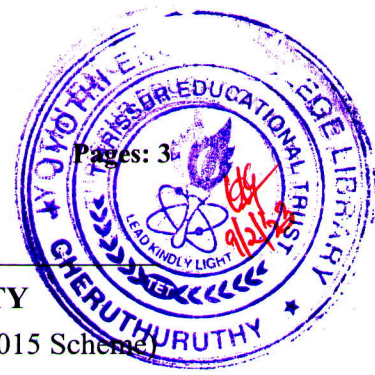


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Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Seventh Semester B.Tech Degree (S, FE) Examination January 2023 (2015 Scheme)

**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 | Describe five types of enclosures used in electrical machines  | (5) |
| 2 | Derive the EMF per turn equation of transformer in terms of KVA rating   | (5) |
| 3 | Define Specific Electric Loading and Specific Magnetic Loading for a DC machine. Write the equations for both specific loadings. | (5) |
| 4 | Define (i) Runaway Speed and (ii) Short Circuit Ratio. State the significance of both terms.                                     | (5) |
| 5 | State and explain three factors which will decide the choice of Specific Magnetic Loading of an Induction Motor.                 | (5) |
| 6 | State and explain four rules which should be followed concerning selection of rotor slots for squirrel cage Induction machines.  | (5) |
| 7 | Draw the flowchart describing the synthesis method of electrical machine design and state the salient points in synthesis method | (5) |
| 8 | Explain how FEM is used for analysis of electrical machines  | (5) |

**( 8 x 5 = 40 Marks)**

**PART B**

*Answer any two full questions, each carries 10 marks.*

- |    |   |     |
|----|---|-----|
| 9  | a) Explain the different types of ventilations in electrical machines.  | (5) |
|    | b) Define Continuous Rating, Short Time Rating, Intermittent Rating and Duty Factor of an electrical machine  | (5) |
| 10 | a) Explain the practical aspects of Unbalanced Magnetic Pull.   | (5) |
|    | b) Derive the Output equation of a single-phase core type transformer.  | (5) |
| 11 | a) Derive the Output Equation of a three-phase core type transformer.   | (5) |
|    | b) Determine the dimensions of core and yoke for a 200 kVA, 50 Hz single phase core type transformer. A cruciform core is used with distance between adjacent | (5) |

limbs equal to 1.6 times width of core laminations. Assume voltage per turn =14 V, maximum flux density =1.1 Wb/m<sup>2</sup>, window space factor = 0.32, current density = 3 A/mm<sup>2</sup>, and stacking factor = 0.9. The net iron area is 0.56 d<sup>2</sup> in a cruciform core where d is the diameter of circumscribing circle. Also the width of largest stamping is 0.85d.

( 2 x 10 = 20 Marks)

**PART C**

*Answer any two full questions, each carries 10 marks.*

- 12 a) Derive the output equation of a DC machine from fundamentals. Define each term used with units. (5)
- b) Design suitable dimensions of armature core for a 50 kW, 4 pole, 600 r.p.m. d.c. shunt generator, the full load terminal voltage being 220 V. if the maximum air gap flux density is 0.83 Wb/m<sup>2</sup> and the armature ampere conductors per meter are 30,000. Use a square pole face. Assume that the full load armature voltage drop is 3 per cent of rated terminal voltage and that the field current is 1 per cent of rated full load current. Ratio of pole arc to pole pitch is 0.67. (5)
- 13 a) Derive the output equation of a 3-phase alternator from fundamentals. Define each term used with units. (5)
- b) Determine the main dimensions for a 1000 kVA, 50 Hz, 3 phase, 375 r.p.m. alternator. The average air gap density is 0.55 Wb/m<sup>2</sup> and the ampere conductors per meter are 28,000. Use rectangular poles and assume that ratio of pole length to pole pitch is 2. Bolted-on pole construction is used for which maximum permissible peripheral speed is 50 m/s. The runaway speed is 1.8 times the synchronous speed. Assume winding factor as 0.955. (5)
- 14 a) List and explain advantages and disadvantages of high number of poles in a DC machine. (5)
- b) State and explain five factors which are considered for selection of armature slots in an Alternator. (5)

( 2 x 10 = 20 Marks)

**PART D**

*Answer any two full questions, each carries 10 marks.*

- 15 a) Derive the output equation of a 3-phase Induction motor from the fundamentals. (5)
- b) Find the main dimensions of a 15 kW, 3 phase, 400 V, 50 Hz, 2810 r.p.m. (5)

squirrel cage induction motor having an efficiency of 0.88 and a full load power factor of 0.9. Assume, specific magnetic loading as  $0.5 \text{ Wb/m}^2$  and specific electric loading as  $25000 \text{ A/m}$ . Take the rotor peripheral speed as approximately  $20\text{m/s}$  at synchronous speed.

- 16 a) State and explain five factors which should be considered when designing length of air gap in an Induction motor. (5)
- b) Draw the flow chart of Analysis method of Computer Aided Design of Electrical machines and describe the salient features of the method. (5)
- 17 a) Explain how FEM method can be applied for Computer Aided Design of Electrical machines. (5)
- b) What are the advantages and drawbacks of Computer Aided Design compared to conventional methods? (5)

( 2 x 10 = 20 Marks)

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