Code No: R32021 **R10** **Set No: 1**

III B.Tech. II Semester Regular Examinations, April/May -2013

ELECTRICAL MACHINE DESIGN

(Electrical and Electronics Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) Explain the major considerations to evolve a good Electrical Machine Design.
   b) Write short notes on Direct cooling.

2. a)What is the significance of Distributed winding? Derive the expression for Distribution factor.
   b) Give the winding details for the following DC armatures.
   (i) 8-poles, 58 slots, 4 circuits with 58 segments
   (ii) 6-poles, 43 slots, 4 circuits with 43 segments

3. Explain the constructional details of a DC machine.

4. a) Make a comparison between Core and Shell type transformers.
   b) Explain three phase transformers and their design features.

5. a) Write short notes on the Optimum design of a Transformer.
   b) Calculate the approximate overall dimensions for a 200 kVA, 6600/440 V, 50 Hz, 3-phase core type transformer. The following data may be assumed: emf per turn = 10 V, maximum flux density = 1.3 Wb/m^2, current density = 2.5 A/mm^2, Window space factor = 0.3. Overall height = Overall width, Stacking factor = 0.9. Use a 3 stepped core. For a three stepped core, Width of largest stamping = 0.9 d, and Net iron area = 0.6 d^2. Where'd' is the diameter of circumscribing circle.

6. a) Write short notes on the choice of conductor rating.
   b) Determine the main dimensions, number of radial ventilating ducts, number of stator slots and the number of turns per phase of a 3.7 kW, 400 V, 3-phase, 4-pole, 5 Hz squirrel cage Induction motor to be started by a star-delta starter. Work out the winding details.

7. Explain in detail the design of squirrel cage rotor.

8. a) Explain the design of salient pole field coil.
   b) Find the main dimensions of 2000 kVA, 180 rpm, 50 Hz, 3-phase, 3 kV, Salient pole synchronous generator. The generator is to be vertical, Water wheel type. The specific magnetic loading is 0.65 Wb/m^2 and the specific electric loading is 30,000 A/m. Use circular poles with ratio of core length to pole pitch = 0.65. Specify the type of pole construction used if the run away speed is above 2 times the normal speed. Assume data if required.

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Code No: R32021 **R10** **Set No: 2**

III B.Tech. II Semester Regular Examinations, April/May -2013

ELECTRICAL MACHINE DESIGN

(Electrical and Electronics Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) What are the Design factors in the Electrical Machine Design?
   b) Explain any one cooling technique in the Electrical Machine Design in detail.

2. a) Derive the emf equation for Full Pitch coils.
   b) Give the winding details for a 4-pole, 36 slot, 72 segment DC armature with 8 parallel paths.

3. Explain the design of Field system in detail.

4. a) Make a comparison between Single and Three phase transformers.
   b) What is the transformer pole? Explain the cross section and design of Transformer pole.

5. a) Write short notes on the design of a coil of a Transformer.
   b) The ratio of flux to full load mmf in a 400 kVA, 50 Hz, Single phase core type power transformer is 2.4×10^{-6}. Calculate the net iron area and the window area of the transformer. Maximum flux density in the core is 1.3 Wb/m^2, current density 2.7 A/mm^2 and window space factors 0.26. Also calculate the full load mmf.

6. a) Write short notes on the stator winding.
   b) Find the main dimensions of a 15 kW, 3-phase, 400 V, 50 Hz, 2810 rpm, Squirrel cage Induction motor having an efficiency of 0.88 and a full load power factor of 0.9. Assume specific magnetic loading = 0.5 Wb/m^2, specific electric loading = 25,000 Am. Take the rotor peripheral speed as approximately 20 m/sec at synchronous speed.

7. a) Explain in detail the design of Wound rotor.
   b) A three phase induction motor has 54 stator slots, with 8 conductors per slot and 72 rotor slots with 4 conductors per slot. Find the number of stator and rotor turns. Find the voltage across the rotor slip ring, when the rotor is open circuited and at rest. Both stator and rotor are star connected and a voltage of 400 is applied across the stator terminal.

8. Explain in detail the constructional features of Synchronous machines.

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Code No: R32021 **R10** **Set No: 3**

III B.Tech. II Semester Regular Examinations, April/May -2013

ELECTRICAL MACHINE DESIGN

(Electrical and Electronics Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) Discuss the modern trends in Electrical Machine manufacturing techniques.
   b) Explain Heat dissipation by Convection in detail.

2. a) Write short notes on the concept of Pole pitch.
   b) The armature core of a 4-pole DC machine has 31 slots. Each design to accommodate 4-coil sides of a simplex wave winding. The winding has a total of 496 conductors. Find the total number of coils, Turns per coil, Commutator segments, Back, Front and Total span.

3. a) Write short notes on the design of Inter poles in DC machine design.
   b) A 350 kW, 500 V generator has 8-poles, an armature diameter of 1.3 meters and a core length of 0.35 m. A duplex wave winding is accommodated in 114 slots with 6 coil sides per slot. The axial length of commutating poles is 0.2 m and the gap length under the commutating poles is 10 mm. Find the necessary mmf for each Inter pole if the specific permeance is $6x10^{-6}$. Find also the number of turns
   .
4. a) Explain the cross section of Yoke of transformer.
   b) Write short notes on cooling of transformers.

5. Explain the types of transformer windings in detail.

6. Explain in detail the design of stator and stator frames, with respect to induction motor.

7. a) Write short notes on rotor slots and rotor bars in the design of Induction motor.
   b) A 6-pole, 3-phase squirrel cage Induction motor has 72 stator slots with 15 conductors in each slot. There are 55 rotor slots. The coil span is 11 slots and the phase spread is 600. Determine the current in the rotor bars and in end rings if the stator current is 24.1 A and the power factor is 0.83

8. a) Write short notes on the choice of specific loadings.
   b) Find the main dimensions of 2500 kVA, 187.5 rpm, 50 Hz, 3-phase, 3 kV, Salient pole synchronous generator. The generator is to be vertical, Water wheel type. The specific magnetic loading is 0.6 Wb/m^2 and the specific electric loading is 34,000 A/m. Use circular poles with ratio of core length to pole pitch = 0.65. Specify the type of pole construction used if the run away speed is above 2 times the normal speed. Assume data if required.

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Code No: R32021 **R10** **Set No: 4**

III B.Tech. II Semester Regular Examinations, April/May -2013

ELECTRICAL MACHINE DESIGN

(Electrical and Electronics Engineering)

Time: 3 Hours **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) Explain the basic principles involved in the Electro Magnetic Machines.
   b) Explain how will you select a material for the Electrical Machine Design.

2. a) Explain the types of DC windings in detail.
   b) Draw the winding diagram in Radial form for a 4-pole, 12 slot Simplex Lap connected DC Generator with commutator having 12 segments. Indicate the Position of Brushes.

3. a) Explain the design of commutator and brushes in the DC machine design
   b) Find the minimum number of poles for a 1200 kW generator if the average voltage between the commutator segment is not to exceed 15 and the armature mmf per pole is not to exceed 10,000 AT.

4. Explain the constructional details of Transformers.

5. a) Derive the output equation of Transformer.
   b) Determine the main dimensions of the core, the number of turns and the cross section of the 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 1 Wb/m^2, a current density 1.4 A/mm^2, and a window space factor 0.2. The height of window is 3 times its width.

6. a) Write short notes on the design of stator slots.
   b) Estimate the stator core dimensions; number of stator slots and number of stator conductors per slot for a 100 kW, 3300 V, 50 Hz, 12-pole star connected slip ring Induction motor. Assume average gap density = 0.4 Wb/m^2. Conductors per meter = 25,000 Am, efficiency = 0.9. Power factor = 0.9 and winding factor = 0.96. Choose main dimensions to give best power factor. The slot loading should not exceed 500 Ampere conductors.

7. a) Write short notes on air gap length and rotor bars in the design of Induction motors.
   b) A 6-pole, 3-phase squirrel cage Induction motor has 72 stator slots with 15 conductors in each slot. There are 55 rotor slots. The coil span is 11 slots and the phase spread is 500. Determine the current in the rotor bars and in end rings if the stator current is 24 A and the power factor is 0.8

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8. a) Define short circuit ratio of the Synchronous machine. Explain the effect of short circuit ratio on machine performance.
   b) Determine the dimensions for a 1000 kVA, 50 Hz, 3-phase, 375 rpm alternator. The average air gap flux density is 0.55 Wb/m2 and the ampere conductors per meter are 28,000. Use the rectangular poles and assume a suitable value for ratio of core length to pole pitch in order that bolted on pole construction is used for which the maximum permissible peripheral speed is 50 m/Sec. The run away speed is 1.8 times the synchronous speed. Assume the data if required.

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