Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	ELECTRICAL MACHINES
COURSE CODE	:	BEF 24103
PROGRAMME CODE	:	BEV
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **ALL** QUESTIONS

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

Q1 (a) List **five (5)** significance of transformer in daily life.

(5 marks)

(b) A single-phase 15,000VA, 7.2/0.24 kV distribution transformer has impedance which referred to the primary of 50 + j100 Ω. The R_C and X_M components of the excitation branch referred to the primary side are 350 kΩ and 70 kΩ, respectively. The primary voltage of the transformer is 8000 V and the load impedance Z_L of 3 + j2 Ω is connected to its secondary side.

(i) Construct the equivalent circuit of the transformer.

(3 marks)

(ii) Determine the secondary current, secondary voltage, actual secondary voltage and voltage regulation of the transformer.

(6 marks)

(iii) Examine the phasor diagram of the transformer.

(3 marks)

(iv) Predict the output power of the transformer if the efficiency and total power loss are 95 % and 330 W, correspondingly.

(3 marks)

Q2 (a) Demonstrate the power flow and power losses diagram for AC motor.

(4 marks)

(b) Examine the generation of induced torque in current carrying loop based on a simple loop in a uniform magnetic field.

(6 marks)

(c) A ferromagnetic core shown in **Figure Q2(b)** has a number of turns, depth, and relative permeability of 3000 turns, 7 cm and 1500 H/m, respectively.

(i) Illustrate the equivalent magnetic circuit of the core.

(2 marks)

(ii) Determine the input current if the flux produced is 0.05 Wb.

(6 marks)

(iii) Estimate the flux density at right side of the core if the number of turns is increased to 500 turns.

(2 marks)

Q3 (a) State **five (5)** qualitative description of induced torque generation in induction motor.
(5 marks)

(b) A 415 V, 22 hp, 50 Hz, four-pole, Y-connected induction motor has the following impedances in ohms per phase referred to the stator (primary) circuit:

$R_1 = 0.641\ \Omega$ $R_2 = 0.332\ \Omega$
$X_1 = 1.106\ \Omega$ $X_2 = 0.464\ \Omega$ $X_M = 26.3\ \Omega$
Slip = 3.3% $P_{rot+core} = 1414$ W

(i) Calculate the synchronous speed, rotor mechanical speed, total current and resulting stator current.
(6 marks)

(ii) Compute the power factor, power converted and power output of the motor.
(6 marks)

(iii) Evaluate the induced torque, load torque and efficiency of the motor.
(3 marks)

Q4 (a) Explain briefly synchronous reactance determination in three-phase generator.
(8 marks)

(b) A 480 V, 200 kVA, 0.8 pf lagging, 50 Hz, two-pole, Y-connected synchronous generator has a synchronous reactance of 0.25 Ω and an armature resistance of 0.03 Ω. Its friction and windage losses are 6 kW, and its core losses are 4 kW. The field circuit has a DC voltage of 200 V, and the maximum current is 10 A. The resistance of the field circuit is adjustable over the range from 20 Ω to 200 Ω. The Open Circuit Characteristics (OCC) of this generator is shown in **Figure Q4 (b).**

(i) Choose the field current when generator is running at no load condition.
(1 mark)

(ii) Calculate the internal induced voltage and field current when generator is running at full load condition.
(5 marks)

(iii) Formulate the input power of the generator.
(3 marks)

(iv) Estimate the torque and efficiency of the generator.
(3 marks)

Q5 (a) Explain clearly **two (2)** methods to control the speed of shunt DC motor.

(10 marks)

(b) A 200 V shunt DC motor has armature resistance, field resistance and rotational loss of 0.1 Ω, of 240 Ω and 236 W, respectively. The full-load line current is 9.8A when the motor running at 1450 rpm.

(i) Calculate the armature current and the internal generated voltage.

(3 marks)

(ii) Estimate the mechanical power converted and power output.

(2 marks)

(iii) Predict the load torque of the motor.

(2 marks)

(iv) Evaluate the full-load efficiency.

(2 marks)

(v) Determine the KW rating of the motor, if a DC motor drives a 200kW generator having an efficiency of 85%.

(1 marks)

- END OF QUESTIONS -

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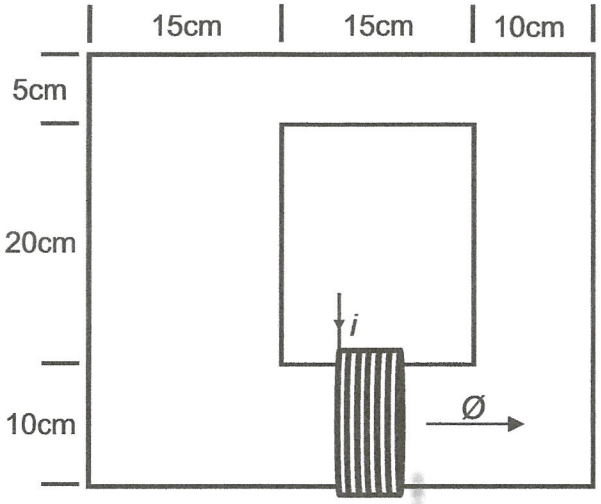

Figure Q2(b)

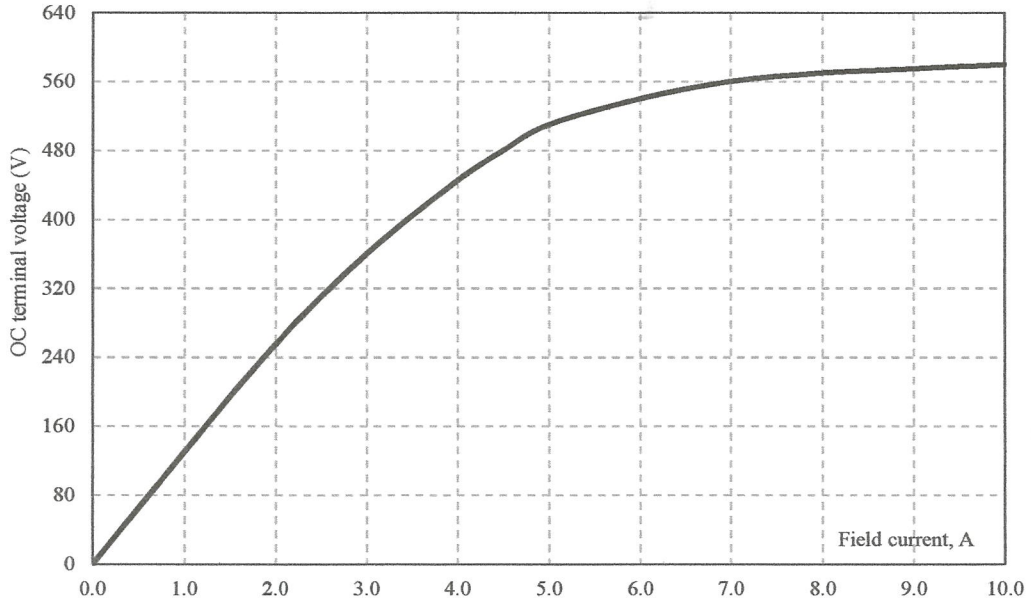

Figure Q4(b)