Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	ELECTRICAL MEASUREMENT AND INSTRUMENTATION
COURSE CODE	:	BEV 20103
PROGRAMME CODE	:	BEV
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) With the help of a block diagram, differentiate between analogue to digital converter (ADC) and digital to analogue converter (DAC).

(4 marks)

(b) Analogue electronic voltmeter is primarily based on an electronic amplifier for input signal processing and the output is obtained by the deflection of the pointer on the calibrated scale. State **two (2)** different type of analogue electronic voltmeter.

(2 marks)

(c) An emitter-follower voltmeter circuit in **Figure Q1(c)** has $V_{CC} = 20$ V, $R_s = 1.5$ kΩ, $R_m = 3.15$ kΩ and $I_C = 2$ mA at full scale deflection (fsd). Given that $V_{BE} = 0.7$ V and $h_{fe} = 250$,

(i) Calculate the meter current when $V_{in} = 10$ V.

(2 marks)

(ii) Determine the voltmeter input resistance, R_i with and without the transistor.

(4 marks)

(iii) Discuss the **two (2)** limitations in using emitter-follower as a voltmeter.

(4 marks)

(iv) Propose a solution to eliminate the limitations stated in **Q1(c)(iii)**.

(4 marks)

Q2 (a) **Figure Q2(a)** shows the waveform of a sinusoidal voltage observed in an oscilloscope. The vertical attenuation selected is 2 mV/div. Calculate the amplitude and RMS value of the sinusoidal voltage.

(4 marks)

(b) An oscilloscope is probably the most versatile tool for development of electronic circuits and systems. Explain **four (4)** electrical parameters that can be observed by the oscilloscopes.

(4 marks)

(c) **Figure Q2(c)** shows a co-axial cable connects a high impedance or 10:1 probe head to the oscilloscope input.

(i) Illustrate the equivalent circuit of the probe.

(2 marks)

(ii) Based on a balanced bridge condition for equivalent circuit in **Q2(c)(i),** derive the formula for resistance, R_1 and capacitor, C_1.

(4 marks)

(iii) Determine the attenuator factor.

(2 marks)

(iv) Calculate the value of capacitance, C_1 for 10:1 probe with input impedance of oscilloscope equal to 1 MΩ in parallel with 35 pF capacitance as shown in **Figure Q2(c).**

(4 marks)

Q3 (a) Instrument transformers are design to transform voltage or current from the high values in the transmission and distribution systems to the low values that can be utilized by low voltage metering devices.

(i) State **two (2)** type of instrument transformers.

(2 marks)

(ii) With the aid of circuit diagram, distinguish the different between the two types of instrument transformers in **Q3(a)(i).**

(6 marks)

(b) A current transducer with a bar has 300 turns in its secondary winding. The resistance and reactance of the secondary circuit are 1.5 Ω and 1.0 Ω, respectively including the transformer winding with a 5 A flowing in the secondary winding and the magnetizing mmf is 100 A. Calculate:

(i) The turn ratio, K_T.

(2 marks)

(ii) The secondary impedance in polar form.

(2 marks)

(iii) The secondary voltage.

(2 marks)

(iv) The magnetizing current.

(2 marks)

(c) A potential transformer rated 14400 V/115 V and a current transformer rated 75 A/5 A are used to measure the voltage and current in a transmission line. Given that the voltmeter indicates 100 V and the ammeter reads 3.5 A, calculate:

(i) The line voltage, V_L.

(2 marks)

(ii) The line current, I_L.

(2 marks)

Q4 (a) Distinguish the circuit configuration of three-voltmeter and three-ammeter methods for power measurement in single-phase AC circuit.

(4 marks)

(b) A supply voltage of 240 V was applied to a parallel configuration of an inductive load and a non-inductive resistor. An inductive load takes a current of 3.3 A and a non-inductive resistor takes 3.1 A. Determine:

(i) The inductive load impedance and non-inductive resistance.

(4 marks)

(ii) The power absorbed by the inductive load.

(2 marks)

(iii) The power factor of the inductive load.

(2 marks)

(c) The power of three-phase circuit can be measured by using a wattmeter.

(i) Illustrate the circuit diagram of wattmeter.

(2 marks)

(ii) Discuss **three (3)** arrangements of wattmeter method to measure the power in three-phase circuit.

(6 marks)

Q5 (a) A resistor is an electrical component, which has been manufactured with specific amount of resistance. State and define the **three (3)** categories of resistance.

(6 marks)

(b) Ammeter-voltmeter method is the simplest method and very commonly use for measurement of low resistance.

(i) Sketch the circuit of ammeter-voltmeter method.

(2 marks)

(ii) Distinguish the advantage and disadvantage of the ammeter-voltmeter method.

(4 marks)

(c) The ammeter-voltmeter method is used to measure an aircraft instrument resistance. With the voltmeter connected across the unknown resistance (R_x), the readings on the ammeter and voltmeter are 0.3 A and 2.4 V, respectively. The resistance of the voltmeter (R_V) is 450 Ω and the resistance of the ammeter (RA) is 0 Ω. Calculate:

(i) The true value of R_x.

(2 marks)

(ii) The percentage error in the value of R_x, if the voltmeter current is ignored.

(4 marks)

(d) Guard wire is very important for high resistance measurement. Discuss the important of guard wire.

(2 marks)

- END OF QUESTIONS -

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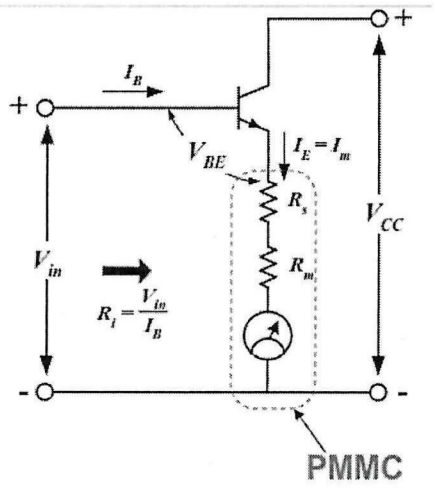

Figure Q1(c)

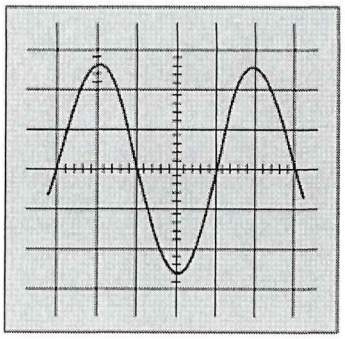

Figure Q2(a)

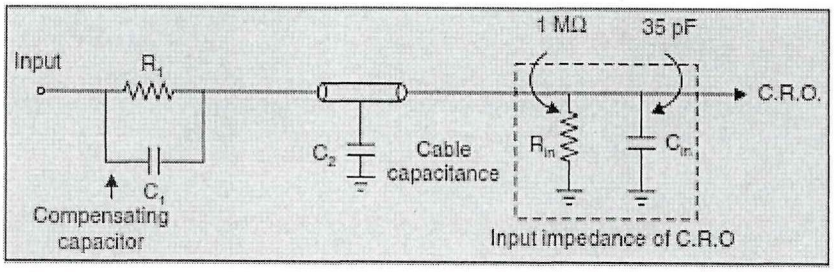

Figure Q2(c)