First Semester M. E. (Electronics and Power Engg.) Examination

MODELLING AND ANALYSIS OF ELECTRICAL MACHINES

1 EEPME 5

P. Pages : 3

Time : Three Hours] [Max. Marks : 80

Note : (1) All question carry equal marks.
(2) Answer **Three** questions from Section A and **Three** questions from Section B.
(3) Due credit will be given to neatness and adequate dimensions.
(4) Assume suitable data wherever necessary.
(5) Use pen of Blue/Black ink/refill only for writing the answer book.

1. (a) Write the volatge equations for Kron's primitive machine in matrix form. What observations are made from the impedance matrix of this machine ? 7

(b) Obtain an expression for elcctrical torque of Kron's primitive machine. Show that no torque is produced by interaction between the flux and current on the same axis. 6

OR

2. (a) Explain various conventions followed in development of generalised machine theory. 7

(b) Draw and explain basic two pole machine representing.

(i) Synchronous machine with dampers.

(ii) D.C. shunt machine without interpoles. 6

3. (a) Explain the term "Invariance of Power" as applied in electrical machines. 6

(b) If the currents are given in complex notation, derive an expression for electrical torque T_e, for any number of poles. 7

OR

4. (a) List the various limitations of generalised theory of electrical machines. 6

(b) What do you understand by the term "Linear Trasformations" used in elelctrical Machine ? Explain with suitable example. 7

5. (a) Draw an equivalent circuit for a poly phase induction motor. What is represented by various parameters involved in this circuit ? 6

(b) A three phase induction motor develops a maximum torque 5 time the full load torque at a slip of 0.3. Rotor resistance is 0.05 Ω per phase. The stator and rotor losses can be neglected.
Calculate :—

(i) Slip at full load torque and

(ii) Staring torque in terms of full load torque. 7

OR

6. (a) If the stator resistance of a polyphase Indiction Motor is neglected, show that its torque can be expressed as

$$T_e = Tem \cdot \frac{2}{\frac{S_m.T}{S} + \frac{S}{S_m.T}}$$ 6

(b) A 3-phase squirrel cage induction motor has rotor starting current 6 times the full load value. The motor has a full load slip of 5% Calculate :—

(i) Starting torque in terms of full load torque.

(ii) Maximum torque in terms of full load torque.

(iii) Slip of maximum torque. 7

SECTION B

7. (a) Explain how Park's transformation transform equations in a, b, c variables to d, q, 0 variables. 7

(b) A three phase star connected 50 Hz synchronous generator has direct axis synchronous reactance of 0.65 pu. and quadrature axis synchronous reactance of 0.5 p.u. The genetaror delivers a rated KVA at rated voltage, at a power factor 0.8 lagging. Calculate the open circuit voltage and voltage regulation. Resistance drop at full load is 0.02 p.u. 6

OR

8. (a) What are the various basic parameters of synchronous machine ? Derive expression for armature to field mutual inductance and armature self inductance for salient pole synchronous machine. 7

(b) A three phase, 50 Hz, cylindrical rotor synchronous machine has following parameters self inductance for phase α = 3.15 mH Armuture leakage inductance = 0.35 mH. Calculate the mutual inductance between armature phases and its synhronous reactance. 6

9. (a) Show that $T_d'' = \frac{T_{do}'' \cdot X''_d}{X_d'}$ 5

(b) Two similar 3-phase star connected alternators supply in parallel a load of 1000 KW at 10 KV at 0.8 p.f. lagging, sharing the load equally. Synchronous impedance of machine is 4 + j50 ohm per phase. Field excitation of first machine is so adjusted that its armature current is 50 A lagging. Determine the armature current and p.f. of second machine and excitation of first machine. 8

OR

10. (a) Explain in detail various types of reactances associated with an alternator and how they are caused. 6

(b) A synchronous motor connected to infinite bus and suddenly a load is added on the shaft of motor. Using equal area criterion, analyse the transient stability of system. 7

11. (a) Explain linearization of machine equation for induction machine. 7

(b) Derive the small displacement equation of an induction machine with flux linkages per second as state variable. Express the equation in fundamental form. 7

OR

12. (a) Formulate the transfer function $(\Delta wr/W_L)/\Delta T_L$ for synchronous machine. 7

(b) Explain in brief the changes that must be made in linearized equation of 3-phase induction machine. 7