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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2018

Branch: Electrical and Electronics Engineering

Stream(s):

1. Electrical Machines
2. Power Systems
3. Power System and Control
4. Power Control and Drives

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. Explain the term invariance of power as applied to electrical machines. Show the power invariance is maintained under three phase to two phase transformation. (4)

   b. Derive the expression for transformer and speed voltages in the armature along the quadrature axis. (3)

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

   i)DC Shunt Machine with Interpoles ii) Single phase AC series Machine. (2)

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

   b. Derive electrical torque expression of Kron's primitive machine in terms of reluctance factor 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 pseudo stationary two phase (d,q) winding. Assume equal number of turns. (9)

PART B

4. a. Obtain the voltage and torque equation of DC series motor from its generalized mathematical model. (6)

   c. Derive the transfer function of separately excited DC motor relating the speed ω_r and armature terminal voltage V_t. (3)

5. a. A separately excited DC generator gave a no load output voltage of 240 V at a speed of ω_r and a field current of 3 A. Find the generated emf per field ampere, $M_d\,\omega_r$. Also find the voltage V_2 as a function of time, when a 240 V 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= 60 Ω , L_f=60 H, r_a=0.02 Ω, L_a=0.01H and R_L=0.38 Ω. (9)

6. a. Derive the power expression for salient pole synchronous machine in terms of fundamental and second harmonic component. (6)

   b. Draw the power angle characteristics of salient pole and cylindrical rotor synchronous machine. (3)

PART C

7. a. Derive the equivalent circuit of a poly phase induction motor with the help of its generalized mathematical model. (10)

   b. Draw the torque slip characteristics of double cage Induction motor. (2)

8. a. Draw the primitive machine diagram of double cage poly phase induction motor and obtain the voltage equation in matrix form. (7)

   b. A 3 phase 400 V double cage Induction motor has per phase standstill leakage impedance of (2.0+j2.0) Ω and (0.5+j10) Ω for the top cage and bottom cages. Find the relative values of torques given by each cage at 5% slip. (5)

9. a. Derive the electromagnetic torque equations from the primitive machine model of a single phase induction motor by applying cross field theory. (7)

   b. Explain revolving field theory as applied to single phase Induction motor. (5)