

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 7 – EXAMINATION – SUMMER 2026

Subject Code: 3172422

Date: 20/05/2026

Subject Name: Advanced Industrial Drives

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.**

- Q.1**
- (a) Define an Electric Drive and list its main parts. **03**
 - (b) Explain various components used for obtaining signals in interlocking and sequencing operations. **04**
 - (c) Discuss the state of art for special electrical machines and classify their applications based on environmental considerations. **07**
- Q.2**
- (a) Explain the constructional features of BLDC machine along with its working principle. **03**
 - (b) Compare axial and radial permanent magnet motors in all aspects. **04**
 - (c) Explain construction and working of Permanent Magnet DC with necessary diagram. **07**
- OR
- Q.2**
- (c) Explain construction and working of Linear Induction Machine with necessary diagram. **07**
- Q.3**
- (a) Draw the equivalent magnetic circuit of a Brushless DC Machine. **03**
 - (b) Outline the microprocessor-based control strategy for a Stepper Motor in an open-loop configuration. **04**
 - (c) Compare the performance characteristics of Switched Reluctance Motors under open-loop and closed-loop control strategies. **07**
- OR
- Q.3**
- (a) List the features of Permanent Magnet Synchronous Motors that make them suitable for high-performance drives. **03**
 - (b) Illustrate the power converter circuit used for controlling a PMSM. **04**
 - (c) Discuss the sensor-less control techniques for SRM and justify their use in modern industrial drives. **07**
- Q.4**
- (a) Describe the constructional features of a Permanent Magnet Axial Flux machine. **03**
 - (b) Demonstrate how energy conservation is achieved in electrical drives through standard motor efficiency labeling. **04**
 - (c) Compare Field Oriented Control and Direct Torque Control for AC machines. **07**
- OR
- Q.4**
- (a) State the thrust equation for a Linear Synchronous Motor. **03**
 - (b) Explain the segregation method for evaluating losses in an electric drive system. **04**

(c) Describe the impact of harmonics on the quality of supply and propose mitigation techniques for an industrial drive system. **07**

Q.5 (a) Label the different operating regions of an advanced electrical motor on a torque-speed characteristic curve. **03**

(b) Explain the concept of Pay Back Analysis to evaluate the cost-effectiveness of replacing a standard motor with an energy-efficient motor. **04**

(c) Design a basic closed-loop control strategy for a BLDC motor using a DSP-based controller. **07**

OR

Q.5 (a) What are the limitations of conventional rotating electrical machines in the context of fast-digital control? **03**

(b) Interpret the motor life cycle stages and their relevance to energy conservation requirements. **04**

(c) Formulate a control scheme for a DC Linear Motor including the derivation of its thrust equation for a specific industrial application. **07**
