UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2016/2017

COURSE NAME	:	POLYPHASE CIRCUIT ANALYSIS
COURSE CODE	:	BEF 23803
PROGRAMME	:	BEV
EXAMINATION DATE	:	DECEMBER 2016/ JANUARY 2017
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Explain what is meant by phase sequence in the context of RYB three-phase systems. (3 marks)

(b) The yellow phase line current of a RYB balanced delta-connected load is $10\angle -40°$ A. The reference for the yellow-phase line current is towards the load. If the phase sequence is negative, calculate the phasor currents,

(i) I_R. (1 mark)
(ii) I_Y. (1 mark)
(iii) I_{RB}. (1 mark)
(iv) I_{BY}. (1 mark)
(v) I_{YR}. (1 mark)

(c) **Figure Q1(c)** shows a 415 V, 50 Hz, 3-phase supply is connected with a delta-connected load. The phase load currents are as followed: I_{RY} = 40 A at p.f. 0.8 lagging, I_{YB} = 30 A at unity p.f. and I_{BR} = 20 A at 0.8 leading. The phase sequence is RYB. Calculate;

(i) the phase impedances Z_{RY}, Z_{YB}, and Z_{BR}. (4 marks)

(ii) the line currents I_{RY}, I_{YB}, and I_{BR}. (4 marks)

(iii) the active power supplied to each phase load. (4 marks)

Q2 (a) (i) Explain the difference between a balanced polyphase system and an unbalanced polyphase system. (2 marks)

(ii) List **two (2)** conditions that typically cause a polyphase system to become unbalanced. (2 marks)

(b) A 415 V, 50 Hz, 3-phase 3-wire star-connected source supplies a star-connected load whose impedances are $Z_R = (9 + j6)$, $Z_Y = 15 + j10)$ Ω and $Z_B = (12 + j9)$ Ω. The star points of the voltage source and the load are not grounded. Assume RYB sequence.

Determine:

(i) the line currents I_R, I_Y, and I_B . (4 marks)

(ii) the phase voltages V_{RN}, V_{YN}, and V_{BN}.

(4 marks)

(iii) the complex power supplied to each phase load.

(4 marks)

(iv) the total complex power supplied to the three loads.

(4 marks)

Q3 (a) Explain why low power factor is undesirable in a power system.

(3 marks)

(b) A three phase power system consists of generators, step-up or step-down tranformers, tranmission line and the loads. Each of them interconnected to each others with short, medium and long tranmissin line.

(i) State **three (3)** advantages of Y-Δ transformer configuration compared to Y-Y configuration.

(3 marks)

(ii) Tabulated **three (3)** comparison between short, medium and long transmission line.

(3 marks)

(iii) Draw the complete single line diagram of the power system from the generating to receiving end of the network.

(4 marks)

(c) A three-phase wye-connected induction motor draws 150 kVA at 0.6 power factor lagging from a 415 V, 50 Hz source. Calculate,

(i) the kVA rating of capacitors to make the combined power factor 0.85 lagging .

(4 marks)

(ii) the line current before and after the power factor correction.

(3 marks)

Q4 (a) Auto transformer differs from the ordinary transformer in the arrangement of the winding for the primary and secondary winding.

(i) Draw the schematic diagram of an ideal auto transformer.

(3 marks)

(ii) State **one (1)** disadvantage and **one (1)** advantage of this autotransformer.

(2 marks)

(b) **Figure Q4(b)** shows a three-phase generator rated at 300MVA, 23kV supply a system load of 240 MVA, 0.9 power factor lagging at 230 kV through a 330 MVA 23Δ/ 230-Y kV step up transformer of leackage reactance 11%. Choose the base values at the load of 100MVA and 230 kV

(i) Calculate I_A, I_B, I_C supplied to the load in per-unit with phase A voltage as a reference.

(6 marks)

(ii) Detemine I_a, I_b and I_c from the generator to its terminal voltage.

(3 marks)

(iii) Calculate the terminal voltage of the generator or load voltage.

(3 marks)

(iv) Draw the single-line diagram with all the values calculated from **Q4b(i)** until **Q4b(iii)**

(3 marks)

Q5 The ratings of the generators, motors and transformers of **Figure Q5** are

Generator 1:	20MVA, 13.8kV, X_d" =0.20 p.u
Generator 2:	20MVA, 13.8kV, X_d" =0.20 p.u
Generator 3:	20MVA, 13.8kV, X_d" =0.20 p.u
Transformer T1 :	25MVA, 220Y/13.8Δ kV, X =10%
Transformer T2 :	single phase units, each rated 10 MVA, 127/18 kV, X =10%
Transformer T3 :	35MVA, 220Y/ 22Y kV, X =10%

(i) Calculate all the impedance that marked in per unit on the network by choosing the base of 50MVA, 18kV in Generator 1.

(10 marks)

(ii) Draw the complete impedance diagram with all reactance marked in per unit.

(3 marks)

(iii) Determine the current at transmission line which is connecting between point B to point C as shown in **Figure Q5.**

(4 marks)

(iv) Determine the amount of current generated from Generator 2.

(2 marks)

- END OF QUESTIONS –

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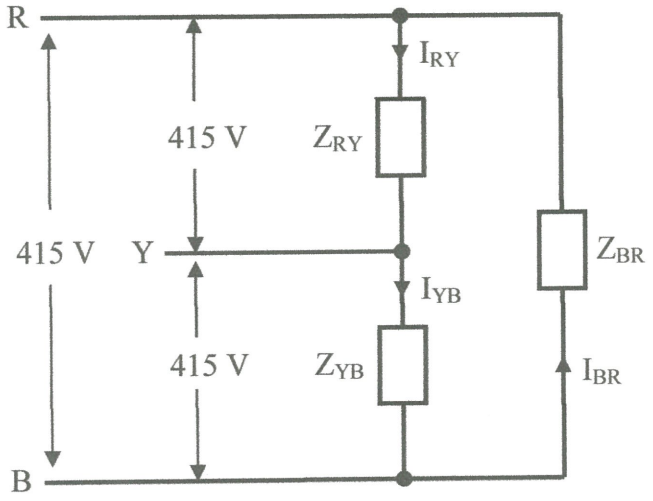

FIGURE Q1(c)

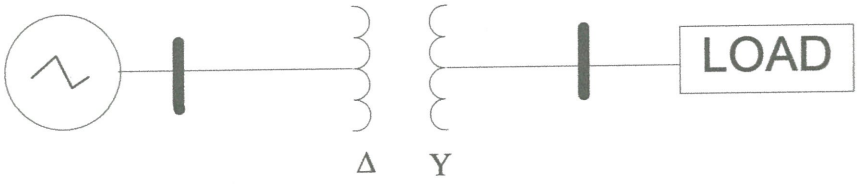

FIGURE Q4(b)

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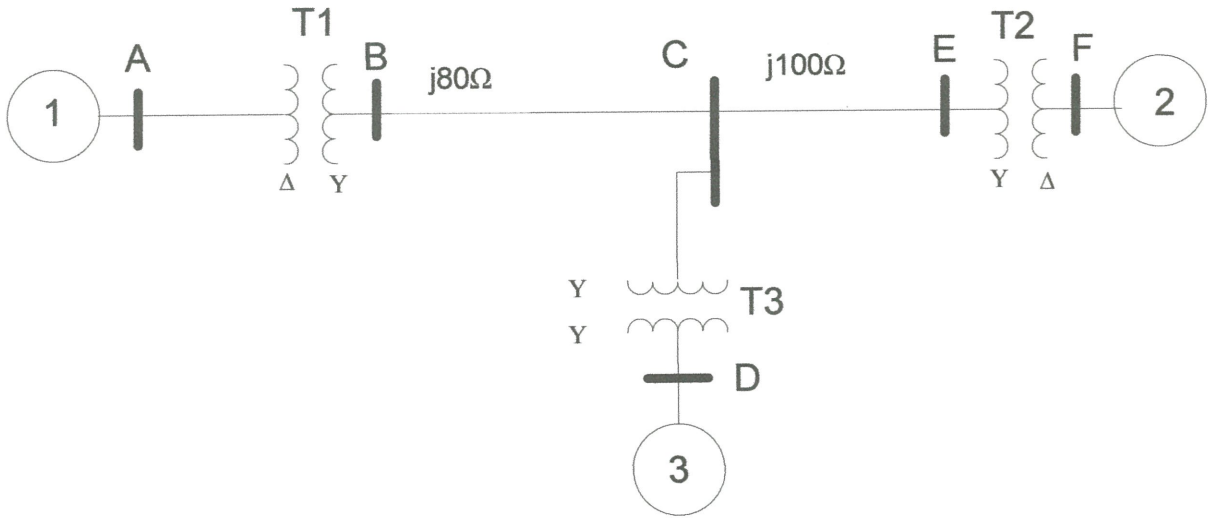

FIGURE Q5