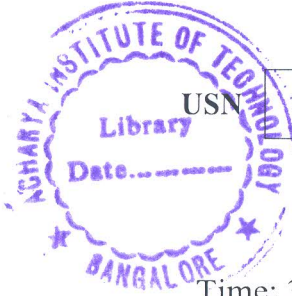


CBCS SCHEME



16/17EPS12

First Semester M.Tech. Degree Examination, June/July 2019 Modelling and Analysis of Electrical Machines

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Indicate the diagrammatic representation of the following rotating electrical machines based on GMT (i) D.C. compound machines (ii) Three phase induction machines (iii) Three phase synchronous machines without and with the damper windings. (08 Marks)
- b. Obtain the voltage equation in matrix form of the Krons generalized machine from fundamental relations corresponding to the four coils. (08 Marks)

OR

- 2 a. Obtain the steady state analysis of a d.c. shunt motor. (08 Marks)
- b. A separately excited d.c. motor fed from silicon controlled rectifier has the following data. Total resistance of motor armature and SCR circuit $R = 0.05 \Omega$, Total inductance of motor armature and SCR circuit $L = 0.01H$, No load source voltage = 250 V. Inertia of rotating parts $J = 18 \text{ kg/m}^2$, Motor torque constant $K_m = 3 \text{ N.m/Amp}$, Friction and windge constant $D = 0$, Calculate the (i) Undamped natural frequency (ii) Damping factor (iii) Damping ratio of the motor system. (08 Marks)

Module-2

- 3 a. With a neat sketch obtain the dynamic model for the three phase induction machine from the two phase machine. (08 Marks)
- b. Obtain and explain the process of transformation to have constant inductance terms in the impedance matrix in an induction machine voltage equation. (08 Marks)

OR

- 4 a. Using synchronously rotating reference frames obtain the torque equation of a three phase induction machine (08 Marks)
- b. A 5 hp, 200 V, 3 phase, 60 Hz, 4 pole star connected induction motor stator resistance is 0.277Ω , rotor resistance is 0.183Ω , mutual inductance is $0.0538H$, stator and rotor inductance are $0.0553H$ and $0.056H$ effective stator to rotor turns ratio $a = 3$. The motor is supplied its rated and balanced voltages. Calculate the a and d axis steady state voltage matrix when the rotor is locked. Use stator reference model induction motor. (08 Marks)

Module-3

- 5 a. Obtain the torque equation of a small signal equations of the induction machine. (08 Marks)
- b. Obtain the DQ flux linkages model derivation of an induction machine. (08 Marks)

OR

- 6 a. With relevant diagrams and equations explain the voltage and phase angle control of a polyphase transformer. (08 Marks)
- b. Three single phase transformers rated at 1000 kVA, 13.2/66 kV, $X_1 = 0.1 \text{ pu}$ and $X_m = 100 \text{ pu}$ are connected in star star connections. Obtain the impedance diagram. (08 Marks)

Module-4

- 7 a. Obtain the stator voltage equations in an arbitrary reference frame variables of a synchronous machine. (08 Marks)
b. Obtain the expression for rotor angle and angle between rotors of synchronous machine. (08 Marks)

OR

- 8 a. Obtain the equation for torque developed by a three phase synchronous machine in per unit system. (08 Marks)
b. Develop the equation for torque developed by a three phase synchronous machines in terms of currents and flux linkages in parks reference frame. (08 Marks)

Module-5

- 9 a. Draw and explain the characteristic of torque versus rotor angle for equal area criterion of synchronous machine for sudden change in input torque. (08 Marks)
b. Draw and explain the block diagram of simulation of synchronous machine in which abc variables are transferred directly to the rotor reference frame with necessary equations. (08 Marks)

OR

- 10 a. Explain the dynamic performance of a synchronous machine during a three phase fault at the machine terminals. (08 Marks)
b. Give a comparison of a actual and transient (approx.) torque angle characteristics during a three phase fault at the terminals of a three phase synchronous machine. (08 Marks)

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