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10EE54

Fifth Semester B.E. Degree Examination, July/August 2022
DC Machines and Synchronous Machines

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, selecting at least TWO questions from each part.

PART – A

- 1 a. What is meant by armature reaction in a DC machine? Briefly explain the effects of armature reaction. (05 Marks)
b. Why a commutator is desired in a DC machine? With relevant figures, explain the process of commutation in a DC machine. (10 Marks)
c. An eight pole wave wound DC generator has 480 armature conductors. The armature current is 200 A. Find the armature reaction demagnetizing and cross magnetizing ampere turns/phase if brushes are on (i) GNA (ii) Brushes are shifted by 6° electrical. (05 Marks)
- 2 a. Explain what is meant by Back emf and discuss its significance in justifying the requirement of starter for DC motor. (05 Marks)
b. When on normal full load, a 500 V DC shunt motor runs at 800 rpm and takes on armature current of 42 amps. The flux/pole is reduced to 75% of its normal value by suitably increasing the field circuit resistance. Calculate the speed of the motor if the total torque exerted on the armature: (i) Unchanged (ii) Reduced by 20%. Armature resistance is 0.6 ohm and voltage drop across brush is 2V. (08 Marks)
c. With a neat sketch, explain Ward-Leonard system of speed control of motor. (07 Marks)
- 3 a. Discuss and briefly explain the various losses occurring in DC machines. (05 Marks)
b. Derive an expression for the condition for maximum efficiency of a DC generator and load current corresponds to maximum efficiency. (05 Marks)
c. Explain Field's test on two similar DC series motors. Obtain the expression for efficiency of motor and generator. (10 Marks)
- 4 a. Explain Swinburne's test to determine the efficiency of a DC machine which can work as a generator and as a motor. What are the disadvantages of this method of testing DC machines? (10 Marks)
b. A shunt generator has a full load current of 196 amps at 220 V, the stray losses are 720 Watts and shunt field coil resistance is 55 ohm. If it has a full load efficiency of 88%, find the armature resistance. Also find the load current corresponds to maximum efficiency. (10 Marks)

PART – B

- 5 a. Why rotating field system and stationary armature winding is chosen in the construct of MW size alternator? Explain the advantages. (06 Marks)
b. Derive the general expression for pitch factor and distribution factor in the presence of any n^{th} harmonic in the induced emf. (08 Marks)
c. A 3 phase, 16 pole, 375 rpm, star connected alternator has 192 slots with 8 conductors/slot and conductors of each phase are connected in series. The coil span is 150° electrical. Find the phase and line induced emf if the flux is 64 mWb and sinusoidally distributed. (06 Marks)

- 6 a. What is meant by voltage regulation of an alternator? Explain MMF method of determining the voltage regulation of an alternator. Why MMF method gives optimistic results? Briefly explain. Assume armature resistance is neglected. (10 Marks)
- b. A 11 KV, 1000 KVA, 3 phase star connected alternator has a resistance of 2 ohms/phase. The open circuit and full load zero power factor characteristics are given below. Find the voltage regulation of alternator for full load current at 0.8 p.f. lagging by Potier method.

Field current (A)	40	50	110	140	180
OCC line voltage (V)	5800	7000	12500	13750	15000
Line volts zero p.f.	0	1500	8500	10500	12500

(10 Marks)

- 7 a. Explain the operating characteristics of synchronous generator for constant load with variable excitation. Draw supportive phasor diagram and V curves. (10 Marks)
- b. Derive an expression for synchronizing power and torque when two alternators are operating in parallel. (10 Marks)
- 8 a. Briefly explain the synchronous condenser and its applications. (05 Marks)
- b. Explain the phenomenon of hunting in synchronous motor. How damper windings minimize hunting? (05 Marks)
- c. A 3 phase 6600 V, star connected synchronous motor delivers 500 KW power to full load. Its full load efficiency is 83%. Its armature resistance is 0.3 ohm/phase and synchronous reactance is 3.2 ohm/phase. It is working with 0.8 leading power factor on full load. Calculate: (i) Generated emf on full load (ii) Load angle (10 Marks)

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