UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	POLYPHASE CIRCUIT ANALYSIS
COURSE CODE	:	BEF 23803
PROGRAMME	:	BACHELOR OF ELECTRICAL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	DECEMBER 2015 / JANUARY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

Q1 (a) Explain what is meant by an unbalanced three-phase system. Illustrate your answer with a proper circuit diagram.

(3 marks)

(b) A 210-V balanced three-phase voltage source feeds an unbalanced four-wire, star-connected load. The branch impedances of the load are: $Z_1 = 10 + j10\Omega$, $Z_2 = 12 + j2\Omega$, Z3=2+j2Ω. Assume RYB phase sequence.

(i) Draw the circuit diagram of load connections

(3 marks)

(ii) Determine the voltage across each phase of the load, V_{RN}, V_{YN}, and V_{BN}.

(3 marks)

(iii) Find the current through each phase of the load, I_R, I_Y, I_B and the neutral current, I_N.

(8 marks)

(iv) Based on the results obtained from **Q1(b)(iii)**, draw the complete phasor diagram.

(3 marks)

Q2 A 10Ω resistor, 20mH inductor and 100μF capacitor are connected in series across an ac supply as shown in **Figure Q2**. Given : $V_S(t) = 220\cos 1000t$

(i) Find the load current.

(3 marks)

(ii) Determine the voltage drop across each element, V_R, V_L and V_C.

(6 marks)

(iii) Calculate the complex power supplied by the source, S_V and the complex power absorbed of each element, S_R, S_L and S_C.

(8 marks)

(iv) Calculate the total power absorbed by all three passive elements.

(3 marks)

Q3 **Figure Q3** shows an unbalanced three-wire star load connected to a balanced three-phase, 415V, 50Hz supply. Assume the phase sequence is RYB and take V_{RN} as the reference phasor. Using Millman's theorem, calculate

(i) The potential difference between the two star points.

(9 marks)

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

(3 marks)

(iii) Line currents I_R, I_Y and $I_{B.}$

(3 marks)

(iv) The complex power absorbed by each phase load.

(3 marks)

(v) Total complex power supplied to the load.

(2 marks)

Q4 **Figure Q4** shows the single line diagram of an industrial centre. The centre is supplied by a balanced three-phase source with a line voltage of 415 V, 50 Hz and has two balanced three-phase loads as follows:

Load 1: 160 kW at 0.7 pf lagging
Load 2: 120 kVA at 0.85 pf lagging

Calculate

(i) The total active consumed by the two loads

(4 marks)

(ii) The total reactive power supplied by the source

(3 marks)

(iii) The system apparent power

(1 mark)

(iv) The system power factor

(1 mark)

(v) The feeder current

(1 mark)

(vi) The size of the shunt capacitor required to raise the system power factor to 0.9 lagging.

(8 marks)

(vii) The feeder current after the power factor correction.

(2 marks)

Q5 (a) A Y-connected 120 MVA, 13.6 kV generator has a phase winding reactance of j25%. If the generator above is short-circuited at its terminals, find the short circuit current and the short circuit power delivered by the generator

(i) in p.u.

(6 marks)

(ii) in %,

(2 marks)

(iii) in the actual units.

(2 marks)

(b) **Figure Q5(b)** shows a 400V, 50Hz, single-phase generator supplying power to an impedance Z_L through a single-phase 30 kVA, 415/110 V, 50 Hz transformer. The transformer has a leakage reactance of j0.81 Ω and the load has an impedance $Z_L = (0.9 + j0.2)\ \Omega$.

(i) Draw the per-unit circuit, labeling all values.

(7 marks)

(ii) Using per unit analysis with an S_{base} of 30 kVA, and voltage base of 415V determine

(a) The per-unit load current

(1 mark)

(b) The actual load current

(1 mark)

(c) The current supplied by the generator

(1 mark)

- END OF QUESTIONS –

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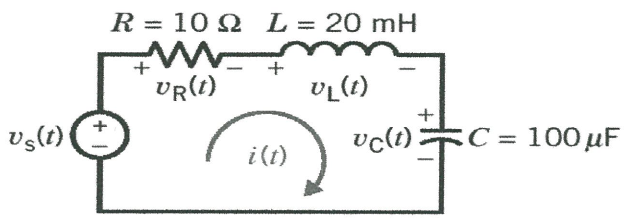

FIGURE Q2

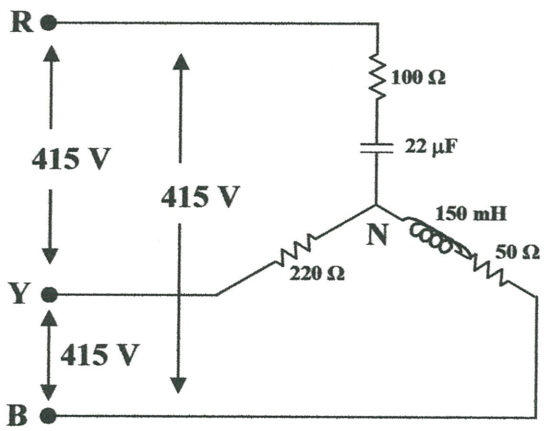

FIGURE Q3

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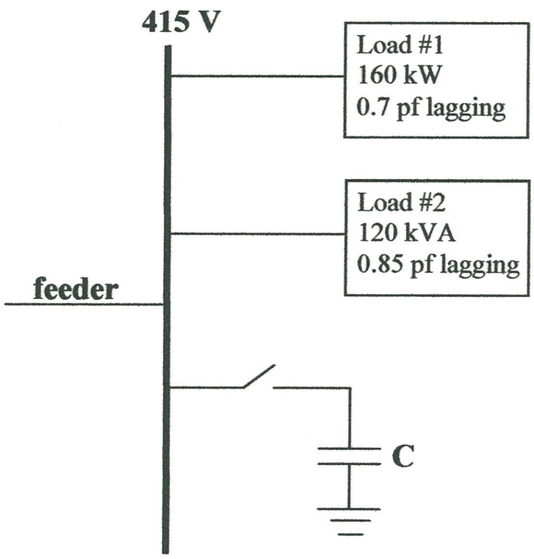

FIGURE Q4

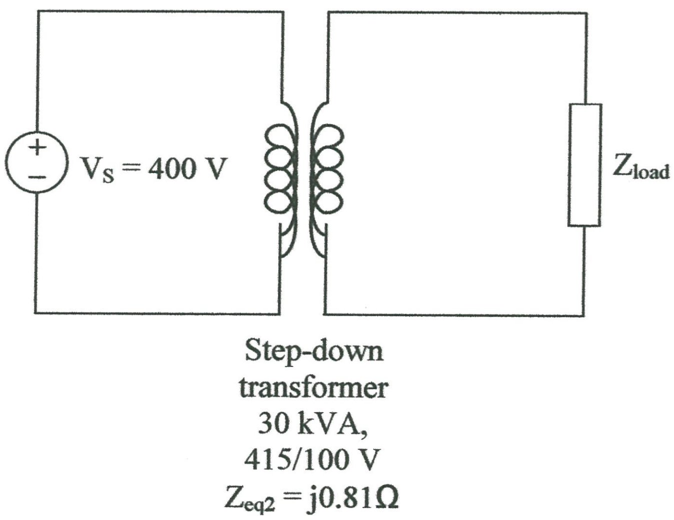

FIGURE Q5(b)