UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2017/2018

COURSE NAME	:	POLYPHASE CIRCUIT ANALYSIS
COURSE CODE	:	BEF 23803
PROGRAMME	:	BEV
EXAMINATION DATE	:	DECEMBER 2017/JANUARY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS.

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

Q1 (a) Argue why a three-phase system is better than a single-phase system.

(5 marks)

(b) Differentiate between real power, reactive power, and apparent power.

(3 marks)

(c) The following loads are connected to a 415 V, 50 Hz three-phase four-wire system: between red line and neutral, a non-inductive resistor of 10 Ω resistance; between yellow line and neutral, an inductor of 30 mH inductance in series with a 20 Ω resistor; and between blue line and neutral, a capacitor of 50 mF capacitance. Assume a RYB sequence.

(i) Calculate line currents I_R, I_Y, I_B,

(6 marks)

(ii) Calculate the power consumed by each phase load,

(4 marks)

(iii) Calculate current in the neutral conductor, I_N.

(1 mark)

(iv) Draw the phasor diagram.

(1 mark)

Q2 (a) Show that in the two-wattmeter method of measuring power, the total power consumed by a balanced, star-connected three-wire load is given by the sum of the wattmeter readings.

(10 marks)

(b) **Figure Q2(b)** shows two wattmeters connected to a balanced three-wire star-connected load, where each phase load consists of a coil of 100 mH inductance in series with a 50 Ω resistance. The load is supplied from a three-phase 415 V, 50 Hz voltage source with RYB phase sequence.

(i) Calculate line currents I_R, I_Y, I_B,

(4 marks)

(ii) Calculate power measured by wattmeter W_1,

(2 marks)

(iii) Calculate power measured by wattmeter W_2,

(2 marks)

(iv) Calculate total active power consumed by the load,

(1 mark)

(v) Calculate power factor of the load.

(1 mark)

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Q3 (a) For the three-phase Y-Y system shown in **Figure Q3(a),** show that potential difference between the two star points *N* and *n* is given by the expression

$$\mathbf{V}_{Nn} = \frac{\dfrac{\mathbf{V}_{rn}}{\mathbf{Z}_{RN}} + \dfrac{\mathbf{V}_{yn}}{\mathbf{Z}_{YN}} + \dfrac{\mathbf{V}_{bn}}{\mathbf{Z}_{BN}}}{\dfrac{1}{\mathbf{Z}_{RN}} + \dfrac{1}{\mathbf{Z}_{YN}} + \dfrac{1}{\mathbf{Z}_{BN}}}$$

(7 marks)

(b) In the three-phase three-wire system shown in **Figure Q3(a)** an unbalanced star-connected load is supplied from a balanced three-phase 415 V, 50 Hz supply with RYB sequence. Given that

$$\mathbf{Z}_{RN} = (9 + j6)\ \Omega; \quad \mathbf{Z}_{YN} = (15 + j10)\ \Omega; \quad \mathbf{Z}_{BN} = (12 + j9)\ \Omega;$$

and taking V_{RN} as reference, calculate

(i) potential difference V_{Nn},

(3 marks)

(ii) line currents I_R, I_Y, I_B,

(4 marks)

(iii) voltage drops V_{RN}, V_{YN}, V_{BN},

(4 marks)

(iv) total active power delivered to the load.

(2 marks)

Q4 (a) Define the phrase "Single-line diagram."

(2 marks)

(b) Summarise the disadvantages of low power factor.

(4 marks)

(c) A small industrial plant receives a balanced 50 Hz three-phase supply voltage at 415V from the local utility. The single-line diagram of the plant's electric supply system is as shown in **Figure Q4(c)**. With the capacitor bank switch in the open position, calculate

(i) total active power delivered to the loads,

(4 marks)

(ii) total reactive power delivered to the loads,

(2 marks)

(iii) total apparent power supplied to the plant,

(2 marks)

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(iv) feeder current

(2 marks)

(v) feeder current when the capacitor bank switch is closed to raise the plant power factor to 0.95 lagging.

(4 marks)

Q5 (a) Explain the per unit system of calculation used in power system analysis.

(2 marks)

(b) Give two (**2**) advantages of using per unit system of calculation in power system analysis.

(2 marks)

(c) **Figure Q5(c)** shows the schematic diagram of a radial distribution system where a three-phase generator is supplying an industrial load of 40 MW, 0.8 power factor lagging at 33 kV. The ratings and reactances of the various components are shown therein. Choose base values at the load of 200 MVA and 33 kV.

(i) Determine the per-unit values of all the components of the single-line diagram.

(10 marks)

(ii) Draw the impedance diagram.

(3 marks)

(iii) Calculate the transmission line current.

(3 marks)

END OF QUESTIONS

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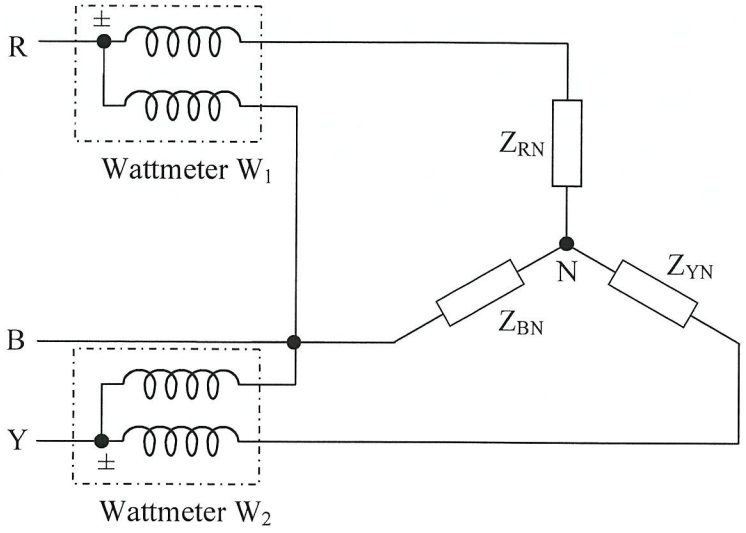

FIGURE Q2(b)

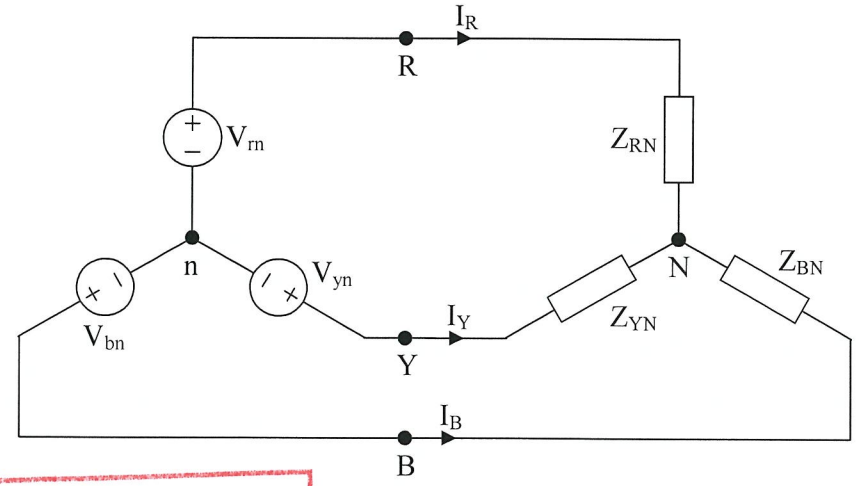

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FIGURE Q3(a)

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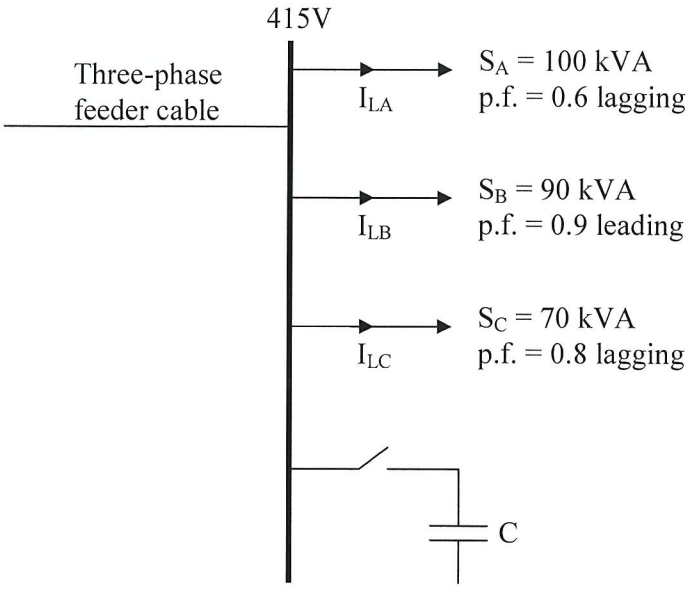

FIGURE Q4(c)

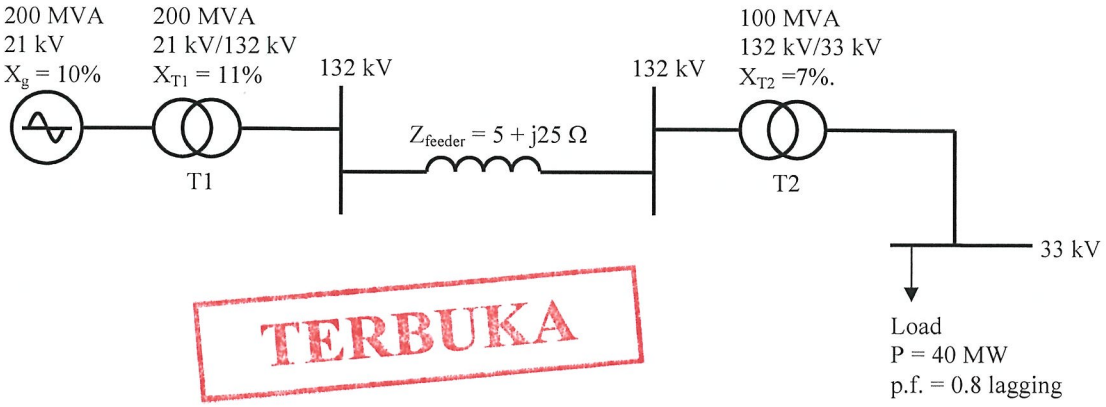

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FIGURE Q5(c)