C 30141 (Pages : 3) Name.....

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SEVENTH SEMESTER B.TECH. (ENGINEERING) DEGREE [2014 SCHEME] EXAMINATION, NOVEMBER 2017

Electrical and Electronics Engineering

EE 14 704 B—ELECTRICAL MACHINE DESIGN

Time : Three Hours Maximum : 100 Marks

Part A

Answer any **eight** *questions.*

1. A design is required for a 50kW, 4pole, 600rpm, and 220V dc shunt generator. The average flux density in the air gap and specific electric loading are respectively 0.57T and 30000 ampere-conductors per meter. Calculate suitable dimensions of armature core to lead to a square pole face. Assume that full load armature drop is 3% of the rated voltage and the field current is 1% of rated full load current. Ratio pole arc to pole pitch is 0.67.
2. Derive the relation between real and apparent flux densities in a DC machine.
3. Describe the effects of higher the value of Bav in the design of DC machines.
4. Derive the relation between emf/turn and KVA rating in a transformer.
5. State the advantages and disadvantages of increasing the airgap length.
6. Highlight the major differences in the design of field system of salient and non-salient pole alternator.
7. Explain the design strategy of damper windings.
8. Discuss the effects of short circuit ratio.
9. Explain the advantages and disadvantage if selecting higher current density in the design of induction machine.
10. What is end ring current and derive its relation ?

(8 × 5 = 40 marks)

Part B

Answer **all** *questions.*

11. (a) Determine the main dimensions of the armature core, number of conductors, and commutator segments for a 350kW, 500V, 450 rpm, 6 pole shunt generator assuming a square pole face with pole arc 70% of the pole pitch. Assume the mean flux density to be 0.7T and ampere-conductors per cm to be 280.

(15 marks)

Or

Turn over

(b) A 500kW, 500V, 375 rpm, 8 pole dc generator has an armature diameter of 110 cm and the number of armature conductor is 896. Calculate the diameter of the commutator, length of the commutator, number of brushes per spindle, commutator losses and temperature rise of the commutator. Assume single turn coils.

(15 marks)

12. (a) Derive the expression for the leakage reactance of core type transformer with concentric LV and HV coils of equal height or length.

(15 marks)

Or

(b) Determine the main dimensions of the core and window for a 500 kVA, 6600/400V, 50Hz, Single phase core type, oil immersed, self-cooled transformer. Assume: Flux density = 1.2 T, Current density = 2.75 A/mm^2, Window space factor = 0.32, Volt / turn = 16.8, type of core: Cruciform, height of the window = 3 times window width. Also calculate the number of turns and cross-sectional area of the conductors used for the primary and secondary windings.

(15 marks)

13. (a) Design the stator frame of a 500 kVA, 6.6 kV, 50 Hz, 3 phase, 12 pole, star connected salient pole alternator, giving the following informations :

(i) Internal diameter and gross length of the frame.

(ii) Number of stator conductors.

(iii) Number of stator slots and conductors per slot.

Specific magnetic and electric loadings may be assumed as 0.56 Tesla and 26000 AC/m respectively. Peripheral speed must be less than 40 m/s and slot must be less than 1200.

(15 marks)

Or

(b) The field coils of a salient pole alternator are wound with a single layer winding of bare copper strip 30 mm deep, with a separating insulation of 0.15 mm thick. Determine a suitable winding length, number of turns and thickness of the conductor to develop an mmf of 12000 AT with a potential difference of 5 volts per coil and with a loss of 1200 w/m^2 of total coil surface. The mean length of the turn is 1.2 m. The resistivity of copper is 0.021 Ω/m and mm^2

(15 marks)

14. (a) Following design data have been obtained during the preliminary design of a 3 phase, 850 kW, 6.6 kV, 50 Hz, 12 pole slip ring induction motor. Gross length of stator core = 45 cm, internal diameter of the stator core = 122 cm, number of stator slots = 144, Number of conductors per slot = 10. For the above stator data design a wound rotor for the motor.

(15 marks)

Or

(b) (i) Determine the main dimensions for a 15 HP, 400 volt, 3-phase, 4-pole, 1425 rpm Induction motor. Adopt a specific magnetic loading of 0.45 Wb/m^2 and a specific electric loading of 230 ac/m. Assume that a full load efficiency of 85% and a full load power factor of 0.88, will be obtained.

(8 marks)

(ii) Discuss the rules for the selection of rotor slots for a cage induction rotor.

(7 marks)

[4 × 15 = 60 marks]