Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	POWER SYSTEM
COURSE CODE	:	BEJ20603/BEF25503
PROGRAMME CODE	:	BEJ/BEV
EXAMINATION DATE	:	JULY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	1) ANSWER **ALL** QUESTIONS **OPEN BOOK EXAMINATION** 2) THE ANSWER BOOKLET AND THE DECLARATION FORM NEEDS TO BE SUBMITTED 15 MINUTES AFTER THE EXAMINATION PERIOD OF THIS PAPER ENDS (SUBMIT ALL THE DOCUMENS IN THE PDF FILES)

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

Q1 (a) If a current is expressed as:

$$i(t) = 7\cos(377t - 90^{\circ}) Ampere$$

(i) Find the rms value of the current.

(2 marks)

(ii) Find the period value of the current.

(2 marks)

(iii) Find the phase value of the current.

(1 mark)

(iv) Determine the phasor of the current in rectangular form.

(1 mark)

(b) An equivalent AC circuit is shown in **Figure Q1(b)** consist of an single-phase input voltage, a transmission line as Z_{AB} and a load as Z_{BC}. If the input voltage is $V_{in} = 240Volt - rms$ at frequency of 50 Hz.

(i) Determine current flow in the transmission line.

(5 marks)

(ii) Determine power factor at the source.

(2 marks)

(iii) Determine power losses at the transmission line.

(3 marks)

(iv) If a 50 μF capacitor is connected in parallel with the Z_{BC} load in the **Figure Q1(b)** , calculate the power losses in the transmission line after the load was added by the capacitor and then calculate the amount of power losses will decrease.

(9 marks)

Q2 (a) Define the meaning of the balanced supply in the three phase system.

2 marks)

(b) Distinguish **four (4)** possible configuration of the balanced three phase system.

(2 marks)

(c) The line voltages applied across the life terminals of a balanced four-wire system, star connected load are 400 V. The load impedance consists of a 4 Ω resistor that is in series with an inductor while the power factor of the system is equal to 0.75, assume the phase sequence is RYB.

(i) Sketch the circuit diagram of the system.

(1 mark)

(ii) Calculate the phase voltages of each loads.

(2 marks)

(iii) Calculate the phase currents that flow into each loads.

(3 marks)

(iv) Draw the phasor diagram of the load currents.

(1 marks)

(v) Draw the phasor diagram of the load voltages.

(2 marks)

(d) A balanced three-phase delta connected source supplies line currents of 15A to a balance three-phase star connected load, consider the line current of I_a as a reference and the phase sequence is RYB. The load in each phase is composed of **two (2)** units of $8 + j6\ \Omega$ impedances that are connected in parallel.

(i) Sketch the circuit diagram of the system.

(1 mark)

(ii) Calculate the phase currents of the source.

(2 marks)

(iii) Deduce the phase currents of the load.

(2 marks)

(iv) Calculate the phase voltage of the source.

(4 marks)

(v) Draw the phasor diagram for the phase currents, line currents and phase voltages of the voltage sources.

(3 marks)

Q3 (a) Define the power factor in power system.

(1 mark)

(b) Sketch the power triangle and label each side of its.

(3 marks)

(c) A single-phase induction motor has nameplate as shown in **Table Q3(c)**.

(i) Calculate the active and reactive power absorbed by this motor when it operates at full load.

(6 marks)

(ii) Sketch the power triangle for this application

(3 marks)

(d) A large factory consumed active power of 10MW during its peak operation. At the time, the power factor was measured to be at 0.77.

(i) Determine the reactive and apparent power of the factory.

(6 marks)

(ii) Determine the reactive power required to increase the power factor to be 0.95.

(4 marks)

(iii) Calculate the kVAr rating of shunt capacitor bank required for reactive power compensation of the factory.

(2 marks)

Q4 (a) Explain what are the characteristic of a single line diagram.

(4 marks)

(b) A one-line diagram of a three-phase power system is shown in **Figure Q4(b)**. Line 1 and 2 have reactances of 65.2Ω and 34.5Ω, respectively. The manufacturer's data for each equipment is given in **Table Q4(b)**. Assume a common base of 100MVA and 22kV on the generator side.

(i) Calculate the per unit impedances of each device in **Figure Q4(b)**.

(18 marks)

(ii) Construct the per unit impedance diagram representing the system illustrated in **Figure Q4(b)**.

(3 marks)

– END OF QUESTIONS–

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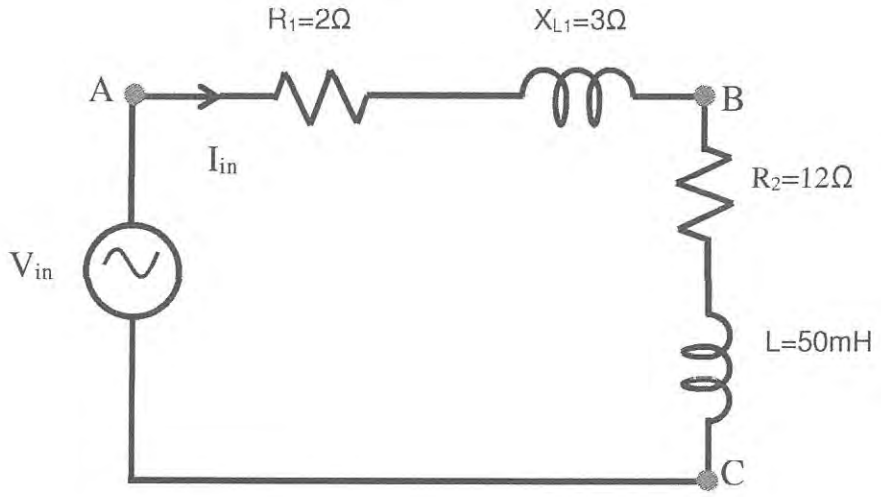

Figure Q1(b)

Table Q3(b)

ELECTRIC MOTOR NAMEPLATE						
MODEL 500		SPLIT PHASE		TOTALLY ENCLOSED		
FRAME		TYPE	INS. CLASS	IDENTIFICATION NO.		
145		KC	J	2538094990298209		
HP	RPM	VOLTS		AMPS	CYC	S.F.
1 ½	1725	115/230		15/7.5	60	1.25
DESIGN CODE: B				PHASE	EFF	p.f.
DRIVE END BEARING BBD 116				1	62%	75%
OPP. END BEARING B0B 117				DUTY: CONTINUOUS		
AMB. 40 C		NO THERMAL PROTECTION				

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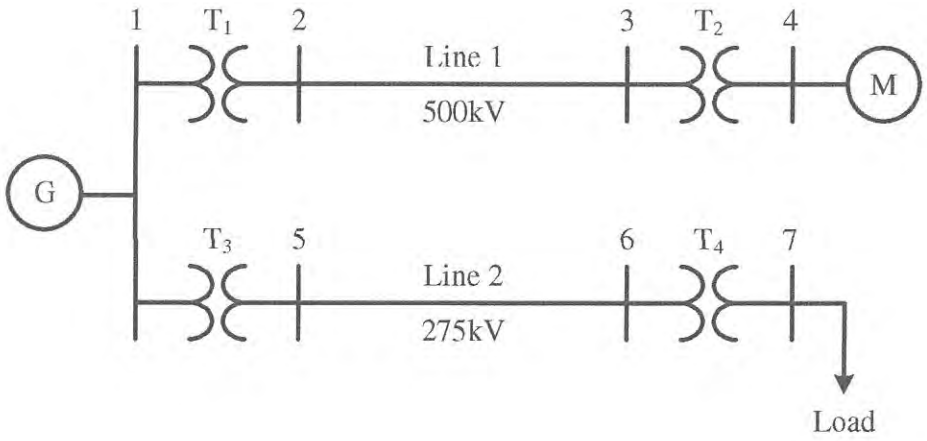

Figure Q4(b)

Table Q4(b)

Device	Rated MVA, S (MVA)	Rated Voltage, V (kV)	Impedance, X (%)	Power Factor
G	110	22	12.0	-
T1	80	22/500	10.0	-
T2	80	500/11	8.5	-
T3	50	22/275	5.5	-
T4	50	275/33	7.0	-
M	70	10.5	15.0	-
Load	45	33	-	0.8 lagging