Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	POWER SYSTEMS
COURSE CODE	:	BEJ 20603
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION		1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**

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

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Q1 (a) (i) Describe the generation of a single phase AC voltage.

(2 marks)

(ii) Sketch the waveform of instantaneous single phase voltage and its direction varying according to the position of the coil within the magnetic field.

(4 marks)

(b) An equivalent circuit of a power system consists of voltage supply, $V_s = 400\ V_{rms}$ and frequency of 50 Hz, respectively is supplying various loads as illustrated in **Figure Q1(b)**. Given $R_1 = 0.5\ \Omega$, $R_2 = 2\ \Omega$, $L_1 = 4$ mH, $L_2 = 2$ mH, $C_1 = 1600\ \mu$F, $C_2 = 1000\ \mu$F.

(i) Find the impedance at each load.

(3 marks)

(ii) Find the current at each load and the total current

(4 marks)

(iii) Compute the complex power at each load.

(3 marks)

(iv) Determine the total real power and reactive power of the system.

(2 marks)

(v) Prove the total complex power in **Q1(b)(iv)** based on the voltage supply and the total current.

(2 marks)

(vi) Draw the phasor diagram and the power triangle of the system and calculate the power factor.

(5 marks)

Q2 (a) A three-phase star-connected source is connected to a three-phase transmission line. The transmission per-phase is $1+j2\ \Omega$. The line feeds a balanced delta-connected load, with inductor impedance per-phase is 15 ohm. If the line voltage across the load terminal has a magnitude of 400 V.

(i) Draw the three-phase circuit of the system.

(3 marks)

(ii) Draw the three-phase Y-Y connected equivalent circuit and find impedance in Y connected per-phase.

(2 marks)

(iii) Draw the equivalent circuit per-phase.

(1 mark)

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(iv) Calculate the magnitude of the phase-voltage and the line voltage at the source end.

(5 marks)

(b) A balanced abc sequence source Vab = $400\angle 30^{o}$ volt is connected to a star-connected (four wires) unbalanced load $Z_{AN} = 8\ \Omega$; $Z_{CN} = j8\ \Omega$. If the total load is 10000 W + j6699 VAR.

(i) Draw the three-phase circuit and find load voltage per-phase.

(5 marks)

(ii) Calculate the phase current of each load.

(7 marks)

(iii) Determine the load Z_{BN}.

(2 marks)

Q3 (a) A balanced three-phase delta-connected source supplies line current of 8 A to a balanced three-phase load. The source has acb sequence and I_a as reference.

(i) Draw the three-phase electric source circuit and determine the source line current.

(5 marks)

(ii) Draw phasor diagram of the source line current.

(3 marks)

(b) A balanced abc sequence source $V_{AB} = 400\angle -30^{o}$ volt is connected to a delta-connected unbalanced load $Z_{AB} = 2\ \Omega$; $Z_{BC} = 4+j3\ \Omega$ and $Z_{CA} = j5\ \Omega$. Assume that the impedance of each transmission line between source and load is ignored.

(i) Draw the circuit and find load voltage per-phase.

(5 marks)

(ii) Calculate the current of each line source.

(6 marks)

(iii) Determine total real and reactive power of the loads.

(4 marks)

(c) Brief explain reliability of the delta-connected three-phase voltage sources in term of winding failure.

(2 marks)

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Q4 (a) A single phase power supply, 230 V_{rms} and 50 Hz is connected to three loads in parallel as follows:

- Load 1 – 10 kW with 0.80 lagging power factor
- Load 2 – 7 kVA with 0.75 lagging power factor
- Load 3 – 5 kW with power factor of 0.85 (Inductive load)

(i) Determine the total complex power and power factor of the power supply.
(10 marks)

(ii) Calculate the total current drawn from the supply.
(2 marks)

(iii) Find the kVAr rating and capacitance required to improve the power factor to 0.95 lagging.
(5 marks)

(iv) Determine the new supply current and reduction of supply current when the capacitor in **Q4(a)(iii)** connected to the system.
(4 marks)

(b) Describe the **TWO (2)** advantages of the high power factor.
(4 marks)

-END OF QUESTIONS –

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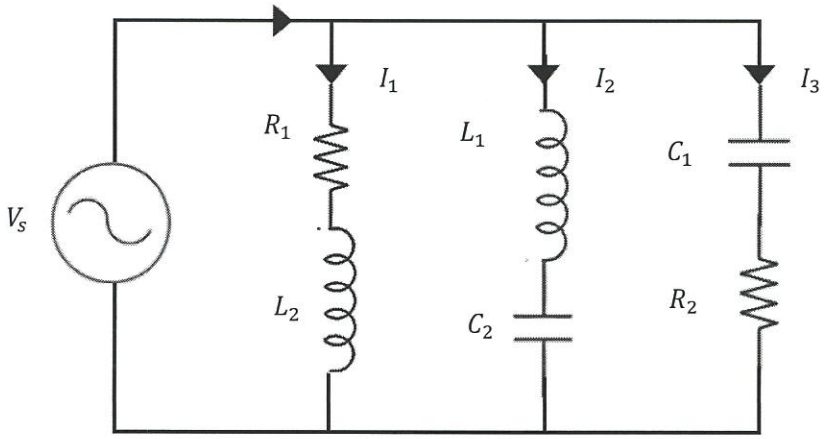

Figure Q1(b)

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