GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–VII (NEW) EXAMINATION – WINTER 2024

Subject Code:3170916   **Date:30-11-2024**
Subject Name: Advanced Electric Drives
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.**
   Simple and non-programmable scientific calculators are allowed.

		Marks
Q.1	**(a)** Classify the PMSM motors on the basis of the direction of field flux and placement of magnets.	**03**
	(b) Explain the generation of space voltage vector $\bar{V}_1(100)$ and $\bar{V}_2$ (110) using the necessary phasor diagram. Clearly indicate the phase voltage magnitudes and switching states for all phases.	**04**
	(c) Explain the vector control of the synchronous machine with necessary block diagram.	**07**
Q.2	**(a)** Draw the cross-section of 6/4 pole SRM motor	**03**
	(b) Draw the stator phase voltages and current waves indicating the converter conducting devices for the control of the BLDC motor using trapezoidal pwm method.	**04**
	(c) Elaborate the application of H-bridge inverter as 4-quadrant dc drive.	**07**
	OR	
	(c) Enlist various DSP families and differentiate between them.	**07**
Q.3	**(a)** Enumerate the family of harmonics generated by sine pwm technique for carrier to modulating frequency ratio, P $\left(\frac{\omega_c}{\omega}\right) = $ 15 and fundamental frequency of 50 Hz.	**03**
	(b) Draw the dynamic d^e axis and q^e axis equivalent circuit of the induction motor and write the necessary equations.	**04**
	(c) Using necessary block diagram explain the steps to implement direct or feedback vector control with rotor flux orientation.	**07**
	OR	
Q.3	**(a)** Write the relation between stationary a-b-c frame to d^s-q^s axis transformation for θ=0°.	**03**
	(b) Write the necessary equations to eliminate 5th and 7th harmonics from the output of the inverter. Find the suitable value of α_3 if the value of $\alpha_1 = 20.9^o$ and $\alpha_2 = 35.8^o$. Also calculate the magnitude of fundamental voltage for the same.	**04**
	(c) Explain the closed loop speed control of BLDC motor in PWM feedback mode with necessary block diagram and waveform.	**07**
Q.4	**(a)** Draw the architectural block diagram of any DSP type.	**03**
	(b) Draw the space vector diagram for the 3-level inverter and clearly indicate the switching states at each corner in the space vector diagram.	**04**
	(c) Elaborate various applications of DSPs in motion control application.	**07**

OR

Q.4 (a) Draw the block diagram to implement CSI fed wound field synchronous machine drive. **03**

(b) Compare the operation of PMSM motors with BLDC motors. **04**

(c) Derive the equation of switching frequency of chopper in terms of peak to peak ripple current Δi_L, inductance L, DC link voltage V_d and ac supply voltage v_s for the application of single phase diode-rectifier with boost chopper for line current wave shaping. Draw necessary block diagram. **07**

Q.5 (a) Compare scalar control scheme and vector control scheme. **03**

(b) Write the equation electromagnetic torque in terms of rotor flux, stator flux and angle between them for an induction motor. Also elucidate the advancement of stator flux and hence change in torque using necessary vectors on d^s-q^s plane in DTC method. **04**

(c) Which peripherals are required with DSP for motion control application? Explain their role in brief. **07**

OR

Q.5 (a) Draw the block diagram to implement Direct torque and flux control method for induction motor control. Clearly indicate the output states of hysteresis band controllers for torque and flux. **03**

(b) Draw the waveforms to show relation between variation of rotor inductance, current and torque production with variation of rotor angle in 6/4 pole SRM. **04**

(c) With necessary block diagram explain the implementation of closed-loop, speed-controlled SRM drive. **07**

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