**Code No: A4301** **NR**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**M.TECH I SEMESTER EXAMINATIONS, APRIL/MAY-2012**
**MACHINE MODELLING AND ANALYSIS**
**(POWER ELECTRONICS)**

**Time: 3 hours** **Max.Marks:60**

**Answer any FIVE questions**
**All questions carry equal marks**
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1.a) What do you mean by a primitive 2-axis machine? Derive the voltage equations of the on this machine.

b) Starting from the fundamentals, derive the expressions for voltage and force/torque of a (i) solenoid with fixed armature
(ii) solenoid with linear movement.

2.a) Derive the mathematical model of a separately excited DC motor by considering Generalized Machine theory.

b) A separately excited DC motor fed from SCRS has the following data:
Total resistance of motor armature and SCR circuit, R = 0.05Ω; Total inductance of motor armature and SCR circuit, L = 0.01H; No-load source voltage = 250V; Inertia of rotating parts, J = 18 kg-$m^2$; Motor torque constant, Km = 3 Nm/ armature-amperes; Friction and windage constant, D=0. (i) Find the undamped natural angular frequency and the damping ratio of the motor system (ii) If the motor takes a no-load current of 10A, Calculate its no-load speed.

3.a) Obtain the mathematical model of a cumulatively compounded DC motor in matrix form.

b) For doing the analysis of DC machines with help of Kron's primitive machine, no transformation is required, why?

4.a) Explain transformation matrix theory and theory of transformation as applied to electrical machines? What are the different types of transformations?

b) Obtain identical transformations for currents and voltages from a rotating balanced 3-phase(a, b, c) winding to a rotating balanced 2-phase (α, β) winding.

5.a) Draw the basic circuit model of 3-φ induction motor as well as rotor and obtain voltage equations in terms of stator and rotor currents in the matrix form.

b) Obtain expressions for flux linkages in the two axis model for a 3-φ induction motor from $\Psi$a, $\Psi$b and $\Psi$c values.

6. Derive the dynamic model of a 3-φ induction motor in synchronizing rotating reference frame in state variable form and represent them in matrix form.

7.a) Write down the flux linkage equations for a 3-φ synchronous motor from the model of the motor.

b) Derive the expression for armature mutual inductances of a salient pole synchronous machine from a consideration of its basic parameters.

8. A basic 3-φ, 2-pole synchronous machine of the salient pole type has the following inductances, where 'θ' is the angle measured from d-axis to the axis of phase A. Phase A self inductance, $La = 0.9+0.2 \cos 2\theta$. Mutual inductance between phase A and field winding F, is $Maf = 8\cos\theta$. Mutual inductance between phase B and C is $Mbc = -0.4 + 0.2 \cos 2\theta$.

a) Write expressions for all the self and mutual inductances in terms of.

b) Determine Ld, Lq and Lo.

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