



ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE

FACULTY OF ENGINEERING

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS
ENGINEERING**

FIRST SEMESTER EXAMINATION 2019/2020 ACADEMIC SESSION

COURSE TITLE: ELECTRICAL MACHINES I

COURSE CODE: EEE 315 / MEE 351

EXAMINATION DATE: 17th February, 2020

COURSE LECTURER: ENGR. OSHIN OLA A

HOD'S SIGNATURE

TIME ALLOWED: 3 HOURS

INSTRUCTIONS:

- 1. ANSWER QUESTION 1 ANY OTHER FOUR QUESTIONS**
- 2. SEVERE PENALTIES APPLY FOR MISCONDUCT, CHEATING,
POSSESSION OF UNAUTHORIZED MATERIALS DURING EXAM.**
- 3. YOU ARE NOT ALLOWED TO BORROW ANY WRITING MATERIAL
DURING THE EXAMINATION.**

QUESTION 1

- 1a. Using suitable diagrams, explain any two characteristics of DC generators (5 marks)
- b. i. what is meant by armature reaction in a d.c machine? (3 marks)
ii. Describe two the remedies to the effects of armature reaction. (2 marks)
- c. A 15 kW shunt generator having an armature circuit resistance of 0.4Ω and a field resistance of 100Ω generates a terminal voltage of 240 V at full load. Determine the efficiency of the generator at full load, assuming the iron, friction and windage losses amount to 1 kW (5 marks)
- d. A 4 pole generator has a wave –wound armature with 820 conductors. It delivers 78 A on full load and the field current is 12A. The brush lead is 20° electrical, calculate
- The armature demagnetization AT_d / pole
 - Cross magnetizing ampere turns per pole AT_c / pole (5 marks)

QUESTION 2

- a. . Discuss how a 3 phase induction motor can be operated as an induction generator (4 marks)
- b. Prove that the Torque, T, of a DC machine is given as $T = \frac{0.159 P \Phi Z I_a}{C}$ (6 marks)
- c. State four conditions necessary for the operation of two transformers in parallel (4 marks)
- d. A 500 V shunt motor takes a total current of 100A runs at 1200 rev/min. if the shunt field resistance is 50Ω , the armature resistance is 0.25Ω and the iron, friction and windage losses amount to 2 kW, determine the overall efficiency of the motor. (6 marks)

QUESTION3

- a. State three advantages of slip ring induction motor or wound rotor induction motor (3 marks)
- b. State two advantages of Squirrel cage induction motor (3 marks)
- c. A 415V, three-phase, 50Hz, 4-pole, star-connected induction motor runs at 23 rev/s on full load. The rotor resistance and reactance per phase are 0.3Ω and 3.4Ω respectively, and the effective rotor-stator turns ratio is 0.78:1

Calculate

- the synchronous speed
- the slip
- the full load torque
- the power output if mechanical losses amount to 700W

- (v) the maximum torque
 - (vi) the speed at which maximum torque occurs, and
 - (vii) the starting torque
- (14 marks)

QUESTION 4

- a. State three methods of speed control in DC motors (3 marks)
- b. Using a Star-connected stator winding diagram, state and identify the different types of stator winding faults (5 marks)
- c. On full-load a 322 V series motor takes 91.8A and runs at 15.2 rev/sec. The armature resistance is 0.102Ω and the series winding resistance is $60\text{ m}\Omega$. Determine the speed when developing full load torque but with a 0.24Ω diverter in parallel with the field winding. Assume that the flux is proportional to the field current. (12 marks)

QUESTION 5

- a. State the D.C motor suitable for (i) cranes and hoist (ii) heavy planer (iii) printing press (3 marks)
- b. What is meant by the term air gap eccentricity in a DC machine? (3 marks)
- c. Explain the meanings of excitation and commutation in a D.C generator (4 marks)
- d. The power supplied to a three-phase induction motor is 48kW and the stator losses are 1500W. If the slip is 4%, Determine
 - i. The rotor copper loss
 - ii. The total mechanical power developed by the rotor
 - iii. The output power of the motor if friction and windage losses are 800 W, and
 - iv. The efficiency of the motor, neglecting rotor iron loss (10 marks)

QUESTION 6

- a. State one application of each of the following motors: Servomotors, Stepper Motor, Precision Motors, Linear Induction Motor, Universal Motor and Hysteresis Motor (6 marks)
- b. Mention four reasons why a running generator will not produce output power. In each case, briefly describe how you will carry out the necessary repair? (6 marks)
- c. An 8-pole lap-wound d.c. motor has a 200 V supply. The armature has 800 conductors and a resistance of 0.8Ω . If the useful flux per pole is 40 mWb and the armature current is 30 A calculate (a) the speed, and (b) the torque developed (8 marks)

QUESTION 7

- a. Using suitable diagram describe the constructional feature of a DC machine (8 marks)
- b. Explain using suitable diagram, the advantage of using field pole lamination with some rectangular holes punched in them in a D.C machine. (6 marks)

c. A series motor runs at 900 rev/min when the voltage is 420 V and the current is 40 A. The armature resistance is 0.3Ω and the series field resistance is 0.2Ω . Calculate the resistance to be connected in series to reduce the speed to 720 rev/min if the current remain the same (6 marks)