3E1484

Roll No. : ______________________ Total Printed Pages : 4

3E1484

B.Tech. (Sem. III) (Main/Back) Examination, February - 2010
Electrical Engineering
(3EE4 Electrical Machine - I)

Time : **3** Hours] [Total Marks : **80**
[Min. Passing Marks : **24**

*Attempt **five** questions in all. Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly.*

Use of following supporting material is permitted during examination.
(Mentioned in form No. 205)

1. ______Nil______ 2. ______Nil______

1 (a) State and briefly explain the various phenomena useful for electromechanical energy conversion in rotating machines. Write an energy balance equation for a motor.

(b) For a singly excited magnetic system, establish relationship between magnetic field energy and coenergy. The magnetic flux density on the surface of an iron face is 1.6 Tesla. Find the force density on iron face.

OR

1 (a) Define energy and coenergy for a singly-excited magnetic system, derive the expression for mechanical force and mechanical work done. Make suitable assumptions.

(b) Derive the expression for the torque developed in doubly excited magnetic system. Clearly state the assumptions made.

8+8

2 (a) Draw a neat sketch of dc generator. State the function of each part. Derive the equation of emf induced in dc generator.

(b) A lap wound dc generator having 80 slots with 10 conductors per slot generates at no load an emf of 400 volts when running at 1000 r.p.m. At what speed should it be related to generate a voltage of 220 V on open circuit?

OR

2 (a) Explain the process of building up a voltage in a dc generator and give the conditions to be satisfied for voltage build up. What is critical field resistance and what is its significance?

(b) A shunt generator gives full load output of 30 kW at a terminal voltage of 200 V. The armature and shunt field resistances are 0.05 Ω and 50 Ω respectively. The iron and friction losses are 1000 Watts. Calculate

(i) emf generated

(ii) copper losses

(iii) efficiency.

8+8

3 (a) Derive an expression for torque developed in a dc motor. Draw and briefly explain torque Vs current (or load) characteristics of dc shunt and series motor.

(b) A 4-pole, 250 volt wave connected shunt motor gives 10 kW when running at 1000 r.p.m. and drawing armature and field currents of 60 Amps and 1 Amp respectively. It has 560 conductors. Its armature resistance is 0.2 Ω. Assuming a drop of 1 volt per brush, determine

(i) total torque developed

(ii) useful flux per pole

(iii) efficiency

OR

3 (a) Why is electric braking of electric motors superior to mechanical braking? What is regenerative braking? Why it cannot be accomplished with a series wound dc motor without modifications in the circuit? Give merits and demerits.

(b) Describe the Hopkinson's test for obtaining the efficiency of two similar shunt motors.

8+8

4 (a) Develop the approximate equivalent circuit referred to primary side of transformer, and indicate how it differs from the exact equivalent circuit.

(b) The following tests were obtained on a 20 kVA, 2200/220V, 50 Hz single phase transformer.

OC test (LV side) : 220 V, 1.1 Amp. 125 Watts

SC test (HV side) : 52.7 V, 8.4 Amp, 287 Watts

The transformer is loaded at unity factor on secondary side with a voltage of 220 V. Determine the maximum efficiency and the load at which it occurs.

OR

4 (a) Explain Sumpner's back to back test for testing two single phase transformers and also explain why this is benificial for finding efficiency of transformers.

(b) The maximum efficiency of a 1-phase 100 kVA, 50 Hz transformer is 98% and occurs at 80% of full load at 0.8 power factor lagg. If the leakage impedance of the transformer is 5%, find the voltage regulation at full load.

5 (a) (i) What are the Vee and Tee-connections of transformer? Where are they used?

(ii) Explain with necessary diagrams how two 3-phase transformers can be used to convert a 3-phase supply to a 2-phase supply.

(b) Two 1-phase Scott-connected transformers supply a 3-phase, 4-wire, 50Hz distribution system with 250 volts between lines and neutral. The high voltage windings are connected to a 2-phase system with a phase voltage of 11000 V. Allow a maximum flux density of 1.2 Web/m^2 in a net core section of 0.9×550 cm^2, determine the number of turns in each section of the high voltage and low voltage windings, and the position of the neutral point.

8+8

OR

5 (a) (i) Explain the advantages of using a tertiary winding in a bank of star-star transformers.

(ii) What is meant by three phase transformer groups? What are possible connections for a 3-phase transformer bank?

(b) What schemes of connections are commonly used for 3-phase to six-phase transformation. Explain one of them.
