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Question Paper Code : 80541

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Sixth Semester

Electrical and Electronics Engineering

EE 8002 — DESIGN OF ELECTRICAL APPARATUS

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the expression of mmf for the smooth and slotted armature.

2. Draw a progressive winding showing the armature coil connected to the commutator segment of armature.

3. Give the pros and cons of using cold rolled steel over hot rolled steel for the core of transformer.

4. Draw the diagram of single phase core type transformer and mark dimensions in terms of depth of width of yoke.

5. List the factors which decide the selection of specific electric loading.

6. List the advantages and disadvantages of having large number of poles in DC machine.

7. Distinguish slip ring and cage rotor.

8. Write the expression of finding magnetizing current of induction machine.

9. Define short–circuit ratio.

10. What is meant by hunting? What are the remedial measures?

PART B — (5 × 13 = 65 marks)

11. (a) Calculate the apparent flux density at a section of the teeth of a dc machine armature from the following data:
Slot pitch 24mm, slot width–tooth width = 12 mm, length of armature core with core duct 10 mm each = 0.38 mm, iron stacking factor = 0.92
True flux density in teeth at the section is 2.2 Wb/m^2 for which the mmf is 70,000 A/m. (13)

Or

(b) (i) Discuss in detail about the materials used for armature and field system. (8)

(ii) Discuss the need for air gap and write short note on leakage flux. (5)

12. (a) (i) From basics, deduce the capacity and volts/turn of three phase transformer. (8)

(ii) Deduce volts/turn of three phase transformer. (5)

Or

(b) (i) Derive the ratio of gross to net iron area of three stepped core. (8)

(ii) Compare the ratio of net iron area of three stepped core over square core. (5)

13. (a) Determine the main dimensions, number of poles and the length of air gap of a 600 kW, 500V,900rpm generator. Assume average gap density as 0.6 Wb/m^2 and ampere conductors /m ad 35000. The ratio of pole arc to pole pitch in 0.25 and the efficiency is 91%.
The following are the design constraints: peripheral speed not greater than 40 m/sec, frequency of flux reversals not greater than 50Hz. Current/brush arm not greater than 400 A and armature mmf/pole not greater than 1500 A.
The mmf required for the air gap is 50% of armature mmf and gap contraction factor is 1.15. (13)

Or

(b) (i) Derive the output equation of DC machine and obtain the output coefficient in terms of output. (8)

(ii) Elaborate the factors in detail which influences specific magnetic loading. (5)

14. (a) Find the values of diameter and length of stator core of a 7.5 kW, 220 V, 50 Hz, 4 pole, 3phase induction motor best power factor.
Given: specific magnetic loading = 0.4 Wb/m^2. ac: 22000 A/m, efficiency = 0.86, power factor is 0.87.
Also find the main dimensions if the ratio of core length to pole pitch is unity. (13)

Or

(b) Calculate the magnetizing current of a 415 V, 4 pole, 3 phase, 50 Hz induction motor having the following data:
Stator slots = 36, conductors/stator slot = 30, stator bore = 0.13 m, stator core length = 0.13 m, effective length = 1 mm. The winding is full pitched and phase spread is 60 degree. Assume that iron has infinite permeability. (13)

15. (a) (i) Derive the output equation of polyphase AC machine. (8)

(ii) Write a note on estimation of air gap length of synchronous machine. (5)

Or

(b) Determine the main dimensions for a 1000 kVA, 50 Hz, 3 phase, 375 rpm alternator. The average air gap flux density is 0.55 Wb/sq.m and the ac/m are 28000.
Use 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 50m/s. The run away speed is 1.8 times the synchronous speed. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Draw the simplex lap winding in radial form for a 4 pole, 12 slot simplex lap connected DC generator with commutator having 12 segments. Indicate the position of the brushes as well. (15)

Or

(b) (i) Design a suitable commutator for a 350 kW, 600 rpm, 440 V, 6 pole DC generator having an armature diameter of 0.75 m. The number of coils is 288. Assume suitable values wherever necessary. (8)

(ii) A 4 pole, 400 V, 960 rpm, Shunt motor has an armature of 0.3 diameter and 0.2 m in length. The commutator diameter is 0.22 m. Give full details of a suitable winding including the number of slots, number of commutator segments and number of conductors in each slot for an average flux density of approximately 0.55 wb/m^2 in the air gap. (7)