

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject code: 2714504**Date: 12-01-2015****Subject Name: Modelling and Analysis of Electrical Machines****Time: 02:30 pm - 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.

Q.1	(a)	Derive voltage equation to represent two magnetically coupled circuits with leakage. Assume magnetic system to be linear. Draw equivalent T-circuit with coil 1 as the reference coil.	07
	(b)	Derive the expression of the Electromagnetic force and Electrostatic force for electromechanical system having one electrical and one mechanical input.	07
Q.2	(a)	The transformation of 2 phase set to the arbitrary reference frame is $\mathbf{f}_{qds} = K_{2s} \mathbf{f}_{abs}$ Where $(\mathbf{f}_{qds})^T = [f_{qs} \ f_{ds}]$; $(\mathbf{f}_{abs})^T = [f_{as} \ f_{bs}]$ $K_{2s} = \begin{bmatrix} \cos \theta & \sin \theta \\ \sin \theta & -\cos \theta \end{bmatrix}$ Using the transformation given, express the current equation in the arbitrary reference frame for a 2 phase capacitive circuit if $C_a=C_b=C$.	07
	(b)	Derive winding inductances and voltage equations for 2 pole, 3 phase and star symmetrical connected induction machines. Mention assumptions made for derivation.	07
		OR	
	(b)	Draw and explain equivalent circuit for steady state operation of a symmetrical induction machine with equation.	07
Q.3	(a)	Explain the dynamic Performance of Permanent Magnet DC machine during starting.	07
	(b)	Prepare time domain block diagram for Permanent Magnet DC machine and derive its state equation.	07
		OR	
Q.3	(a)	Explain the dynamic Performance of Permanent Magnet DC machine during sudden change in load torque is applied.	07
	(b)	Derive state equation for shunt connected DC machine.	07

Q.4	(a)	Clarke's transformation may be written as $f_{\alpha\beta 0} = C f_{abs}$ Where, $(f_{\alpha\beta 0})^T = [f_{\alpha} \quad f_{\beta} \quad f_0]$ $C = \frac{2}{3} \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & \frac{\sqrt{3}}{2} \\ \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{bmatrix}$ Relate $f_{qs}^s, f_{ds}^s, f_{\alpha}, f_{\beta}$ and f_0.	07
	(b)	A Resistor and inductor are connected in series, with $R = 15 \Omega$ and $L = 250 \text{ mH}$. Determine energy stored in inductor W_{es} and energy dissipated by resistor W_{el} for $t > 0$, if $I(0) = 10 \text{ A}$.	07
		OR	
Q.4	(a)	Determine the expression for f_{qs}, f_{ds} and f_{0s} , if $f_{as} = \cos t, f_{bs} = 0.5t$ and $f_{cs} = -\sin t$. Assume that $\omega(0) = -\pi/12, N_p = 1 \text{ rad/sec}$ and $t = \pi/3 \text{ sec}$.	07
	(b)	The parameter of a DC shunt machine are $R_f = 240 \Omega, L_{FF} = 120 \text{ H}, L_{AF} = 1.8 \text{ H}, R_a = 0.6 \Omega, L_{AA} = 0$. The load torque is 5 N-m and $V_a = V_f = 240 \text{ V}$. Calculate the steady state rotor speed in rpm.	07
Q.5	(a)	Derive voltage and torque equations in machine variable for permanent magnet brushless DC machine.	07
	(b)	Explain the computer simulation of symmetrical induction machine in arbitrary reference frame using appropriate block diagram.	07
		OR	
Q.5	(a)	Derive the torque speed characteristics of permanent magnet brushless DC machine and define common mode of operation.	07
	(b)	Explain the mathematical model of switch reluctance motor.	07
