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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME : ELECTRICAL MACHINES &
DRIVES
COURSE CODE : DAE 32303
PROGRAMME : DAE
EXAMINATION DATE : JANUARY / FEBRUARY 2022
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER **FOUR (4)**
QUESTIONS ONLY FROM **SIX (6)** QUESTIONS PROVIDED.
2. THIS FINAL EXAMINATION IS
AN **ONLINE ASSESSMENT**
AND CONDUCTED VIA
CLOSE BOOK.

THIS QUESTION PAPER CONSISTS OF SEVEN (7) PAGES

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- Q1 (a) State the function of slip ring and commutator in AC / DC machine. (3 marks)
- (b) Name **three (3)** types of DC machines. (3 marks)
- (c) A 220 V DC shunt motor has an armature resistance 0.5Ω and armature current 20 A
- (i) Draw and label completely the circuit. (2 marks)
- (ii) Calculate the counter emf E_c (3 marks)
- (d) A 240 V DC shunt generator has an armature resistance 0.8Ω and armature current 10 A
- (i) Draw and label completely the circuit. (2 marks)
- (ii) Calculate the generated emf E_g (3 marks)
- (e) A compound DC motor rated at 415 V, 7 HP, 2010 rpm has an armature resistance of 0.20Ω , series field resistance of 0.4Ω and shunt field resistance of 150Ω . The rotational losses are 210 W. Given the full load line current flowing is 45 A.
- (i) Draw and label completely the circuit. (2 marks)
- (ii) Calculate the developed mechanical power. (5 marks)
- (iii) Determine the output power. (2 marks)

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- Q2** (a) Draw and label completely the basic circuit of the transformer. (3 marks)
- (b) An ideal transformer has 2000 turns in primary coil and 100 turns in the secondary coil. The primary terminal of the transformer is connected to an AC supply of 2400 V, 50 Hz and 10.4 A current flows in the primary, determine:
- (i) The type of the transformer used. (2 marks)
 - (ii) The turn's ratio 'a'. (2 marks)
 - (iii) The voltage on the secondary. (2 marks)
 - (iv) The load current. (2 marks)
 - (v) The input power supplied to the primary (2 marks)
 - (vi) The output power delivered to the load. (2 marks)
- (c) A step-up transformer is rated 100kVA, 400/1000 V and has the following equivalent circuit parameter:
- | | | |
|------------------|------------------|--------------------|
| $R_p = 10\Omega$ | $R_s = 40\Omega$ | $R_m = 5000\Omega$ |
| $X_p = 20\Omega$ | $X_s = 60\Omega$ | $X_m = 1200\Omega$ |
- (i) Calculate the value of equivalent resistance (**Req**) and equivalent reactance (**Xeq**) refer to low voltage side. (5 marks)
 - (ii) Determine the value of equivalent resistance (**Req**) and equivalent reactance (**Xeq**) refer to high voltage side. (5 marks)

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- Q3** (a) Name the following;
- (i) The stationary part of the machine. (1 mark)
 - (ii) The rotating part of the machine. (1 mark)
- (b) List **three (3)** advantages of the Induction motor. (3 marks)
- (c) A 0.5 hp, 8-pole induction motor is excited by a 3-phase, 60 Hz source. If the full-load speed is 100 rpm, calculate
- (i) The synchronous speed. (2 marks)
 - (ii) The slip. (3 marks)
- (d) A 4 poles, 50 Hz, Y-connection 3-phase induction motor having a rating 50 kW and 415 V. The slip is 5%, at 0.85 lagging power factor. If the full load efficiency is 85%,
- Calculate :
- (i) Input power (3 marks)
 - (ii) The line current and the phase current. (3 marks)
 - (iii) The speed of the rotor (in rpm) (3 marks)
 - (iv) The frequency of the rotor (3 marks)
 - (v) The torque developed by the motor. (3 marks)

- Q4** (a) A 3-phase Y-connected synchronous generator supplies a load of 15 MW at power factor 0.75 lagging and the terminal voltage is 20 kV. The armature resistance is 0.1 ohm/phase and synchronous reactance of 0.25 ohm/phase.
- (i) Calculate the armature current (2 marks)
 - (ii) Determine the internal generated voltage (2 marks)
 - (iii) Estimate the voltage regulation. (2 marks)
 - (iv) Draw the phasor diagram. (2 marks)
- b) A 4600 V, 200 hp, 60Hz, 6 poles, delta-connected synchronous motor has a synchronous inductance of 10 mH/phase and armature resistance of 1.5 Ω /phase at rated power factor of 0.80 leading. The efficiency is 85% at full load. Find the following parameters for this machine when it is operating at full load.
- (i) Draw equivalent circuit of synchronous motor (2 marks)
 - (ii) Determine the AC line current, I_L (2 marks)
 - (iii) Draw a phasor diagram to represent back emf (3 marks)
 - (iv) Calculate the generated emf, E_A (4 marks)
 - (v) Sketch the power flow diagram (2 marks)
 - (vi) Calculate the developed mechanical power (4 marks)

- Q5**
- (a) Describe **two (2)** differences between a reluctance and a permanent magnet stepper motor. (4 marks)
 - (b) Explain the limitations of open loop operation and need for the closed loop operation of stepper motor. (5 marks)
 - (c) Give **three (3)** comparisons between capacitor start-induction run motor and shaded-pole motor. (6 marks)
 - (d) A universal control motor speed can be controlled
 - i) Name **one (1)** circuit that can control the speed. (2 marks)
 - ii) Explain **two (2)** techniques to cause the mentioned circuit to switch into conduction mode. (3 marks)
 - (e) A universal motor speed has characteristic.
 - i) Describe a general characteristic of this motor. (2 marks)
 - ii) Briefly explain a solution to the over speeding problem that could damage the motor. (3 marks)

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- Q6** (a) Draw and label completely the block diagram of power electronic system. (4 marks)
- (b) A wind generator system requires power electronic systems to produce AC electricity in grid system. State **three (3)** power electronic systems that can convert wind energy to direct current, increase the current and then produce alternate current. (6 marks)
- (c) Briefly describe the speed control for induction motor using supply frequency control method. (5 marks)
- (d) Briefly explain an armature resistance control method for the DC motor speed control (5 marks)
- (e) DC motor drive has many applications
- i) State **two (2)** examples of the application that required DC motor drive. (2 marks)
- ii) Give **three (3)** reasons why the DC motor drive is used. (3 marks)

- END OF QUESTION -

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