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10EE54

Fifth Semester B.E. Degree Examination, Dec. 2013/Jan. 2014
DC Machines and Synchronous Machines

Time: 3 hrs. Max. Marks: 100

Note: ***Answer FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Derive the expression for emf induced in a DC generator with usual notations. **(06 Marks)**

b. Draw the no load characteristic of a DC shunt generator and comment on its shape. Explain how critical resistance can be found out from the no load characteristic. **(08 Marks)**

c. A 6 pole, 148 A DC shunt generator has 480 conductors and is wave wound. Its field current is 2 A. Find the demagnetizing and cross magnetizing amp turns /pole at full load if
   i) The brushes are at the geometrical neutral axis (GNA)
   ii) The brushes are shifted from GNA by 5° electrical
   iii) The brushes are shifted from GNA by 5° mech. **(06 Marks)**

2 a. Classify DC motors according to their field winding connections. Draw the circuit diagrams and write the voltage and current relationships in all the types. **(10 Marks)**

b. With the help of relevant characteristic, explain why a series motor should never be started at no load. **(04 Marks)**

c. A 200 V DC shunt motor takes 22 amp at rated voltage and runs at 1000 rpm. Its field resistance is 100 Ω and armature resistance is 0.1 Ω. Compute the value of additional resistance required in the armature circuit to reduce the speed to 800 rpm when
   i) The load torque is proportional to the speed
   ii) The load torque is proportional to the square of the speed. **(06 Marks)**

3 a. What are the losses occurring in a DC machine. Explain how do they vary with the load. Derive the condition for maximum efficiency of a DC generator. **(08 Marks)**

b. Draw the power flow diagram of a DC long shunt compound generator and explain. **(04 Marks)**

c. A 10 KW 250 V shunt generator has total no load rotational loss of 400 W, the armature and field resistances are 0.5 Ω and 250 Ω respectively. Calculate the shaft power input and efficiency at the rated output. Also calculate the maximum efficiency and the corresponding power output. **(08 Marks)**

4 a. Explain, with the help of necessary circuit diagram, how the efficiency of a DC generator and motor can be predetermined by conducting Swinburn's test. Obtain the efficiency expressions for the motor and generator. **(10 Marks)**

b. Two identical DC shunt machine, when tested by Hopkinson's method, gave the following data :
   Line voltage = 230 V
   Line current excluding the field current = 30 A
   Motor armature current = 230 A
   Field currents 5 A and 4 amp. The armature resistance of each machine is 0.025 Ω. Calculate the efficiency of both the machines. **(10 Marks)**

PART – B

5 a. Define pitch factor and distribution factor. Derive the expressions for theses factors. Explain the effect of harmonics on them. **(10 Marks)**

b. A 3 phase 8 pole 50 Hz star connected alternator has 96 slots with 4 conductors /slot. The coil span is 10 slots and the flux per pole is 0.06 wb. Determine the line emf generated. If each phase is capable of carrying 650 amp, what is the KVA rating of the machine? **(10 Marks)**

6 a. With the help of neat sketches, explain how the voltage regulation can be determined using EMF method from the O.C and S.C test results. **(10 Marks)**

b. A 220 V, 50 Hz 6 pole star connected alternator with armature resistance 0.06 Ω /phase gave the following data for open circuit and short circuit characteristic. Find the % voltage regulation at full load current of 40 amp at a power factor of 0.8 lag by mmf method.

Field current I_f A	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.8	2.2	2.6	3.0	3.4
O.C voltage/ ph Eo_{ph} V	16.7	33.5	50.2	67	84.3	99.3	112	134	151	164	173.2	179
S.C current I_{SC} A	6.6	13.2	20	26.5	32.4	40	46.3	59.0	–	–	–	–

(10 Marks)

7 a. What are the conditions to be satisfied when two alternators are connected in parallel? Derive the expressions for synchronizing power and torque neglecting the effect of Ra. **(10 Marks)**

b. Two identical 3 phase alternator work in parallel and supply a load of 1500 KW at 11 KV at a p.f of 0.867 lag. Each machine supplies half the total power. The synchronous reactance of each machine is 50 Ω/ phase and the resistance is 4 Ω/ph. The field excitation of the 1st machine is so adjusted that its armature current is 50 A lagging. Find the armature current of the second alternator and the generated emf of the first. **(10 Marks)**

8 a. Explain why a synchronous motor is not self starting. Briefly explain the following starting methods in detail,

i) Auxiliary motor starting

ii) Induction motor starting. **(10 Marks)**

b. Briefly explain the effect of varying excitation on armature current and power factor. **(10 Marks)**

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