Roll No.											

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY 2025

Date: 28-05-2025 **Time:** 01:00 pm – 04:00 pm

School: SOE	**Program:** B. Tech (EEE)	
Course Code: EEE2025	**Course Name:** Electrical Machines-II	
Semester: IV	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**26**	**24**	**26**	**24**	**-**

Instructions:

(i) Read all questions carefully and answer accordingly.
(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	Why a single-phase induction motor is not self-starting?	**2 Marks**	**L1**	**CO1**
2.	What is the role of the auxiliary winding in a single-phase induction motor?	**2 Marks**	**L1**	**CO1**
3.	A single-phase induction motor is rated at 2 HP with 4 poles and operates at a supply frequency of 50 Hz. What is the value of synchronous speed of the motor.	**2 Marks**	**L1**	**CO1**
4.	Why are slip-ring induction motors used in elevators and rolling mills instead of squirrel cage motors?	**2 Marks**	**L1**	**CO2**
5.	A three-phase induction motor has an induced EMF of 300V at standstill condition. If the motor operates at a slip of 0.03. What would be the value of induced EMF at the running condition.	**2 Marks**	**L1**	**CO2**

6.	How does the synchronous motor's speed relate to the frequency of the supply voltage, and what would be the value of load angle to produce positive Maximum torque?	2 Marks	L1	CO3
7.	What is the principle of operation of a synchronous motor, and how does it differ from an induction motor?	2 Marks	L1	CO3
8.	A 3-phase synchronous motor operating at unity power factor draws 10 kW. If the efficiency of the motor is 90%, What would be the value of the input current drawn from a 400 V, 3-phase supply.	2 Marks	L1	CO3
9.	A 3-phase, 16-pole alternator is running at 375 rpm. What would be the value of the frequency of the generated voltage.	2 Marks	L1	CO4
10.	Why is synchronization necessary before connecting a synchronous generator to the grid?	2 Marks	L1	CO4

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	In industrial cooling fan systems, single-phase induction motors are widely used for ventilation and air circulation. However, these motors are not inherently self-starting. i) Explain the Double Revolving Field Theory in detail. ii) How does this theory help in understanding the self-starting behavior of a single-phase induction motor in industrial applications like cooling fan systems? iii) **Support your explanation with appropriate** diagrams and mathematical expressions**.**	**20 Marks**	**L2**	**CO 1**
		Or			
12.	**a.**	Single-phase induction motors with similar ratings are widely used in industrial cooling fan systems, ensuring temperature control and ventilation in factories, warehouses, and data centers. These motors provide reliable and efficient airflow, enhancing the performance of HVAC systems and thermal management in electrical equipment. Data: Voltage (V) = 230V Frequency (f) = 50Hz Poles (P) = 4 Stator Resistance (R_1) = 3.2Ω Stator Reactance (X_1) = 5.1Ω Magnetizing Reactance (X_m) = 170Ω Referred Rotor Resistance (R_2') = 5.0Ω Referred Rotor Reactance (X_2') = 5.1Ω Slip (s) = 0.04 i. Draw the equivalent circuit with all parameters ii. Compute the input current (I_1)	**20 Marks**	**L3**	**CO 1**

		iii. Input power factor (PF)			

13.	**a.**	Explain the mechanism of RMF generation in a three-phase induction motor with relevant diagrams by considering different instant like 0^0, 60^0 and 120^0 and justify how the RMF interacts with the rotor to produce torque.	**20 Marks**	**L2**	**CO 2**
Or					
14.	**a.**	The following test data was obtained for a 3.73 kW, 200 V, 50 Hz, 4-pole, 3-phase star-connected induction motor: • No-Load Test: 200 V, 5 A, 350 W • Blocked Rotor Test: 100 V, 26 A, 1750 W Draw the circle diagram and compute the following parameters i) Input current at full load ii) Input power factor at rated condition iii) Rated slip iv) Fixed losses	**20 Marks**	**L3**	**CO 2**

15.	**a.**	A 415 V, 75 kVA, Δ-connected, synchronous motor, 50 Hz operates under the following conditions: Assume Ra≈0, Xs=3.5 Ω, P_{FW}=2.5 kW, P_{core}=1.5 kW. Initially, the shaft is loaded with 25 HP, and the power factor is 0.85 leading. (a) Draw the phasor diagram. Find I_L (Line current), I_a(Armature current), and E_a (Internal generated voltage). (b) If the motor is loaded at 50 HP, find I_L, I_a, and E_a. (c) Comment on the variation of armature current, power factor, and load angle with respect to output power	**20 Marks**	**L3**	**CO 3**
Or					
16.	**a.**	A 300 kW, 3-phase, 3.3 kV, 50 Hz, 0.9 (lagging) power factor, 6-pole, star-connected synchronous motor has the following parameters: X_s=20 Ω, R_s=0Ω. Rated field current is 7.2 A. Calculate: (i) Armature current and power factor at half the rated torque and rated field current. (ii) Field current required to achieve unity power factor at the rated torque. (iii) Torque developed for unity power factor operation at a field current of 10.2 A.	**20 Marks**	**L3**	**CO 3**

17.	**a.**	A *Kirloskar Electric Make* 3-phase, star-connected alternator is installed in a thermal power station. The alternator is designed with short-pitched coils and double-layer distributed winding	**20 Marks**	**L3**	**CO 4**

		to minimize harmonics and improve the waveform. The specifications of the alternator are as follows: • **Number of poles =** 6 • **Supply frequency =** 50 Hz • **Number of stator slots =** 54 • **Conductors per slot =** 8 • **Coil span =** 140° electrical **(short-pitched)** • **Flux per pole =** 0.06 Wb **The alternator employs** short-pitched winding **and** distributed winding **for better performance.** a) Calculate the synchronous speed and the number of slots per pole per phase. (4 Marks) b) Determine the **pitch factor (K_p)** based on the given coil span. (5 Marks) c) Compute the **distribution factor (K_d)** using the slot and pole data. (5 Marks) d) Calculate the **RMS value of the generated phase EMF (E_{ph})** using the EMF equation with winding factors. (6 Marks)			
		Or			
18.	**a.**	A *Kirloskar Electric Make* 3-phase, star-connected synchronous generator rated at **25 kVA, 400 V, 50 Hz** has an effective armature resistance of **0.25 Ω per phase**. The generator was subjected to the following standard tests: • A field current of **1.8 A** produced a **short-circuit current of 18 A**. • The same field current produced an **open-circuit voltage of 90 V (phase)**. a) Calculate the full-load current per phase of the generator. (3 Marks) b) Determine the synchronous impedance (Z_s) per phase using the given test data. (4 Marks) c) Compute the synchronous reactance (X_s) per phase. (3 Marks) d) Using the synchronous impedance method, calculate the generated EMF (E_0) at full load and unity power factor. (5 Marks) e) Calculate the voltage regulation at full load and unity power factor. (5 Marks)	**20 Marks**	**L3**	**CO 4**