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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

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

COURSE NAME : ELECTRICAL MACHINES AND DRIVES
COURSE CODE : DAE 32303
PROGRAMME CODE : DAE
EXAMINATION DATE : DECEMBER 2019/JANUARY 2020
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : ANSWER **FOUR (4)** QUESTIONS ONLY

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THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

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- Q1**
- (a) List **two (2)** types of copper losses in DC machines. (2 marks)
- (b) Name **three (3)** main parts of the DC generator. (3 marks)
- (c) Draw and label completely the schematic diagrams of:
- (i) DC shunt generator (4 marks)
- (ii) DC series motor (4 marks)
- (d) A 200 V shunt motor has the following parameters:
 $R_a = 1 \Omega$, $R_f = 200 \Omega$ and rotational loss 300 W. On full load the line current is 23 A and the motor runs at 2000 rpm. Determine:
- (i) The developed mechanical power. (5 marks)
- (ii) The output power (2 marks)
- (iii) The output torque (3 marks)
- (iv) The efficiency at full load (2 marks)

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Q2 Short-circuit and open-circuit tests were performed on a 1000 VA transformer, 50 Hz, rated at 230V/115 V, and the results are listed as follows:

$$\begin{aligned}V_{sc} &= 13.2 \text{ V} \\I_{sc} &= 4.35 \text{ A} \\P_{sc} &= 20.1 \text{ W}\end{aligned}$$

$$\begin{aligned}V_{oc} &= 115 \text{ V} \\I_{oc} &= 0.45 \text{ A} \\P_{oc} &= 30 \text{ W}\end{aligned}$$

- (a) Determine the transformer ratio (2 marks)
- (b) Draw and label completely the circuit for short-circuit test arrangement (2 marks)
- (c) Calculate the values of Z_{eq} , R_{eq} and X_{eq} (6 marks)
- (d) Draw and label completely the circuit for open-circuit test arrangement (2 marks)
- (e) Calculate the values of Θ_{OC} , I_R and I_X (6 marks)
- (f) Find the values of R_m and X_m (4 marks)
- (g) Draw the equivalent circuit parameters of the transformer referred to the high voltage side (HVS). (3 marks)

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- Q3** (a) A 220 V, 6 pole, 50Hz, 3 phase wound rotor induction motor has a delta connected stator winding and a star connected rotor winding. The number of turns of the rotor winding is half of the stator winding turns. At a speed of 880 rpm, calculate:
- (i) the percentage of slip (2 marks)
 - (ii) the rotor voltage/phase at standstill (2 marks)
 - (iii) the rotor voltage/phase (2 marks)
 - (iv) the rotor line voltage (2 marks)
 - (v) the rotor frequency (2 marks)
- (b) If the motor in **Q3(a)** above has a rotor resistance of 0.1Ω and a rotor reactance of 0.5Ω , calculate:
- (i) the rotor current at that speed (3 marks)
 - (ii) the input power to the rotor (3 marks)
 - (iii) the rotor copper loss (3 marks)
 - (iv) the power produce in the rotor (3 marks)
 - (v) the torque transferred from the rotating field to the rotor (3 marks)

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- Q4** (a) Name the fundamental parts of the AC generator. (1 mark)
- (b) Briefly describe the operating principles of the AC generator. (2 marks)
- (c) State a difference between AC generator and DC generator. (2 marks)
- (d) With the help of a diagram describe the features of the two types of rotor used in the AC generator. (5 marks)
- (e) A 3-phase AC generator, 50kVA, 440V, 50Hz star connected has an armature winding resistance of 0.28Ω . Its armature reactance and its synchronous reactance are $0.5\Omega/\text{phase}$ and $3.2\Omega/\text{phase}$ respectively. Calculate at full load condition and unity power factor the following:
- (i) The generated voltage, E_A (10 marks)
- (ii) The percentage of voltage regulation (3 marks)
- (iii) The reactance of armature reaction (2 marks)

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- Q5** (a) Draw and label completely the basic circuits of the universal motor.
(2 marks)
- (b) Briefly explain the operating principles of the universal motor.
(6 marks)
- (c) Determine the following for the single phase induction motor with the rotor speed (N_r) of 590 rpm and using power supply of 240V, 50 Hz.
- (i) Synchronous speed, N_s (2 marks)
 - (ii) Number of poles, p (2 marks)
 - (iii) Percentage of slip, % S . (2 marks)
 - (iv) Give **two (2)** advantages of the single phase motors. (2 marks)
- (d) Give **three (3)** reasons why the universal motors are suitable for drills, food mixers and household blenders. (3 marks)
- (e) Give **two (2)** reasons why the repulsion-start motors are suitable for large air conditioning units and large pumps. (2 marks)
- (f) State the relationship between the percentage slip (% S) of the motor, rotor speed (N_r), time consumption, cost of operation and the efficiency of the motor. (4 marks)

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- Q6** (a) State the function of power electronic circuit. (2 marks)
- (b) Draw and label completely the symbols of the following components:
- (i) Unijunction Transistor, UJT (2 marks)
 - (ii) Triode for Alternating Current , TRIAC (2 marks)
 - (iii) Insulated Gate Bipolar Transistor, IGBT (2 marks)
 - (iv) Silicon - Controlled Rectifier, SCR (2 marks)
- (b) State **six (6)** applications of DC motor drives in industries. (6 marks)
- (c) Briefly explain the speed control of the DC motor drives using the field flux control method. (4 marks)
- (d) Briefly explain an armature resistance control method for the DC motor speed control (5 marks)

- END OF QUESTION -

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