Code No: C4301, C4201, C5401 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech I Semester Examinations, April/May 2012
MACHINE MODELLING AND ANALYSIS
(COMMON TO POWER ELECTRONICS, POWER AND INDUSTRIAL DRIVES, POWER ELECTRONICS AND ELECTRIC DRIVES)

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

Answer any five questions
All questions carry equal marks
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1.a) What is primitive 2-axis machine? How the various windings of a machine are represented by the primitive machine and write the voltage equations?
b) Derive the mathematical expressions for voltage and force/torque from the fundamental principles for
i) Solenoid with fixed armature
ii) Solenoid with angular movement.

2.a) Obtain the transfer function of a separately excited DC motor by considering armature inductance, La and load torque, T_L in terms of undamped natural angular frequency and damping factor.
b) Obtain the mathematical model of DC series motor in state variable form.

3.a) Obtain the mathematical model of a differentially compounded DC motor in matrix form.
b) A 10 kW, 230V, 1500 rpm DC motor has the following constants:
Ra = 1.0Ω; La = 0.104; km = 4.00 Nm/armature-amps; J = 1.00 kg-m^2;
The load coupled with the motor has its inertia equal to 1.00 kg-m^2. If the load torque varies linearly with speed, then calculate undamped natural angular frequency, damping ratio and investigate its dynamic behavior. Neglect rotational losses.

4.a) Explain the importance of phase and active transformations in case of AC motors.
b) In order to ensure power invariance in transforming one set of variables to another, show that the transformation matrix should be equal to its inverse.

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) What is commutator transformation? Explain it with respect to 3-φ induction motor.

6. Obtain the state space model of a 3-φ induction motor with
i) Stator reference frame
ii) Rotor reference frame.

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

8.a) Explain Park's transformation for a synchronous machine and develop and develop a mathematical model based on it.

b) Explain how flux linkage equations of synchronous machine model can be transformed from stator reference frame to rotor reference frame.

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