Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S8 (R,S) Exam April 2025 (2019 Scheme)

Course Code: EET444

Course Name: ELECTRICAL MACHINE DESIGN

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all questions, each carries 3 marks. Marks

1	Describe three properties of insulating materials used in electrical machines	(3)
2	List the methods employed for calculation of MMF required for tapered teeth	(3)
3	Explain any three factors considered for the choice of specific electric loading of DC machine.	(3)
4	Explain in steps the design of series field winding for a DC machine.	(3)
5	Explain why stepped cores are used in large power transformers.	(3)
6	Write the design equations to find the area of cross section of conductor for both primary and secondary of a transformer.	(3)
7	State the factors considered for selection of air gap length in induction motors.	(3)
8	Explain the rules for selecting number of rotor slots in a three phase induction motor.	(3)
9	Explain how short circuit ratio affects the performance of synchronous machine.	(3)
10	List out any three finite element based software used for analysis of electrical machines.	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11	a)	Derive the expression for reluctance of air gap in slotted armature having radial ventilating ducts with necessary sketches.	(10)
	b)	A DC motor has final temperature rise of 80^0C and a heating time constant of 75 minutes. Estimate at this load, the temperature rise after 1 hour.	(4)

OR

12	a)	Describe any four methods of cooling employed in transformers.	(8)

b) Calculate the apparent flux density at a section of the tooth of an armature of a dc machine from the following data at that section: slot pitch = 24mm, tooth width = slot width =12mm, length including 5 duct of 10mm each is 0.38m, iron stacking factor =0.9,true flux density of teeth at that section is 2.2T for which the MMF is 70000 AT/m. (6)

Module II

13 a) What are the disadvantages of high specific electric and magnetic loading (6)

b) The following data refers to a shunt field coil of 440V, 6 pole DC Generator. Ampere turns per pole is 7000A, depth of winding is5cm, length of outer turn 140cm. Loss dissipated from outer surface excluding ends (top and bottom) is 1400W/m^2. Conductor space factor 0.562, resistivity of copper is 2×10^{-6} Ωm. Find diameter of wire, height of field coil, number of turns and excitation current. Assume a voltage drop of 20% across field regulator. (8)

OR

14 a) Discuss any two factors to be considered while designing armature slots in DC machine. (4)

b) Determine the diameter and length of armature core for a 55kW, 110V, 1000 r.p.m, 4 pole shunt generator, assuming the specific electric and magnetic loadings as 26000 ampere conductor per metre and 0.5Wb/m^2 respectively. The pole arc should be about 70 per cent of pole pitch and length of core about 1.1 times the pole arc. Allow 10A for field current and assume a voltage drop of 4V for the armature circuit. (10)

Module III

15 a) Distinguish between power transformers and distribution transformers (8)

b) The ratio of full load mmf in a 400kVA, 50Hz, single phase core type transformer is 2.4×10^{-6}. Calculate the net iron area and the window area of the transformer. The maximum flux density in the core is 1.3Wb/m^2 current density is 2.7A/mm^2 and the window space factor is 0.26. Also calculate the full load mmf. (6)

OR

16 a) Justify why low voltage winding is placed on the inner side nearer to the core with high voltage winding on the outside in core type construction of transformers. (7)

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 sort side. The window height is three times the width. Volt per turn is 1.8V, (7)

window space factor is 0.2, current density is 1.8A/mm^2 and maximum flux density is 1Wb/m^2.

Module IV

17 a) State the main constructional differences between cage induction motor and slip ring induction motor. (4)

b) A 15kW, 440V, 4 pole, 50Hz three phase induction motor is built with a stator bore 0.25m and core length of 0.16m. The specific loading is 23000 ampere conductor per meter. Using data of this machine; determine the core dimensions, number of stator slots and number of stator conductors for a 11kW, 460V, 6 pole, 50Hz motor. Assume a full load efficiency of 84% and power factor 0.82 for each machine. The winding factor is 0.955 (10)

OR

18 a) What are the guiding factors that decide the selection of ampere conductor per metre of an induction machine? (6)

b) Determine the main dimensions of 250hp, 3 phase, 50Hz 400V, 1410rpm slip ring induction motor. The specific loadings are 0.5Wb/m^2 and 30000 A/m, efficiency 0.9 and power factor 0.9, winding factor 9.55, current density 3.5A/mm^2 and ratio of core length to pole pitch is 1.2, the machine is delta connected. (8)

Module V

19 a) Explain why stationary armature is and revolving field type of construction is most convenient for a synchronous generator. (7)

b) Find the main dimensions of a 100MVA, 11KV, 50Hz, 150rpm three phase water wheel generator. The average gap density is 0.65Wb/m^2 and ampere conductors per meter are 40,000. Assume a winding factor of 0.955. The peripheral speed should not exceed 65m/s at normal running speed in order to limit the runaway peripheral speed. (7)

OR

20 a) Explain how finite element method is used for analysis of electrical machines. (7)

b) Describe the salient features of computer aided design of electrical machines. What are the advantages of computer aided design? (7)

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