

**A**

**Reg. No. :**

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**Question Paper Code: R4301**

B.E. / B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Fourth Semester

Electrical and Electronics Engineering

R21UEE401 – ELECTRICAL MACHINES - II

(Regulations R2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Which one the following represents the pitch factor? CO1- U  
(a)  $\cos \alpha$                       (b)  $\cos (2\alpha)$                       (c)  $\cos \alpha$                       (d)  $\cos (2\alpha)$
2. In the alternator, the following coils will have emf closer to the sine waveform. CO1- U  
(a) Concentrated winding in full-pitch coils                      (b) Concentrated winding in short-pitch coils  
(c) Distributed winding in full-pitch coils                      (d) Distributed winding in short-pitch coils
3. Identify the rotor current frequency for a 3-phase, 440 V, 50 Hz induction motor with a 4% slip. CO2- App  
(a) 50HZ                      (b) 25HZ                      (c) 50HZ                      (d) 25HZ
4. Relate the condition for maximum torque of an induction motor CO1- U  
(a)  $R_2 = X_2$                       (b)  $R_2 = sX_2$                       (c)  $R_2 = X_2$                       (d)  $R_2 = sX_2$
5. Relate which method of speed control of the Induction motor gives constant maximum torque CO1- U  
(a) Voltage control                      (b) Frequency control                      (c) V/F control                      (d) Pole changing
6. For Small and Medium size Induction Motors, which type of Starter is used? CO1- U  
(a) DOL Starter                      (b) Auto Transformer Starter  
(c) Star –Delta Starter                      (d) Rotor Resistance Starter

7. Hunting in a synchronous motor takes place CO1- U  
 (a) When load varies (b) When supply voltage fluctuates  
 (c) When the power factor is unity (d) Motor is under loaded
8. The damping winding in a synchronous motor is generally used CO1- U  
 (a) to provide starting torque only (b) to reduce the noise level  
 (c) to reduce eddy currents (d) to prevent hunting and provide the starting torque.
9. Split-phase induction motors are available in the range of CO1- U  
 (a) 1/2 to 1/10 kW (b) 1/20 to 1/2 kW (c) 1/10 to 1/20 kW (d) None of these
10. The following motor is used in wrist watches CO1- U  
 (b) Universal motor (c) Stepper motor (d) Reluctance motor (d) linear Induction motor

PART – B (5 x 2= 10 Marks)

11. Identify the synchronous speed of an alternator operating at a frequency of 50 Hz with a 4-pole configuration. CO2- App
12. 59 A, 3-phase, 4-pole, induction motor operates from a supply whose frequency is 50 Hz. Calculate the frequency of the rotor current at a standstill and the speed at which the magnetic field of the stator is rotating. CO2- App
13. Compare the Static and conventional Kramer Slip Power Recovery Scheme CO1- U
14. A Synchronous motor always runs with Synchronous speed, Justify. CO1- U
15. Analyze why a single-phase induction motor has a low power factor CO1- U

PART – C (5 x 16= 80 Marks)

16. (a) A 3-phase star connected alternator is rated at 1600kVA, 13500V. CO5-Ana (16)  
 The alternator effective resistance and synchronous reactance are 1.5  $\Omega$  and 30  $\Omega$  per phase respectively. Analyze the performance of the machine based on its percentage regulation for a load of 1280 kW at power factors of i) 0.85 lagging ii) 0.85 leading.

Or

- (b) A 1.1 MVA, 2.2kV, 3 phase star connected alternator gave the following test results during open circuit and short circuit test. (5 Marks) CO5-Ana (16)

|               |      |      |      |       |      |
|---------------|------|------|------|-------|------|
| $I_f$ (A)     | 10   | 20   | 30   | 40    | 50   |
| $V_{oc}$ (kV) | 0.88 | 1.65 | 2.20 | 2.585 | 2.86 |
| $I_{sc}$ (A)  | 200  | 400  | --   | --    | --   |

The effective resistance of the 3-phase winding is  $0.22\Omega/\text{ph}$ . Analyze the full load voltage regulation at 0.8 P.F. lagging using the following methods by

- Synchronous impedance method
- Ampere – turn method.

17. (a) A 3-phase 500 V, 50 Hz induction motor with 6 poles gives an output of 20 kW at 950 rpm with a power factor of 0.8. The mechanical losses are equal to 1 kW. Calculate for this load slip, rotor copper loss, and input, if the stator losses are 1.5 kW. CO2-App (16)

Or

- (b) A 3-phase induction motor is wound for 4 poles and is supplied from a 50-Hz system. Calculate (i) the synchronous speed (ii) the rotor speed, when the slip is 4% and (iii) the rotor frequency when the rotor runs at 600 rpm. CO2-App (16)

18. (a) A 4-pole, 3-phase, 50Hz, slip ring IM has a rotor resistance of  $0.25\Omega$  per phase and rotor reactance of  $2\Omega$  per phase at standstill condition. It is running at 1455 r.p.m speed. Calculate the value of external resistance per phase required in the rotor circuit to reduce the speed by 17 %. Assume load torque constant. CO3-App (16)

Or

- (b) The rotor of a 4-pole, 50Hz slip ring IM has a resistance of  $0.25\Omega$  per phase, rotor reactance of  $2\Omega$  per phase at standstill condition, and runs at 1440 r.p.m. at full load. Calculate the external resistance per phase which must be added to lower the speed at 1200 r.p.m., the torque being the same as before. CO3-App (16)

19. (a) Explain the relationship between the excitation of a synchronous motor and its power factor. Analyze how varying the excitation affects the armature current and reactive power drawn by the motor, leading to the characteristic shapes of the V-curves and inverted V-curves CO1 -U (16)

Or

- (b) Explain the construction and Working Principle of Synchronous Motor. CO1 -U (16)

20. (a) Explain the principle of operation of capacitor run induction motor and capacitor start capacitor run induction motor. CO1- U (16)

Or

- (b) Construct a step-by-step description of the sequence of energizing the windings in a stepper motor to achieve the desired angular displacement. CO1 -U (16)