UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	POLYPHASE CIRCUIT ANALYSIS
COURSE CODE	:	BEF 23803
PROGRAMME CODE	:	BEV
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1   (a)   With the aid of diagram, explain the concepts of three phase voltage.

(4 marks)

(b)   For an unbalanced four wire system, the three line currents are given as:
$I_R - 25\angle - 63.4° A$, $I_Y - 46\angle - 173.1° A$, $I_B = 9\angle - 293.13° A$
Find the neutral current and sketch the disposition of all currents.

(4 marks)

(c)   Illustrate a diagram of a three phase three wire star connected balanced loads with complete labels.

(3 marks)

(d)   A 400 V, three-phase supply feeds an unbalanced three-wire, star-connected load. The branch impedances of the load are

$$Z_R = (4 + j8)\Omega \ , \ Z_Y = (3 + j4)\Omega \ , \ Z_B = (15 + j20)\Omega$$

By transforming to the equivalent delta circuit, calculate the phase currents.

(9 marks)

Q2   (a)   Point out the difference between the complex power, the real power and the reactive power.

(6 marks)

(b)   The circuit configuration used by the distribution system to supply three-phase power to industrial and residential consumers depends to some extent on the type and size of load to be connected. List **two (2)** methods of possible connection.

(2 marks)

(c)   A three-phase three-wire 415 V ABC system supplies a delta- connected load whose phase impedance is $60\angle45°$ Ω.

(i)   Find the phase currents and the line currents in this system.

(9 marks)

(ii)   Draw the phasor diagram from the answer of **Q2(c)(i).**

(2 marks)

(iii)   In one sentence, summarize your answer in **Q2(c)(i)** and **Q2(c)(ii).**

(1 mark)

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Q3 (a) What is the main assumption to be made when single line diagram is use to analyse a three phase system.

(2 marks)

(b) List **four (4)** advantages of single line diagram.

(4 marks)

(c) **Figure Q3(c)** shows the single line diagram of a system which consists of three generators, two transformers and a load.

(i) Draw the impedance diagram.

(6 marks)

(ii) Draw the reactance diagram.

(4 marks)

(iii) Differentiate between impedance and reactance diagrams.

(4 marks)

Q4 (a) List **three (3)** classes of power lines and identify each length.

(3 marks)

(b) (i) Sketch the transmission line tower structure.

(3 marks)

(ii) Explain the function of conductors, support poles, insulators, and cross arms.

(4 marks)

(c) A 60 Hz, 220-kV, three-phase transmission line is 40 km long. The resistance per phase is 0.15 Ω per km and the inductance per phase is 1.3263 mH per km. The shunt capacitance is negligible. The line is supplying a three phase load of 381 MVA at 0.8 power factor lagging at 220 kV.

(i) Calculate the line voltage at the sending end.

(8 marks)

(ii) Calculate the voltage regulation.

(2 marks)

Q5 (a) Determine per unit system in electrical engineering term.

(2 marks)

(b) A transformer is rated 2000 VA, 200V/400V, and has an internal impedance of j4 Ω as seen from the low voltage side. Based on **Figure Q5(b),** calculate the per-unit impedance of the simplified transformer equivalent circuit;

(i) with the primary side as a base.

(4 marks)

(ii) with the secondary side as a base.

(6 marks)

(c) A three phase 500 MVA, 22 kV generator has winding reactance of 1.065 Ω.

(i) Calculate the per-unit reactance.

(6 marks)
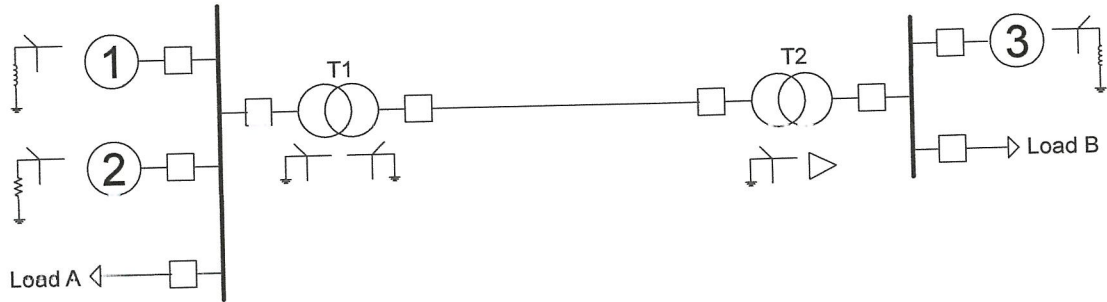
(ii) Sketch the per unit equivalent circuit.
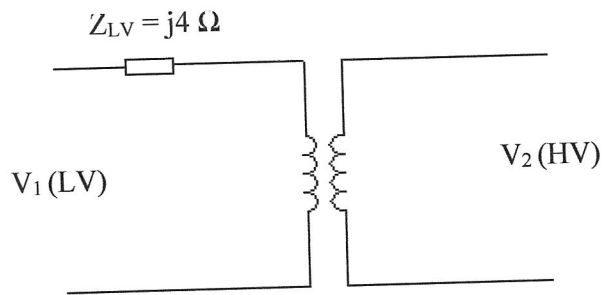
(2 marks)

- **END OF QUESTIONS** -

Figure Q3(c)

$Z_{LV} = j4 \ \Omega$

$V_1 \, (LV)$

$V_2 \, (HV)$

Figure Q5(b)