Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – December 2025

Programme Name: B Tech (ME)

Semester: III

Subject Code: UG11T5303

Subject Name: Electrical Machines

Date: 11.12.2025	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) Only non-programmable scientific calculators are allowed

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. No-load current in the transformer is _____
   (a) Sinusoidal distorted (b) Sinusoidal
   (c) Steps (d) Straight DC

2. In a three-phase star-delta transformer, what is the phase angle difference between the primary and secondary phase voltages?
   (a) Delta side leads by 30° (b) Star side leads by 30°
   (c) Delta side leads by 0° (d) Star side leads by 0°

3. A DC 4 pole lap wound generator is running at 1000 rpm having 1200 conductors and flux density is 10 mWb. Find the generated emf?
   (a) 200000 (b) 200
   (c) 400 (d) 400000

4. A 4-pole wave wound DC motor drawing an armature current of 20 A has provided with 360 armature conductors. If the flux per pole is 0.015 Wb then the torque developed by the armature of motor is _____
   (a) 10.23 N-m (b) 34.37 N-m
   (c) 17.17 N-m (d) 19.08 N-m

5. A 3-phase 440 V, 50 Hz induction motor has 4% slip. The frequency of rotor current will be
   (a) 50 Hz (b) 25 Hz
   (c) 5 Hz (d) 2 Hz

6. In a capacitor start single phase induction motor
   (a) Current in starting winding leads the voltage
   (b) Current in starting winding lags the voltage

(c) Current in starting winding is in phase with voltage in running winding
(d) None of the above

7. An alternator is said to be over-excited when it is operating at
(a) Leading Power Factor (b) Lagging Power Factor
(c) Unity Power Factor (d) Leading & Lagging PF

8. The small diameter and large axial length are the features of _____ rotor?
(a) Salient pole rotors (b) Smooth cylindrical rotors
(c) Both a and b (d) None of the above

9. If the output frequency of an alternator increases, it is due to _____
(a) increase in shaft speed
(b) decrease in shaft speed
(c) not affected by shaft speed change
(d) None of the options are correct

10. Which motor type is commonly used in robotics and precision control application?
(a) Stepper motor (b) Synchronous motor
(c) AC Induction motor (d) Brushless DC motor

Section B

Five Questions of 02 Marks each

11. Why transformers are rated in kVA instead of kW?

12. Why a starter is necessary for a DC motor?

13. Why an induction motor cannot run at synchronous speed?

14. Why practically most of the alternators are connected in star?

15. What is the working principle of stepper motor?

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. (a) Draw the phasor diagram of a single-phase transformer supplying a lagging power factor load. (3 Marks)

16(b) A 5.5KVA, 440V/220V, 50Hz, single phase transformer gave the following test results:

Open circuit (on low voltage side) - 220V, 1.25A, 160 watts.

Short circuit (on high voltage side) - 22V, 12.5A, 190 watts.

Compute parameters of the approximate equivalent circuit referred to low voltage side and draw the approx. equivalent circuit. (7 Marks)

17. (a) Explain delta – star and delta -delta transformers with neat sketches and also write relation between primary and secondary line and phase voltages. (5 Marks)

17. (b) State working principle of three phase induction motor. (5 Marks)

18. (a) Derive an expression for the emf generated in the armature winding of a DC Generator. (5 Marks)

18. (b) A 100 kW DC shunt generator driven by a belt from an engine runs at 300 rpm and is connected to 200 V dc mains. When the belt breaks, it continues to run as a motor drawing 10 kW from the mains. At what speed would it run? Given: Armature resistance = 0.025 Ω and field resistance = 50 Ω and brush drop 2V. (5 Marks)

19. (a) Describe the working principle with diagram of a three-point starter for a DC shunt motor. (5 Marks)

19. (b) Explain briefly "hunting of synchronous machines. (5 Marks)

20. (a) Show that in an induction motor, "Rotor input : power developed : rotor copper losses :: 1 : (1-S) : S", where S is the fractional slip. (5 Marks)

20. (b) An induction motor has an efficiency of 80% when the load is 40kW. At this load, the stator copper loss and rotor copper loss are equal to the core-loss. The mechanical losses are one-fifth of the no-load loss. Calculate the slip. (5 Marks)

21.(A) Describe with neat sketch the working of universal motor/ac series motor. (5 Marks)

21.(B) State the advantages and disadvantages stepper motor. (5 Marks)

22. (a) Explain the necessary conditions for paralleling of two 3-phase alternators. (5 Marks)

22. (b) A 3-phase, 50 Hz, 410 V, Y connected synchronous alternator operates at rated voltage and at a leading pf of 0.85. Shaft power is 14 kW and the excitation emf is 380V. If per-phase resistance is 0.4 ohm, find the synchronous reactance, neglect mechanical losses of the system. (5 Marks)