NEW SCHEME

EE62

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Sixth Semester B.E. Degree Examination, July/August 2005

Electrical & Electronics Engineering

Electrical Machine Design

Time: 3 hrs.] [Max.Marks : 100

Note: *1. Answer any FIVE full questions.*
2. Missing data, if any, can be suitably assumed.

1. (a) Classify the insulating materials based on thermal considerations. Give examples for each classification. **(7 Marks)**

(b) What are the major considerations accounted for the good design of electrical machines. **(5 Marks)**

(c) Derive the output equation of a d.c. machine. **(8 Marks)**

2. (a) Determine the main dimensions, number of poles, and length of air gap of a 600 kW, 500V, 900 rpm d.c. generator. Assume average gap density as $0.6 Wb/m^2$ and ampare conductors per meter as 35000. The ratio of pole arc to pole pitch is 0.75 and the efficiency as 91 per cent.

The design limitations are :
Peripheral speed not to exceed 40 m/sec
Armature mmf/pole not to exceed 7500
The mmf required for the air gap is 50 percent of armature mmf . kg=1.15. **(12 Marks)**

(b) Explain the procedure for designing a shunt fluid coil for d.c. machine. **(8 Marks)**

3. (a) Calculate the approximate overall dimensions for a 200 kVA, 6600/440V, 50Hz, 3 phase core type transformer. The following data may be assumed :
EMF per turn = 10V. Maximum flux density = 1.3 Wb/m^2. Current density = 2.5A $/mm^2$. Window space factor = 0.3 : overall height = overall width. Stacking factor = 0.9. Use a three stepped core. For a three stepped core, take $a = 0.9d$; $Ai = 0.6d^2$, with usual notations. **(10 Marks)**

(b) Derive an expression for the leakage reactance of a transformer with primary and secondary cylindrical coils of equal length. State clearly the assumptions made. **(10 Marks)**

4. (a) Obtain an expression for the no load current of a single phase transformer. **(5 Marks)**

(b) Write a short note on cooling of transformers. **(5 Marks)**

(c) A single phase, 400V, 50 Hz transformer is made of stampings having a relative permeability of 1000. The length of flux path is 2.5 metres. The area of cross section of the core is $25 cm^2$ and the primary winding has 800 turns. Estimate the maximum flux and the no load current of the transformer. The iron loss at the working flux density is 2.6 W/kg. Iron weighs $7.8 \times 10^3\ kg/m^3$. **(10 Marks)**

5. (a) Derive the output equation of a three phase induction motor. **(10 Marks)**

(b) A 15 kW, 400V, 3 phase, 50 Hz, 6 pole induction motor has a diameter of 30cm and core length of 12cm. The number of stator slot is 72 with 20 conductors per slot. The stator is delta connected. Calculate the magnetising current per phase if the length of the air gap is 0.55mm. Assume gap contraction factor as 1.2. Assume, mmf required for the iron parts is 35 per cent of the air gap mmf coil span = 11 slots. **(10 Marks)**

6. (a) Explain the phenomenon 'Cogging and crawling' of 3 phase squirrel cage induction motor. What are the rules used to avoid cogging, crawling and hooks and cusps on the torque speed characteristic of the motor? **(10 Marks)**

(b) A 90 kW, 500V, 50Hz, 3 phase, 8 pole induction motor has a star connected stator winding kept in 63 slots with 6 conductors per slot. If the slip ring voltage on open circuit is to be 400V find a suitable rotor winding stating :

i) Number of slots

ii) Number of conductors per slot

iii) Coil span

iv) Slipping voltage on open circuit.

v) Full load current per phase in rotor.

Assume efficiency = 0.9. Power factor = 0.86. **(10 Marks)**

7. (a) Define short circuit ratio of a synchronous machine. What are its effects on the machine performance? **(10 Marks)**

(b) Determine the main dimensions for a 10 kVA, 3 phase, 400/230V, star connected 1500rpm, 50Hz, alternator. Assume B av=0.45T, q=22000 ac/m Winding factor = 0.96. Ratio of core length to pole pitch =1. Also determine the number of slots and conductors per slot. **(10 Marks)**

8. (a) The field coils of a salient pole alternator are wound with a single layer winding of bare copper strip 30mm deep, with separating insulation of 0.15 mm thick. Determine suitable winding length, number of turns and thickness of conductor to develop an mmf of 12000 amp turns 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 1.2m. The resistivity of copper is 0.021 ohm/m and mm^2. **(10 Marks)**

(b) Discuss the procedure for the design of the rotor of a single phase induction motor. **(10 Marks)**

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