C 6130

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Name.....

Reg. No.....

SIXTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, JUNE 2010

EE 04 605—ELECTRICAL MACHINE DESIGN

(2004 Admissions)

Time : Three Hours

Maximum : 100 Marks

Answer **all** *questions.*

I. (a) What are the factors to be considered for selecting the no. of poles of a D.C. machine ?

(b) Derive the output equation of a D.C. machine.

(c) Differentiae between the specific electric and magnetic loading of a transformer.

(d) What are the different categories CTs ? How CTs are different from ordinary transformers ?

(e) Explain the various methods employed in the reduction of harmonics in alternators.

(f) Enumerate the various factors to be considered while selecting the no. of armature slots in a synchronous machine.

(g) Explain the phenomenon of cogging in induction machines.

(h) What is meant by dispersion coefficient in an induction machine ? How it affects the performance of the machine ?

(8 × 5 = 40 marks)

II. (a) (i) What is commutation in D.C. machines ? What are the steps to improve commutation ?

(6 marks)

(ii) A d.c. machine has the following name plate data and physical properties : 550 V, 275 kW, 900 r.p.m., 6 poles wave wound armature winding in 180 slots with 8 conductors in each slot, 70% of armature surface covered by poles. Find

1 the armature m.m.f. per pole at rated armature current.

2 the no. of conductors that should be placed in each pole face to provide adequate compensating winding.

3 the number of turns required on each of the 6 commutating poles to provide a flux density across on effective gap length of 5 mm if the machine has no compensating windings.

(9 marks)

Or

Turn over

(b) Calculate the diameter and length of armature for a 7.5 kW, 4 pole, 1000 r.p.m., 220 V shunt motor. Given full load efficiency as 0.83, maximum gap flux density as 0.9 Wb/m^2, specific electric loading = 30000 ampere conductors per metre, field form factor = 0.7. Assume that maximum efficiency occurs at full load and the field current is 2.5% of rated current. The pole face is square.

(15 marks)

III. (a) (i) Explain the design procedure for CTs. (7 marks)

(ii) What are the different types of core designs employed in transformers? How they are selected?

(8 marks)

Or

(b) Determine the main dimensions of the core, the no. of turns and the cross-section of conductors for a 5 kVA, 11000/400 V, 50 Hz single phase core type distribution transformer. The net conductor area in the window is 0.6 times the net cross-section of iron in the core. Assume a square cross-section for the core, a flux density of 1 Wb/m^2, a current density of 1.4 A/mm^2 and a window space factor 0.2. The height of the window is 3 times its width.

(15 marks)

IV. (a) (i) Enumerate the various factors to be considered in the design of the magnetic circuit of an alternator.

(5 marks)

(ii) The field coils of a salient pole alternator are wound with a single layer winding of bare copper strip 30 mm deep, with separating insulation 0.15 mm thick. Determine a suitable winding length, number of turns and thickness of conductor to develop an m.m.f. of 12,000 A with a potential difference of 5 V per coil and with a loss of 1200 W/m^2 of total coil surface. The mean length of turn is 1.2 m. The resistivity of copper is 0.021 Ωm.

(10 marks)

Or

(b) Determine the main dimensions of a 75000 kVA, 13.8 kV, 50 Hz, 62.5 r.p.m., 3 phase star connected alternator. Also find the number of stator slots, conductors per slot, conductor area and work out the winding details. The peripheral speed should be about 40 m/s. Assume average gap density = 0.65 Wb/m^2, ampere conductors per meter = 40,000 and current density is 4 A/mm^2.

(15 marks)

V. (a) (i) Explain the significance of length of airgap in the design of rotor of an induction motor.

(5 marks)

(ii) A 15 kW, 3 phase 6 pole 50 Hz squirrel-cage induction motor has the following data :

Stator bore diameter = 0.32 m ; axial length of stator core = 0.125 m ; no. of stator slots is 54 ; number of conductors per stator slots = 24 ; current in each stator conductor = 17.5 A ; full load power factor = 0.85 lagging.

Design a suitable cage rotor giving number of rotor slots, section of each bar and section of each ring. The full load speed is to be about 950 r.p.m. approximately. Use copper for rotor bars and end rings. Resistivity of copper is 0.02 Ωm.

(10 marks)

Or

(b) Determine the main dimensions, number of radial ventilating ducts, number os stator slots and the number of turns per phase of a 3.7 kW, 400 V, 3 phase, 4 pole, 50 Hz squirrel-cage induction motor to be started by a star-delta starter. Work out the winding details.

Assume :

Average flux density in the gap = 0.45 Wb/m^2, ampere conductors per metre = 23000, efficiency = 0.85 and power factor = 0.84.

(15 marks)

[4 × 15 = 60 marks]