C

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2015

Electrical & Electronics Engineering

Streams: Electrical Machines, Power Systems, Power Control & Drives, Power system and Control

01EE6301: MODELLING OF ELECTRICAL MACHINES

Time: 3 hours Max marks: 60

Answer any two full questions from each part.

PART–A (Module I and II)

1 a. Differentiate between transformer and speed voltages. (3)

b. A coil moves in a time varying magnetic field whose spatial distribution along the air gap periphery is sinusoidal. Find an expression for voltage induced in the coil identifying the terms therein. (6)

2 a. Explain the reason for using transformation in electrical machines. (3)

b. Obtain identical transformations for currents and voltages from a rotating balanced 3 phase (a,b,c) winding to a rotating 2 phase (α, β) winding. Show that power invariance is maintained in the transformation. (6)

3 a. Explain the term power invariance applied to electrical machines (3)

b. Substantiate the advantages of using per unit system with examples. (6)

Part B (Module III and IV)

4 a. Derive the expression for motional inductance of a dc machine (3)

b. A 250 V dc series motor running at 150 rad/sec takes 20 amperes from the supply mains. The armature and field resistances are $r_a + r_f = 1.0\ \Omega$. Total J= 5.4 kg.m^2 and D= 0.02 Nm.sec/rad. Calculate the rotational mutual inductance and the load torque. If the supply voltage is suddenly reduced to 220V with the load torque remaining constant, find the speed as a function of time. (6)

5 a. Write the impedance matrix for a 3 phase salient pole synchronous machine. Hence obtain an expression for instantaneous electromagnetic torque and identify the various terms in it. (6)

	b.	A salient pole synchronous generator has X_q = 0.8 pu and r_a= 0.02 pu. if this generator delivers rated kVA at 0.8 pf lagging and at a rated voltage, compute the load angle	(3)
6	a.	Derive expressions for armature to field mutual inductances and armature self inductances for a salient pole synchronous machine.	(6)
	b.	Draw an electrical equivalent circuit of a separately excited dc generator	(3)

Part C - Module (V &VI)

7	a.	Draw the generalized mathematical model of a poly phase induction machine. Write down the voltage equations for the model and obtain there from the equivalent circuit for a poly phase induction motor	(6)
	b.	A 10 kW, 50 Hz, 6 pole, poly phase induction motor has a full load slip of 0.04. If its friction and windage losses are 4% of the output, then compute the rotor copper loss at full load, full load electromagnetic torque and rotor efficiency	(6)
8	a.	Compare the performance of a single cage and double cage motor of the same rating.	(4)
	b.	Derive the equivalent circuit of a single phase induction motor with the help of double field revolving theory	(8)
9	a.	Compare single phase and poly phase induction motors	(4)
	b.	A 230V, 4 pole, 50 Hz single phase induction motor has the following constants and losses: r1 = 2.3 Ω, x1= 3.2 Ω, r2= 4.2Ω, x2 = 3.2Ω, Xm =74Ω, core loss = 98 W, friction and windage loss = 30W. If this motor is running with a slip 0.05 at rated voltage and frequency, then compute the stator current, pf, power output, torque and efficiency with its auxiliary winding open.	(8)
