MEPS-105

M.E./M.Tech., I Semester

Examination, December 2017

Advance Course in Electrical Machines

Time : Three Hours

Maximum Marks : 70

Note: i) Attempt any Five questions.
ii) All questions carry equal marks.

1. a) Derive the transformations for currents between a rotating balanced 2-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 transformation matrix is equal to its inverse. 10
   b) What is meant by 'power invariance'? 4

2. a) Enlist the assumptions pertaining to the use of generalized mathematical model of D.C. machines. 4
   b) For a D.C. machine show that the motional inductance M_d is given by

$$M_d = \frac{\phi z}{\pi A} \cdot \frac{1}{I_f}$$

   The symbols used have their usual meaning. 10

3. Draw the generalized mathematical model of a 3-phase induction machine. Write down the voltage equations for this model and obtain equivalent circuit for the 3-phase induction machine. 14

4. a) Derive the equivalent circuit of a single-phase induction motor with the help of double revolving field theory. 6

   b) A 3-phase induction motor, driving a constant load, is connected to constant-frequency voltage source. For this induction motor, explain, with the reduction in supply voltage, the stator current increases. 8

5. Derive the expressions for armature to field mutual inductances and armature self inductances for a salient-pole synchronous machines. How are these inductance expressions modified for cylindrical-rotor synchronous machines. What are the advantages of resolving armature mmf into d-q axes components? 14

6. a) Explain how the Park's transformations transform equations in a, b, c variables to d, q, o variables. 4
   b) Write the expression of impedance matrix for a 3-phase salient-pole synchronous machine fitted with damper winding. Obtain an expression for the instantaneous electromagnetic torque. 10

7. a) Explain the effect of Short Circuit Ratio (SCR) on the operating characteristics and the physical size of synchronous machine. 6
   b) A 3-phase, 50 Hz cylindrical-rotor synchronous machine has the following parameters :
   Self-inductance for phase "a" = 3.15mH
   Armature leakage inductance = 0.35mH
   For this machine, calculate the mutual inductance between armature phases and its synchronous reactance. 8

8. a) Show that the condition for stability for large angular oscillations inn synchronous machine is given by

$$\frac{d\delta}{dt} = 0$$

   7
   b) What is equal-area criterion of stability? Explain how it is used to determine the transient stability of synchronous machine system. 7

******