



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2021/2022**

COURSE NAME : ELECTRICAL POWER & MACHINE  
COURSE CODE : BNJ 20502  
PROGRAMME CODE : BNL  
EXAMINATION DATE : JULY 2022  
DURATION : 3 HOURS  
INSTRUCTION : 1. ANSWER ALL QUESTIONS.  
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSE BOOK**.  
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

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THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

- Q1** (a) List **TWO (2)** examples of passive and active element. (4 marks)
- (b) Identify the equivalent resistance,  $R_{ab}$  for the circuit in **Figure Q1(b)**. (10 marks)
- (c) A circuit consists of a  $120\ \Omega$  resistor in parallel with a  $40\ \mu\text{F}$  capacitor and is connected to a 240 V, 60 Hz supply. Calculate:
- (i) The branch current and the supply current (7 marks)
- (ii) The circuit phase angle (2 marks)
- (iii) The circuit impedance (2 marks)
- Q2** (a) Differentiate the advantages and disadvantages of unity power factor. (6 marks)
- (b) A single phase motor connected to a 240 V, 50 Hz supply taken 9.615 A RMS at 1.5 kW power.
- (i) Calculate the apparent power of this load. (2 marks)
- (ii) Calculate the power factor of the load. (2 marks)
- (iii) Calculate the reactive power of the load. (2 marks)
- (iv) Investigate the capacitance required in parallel with the motor to raise the power factor to 0.85 lagging. (12 marks)
- (v) Determine the percentage reduction in feeder current resulting from the pf correction. (1 marks)

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- Q3** (a) State Faraday's Law. (2 marks)
- (b) A ferromagnetic core is shown in **Figure Q3(b)**. The depth of the core (into the page) is 5 cm, and the other dimensions are as shown in **Figure Q3(b)**. There are 500 turns coil wrapped around the left side of the core. Assume that the relative permeability of the core is 1000.
- (i) Analyze the value of current that will produce a flux of 0.003 Wb. (6 marks)
- (ii) Determine the flux density at the right side of the core. (2 marks)
- (iv) Demonstrate the flow of the magnetic flux induced in the ferromagnetic core in a magnetic circuit analogy. (2 marks)
- (c) Explain **THREE (3)** advantages of AC system over the DC system. (6 marks)
- (d) A circuit is connected to a sinusoidal voltage source having a frequency of 60 Hz, an amplitude of 100 V<sub>rms</sub> and combination of series resistance, R<sub>1</sub> and R<sub>2</sub>. The following circuit is shown in the **Figure Q3(d)**.
- (i) Illustrate the waveform of the signal and label properly the period of the waveform. (2 marks)
- (ii) Calculate the rms current, rms voltage, peak voltage, peak-to-peak voltage and average voltage across R<sub>1</sub>. (5 marks)
- Q4** (a) Sketch and label the power flow diagram of DC motor. (2 marks)
- (b) A shunt motor rotating at 1500 rpm delivers 200 A at a terminal of 240 V. The armature resistance and shunt field resistance are 0.02 Ω and 45 Ω respectively. The iron and friction losses are equal to 900 W and the other losses are neglected. Calculate:
- (i) the developed power. (4 marks)
- (ii) the output power delivered to the load. (2 marks)
- (iii) the output torque. (2 marks)

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- (iv) If an application required a generator with an efficiency above 98%, evaluate whether this motor is capable to fulfill the requirement. Support your answer with a clear mathematical solution. (4 marks)
- (c) A three phase, 12 hp, 450 V, four-pole, 50 Hz, 1428 rpm AC induction motor delivers full output power to a load connected to its shaft. The windage and friction loss of the motor is 730 W and the stator copper loss is 1000 W. Determine:
- (i) the mechanical power developed. (2 marks)
  - (ii) the power transmitted to the rotor. (2 marks)
  - (iii) the rotor copper loss. (1 mark)
  - (iv) the efficiency of the motor. (2 marks)
  - (v) the new motor efficiency if the speed of the induction motor is reduced to 35% of its synchronous speed. (4 marks)

- END OF QUESTIONS -

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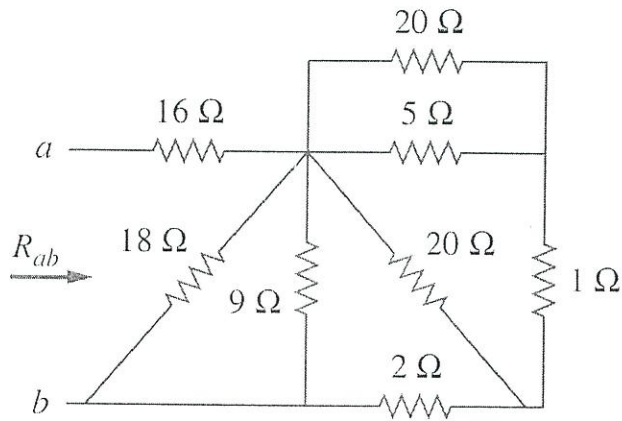


Figure Q1 (b)

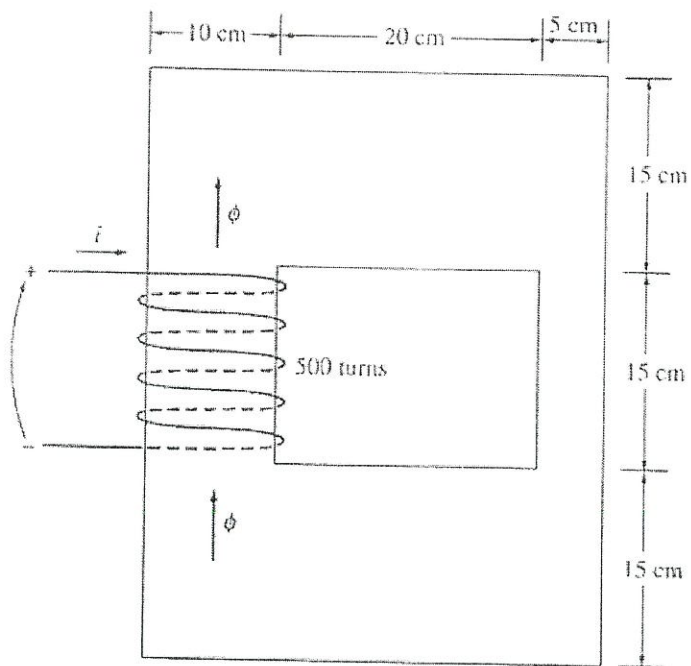


Figure Q3 (b)

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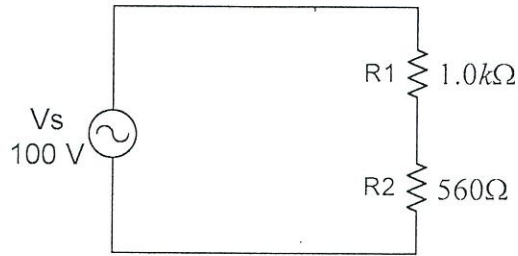


Figure Q3 (d)

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