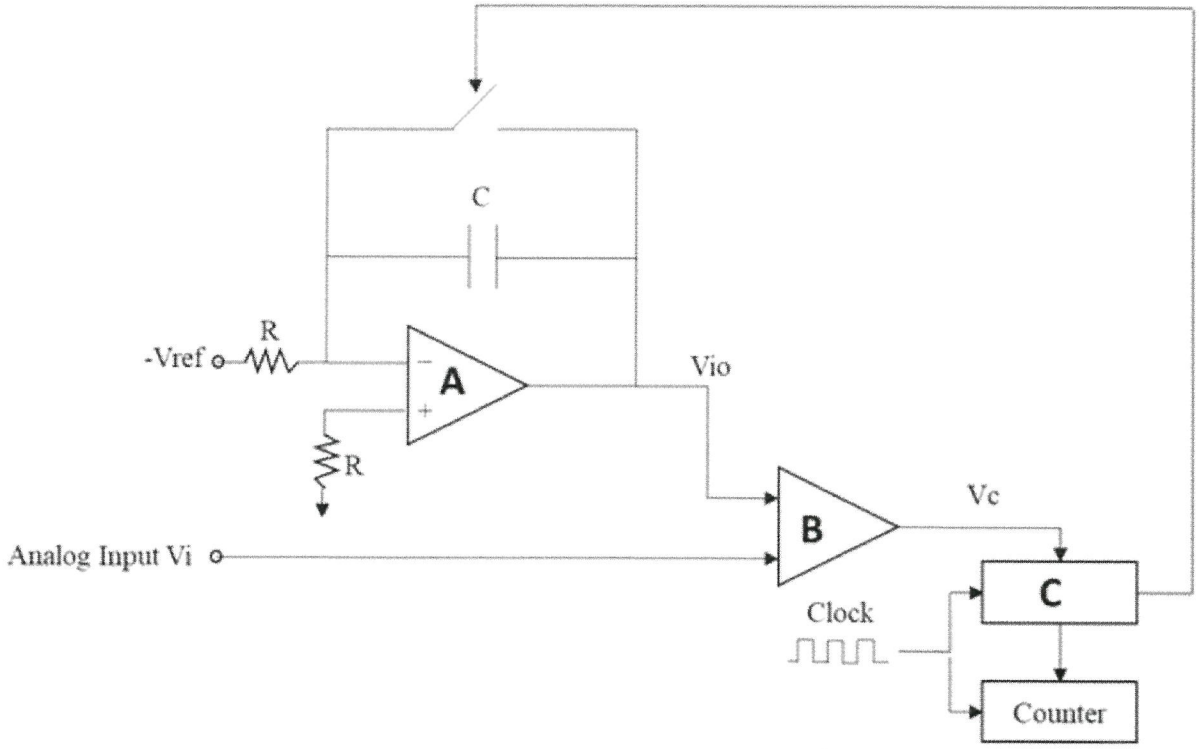

Figure Q4(c)