Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code: EE409

Course Name: Electrical Machine Design

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1 Briefly explain the different types of enclosures used in electrical machines. (5)

2 Give two differences between power transformer and distribution transformer. (5)

3 Explain in steps the design of series field winding for a DC machine. (5)

4 Salient pole alternators are not suitable for high speeds. Why? (5)

5 State and explain the factors considered for selection of air gap length in induction motors. (5)

6 List and justify the advantages of a larger air gap in induction motor. (5)

7 List out and explain the features of three finite element based softwares for analysis of electrical machines. (5)

8 Explain the basic concept of computer aided design. (5)

PART B

Answer any two full questions, each carries 10 marks.

9 Explain the procedure to calculate MMF for air gap and teeth in an electrical machine. (10)

10 a) Write the design equations to find the area of cross section of conductor for both primary and secondary of a transformer. (3)

b) Determine the dimensions of core and window for a 5kVA, 50Hz, single phase core type transformer. A rectangular core is used with long side twice as long as short side. The window height is three times the width. Volt per turn is 1.8V, window space factor is 0.2, current density is 1.8A/mm^2 and maximum flux density is 1Wb/m^2. (7)

11 a) A 15kW 230V 4 pole dc machine has the following data. (7)

Armature diameter 0.25m, armature core length 0.125m, length of air gap at pole centre 2.5mm, flux per pole 11.7 mWb, Ratio of pole arc to pole pitch 0.66. Calculate the mmf required for air gap if (i) armature surface is treated as smooth (ii) armature is slotted and the gap contraction factor is 1.18.

b) Examine the factors that influence the choice of flux density of a transformer. (3)

PART C

Answer any two full questions, each carries 10 marks.

12 a) Differentiate between square pole face and rectangular pole face. (3)

b) A 4 pole 25hp, 500 V,600 rpm DC series motor has an efficiency of 82%.The pole faces are square and the ratio of pole arc to pole pitch is 0.67, B_{av}=0.55 Wb/m^2, ac=17000A/m. Obtain the main dimensions, number of slots, and conductors per slot. Assume it to be wave winding. (7)

13 a) List the factors to be considered for the choice of specific electric loading in synchronous machines. (4)

b) A 3 phase 1800 kVA, 3.3 kV, 50 Hz, 250 rpm, salient pole alternator has the following design data. (i) Stator bore diameter = 230 cm (ii) Gross length of stator bore = 38 cm, (iii)Number of stator slots = 216, (iv)Number of conductors per slot = 4 (v) Sectional area of stator conductor = 86 mm^2 , Using the above data, calculate (i) Flux per pole (ii) Flux density in the air gap (iii) Current density (iv) Size of stator slot. (6)

14 a) What are the advantages and disadvantages of higher number of poles in dc machine? (5)

b) Explain any 3 methods of cooling for turbo alternators. (5)

PART D

Answer any two full questions, each carries 10 marks.

15 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, ampere conductors per metre = 25,000 A/m, Efficiency = 90%, 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. (10)

16 a) Explain on synthesis method of solving electrical machine using CAD with a flow chart. (7)

b) What are the advantages of hybrid methods? (3)

17 a) Explain how finite element method is used for analysis of electrical machines. (5)

b) Derive from first principles, the output equation of a 3-phase induction motor. Explain each term used. (5)

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