UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	POLYPHASE CIRCUIT ANALYSIS
COURSE CODE	:	BEF 23803
PROGRAMME	:	2 BEF
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) State two (2) common equations and describe the definition of power factor.

(5 marks)

(b) With the aid of phasor diagram and mathematical equation, prove that the line-to-line voltage for Y-connected three-phase generator and total line-to-line voltage is given as follow:

$$\vec{E}_L = \sqrt{3}E_\phi \angle 30^0 \ V$$
$$V_{ab} + V_{bc} + V_{ca} = 0$$

(8 marks)

(c) Figure Q1(c) shows the three-phase generator system with a balance source and positive phase sequence. Let f = 50 Hz. Analyze the followings:

(i) The line current, I_a, I_b and I_c
(ii) The complex power absorb by each phase of the load
(iii) The total complex power absorb by the three phase load and power factor
(iv) The capacitor value connected in parallel with the load to improve the total power factor into 0.98 lagging

(12 marks)

Q2 (a) Explain three (3) advantages of three-phase system when compared with single-phase system

(3 marks)

(b) Describe the definition of three-phase networks and the importance of single-line diagram.

(4 marks)

(c) A three-phase transmission system is shown in Figure Q2(c). The related data for generator, transformer and lines are given below:

Generator G1	:	70 MVA	11 kV	X=15%
Transformer T1	:	60 MVA	11/220 kV	X=8%
Transformer T2	:	40 MVA	220/11 kV	X=5%
Line 1	:		220 kV	X=65Ω
Line 2	:		220 kV	X=50Ω
Load 1	:	80 MVA	10 kV	0.8 pf lagging
Load 2	:	50 MVA	11 kV	0.5 pf leading

Let consider base values of 100 MVA and 11 kV at the generator side. Analyze and construct the per unit equivalent circuit of the given network.

(18 marks)

Q3 (a) Short transmission line model has been defined as model of transmission line with line length less than 80km and transmission voltage less than 69 kV.

(i) Draw the equivalent model of short transmission line
(ii) Proof that the ABCD parameter for short transmission line is given as below:

$A = 1\ pu \qquad B = Z\ \Omega$

$C = 0 \qquad D = 1\ pu$

(8 marks)

(b) A 275 kV, three-phase 50 Hz transmission line is 150 km long. The resistance per phase, the inductance per phase and the shunt capacitance are 0.05 Ω per km, 0.9 mH per km and 0.012 μF per km respectively. The receiving end load is 260 MVA with 0.8 power factor lagging at 275 kV. Use the medium line π-model to estimate:

(i) The phase and line voltages at the sending end
(ii) Power at the sending end and the efficiency of the transmission line

(17 marks)

Q4 (a) Examine three (3) general components of buses in power system network including their importance.

(4 marks)

(b) Figure Q4(b) shows the impedance diagram of four busbar network.

(i) Construct the admittance diagram of the system
(ii) Estimate the bus admittance matrix of the given network
(iii) Analyze the $Y_{bus(new)}$ and V_1 using Kron reduction method when node 2 is removed from the nodal admittance equation matrix. Given I_1 is 2.0 pu.

(13 marks)

(c) Create the symmetrical components of a set of unbalanced currents:
$I_a = 1.8\angle 15°,\ I_b = 1.1\angle 210°,\ I_c = 0.8\angle 132°$

(5 marks)

(d) Evaluate the positive sequence impedance network of Figure 4(d).

(3 marks)

- END OF QUESTIONS -

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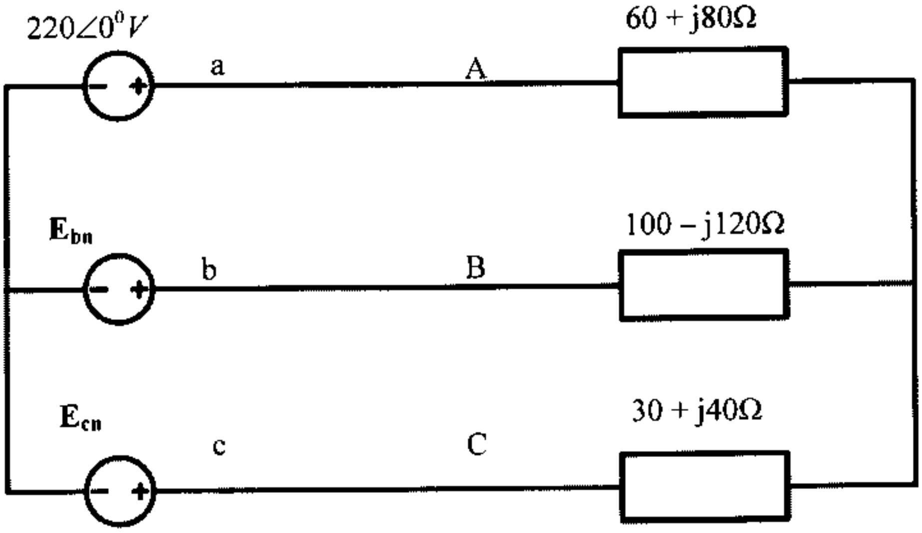

FIGURE Q1(c)

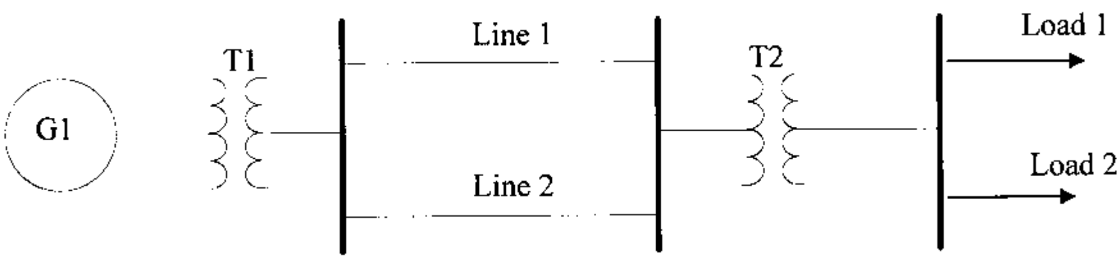

FIGURE Q2(c)

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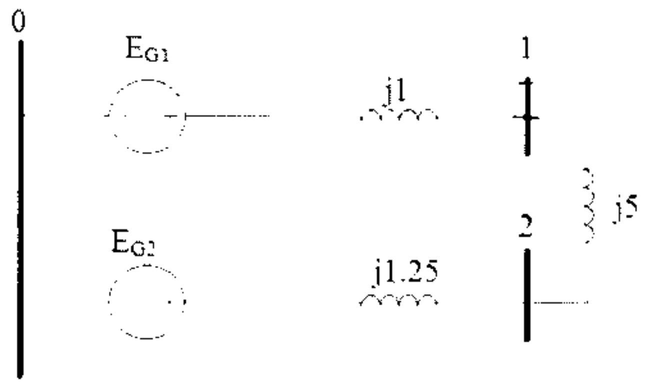
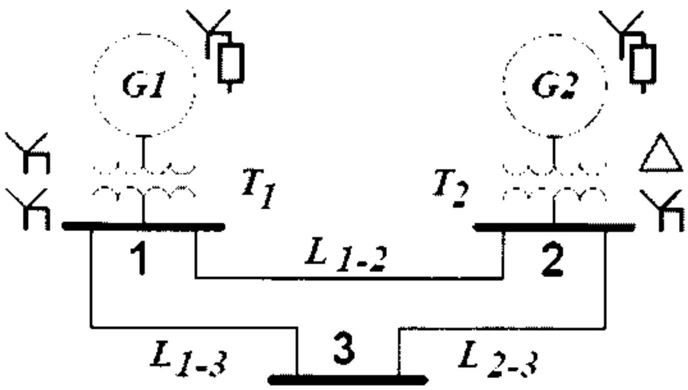


FIGURE Q4(b)



Item	V Rating	X^1	X^2	X^0
G1	20kV	15%	15%	5%
G2	20kV	15%	15%	5%
T1	20/200kV	10%	10%	10%
T2	20/200kV	10%	10%	10%
L 1-2	200kV	12.5%	12.5%	30%
L 1-3	200kV	15%	15%	35%
L 2-3	200kV	25%	25%	71.25%

FIGURE Q4(d)