

SULIT



Second Semester Examination
2022/2023 Academic Session

July/August 2023

EEK241 – Power Electrical Technology

Duration : 3 hours

Please check that this examination paper consists of **SEVEN (7)** pages of printed material including appendix before you begin the examination.

Instructions : This paper consists of **FOUR (4)** questions. Answer **ALL** questions.

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1. a) Phase relationship of resistor, inductor and capacitor is an important knowledge in the AC circuit. Explain their difference by using the related phasor diagrams.

(15 marks)

- b) A 7.2 kV source delivers power to a 24Ω resistor and a 400kW electric boiler as referred in Figure 1. Draw the equivalent per-unit circuit diagram. Label with the obtained values for per-unit $E(\text{pu})$, $R(\text{pu})$, $P(\text{pu})$, $I_1(\text{pu})$, $I_2(\text{pu})$, and $I_L(\text{pu})$. Use the given base values:

$E_B = 4 \text{ kV}$	$I_B = 125 \text{ A}$
$P_B = 500 \text{ kW}$	$Z_B = 32 \Omega$

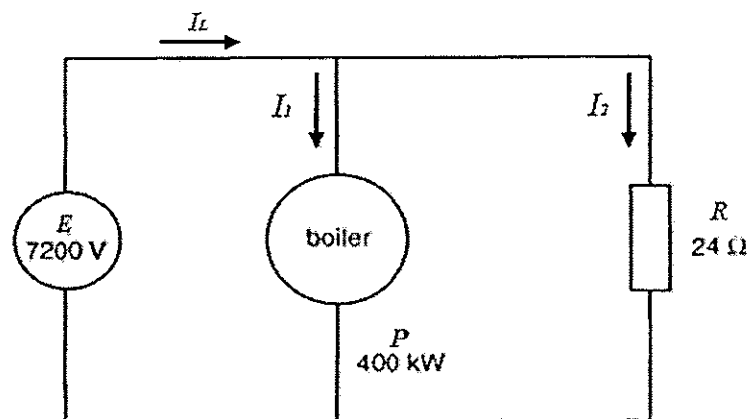


Figure 1(b)

(50 marks)

- c) A sinusoidal waveform is defined as: $V_m = 169.8 \sin(377t)$ volts. Calculate the RMS voltage of the waveform, its frequency and the instantaneous value of the voltage, (V_i) at 6ms.

(35 marks)

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2. a) Determine the current in the given circuit in Figure 2 if the source voltage is $V_s = 12 \cos(1000t + 15^\circ)$. Given that the impedance angle, $\theta = \tan^{-1}(4/3)$ degree.

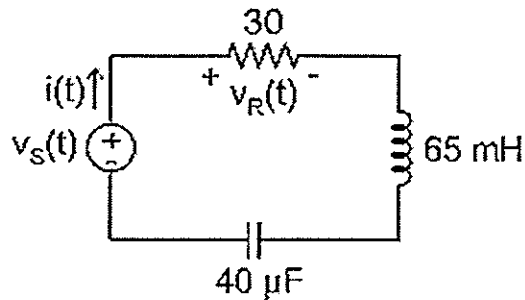


Figure 2 (a)

(20 marks)

- b) A wound coil has an inductance of 180mH and a resistance of 35Ω. It is connected to a 100V 50Hz supply as shown in Figure 3. Calculate:
- The power factor and phase angle
 - The apparent power consumed

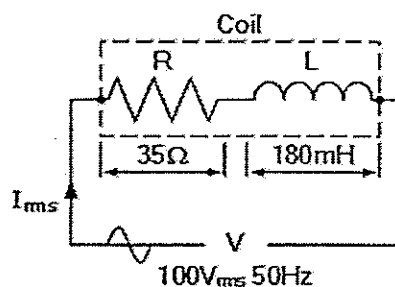


Figure 3 (b)

(40 marks)

- c) A 415V, 3-phase a.c. motor has a power output of 12.75kW and operates at a power factor of 0.77 lagging and with an efficiency of 85 per cent. If the motor is delta-connected, determine:
- The power input
 - The line current
 - The phase current

(40 marks)

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3. a) An energy audit of a hotel shows that electrical power can be reduced by replacing the condensing and chilled water pump motors of the air-conditioning installation with newer, more efficient motors of the same horse power ratings. There are 2 sets of condensing water pumps and 2 sets of chilled water pumps. All four pumps operate continuously for 24 hours per day. The existing condensing water pumps are rated at 60 hp with an efficiency of 83%, while the existing chilled water pumps are rated at 75 hp with an efficiency of 83%. If the new motors have an efficiency of 90%, calculate the annual savings in the electricity consumed. The electricity charge is RM0.323 per kWh.

(40 marks)

- b) A power station has to meet the following demand:

Group A: 200 kW between 8 A.M. and 6 P.M.

Group B: 100 kW between 6 A.M. and 10 A.M.

Group C: 50 kW between 6 A.M. and 10 A.M.

Group D: 100 kW between 10 A.M. and 6 P.M. and then between 6 P.M. and 6 A.M.

- i) Plot the daily load curve and determine

(10 marks)

- ii) Diversity factor

(10 marks)

- iii) Units generated per day

(10 marks)

- iv) Load factor.

(10 marks)

- c) Explain the classification of transmission line based on their length and the parameters that represent the model.

(20 marks)

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4. a) USM plans to install a hydropower station to provide electricity in a rural area in Royal Belum, Perak. A stream of waterfall runs down a hill to an Orang Asli village, Kampung Sg. Kejar, where the installation of hydropower station will be done. The effective head (h) is 30 m and water flows through the system at a rate of $0.08 \text{ m}^3/\text{s}$. The simple inexpensive hydropower has an overall efficiency of 70%.

i) Determine the amount of energy that can be generated by this system for one year.

(20 marks)

ii) How many houses can be supported from the energy generated, assuming an average community consumption of 6,000 kWh per year per house?

(10 marks)

iii) Find the yearly coal consumption (in metric tonnes) for a thermal power plant to generate the equivalent amount of electrical energy as the hydropower generates in a year? Given:

(20 marks)

- Energy content of coal = 6400 kcal/kg
- Thermal efficiency = 35%
- Electrical Efficiency = 75%

[Note: 1 metric tonne = 1016.05 kg]

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b) A 30 km, three phase 50 Hz transmission line is transferring power to a 500 kW load with power factor of 0.9 lagging. The load voltage is 10 kV. Given resistance and inductance of the line per phase of 0.1 Ω per km and 0.424 mH per km, respectively, calculate

i) Current (15 marks)

ii) Voltage at the sending end of the line. (15 marks)

c) Compare between steam, hydroelectric, diesel, nuclear power plants in terms of space required, maintenance cost, transmission and distribution cost.

(20 marks)

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APPENDIX

Question	Course Outcome (CO)	Programme Outcome (PO)
1	1	PO1
2	2	PO3
3	3	PO3
4	4	PO6