Code No: A4309 **NR**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH I - SEMESTER EXAMINATIONS, APRIL/MAY-2012
DYNAMICS OF ELECTRICAL MACHINES
(POWER ELECTRONICS)

Time: 3hours **Max. Marks: 60**

Answer any five questions
All questions carry equal marks

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1.a) Describe the steady state equations of a squirrel cage induction motor and hence deduce its equivalent circuit?

b) What is meant by magnetic saturation? Discuss its affect on the modeling of DC machines?

2. A 240-V, permanent magnet, DC motor takes 2 A whenever it operates at no load. Its armature winding resistance and inductance are 1.43 Ω and 10.4 mH, respectively. The flux per pole is 5 mWb and the motor constant K_a is 360. The moment of inertia is 0.068 kg.m^2. If the motor is suddenly connected to a 240-V DC source while operating at no load, determine its speed and armature current as a function of time.

3.a) What are the state variables and input variables in the linear dynamic representation of a separately excited DC motor? Explain them.

b) Derive the speed control system for an armature controlled DC motor.

4.a) Explain the modeling of separately excited DC generators with its steady state and transient analysis.

b) A l000-kVA, 4.6-kV 60-Hz, 4-pole synchronous generator delivers 0.9 pu of average power at a power angle of 18^0 when a three-phase short circuit develops cross its terminals. Calculate

i) The per-unit power generated by the generator when the fault is cleared four cycles after its inception and

ii) The critical time to clear the fault in order not to lose the stability. The inertia constant is given as 10 J/VA.

5.a) Derive the torque expression of separately excited DC motor.

b) A 230V separately excited DC motor is driving a constant load torque with the following data:
R_a=0.4 Ω, L=0.01H, R_f =115 Ω, $K_m = M_d I_f$ =2Nm/armature amp, D=0
The armature current is 50A with rated voltage across the armature and field. Determine the magnitude of constant load torque if the armature voltage is suddenly reduced by 20V. Find the speed as function of time. Total J= 12kgm^2.

6. A 3 phase,4 pole, 50 Hz squirrel cage Induction Motor has the following speed torque characteristics at rated voltage and frequency:

Speed, rpm	1500	1425	1350	1200	1125	1050	900	750	600	450	300	150	0
Torque, Nm	0	31.5	55	80	78	73.5	62	53	45	37.5	35	32	30

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This motor is coupled with a fan whose torque requirement is proportional to square of the speed. The fan takes a torque of 31.5Nm at 1425 rpm. Determine the time taken by the fan to reach its rated speed when DOL starter is used. The combined moment of inertia of motor and load is 2Kg-m^2.

7.a) Derive the expression for kinetic energy 'H' of a Synchronous Motor.

b) Develop the electromechanical equation for Synchronous generator.

8.a) What is the need of representing the oscillation equations in state variable form in Synchronous machines?

b) Explain the state variable form representation of oscillation equations in Synchronous machines.

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