Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER I
## SESSION 2019/2020

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|---|---|---|
| COURSE NAME | : | ELECTRICAL POWER & MACHINE |
| COURSE CODE | : | BNJ 20502 |
| PROGRAMME CODE | : | BNM |
| EXAMINATION DATE | : | DECEMBER 2019 / JANUARY 2020 |
| DURATION | : | 2 HOURS |
| INSTRUCTION | : | ANSWER **ALL** QUESTIONS |



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

**Q1** (a) Calculate the voltage drop across the 60 Ω load in the circuit shown in **Figure Q1 (a)**.
(4 marks)

(b) Three identical capacitors are connected in delta to a 415 V, 50 Hz, 3-phase supply. If the line current is 15 A, determine the capacitance of each of the capacitors.
(6 marks)

(c) Based on electrical power system, illustrate complete diagram of typical voltage level in a power system from power generator until end user (domestic customer).
(10 marks)

**Q2** A coil of inductance 318.3 mH and negligible resistance is connected in series with a 200 Ω resistor to a 240 V, 50 Hz supply.

(a) Draw the equivalent circuit of R-L series A.C circuit.
(2 marks)

(b) Calculate the voltage across the coil.
(8 marks)

(c) Calculate the voltage across the resistor.
(2 marks)

(d) Calculate the circuit phase angle, the leading or lagging condition and the power factor.
(5 marks)

(e) Propose **ONE (1)** method to improve power factor. List **TWO (2)** advantages of power factor correction.
(3 marks)

**Q3** (a) State Lenz'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) Determine the value of current that will produce a flux of 0.003 Wb.
(10 marks)

(ii) Determine the flux density at the right side of the core.
(2 marks)

(iii) Demonstrate the flow of the magnetic flux induced in the ferromagnetic core in a magnetic circuit analogy.

(2 marks)

(c) A 10 kVA, single-phase transformer has a turns ratio of 12:1 and is supplied by a 2.4 kV voltage. Neglecting losses, determine the full-load secondary current.

(4 marks)

**Q4** (a) Differentiate any **THREE (3)** types of DC motors by sketching their equivalent circuit diagrams.

(6 marks)

(b) A 230 V, 10-HP DC series motor delivers power to a load at 1200 rpm. The armature current drawn by the motor is 20 A. The armature circuit resistance of the motor is 0.2 Ω and the field resistance is 1.5 Ω. If the rotational losses are 500 W, determine the load torque and the efficiency of the motor.

(14 marks)

**Q5** (a) Describe **TWO (2)** advantages of squirrel-cage motor compared to wound-rotor motor.

(4 marks)

(b) Explain the working principle of squirrel-cage motor with the aid of **Figure Q5 (b)**.

(4 marks)

(c) An induction motor rotates at 2000 rpm has a power flow as shown in **Figure Q5 (c)**. The vertical arrow indicates the losses at several stages in the motor. Given the $P_{js}$ = 1000 W, $P_f$ = 2000 W, $P_{jr}$ = 2500 W, $P_m$ = 50000 W, $P_v$ = 1000 W and the slip is 6 %.

(i) Analyze the diagram, then, determine the efficiency of the motor.

(8 marks)

(ii) Calculate the torque at the given speed.

(4 marks)

**-END OF QUESTIONS-**

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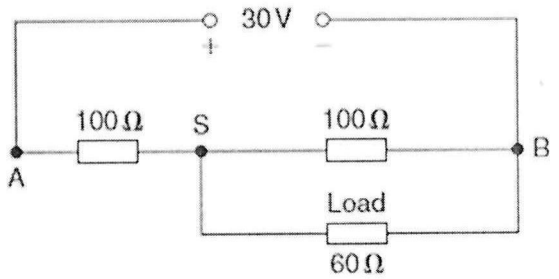


**Figure Q1 (a)**

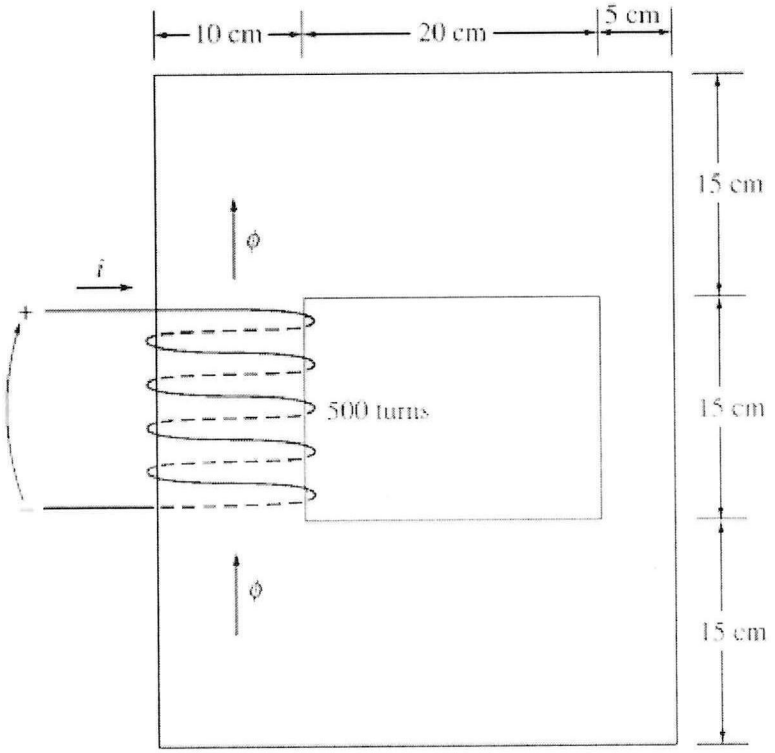


**Figure Q3 (b)**

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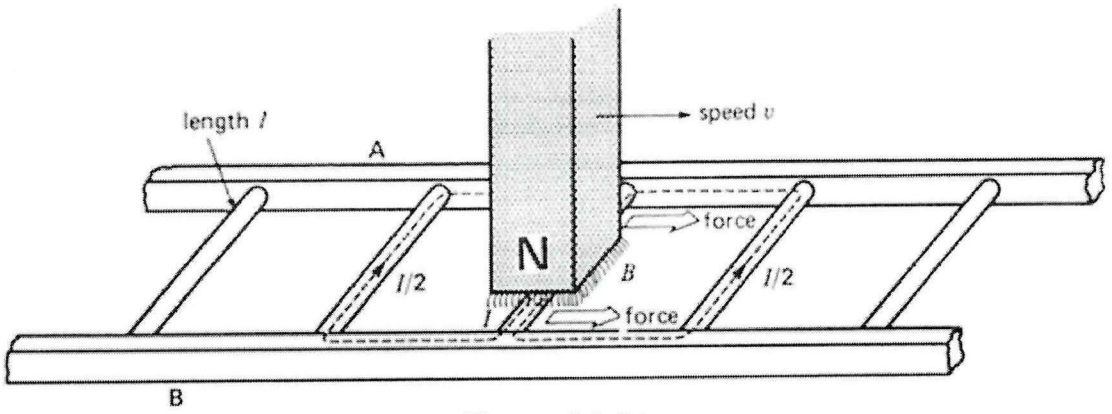


**Figure Q5 (b)**

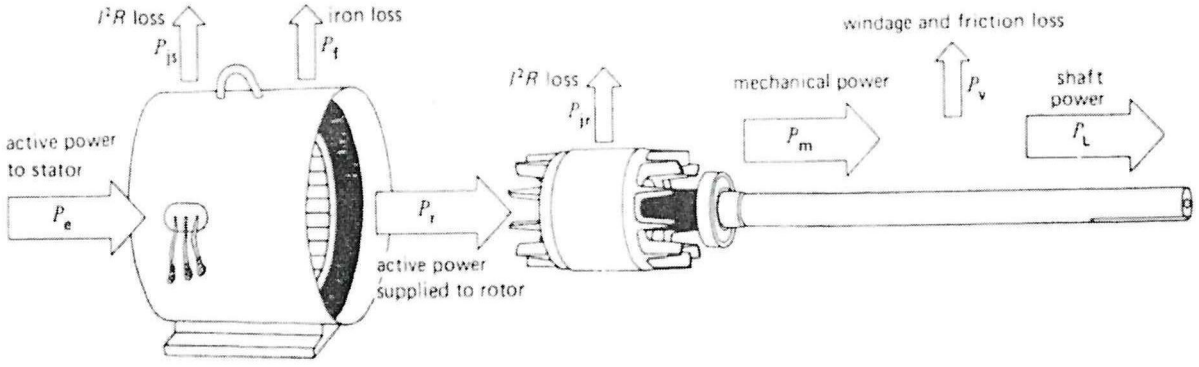


**Figure Q5 (c)**