Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII EXAMINATION – SUMMER 2025

Subject Code:3170916 **Date:16-05-2025**

Subject Name:Advanced Electric 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.**

			Marks
Q.1	**(a)**	With necessary phasor diagram derive the equation of reference vector V^*, in terms of adjacent voltage space vectors using space vector modulation. Also mention the equations to calculate the switching time of adjacent space-vectors and zero vectors (t_a, t_b and t_0).	**03**
	(b)	Compare the performance and operation of two-level inverter and three-level inverter.	**04**
	(c)	Draw the dynamic d-q equivalent circuit for d-axis and q-axis circuit in terms of synchronously rotating reference frame and write the equation of v_{qs} and v_{ds} from it. Also write the equations of flux linkages in terms of current in it.	**07**
Q.2	**(a)**	Explain the DC drive analogy for the implementation of vector control in induction motor.	**03**
	(b)	Draw the switching patterns for the upper half of the inverter for (i) sector-3 and (ii) sector-5, when applying Space Vector Modulation Technique in under modulation.	**04**
	(c)	Explain the advancement of stator flux vector trajectory in the DTC method. Also tabulate the selection of inverter voltage space vectors based on torque and flux hysteresis error.	**07**
		OR	
		Mention the Converter which can be used to run a DC motor in four quadrant and also as a single phase inverter. Explain its operation to run a DC motor in four quadrant.	**07**
Q.3	**(a)**	Write the equation of harmonics generated from the output of sine pwm technique. Clearly mention each term. Also find the harmonics and sidebands of harmonic generated by sine pwm technique, if carrier frequency is 1050 Hz and modulating frequency is 50 Hz.	**03**
	(b)	Draw the induction machine model block diagram in a synchronously rotating reference frame with input voltage and output current transformation.	**04**
	(c)	Elucidate the differences in application of selected harmonic elimination PWM technique to (i) voltage source inverter and (ii) current source inverter. Also derive the equations to find α_i, to remove the 3rd and 5th harmonic from the output of the voltage source inverter and draw the corresponding output voltage wave.	**07**

OR

Q.3 **(a)** Enlist various DSP series evolved and mention their specific application in brief. **03**

(b) Draw the block diagram to implement direct vector control in the induction motor and describe the function of each block in brief. **04**

(c) Enlist the peripherals required with DSP for motion control application. Elaborate the function of following peripherals of DSP.
(i) watchdog timers (ii) JTAG port (iii) Event Managers **07**

Q.4 **(a)** The power output of the PM BLDC machine is more than that of the PMSM machine. Justify this statement. **03**

(b) Transform V_{qs}^{s} and V_{ds}^{s} from stationary reference frame to synchronous reference frame with necessary phasor diagram. **04**

(c) Draw the block diagram of the converter circuit with BLDC motor drive. Elaborate the working of BLDC motor drive in $2\pi/3$ angle switch-on mode with necessary stator voltage and current waveforms. **07**

OR

Q.4 **(a)** Draw the architectural block diagram of DSP. **03**

(b) Draw the power circuit with a typical block diagram for the speed control of the induction motor using the DSP controller. **04**

(c) Classify various types of PMSM machines on the basis of (i) direction of field and (ii) on the basis of arranging magnets on the rotor. Differentiate the various PMSM machines on the basis of placement of poles on rotor. **07**

Q.5 **(a)** Write the equations of voltage and torque developed from SRM and clearly mention each term. **03**

(b) With suitable example show the motoring and generating action of SRM due to variation of inductance with rotor position. **04**

(c) Draw the construction and elucidate the working of 6/4 pole Switched Reluctance Motor in detail. **07**

OR

Q.5 **(a)** Draw the block diagram to implement open loop v/f control for synchronous machine. **03**

(b) Explain the working of a CSI fed synchronous machine. **04**

(c) Draw and explain the block diagram and phasor diagram to implement vector control in wound field synchronous machine. **07**

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