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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023**

- COURSE NAME : ELECTRICAL MACHINES & DRIVE
COURSE CODE : DAE 32303
PROGRAMME CODE : DAE
EXAMINATION DATE : FEBRUARY 2023
DURATION : 2 HOURS 30 MINUTES
INSTRUCTION : 1. ANSWER ALL QUESTIONS.
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA **CLOSED BOOK**

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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- Q1** (a) Name **three (3)** types of DC Machines (3 marks)
- (b) By using Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL), derive the equations of
- i) Counter emf **E_c** in series motor & shunt motor (4 marks)
- ii) Generated emf **E_g** in series generator & shunt generator (4 marks)
- (c) A 3-phase induction motor, wye connection, 60 Hz is connected to a 220V source. The slip is 5% and rotor speed is 855 rpm. The equivalent circuit per phase is:-

$R_1 = \text{Stator resistance} = 0.4\Omega$
 $X_1 = \text{Stator leakage inductance} = 1\Omega$
 $R_2' = \text{Rotor resistance} = 0.8\Omega$
 $X_2' = \text{Rotor leakage inductance} = 3.5\Omega$
 $R_m = \text{no-load losses resistance} = 150\Omega$
 $X_m = \text{magnetizing reactance} = 10\Omega$

Calculate:

- i) Number of poles (3 marks)
- ii) Input power (3 marks)
- iii) Mechanical power (3 marks)
- iv) Developed torque (3 marks)
- v) Efficiency (2 marks)

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- Q2**
- (a) List the **three (3)** types load for synchronous machine (3 marks)
 - (b) Illustrate the phasor diagram with related circuit for the three (3) types of loads for synchronous generator. (6 marks)
 - (c) A 2300V, 120hp, 50Hz, eight poles, Y-connected synchronous motor has a synchronous inductance of 6.63mH/phase and armature resistance of 1Ω/phase at rated power factor of 0.85 leading. At full load, the efficiency is 90 percent. Find the following quantities for this machine when it is operating at full load.
 - i) Draw a phasor diagram to represent back emf, supply voltage and armature current. (4 marks)
 - ii) Voltage regulation (3 marks)
 - iii) Output power (2 marks)
 - iv) Input power (2 marks)
 - v) Developed mechanical power. (3 marks)
 - vi) Draw the power flow diagram (2 marks)
- Q3**
- (a) Define a stepper motor. (2 marks)
 - (b) Briefly describe the principle operation of the following types of stepper motors:
 - i) Permanent magnet (PM) stepper (2 marks)
 - ii) Variable reluctance stepper (2 marks)
 - iii) Hybrid synchronous stepper (2 marks)
 - (c) Relate the limitation of open-loop operation and the need for closed-loop operation of the stepper motor. (5 marks)
 - (d) List **two (2)** examples of applications of the universal (series-wound) motor in domestic, commercial and service sectors. (2 marks)
 - (e) Explain in detail any **one (1)** of the following motors by considering its design and operating fundamentals.
 - i) Universal motor
 - ii) Servo motor
 - iii) Reluctance motor

- Q4** (a) State the functions for each of the following: (10 marks)
- i) Power electronic circuit (2 marks)
 - ii) AC / DC converters (rectifier) (2 marks)
 - iii) DC / AC converters (inverter) (2 marks)
- (b) Explain the working concept of the diode as a power switch by using I-V characteristic graph. (7 marks)
- (c) Ward Leonard drive is a basic armature voltage control method used for controlling the speed of a DC motor.
- i) Briefly explain the working concept of this drive. (5 marks)
 - ii) Illustrate the schematic diagram of Ward Leonard drive. (5 marks)
- (d) Identify **one (1)** reason, why the DC motor drives are widely used in industries such as rolling mills, paper mills and textile mills. (2 marks)

– END OF QUESTIONS –