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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRSTSEMESTER M.TECH DEGREE EXAMINATION, JUNE/JULY 2018

Branch: Electrical and Electronics Engineering

Stream(s):

1. Power Control and Drives
2. Electrical Machines
3. Power systems

Course Code & Name: 01EE6301: MODELLING OF ELECTRICAL MACHINES

Answer *any two full* questions from *each* part

Limit answers to the required points.

Max. Marks: 60 Duration: 3 hours

PART A

1. a. Write any four conventions to be followed to get the two pole model. (2)

   b. Derive the expression for transformer and speed voltages in the armature along the d – axis. (4)

   c. Draw the basic two pole machine representation for the following machines:

      i) DC Compound Machine
      ii) Synchronous Machine with damper bars

      (3)

2. a. Write the voltage equations for Kron's primitive machine in matrix form (5)

   b. Derive electrical torque expression of Kron's primitive machine in terms of reluctance and show that no torque is produced by interaction between flux and current on the same axis. (4)

3. a. Explain transformations for currents between a rotating balanced three phase (a, b, c) winding to a rotating two phase (α,β) winding. Assume equal number of turns. (6)

   b. Explain the term invariance of power as applied to electrical machines. Show the power invariance is maintained under this transformation. (3)

PART B

4. a. Show that the rotational mutual inductance or motional inductance of a DC machine as:

$$M_d = \frac{\emptyset Z}{\pi A} \frac{1}{Ids} \quad (3)$$

b. Obtain the voltage and torque equation of a separately excited DC motor from its generalized mathematical model. (4)

c. Derive the transfer function of separately excited DC generator under no load operation. (2)

5. a. A separately excited DC generator gave a no load output voltage of 240V at a speed of ω_r and a field current of 3A. Find the generated emf per field ampere, $M_d\omega_r$. Also find the voltage V_2 as a function of time, when a 240V is suddenly applied to the field winding with the armature running at constant speed ω_r. The other constants of the generator are r_f= 60Ω, L_f=60H, r_a=0.02Ω, L_a=0.01H and R_L=0.38Ω. (9)

6. a. Derive the power expression for salient pole synchronous machine in terms of load angle δ and draw the power angle characteristics. (6)

b. Derive the voltage equations in matrix form for a three phase synchronous machine with no amortisseurs. (3)

PART C

7. a. Derive the equivalent circuit of a double cage induction motor with the help of its generalized mathematical model. (9)

b. Draw the torque slip characteristics of poly phase Induction motor. (3)

8. a. Draw the primitive machine diagram of double cage poly phase induction motor and obtain the voltage equation in matrix form. (8)

b. Derive the equivalent circuit of a double cage poly phase induction motor with the help of its generalized mathematical model. (4)

9. a. Write down the electromagnetic torque equations from the primitive machine model of a single phase induction motor and obtain the equivalent circuit for a single phase induction motor. (9)

b. Explain briefly the double field revolving theory of single phase Induction motor. (3)