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^2, window space factor = 0.32, current density = 3 A/mm^2 , and stacking factor = 0.9. The net iron area is 0.56 d^2 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^2 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^2 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 Wb/m^2 and specific electric loading as 25000 A/m. Take the rotor peripheral speed as approximately 20m/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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