Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME SEMESTER II EXAMINATION – SUMMER 2017

Subject Code: 2720715 **Date: 26/05/2017**

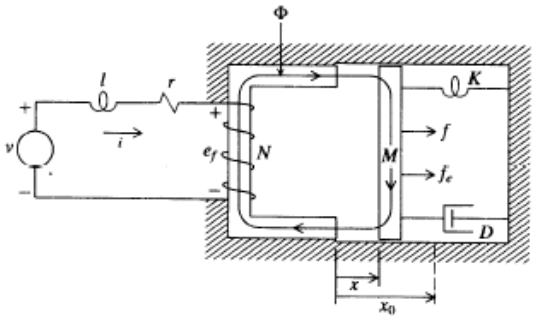
Subject Name: Electrical Machine Modelling and Analysis

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.**

Q.1 (a) Derive the Energy balance equation for the system shown in the figure. Modify the equation for multiple electrical and mechanical inputs. **07**



(b) Explain the modelling of electromechanical energy conversion takes place in electromagnetic circuit **07**

Q.2 (a) Prove the power equivalence between three phase and d-q based machine model. State clearly the assumptions made. **07**

(b) Explain free acceleration characteristic of an induction machine using different references frames **07**

OR

(b) Explain the Clarke (αβ0) ,Park (dq0) , Inverse Clarke and Inverse Park power invariant transformations. **07**

Q.3 (a) Determine the expression for f_{ds}, f_{qs} and f_{os} for f_{as}=cost, f_{bs}=t/2, f_{cs}= -sint, assume θ (0) = -π/12 and ω=1 rad/sec, for t= π/3 sec. **07**

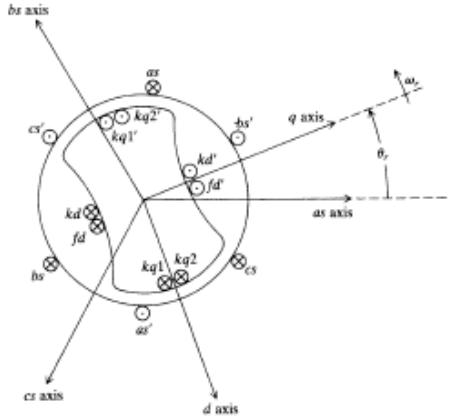
(b) Develop the mathematical model for the three phase Induction Motor in arbitrary reference frame. Support your answer with necessary diagrams and equations. **07**

OR

Q.3 (a) Derive torque equations for three phase induction motor machine in synchronous reference frame. **07**

(b) Can the d-q models be used for supply unbalance studies? And will the type of winding (star or delta) of the stator connection change the dynamic model of IM? **07**

Q.4 **(a)** Derive winding inductances and voltage equations for Synchronous machine shown in fig. Mention assumptions made for derivation. **07**



(b) Analysis the Synchronous machine performance when a three phase fault occurs at the machine terminals using dynamic model **07**

OR

Q.4 **(a)** Derive voltage equations for Synchronous machine in rotor reference frame. **07**

(b) Analysis the steady state operation of synchronous machine **07**

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Q.5 **(a)** Explain in brief the procedure of linearization of machine equations **07**

(b) Derive the voltage equation in rotor reference frame variable of BLDC Machine **07**

OR

Q.5 **(a)** Obtain the linearized model of IM **07**

(b) Derive the Torque equation in rotor reference frame variable of BLDC Machine. **07**

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