Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	ELECTRICAL PRINCIPLES II
COURSE CODE	:	BNR 10303
PROGRAMME CODE	:	BND/BNE/BNF
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

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

PART A

Q1 A sinusoidal current is usually referred to as alternating current (ac). A sinusoidal signal is a signal has the form of the sine or cosine function.

(a) In a linear circuit, the voltage source, v_s, is:

$$v_S = 6.7\cos(430t + 15^0)\,\text{V}$$

(i) What is the angular frequency of the voltage?

(2 marks)

(ii) What is the frequency of the source?

(2 marks)

(iii) Find the period of the voltage.

(2 marks)

(iv) Express v_s in sine form.

(2 marks)

(v) Determine v_s at $t = 1.83$ ms.

(2 marks)

(b) Given two sine wave voltages as follows:

$v_1 = 100\sin(314t - 30^0)$ and $v_2 = 200sin(314t + 60^0)$,

(i) Sketch the complete waveform of both voltages on the same set of axis.

(3 marks)

(ii) Determine the phase angle difference and the phase relation between both waveforms.

(2 marks)

(c) Determine the input impedance of the circuit in **Figure Q1.1**. Assume that the circuit operates at $\omega = 25$ rad/s.

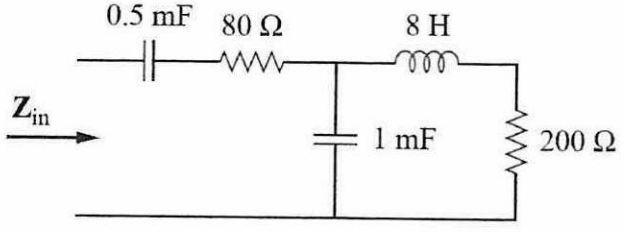

Figure Q1.1

(5 marks)

Q2 The steady-state response of circuits to sinusoidal inputs can be obtained by using phasors.

(a) Calculate the value of I_o in **Figure Q2.1** by using mesh analysis.

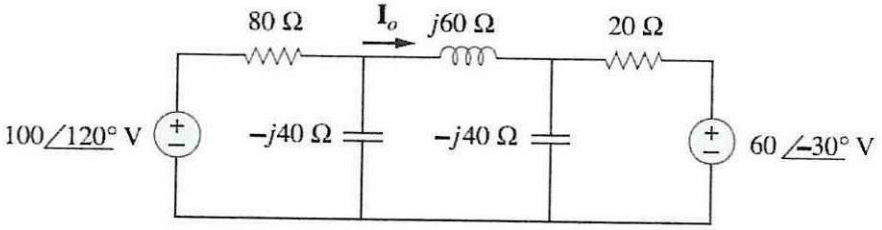

Figure Q2.1

(8 marks)

(b) Verify the answer of I_o in **Q2(a)** by using nodal analysis.

(8 marks)

(c) Based on your understanding, explain how you conduct the source transformation technique and state **TWO (2)** benefits of using Thevenin's Theorem technique.

(4 marks)

Q3 Power analysis is of paramount importance. Power is the most important quantity in electric utilities, electronic, and communication systems, because such systems involve transmission of power from one point to another.

(a) In a TV transmitter, a series circuit has an impedance of 3 kΩ and a total current of 50 mA. Determine the power factor of the circuit if the voltage across the resistor is 80 V.

(4 marks)

(b) An industrial heater has a nameplate that reads:

210 V, 60 Hz, 12 kVA, 0.78 pf lagging.

Identify:

(i) The apparent and complex power.

(2 marks)

(ii) The impedance of the heater.

(2 marks)

(c) Two loads connected in parallel draw a total of 2.4kW at 0.8 pf lagging from a 120 V_{rms}, 60 Hz line. One load absorbs 1.5 kW at a 0.707 pf lagging. Identify:

(i) The power factor of the second load.

(10 marks)

(ii) The parallel element that is required to correct the power factor to 0.9 lagging for the two loads.

(2 marks)

Q4 A three-phase system is produced by a generator consisting of three sources having the same amplitude and frequency but different phases.

(a) Differentiate between balanced phase voltages and balanced load.

(4 marks)

(b) Three phase Y-connected source is connected to a balanced Y-connected load as shown in **Figure Q4.1**. Find the line currents, the line voltages, and the load voltages.

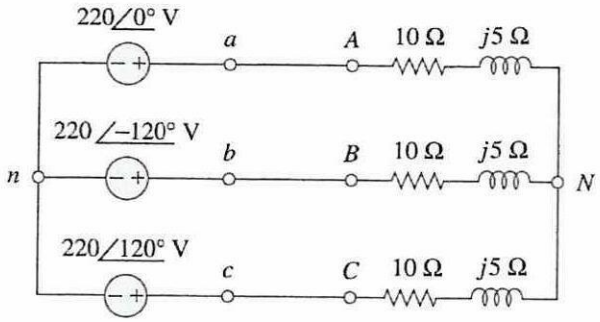

Figure Q4.1

(10 marks)

(c) In a balanced three-phase Y-Y system, the source is an *abc* sequence of voltages and $V_{an} = 100 \angle 20°$ V rms. The line impedance per phase is 0.6 + j1.2 Ω, while the per-phase impedance of the load is 10 + j14 Ω. Calculate the line currents and the load voltages.

(6 marks)

Q5 The transformer is an electrical device designed based on the concept of magnetic coupling. It uses magnetically coupled coils to transfer energy from one circuit to another.

(a) Based on the matrix form in Q5(a), determine the voltage drop across resistor in loop I_2.

$$[2 \quad 0] = [4 + j8 \quad -j4 \quad -j4 \quad 2 + j4][I_1 \quad I_2]$$

(9 marks)

(b) If the transformer ratio between turns on in the primary and turns on in the secondary is 40:1. Determine the secondary current if R=10 Ohm and transformer voltage is more than 3000 rms.

(3 marks)

(c) If a linear transformer has, L_1= 10 for primary coil, L_2= 4 for secondary coil and M = 2 for mutual inductance, calculate and sketch the T- equivalent circuit of the linear transformer.

(2 marks)

(d) An ideal transformer is rated with 22:1 ratio with 9600 VA and has 1000 turns on the primary side. Analyse the current ratings for the primary and secondary windings.

(6 marks)

- END OF QUESTIONS -