**Seat No./Enrollment No.: _____**

# GUJARAT TECHNOLOGICAL UNIVERSITY
## BACHELOR OF ENGINEERING – SEMESTER 5 – EXAMINATION – SUMMER 2026

**Subject Code: 3150910** **Date: 25/05/2026**

**Subject Name: Electrical Machine- II**

**Time: 02:30 PM TO 05:00 PM** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

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| **Q.1** | **(a)** | List any three methods used to start a synchronous motor. | **03** |
| | **(b)** | Summarize the steps involved in conducting a no-load and blocked rotor test on an induction motor. | **04** |
| | **(c)** | Draw and explain the equivalent circuit of a single-phase induction motor based on the double revolving field theory. Use it to calculate total impedance and input current for a given load condition | **07** |
| **Q.2** | **(a)** | State any three applications of synchronous motors. | **03** |
| | **(b)** | Describe the purpose of the shading coil in a shaded pole motor. | **04** |
| | **(c)** | A 1100-V, 50-Hz delta-connected induction motor has a star-connected slip-ring rotor with a phase transformation ratio of 3.8. The rotor resistance and standstill leakage reactance are 0.012 ohm and 0.25 ohm per phase respectively. Neglecting stator impedance and magnetizing current Determine (a) the rotor current at start with slip-rings shorted (b) the rotor power factor at start with slip-rings shorted (c) the rotor current at 4% slip with slip-rings shorted (d) the rotor power factor at 4% slip with slip-rings shorted. | **07** |

OR

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| **Q.2** | **(c)** | The star connected rotor of an induction motor has a standstill impedance of 0.4 + j4 ohm per phase and the rheostat impedance per phase is 6 + j2 ohm. The motor has an induced e.m.f. of 80 V between slip-rings at standstill when connected to its normal supply voltage. Find (i) rotor current at standstill with the rheostat is in the circuit. (ii) When the slip-rings are short-circuited and motor is running with a slip of 3%. | **07** |
| **Q.3** | **(a)** | Summarize the key differences between axial flux and radial flux machines. | **03** |
| | **(b)** | Identify and name the types of stepper motors. State one application of each. | **04** |
| | **(c)** | Analyze how the power factor of the load affects the voltage regulation of a 2000-V, 1-phase alternator using the synchronous impedance method. Given test data includes: A field current of 2.5 A produces 100 A armature current on short circuit, and 500 V on open circuit. Armature resistance is 0.8 Ω. Compare the differences in regulation at unity, 0.8 leading, and 0.71 lagging power factors. | **07** |

OR

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| **Q.3** | **(a)** | Describe the working of a permanent magnet brushless DC motor. | **03** |
| | **(b)** | State the principle of operation of a linear induction motor. Mention two uses. | **04** |

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|---|---|---|---|
| | **(c)** | Analyze how the presence of the third harmonic component in the flux per pole affects the R.M.S. value of the induced e.m.f. per phase in a 6-pole, 3-phase, 50-Hz alternator with 3 slots per pole per phase and 4 conductors per slot arranged in two layers. The coil span is 150°, and the fundamental flux per pole is 0.12 Weber. | **07** |
| **Q.4** | **(a)** | Briefly describe the working principle of a repulsion motor. | **03** |
| | **(b)** | Explain the concept of two-reaction theory in salient pole machines | **04** |
| | **(c)** | List and briefly describe the different methods used for determining voltage regulation of synchronous generators. | **07** |
| | | OR | |
| **Q.4** | **(a)** | Explain the function of the capacitor in a capacitor-start single-phase motor | **03** |
| | **(b)** | Explain the conditions required for the parallel operation of alternators. | **04** |
| | **(c)** | State the conditions necessary for synchronization of alternators and list the methods used to achieve it. | **07** |
| **Q.5** | **(a)** | Evaluate the implications of neglecting core loss in the equivalent circuit of a single-phase induction motor. How does this simplification affect the accuracy of performance calculations? | **03** |
| | **(b)** | Analyze the effect of under-excitation, normal excitation, and over-excitation on the operation of a synchronous motor. | **04** |
| | **(c)** | Compare and evaluate the performance of a squirrel cage and a slip-ring induction motor for industrial applications requiring high starting torque. Justify your recommendation. | **07** |
| | | OR | |
| **Q.5** | **(a)** | Compare two common methods used to make a single-phase induction motor self-starting. Compare their effectiveness and state which method you would recommend for a small household appliance. | **03** |
| | **(b)** | Analyze the effect of increasing mechanical load on a synchronous motor operating at constant excitation. | **04** |
| | **(c)** | Compare the effectiveness of various speed control methods for an induction motor (voltage control, frequency control, rotor resistance control) and justify which is most efficient for variable torque loads. | **07** |

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