Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
MASTER OF ENGINEERING – SEMESTER 2 – EXAMINATION – SUMMER 2026

Subject Code: 3720727 **Date: 10/06/2026**

Subject Name: Modeling And Analysis Of Electrical Machines

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. Attempt all questions.

2. Make suitable assumptions wherever necessary.

3. Figures to the right indicate full marks.

Q.1 **(a)** Illustrate how electromechanical energy conversion principles is useful in the mathematical modeling of electrical machines. **07**

(b) Compare free acceleration characteristics observed from different reference frames. **07**

Q.2 **(a)** Discuss rotor angle dynamics and its influence on synchronous machine stability. **07**

(b) Critically examine the role of airgap MMF distribution in determining machine performance. **07**

OR

Q.2 **(b)** Analyze the importance of voltage equations in predicting transient stability. **07**

Q.3 **(a)** A balanced three-phase set of stator currents is given in stationary reference frame. **07**

1. Convert it into rotating dq reference frame.
2. Explain interpretation of the results.

(b) Discuss the operational challenges of symmetrical induction machines under unbalanced conditions. **07**

OR

Q.3 **(a)** A 3 phase induction motor operating at steady state has d axis current (i_d = 15 A), q axis current (i_q = 0). Suddenly, load torque increases, causing (i_q = 8 A). Assume number of poles=4, flux linkages psi_d and psi_q are 0.8 and 0 respectively. Calculate electromagnetic torque. **07**

(b) Assess the role of reference frame transformations in simplifying induction machine analysis. **07**

Q.4 **(a)** Analyze torque-speed characteristics of induction machine during transient operation with mathematical justification. Clearly indicate the operating region. **07**

(b) Compare PMSM with BLDC motor. Comment on their operating principle and application area. **07**

OR

Q.4 **(a)** For induction machine mathematical model, define the term speed voltage? Explain the parameters on which it depends and its significance. **07**

(b) Critically evaluate the advantages of brushless DC motors over conventional DC machines. **07**

Q.5

	(a)	Evaluate the utility of per-unit system in synchronous machine transient analysis.	**07**
	(b)	Evaluate trapezoidal wave back-emf PM machines in terms of torque ripple and efficiency.	**07**

OR

Q.5	**(a)**	Derive steady-state operation equations and critique their applicability under dynamic conditions.	**07**
	(b)	Assess the contribution of Park's equations in simplifying dynamic analysis of synchronous machine.	**07**

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