Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

ME Semester –I Examination Feb. - 2012

Subject code: 714504N **Date: 21/02/2012**
Subject Name: Modeling & Analysis of Electric machines
Time: 10.30 am – 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)** For a singly excited magnetic system, derive the relation for the magnetic stored energy in terms of reluctance. **07**

(b) Why reference frame theory is used in the analysis of electrical machines? Describe various reference frames used to transform three phase abc variables in to 2-phase qs and ds axis variables. **07**

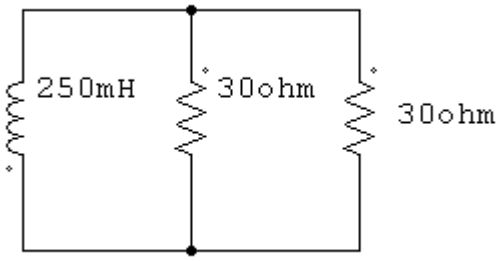
Q.2 **(a)** Derive voltage and torque equation of salient pole synchronous machine in phase variable. **07**

(b) Explain the computer simulation of three phase synchronous machine into rotor reference frame using suitable block diagram. **07**

OR

(b) Explain the computer simulation of three phase symmetrical induction machine in balanced stator and rotor condition in arbitrary reference frame. **07**

Q.3 **(a)** Determine energy stored in inductor and energy dissipated by resistors for i>0 if i(0)=20 A for the following circuit. **07**



(b) Derive voltage equation to represent two magnetically coupled circuits with leakage. Assume magnetic system to be linear. Draw equivalent T-circuit with coil1 as the reference coil. **07**

OR

Q.3 **(a)** For an electromagnetic system show that the mechanical work done is equal to the area enclosed between the two magnetization curves at open and closed positions of the armature and the ψ-i locus during the armature movement. **07**

(b) The transformation for a 2-phase set to the arbitrary reference frame is **07**

$$f_{qds}=K_{2s}\, f_{abc}$$

Where $[f_{qds}]^T=[f_{qs} \quad f_{ds}]$ & $[f_{abs}]^T=[f_{as} \quad f_{bs}]$

$$K_{2s} = \begin{bmatrix} cos\theta & sin\theta \\ sin\theta & -cos\theta \end{bmatrix} \text{ \& } \theta = \int_0^t \omega(\xi)_d \xi + \theta(0)$$

Show that $f_{as}^2 + f_{bs}^2 = f_{qs}^2 + f_{ds}^2$

Q.4	**(a)**	Explain steady state analysis of three phase symmetrical induction machine. Derive the expression of stator voltage and rotor voltage in steady state condition.	**07**
	(b)	Derive the expression of the Electromagnetic force and Electrostatic force for electro mechanical system having one electrical and one mechanical input.	**07**

OR

Q.4	**(a)**	Derive voltage equation to represent two magnetically coupled circuits with leakage. Assume magnetic system to be linear. Draw equivalent T-circuit with coil1 as the reference coil.	**07**
	(b)	Transform the variables of stator reference frame in to the synchronously rotating magnetic frame.	**07**
Q.5	**(a)**	Derive voltage and torque equation of brushless dc machine in machine variables and in rotor reference frame variables.	**07**
	(b)	Explain electromechanical energy conversion process in electric drives.	**07**

OR

Q.5	**(a)**	Explain the mathematical model of switch reluctance motor.	**07**
	(b)	Explain generalized theory of rotating electrical machine and Kron's primitive machine	**07**

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