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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023**

COURSE NAME : POLYPHASE CIRCUIT
COURSE CODE : BEV 20403
PROGRAMME CODE : BEV
EXAMINATION DATE : FEBRUARY 2023
DURATION : 3 HOURS
INSTRUCTION :
1. ANSWERS **ALL** QUESTIONS.
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **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

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- Q1** (a) (i) State **two (2)** factors which cause unbalanced three-phase electrical system. (2 marks)
- (ii) For a three-phase electrical system, list down **three (3)** real examples of the cause of imbalance to occur. (3 marks)
- (b) Voltage measurements carried out between the different phases of a three-phase supply gave the following readings :

$$\begin{aligned} V_{ry} &= 420 \text{ V} \\ V_{yb} &= 422 \text{ V} \\ V_{br} &= 415 \text{ V} \end{aligned}$$

- Calculate the percentage of the unbalanced voltage. (5 marks)
- (c) A symmetrical delta-connected, 410V three-phase supply is feeding an asymmetrical delta-connected load as shown in **Figure Q1(c)**. The impedances of the load $Z_{RY} = 40 + j70 \Omega$, $Z_{YB} = 30 - j40 \Omega$ and $Z_{BR} = 50 + j60 \Omega$. Assuming RBY sequence,
- (i) Determine and draw the phasor diagram of each phase current in the load. (9 marks)
- (ii) Determine and draw the phasor diagram of line currents in the system. (6 marks)

- Q2** (a) Draw the power triangle and write the equivalent equations for a system showing the real power consumed by the resistive component of the load and the reactive power generated by its capacitive component. (5 marks)
- (b) A three-phase supply of 415V, 50Hz, negative sequence supplies a balance star load with a phase impedance consisting of a 45Ω resistance in series with 0.4H inductance. Choose V_{BN} as the reference phasor.
- (i) Determine the line currents. (10 marks)
- (ii) Determine the total complex power consumed by the three load impedances and draw the power triangle of the system. (10marks)

Q3 (a) A three phase transformer is used to transfer a large amount of power. It is required to step-up and step-down the voltages at various stages of a power system network.

(i) Explain **two (2)** advantages and **two (2)** disadvantages of three phase transformer.

(4 marks)

(ii) Describe **two (2)** common faults of three phase isolation transformers.

(2 marks)

(b) With taking frequency as 50 Hz, a three-phase transmission lines have following parameters.

Sending End Voltage, $V_S = 450$ kV

Distance, $\ell = 200$ km

Resistance, $R = 0.035$ Ω /km

Inductance, $L = 0.7$ mH/km

Shunt Capacitance, $C = 0.012$ μ F/km

Receiving End Voltage, $V_R = 400$ kV

Receiving End Power, $S_R = 360$ MVA

Power Factor, p.f = 0.8 lagging

(i) Draw the nominal π model of the above transmission line.

(2 marks)

(ii) Determine constant A, B, C and D of two-port network representation.

(5 marks)

(iii) Determine the per phase receiving current, $I_{R(1\phi)}$ and sending current, $I_{S(1\phi)}$

(5 marks)

(iv) Determine the sending end line voltage, $V_{S(L-L)}$

(3 marks)

(v) Calculate the three-phase sending end total power, $S_{S(3\phi)}$

(2 marks)

(vi) Analyse the voltage regulation of the entire system, % VR

(2 marks)

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- Q4** (a) Define per unit quantity in electrical power system. (2 marks)
- (b) A three-phase generator is supplying an industrial load as represented in the schematic diagram of **Figure Q4(b)**. The ratings and reactance of the various components are presented. Let the base values of reactance power, S_{base} equal to 50MVA at all zones.
- (i) Determine impedances base, Z_{base} for all zones. (5 marks)
- (ii) Determine the current base, I_{base} for each zone. (3 marks)
- (iii) Determine the per-unit impedances values of all components. (5 marks)
- (iv) Determine the per-unit load current, $I_{L(pu)}$ and load impedance, $Z_{L(pu)}$ (8 marks)
- (v) Draw the impedance diagram. (2 marks)

-END OF QUESTIONS –

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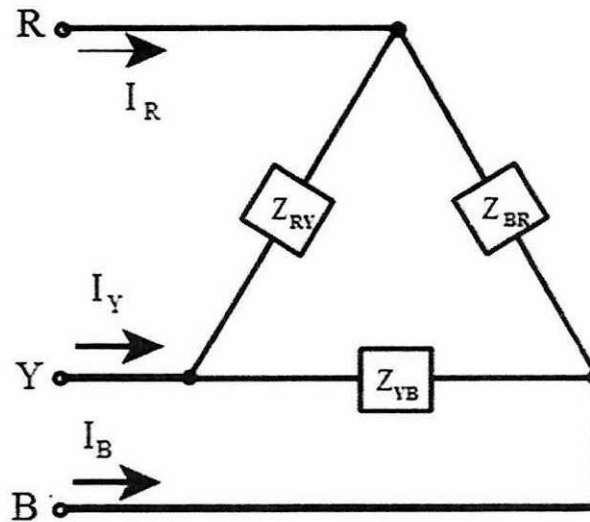


Figure Q1(c)

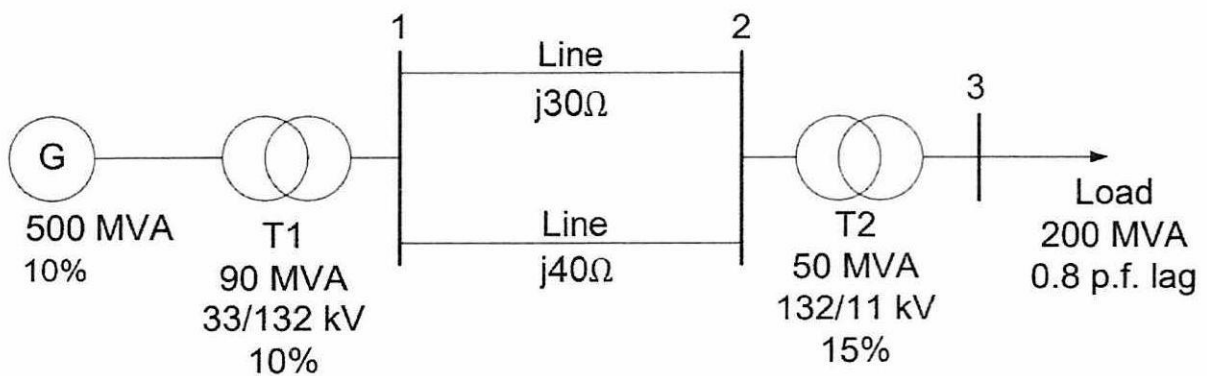


Figure Q4(b)

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