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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2015/2016**

COURSE NAME : ELECTRICAL MACHINES &
DRIVES
COURSE CODE : DAE 32303
PROGRAMME : 2 DAE
EXAMINATION DATE : JUNE 2016 / JULY 2016
DURATION : 2 1/2 HOURS
INSTRUCTION : ANSWER **FOUR (4)** QUESTIONS
ONLY

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

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- Q1** (a) Name **Four (4)** losses in iron losses of DC machines. (2 marks)
- (b) State the difference between DC motor and DC generator. (3 marks)
- (c) Draw and label completely the basic circuit of:-
- (i) DC series motor
- (ii) DC shunt generator (8 marks)
- (d) From the circuit of DC series motor in **Q1(c)(i)**, derive the equation of counter emf (E_m) by using KCL and KVL. (6 marks)
- (e) From the circuit of DC shunt generator in **Q1(c)(ii)**, derive the equation of generated emf (E_g) by using KCL and KVL. (6 marks)

- Q2** (a) The purpose of open circuit test and short circuit test is to determine the shunt and series branch parameter of a practical transformer. Briefly explain with the aid of an appropriate circuit configuration, the open circuit test procedures. (3 marks)
- (b) Short-circuit and open-circuit tests were performed on a 170 kVA transformer, 50 Hz, rated at 220V/2400V, and the results are listed as follows:

$$\begin{aligned} V_{sc} &= 43 \text{ V} \\ I_{sc} &= 44.57 \text{ A} \\ P_{sc} &= 480 \text{ W} \end{aligned}$$

$$\begin{aligned} V_{oc} &= 220 \text{ V} \\ I_{oc} &= 7 \text{ A} \\ P_{oc} &= 85 \text{ W} \end{aligned}$$

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- i) Compute the value of R_{eq} and X_{eq} (4 marks)
- ii) Solve the value of R_m and X_m (4 marks)
- iii) Draw the equivalent circuit parameters of the transformer referred to high voltage side . (9 marks)
- iv) Draw the equivalent circuit parameters of the transformer referred to low voltage side (5 marks)

- Q3**
- (a) Briefly describe by using a block diagram the mechanism of energy transferred in Induction Motor (2 marks)
 - (b) State **Two (2)** advantages of an Induction machines. (2 marks)
 - (c) A 3-phase induction motor, wye connection, 50 Hz is connected to a 240V source. The slip is 3% , the rotor speed is 900 rpm and the friction and winding losses is 3 kW. The equivalent circuit perphase is listed below;

- R_1 = Stator resistance = 0.4Ω
- X_1 = Stator leakage inductance = 1.2Ω
- R_2' = Rotor resistance = 0.7Ω
- X_2' = Rotor leakage inductance = 4.0Ω
- R_m = no-load losses resistance = 150Ω
- X_m = magnetizing reactance = 10Ω

- (i) Calculate the number of poles. (2 marks)
- (ii) Estimate the Input Power , P_{in} . (5 marks)
- (iii) Indicate the Mechanical power developed, P_m (7 marks)
- (iv) Solve the induced torque, T_{dev} (3 marks)
- (v) Identify the efficiency of the motor. (4 marks)

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- Q4** (a) A 3-phase Y-connected synchronous generator supplies a load of 15 MW at power factor of 0.80 lagging with its terminal voltage 15 kV. The armature resistance is 0.1 ohm/phase and its synchronous reactance is 0.8 ohm/phase.
- (i) Calculate the armature current (2 marks)
 - (ii) Indicate the internal generated voltage (2 marks)
 - (iii) Estimate the voltage regulation. (1 marks)
 - (iv) Draw the phasor diagram. (2 marks)
- b) A 2400V, 120hp, 50Hz, 6 poles, Y-connected synchronous motor has a synchronous inductance of 7mH/phase and armature resistance of 1Ω/phase at rated power factor of 0.85 leading. At full load, the efficiency is 85 percent. Find the following quantities for this machine when it is operating at full load.
- (i) Sketch the phasor diagram to represent back emf, (1 marks)
 - (ii) Estimate the input power, P_{in} . (2 marks)
 - (iii) Indicate the armature current, I_a (3 marks)
 - (iv) Calculate the supply voltage, E_A (4 marks)
 - (v) Indicate the voltage regulation. (2 marks)
 - (vi) Sketch the power flow diagram (2 marks)
 - (vii) Solve the developed mechanical power (4 marks)

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- Q5** (a) Draw and label completely the circuit of split-phase motor. (5 marks)
- (b) (i) State one of the maximum value for the speed of an ac electric motor.
- (ii) Give a reason for your answer in **Q5 (b)(i)**. (5 marks)
- (c) Determine the following for an induction motor with a rotor speed of 2970 rpm and using power supply of 240V, 50 Hz.
- (i) The synchronous speed, N_s
- (ii) The number of poles, p
- (iii) The percentage of slip, %S (5 marks)
- (d) Give **Three (3)** comparisons between capacitor start-induction run motor and shaded-pole motor. (5 marks)
- (e) Give **Five (5)** examples of applications of split-phase motor in domestic, commercial or industrial sectors. (3 marks)
- (f) State the relationship between output power, efficiency and losses of an induction motor. (2 marks)
- Q6** (a) State the function of power electronic circuit. (2 marks)
- (b) Draw and label completely the block diagram of power electronic system. (5 marks)
- (c) State the function of the following:-
- (i) DC / DC converters (chopper)
- (ii) AC / DC converters (rectifier)
- (iii) AC / AC converters (AC voltage controller)
- (v) DC / AC converters (inverter) (8 marks)

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- (d) Briefly describe the speed control for induction motor using supply frequency control method.
(5 marks)

- (e) Briefly explain an armature resistance control method for the DC motor speed control
(5 marks)

- END OF QUESTION -

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