
Indian Maritime University
(A Central University, Govt of India)

Mar/Apr/26 SE

Programme Name: B Tech (ME)

Semester: III

Subject Code: UG11T5303

Subject Name: Electrical Machines

Date: 23.03.2026

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.
- (iii) Tables (Steam/Log/Nautical Almanac etc) that can be used.
- (iv) Chart Work Booklets to be used.

Section A

Answer all the questions (10x1=10)

1. The full-load copper loss of a transformer is 1600 W. At half-load, the copper loss will be _____

- A) 1600 W
- B) 6400 W
- C) 400 W
- D) 800 W

2. A 3-phase 440 V, 50 Hz induction motor has 3% slip. The frequency of rotor current will be

- (A) 50 Hz
- (B) 25 Hz
- (C) 1.5 Hz
- (D) 2 Hz

3. A 2 KVA, 230 V, 50 Hz single phase transformer has an eddy current loss of 40 watts. The eddy current loss when the transformer is excited by a dc source of same voltage will be _____

- A) Equal to 40W
 - B) Less than 40W
 - C) More than 40W
 - D) Zero watts
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4. The current drawn by the armature of DC motor is directly proportional to _____

- (A) Torque
- (B) Speed
- (C) The voltage across the terminals
- (D) Cannot be determined

5. In a three-phase induction motor, the maximum torque is independent of

- (A) rotor reactance
- (B) rotor resistance
- (C) synchronous speed
- (D) applied voltage

6. Which motor should not be started on no-load?

- (A) DC Series motor
- (B) DC Shunt motor
- (C) Synchronous motor
- (D) Induction motor

7. Voltage induced in the induction motor is highest at _____

- (A) starting
- (B) standstill
- (C) rated speed
- (D) any of the mentioned

8. In a synchronous motor, "hunting" does not depend upon which of the following parameter variation.

- (A) Supply Frequency
- (B) Load fluctuation
- (C) Supply voltage
- (D) Winding friction

9. A synchronous condenser is a synchronous motor work as _____

- (A) No load with under-excited fields
- (B) No-load with over-excited fields
- (C) Normal load with minimum excitation
- (D) Normal load with normal excitation

10. Which of the following statements is true regarding Universal motor?

- I. Stator winding is in series with rotor winding.
- II. This motor is designed to work on both AC and DC supply.

- (A) Both I and II
 - (B) Neither I nor II
 - (C) Only I
 - (D) Only II
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Section B

Answer all the questions (5x2=10)

11. In short circuit test the core loss is negligible w.r.t. full load ohmic loss, explain.
12. Draw the torque-slip characteristics of three phase induction motor and show the various regions of operation.
13. What are the effects of hunting on synchronous motor?
14. In a stepper motor, what is the purpose of the rotor's teeth or poles?
15. What is the importance of back emf in case of dc motor?

Section C

Answer any five questions (5x10=50)

16. A 746-kW, 3-phase, 50-Hz, 16-pole induction motor has a rotor impedance of $(0.02 + j 0.15) \Omega$ at standstill. Full-load torque is obtained at 360 rpm. Calculate
- (i) the ratio of maximum to full-load torque [3]
- (ii) the speed of maximum torque and [3]
- (iii) the rotor resistance to be added to get maximum starting torque. [4]

17. A 4-pole, 50 Hz, 3-phase wound-rotor induction motor draws 9100 W of electrical input power. The motor exhibits the following losses: core loss = 290 W, stator copper loss = 568 W, rotor copper loss = 445 W, and friction & windage losses = 100 W.

Determine:

- (a) the power transferred across the air gap, [3]
- (b) the mechanical power developed (in watts), [3]
- (c) the overall efficiency of the motor. [4]

18. A synchronous motor absorbing 60 kW operates in parallel with a factory load of 240 kW at a lagging power factor of 0.8. If the combined load has a power factor of 0.9, determine:

- (a) the leading reactive power (kVAr) supplied by the motor
- (b) the power factor at which the motor is operating. [5+5]

19. A D.C. series motor operates at 800 r.p.m. with a line current of 100 A from 230-V mains. Its armature circuit resistance is 0.15Ω and its field resistance 0.1Ω . Find the speed at which the motor runs at a line current of 25 A, assuming that the flux at this current is 45 per cent of the flux at 100 A. [10]

20. A 5KVA, 400V/200V, 50Hz, single phase transformer gave the following test results:

Open circuit (on low voltage side) - 200V, 1.25A, 150 watts.

Short circuit (on high voltage side) - 20V, 10.5A, 175 watts.

Find the efficiency of the transformer at half load, 0.8 power factor lagging.

[10]

21. (a) Explain the Ward-Leonard method of speed control for DC motor? List out the advantages and disadvantages of this method. [7]

(b) Why synchronous motors are not self-starting like 3 phase induction motors. State the methods of starting synchronous motors. [3]

22. Define step angle in stepper motor. Explain various types of stepper motor. [10]

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