Code No: 52101/MT

M.Tech. I-Semester Examinations,February-2007.
MACHINE MODELLING AND ANALYSIS
(Common to Power Electronics and Electric Drives, Power and Industrial Drives and Power Electronics)

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

Answer any FIVE questions
All questions carry equal marks
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1.a) Write the voltage equations for Kron's primitive machine in matrix form. What observations are mode from the impedance matrix of this machine?

b) Draw the i) basic two pole machine diagram and ii) primitive machine diagrams for the following machines. D.C compound machine, poly phase Induction machine and synchronous machine with amortisseurs.

2.a) Derive the transformations for currents between a rotating balanced z-phase (α, β) winding and a pseudo-stationary two-phase (d, q) winding. Assume equal turns on all coils. Show that the transpose of current transformulation matrix is equal to its inverse.

b) For steady slato balanced operation with

$$i_a = I_m \cos (wt+\phi)$$

$$i_b = I_m \cos (wt+\phi - \frac{2\pi}{3})$$

$$i_c = I_m \cos (wt+\phi+\frac{2\pi}{3})$$

Determine the primitive coil current i_d and i_q and show that these are steady d.c. values.

3.a) The brush axis of a separately excited d.c. motor armature is displaced from q-axis by an angle of $\propto^o$. Show that its electro magnetic torque T_e is given by the expression

$$T_e = [M_d I_f I_a \cos \propto + \frac{1}{2} I_a^2 (2_d-L_q) \sin 2\propto]$$

b) A 220v, 5Kw, 1480 r.p.m. separately excited d.c. motor has the following data:

$r_a = 1.2\Omega$ no load speed = 1500 r.p.m

$J = 1.6$ Kg.m^2 no load current = 3A

Assume constant field current and neglect armature inductance. Find the parameters of equivalent electrical circuit.

Contd...2

4.a) Develop the complete mathematical model of d.c. shunt machine from its basic equations.

b) Derive the transfer function of the separately excited d.c. motor and show that

$$\text{T.F, } \frac{W_r}{V_t} = \frac{K_m}{JL_a} \cdot \frac{1}{S^2 + \frac{1}{T_a}S + \frac{1}{T_a T_m}}.$$

When Load torque is neglected.

5.a) Derive the equation $\frac{w_r(s)}{V_t(s)} = \frac{1}{Km} \cdot \frac{1}{1+T_m.s}$

from the transfer function model of separately excited d.c. motor.

b) Obtain an electrical circuit which is equivalent to a separately excited d.c. motor.

6.a) Draw the basic circuit model for a 3-phase Induction motor and obtain the voltage equations in the form of matrices in terms of stator and rotor currents.

b) Derive and obtain expressions for flux linkages in the two-axis model for a 3-phase induction motor from φ_a and φ_b and φ_c values.

7.a) Explain steady state analysis of a 3-phase Induction machine from its mathematical model and obtain its equivalent circuit from its steady state analysis.

b) Derive the steady state torque equation from its mathematical model and what are your observation on it.

8.a) Derive the circuit model of a 3-phase synchronous motor and mention few salient features from its model.

b) Derive torque equation for a 3-phase synchronous motor model and obtain steady state power angle characteristics based on its torque expression.

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