

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

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 | List five types of enclosures used in electrical machines. | (5) |
| 2 | Derive the output equation of a single phase core type transformer. | (5) |
| 3 | Define specific magnetic loading? Explain the factors need to be considered for choice of specific magnetic loading in a dc machine | (5) |
| 4 | Write short notes on (i) Short circuit ratio (ii) Run away speed. | (5) |
| 5 | How do you separate 'D' and 'L' from the volume D^2L of a 3 phase induction motor? | (5) |
| 6 | Explain the rules for selecting number of rotor slots in a three phase induction motor. | (5) |
| 7 | What is meant by discretization in finite element method? | (5) |
| 8 | Explain the hybrid techniques available for computer aided design. | (5) |

PART B

Answer any two full questions, each carries 10 marks.

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| 9 | a) Examine the different types of ventilations in electrical machines. | (4) |
| | b) Derive the gap contraction factor for slots. | (6) |
| 10 | Determine the dimensions of core and yoke for a 100KVA 50Hz single phase core type transformer. A square core is used with distance between the adjacent limbs equal to 1.6 times the width of laminations. Assume Emf/turn 14V, Maximum flux density 1.1 Wb/m^2 , current density 3 A/mm^2 , window space factor 0.32, stacking factor 0.9. Flux density in the yoke to be 80% of flux density in the core. | (10) |
| 11 | a) Explain the procedure to calculate MMF for air gap and teeth in an electrical machine. | (5) |
| | b) Derive the volt per turn equation of a single phase transformer. | (5) |

PART C

Answer any two full questions, each carries 10 marks.

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| 12 | a) Explain in steps how to separate D and L for a DC machine? | (3) |
| | b) Find out the main dimensions of a 50kW, 4 pole, 600 rpm DC shunt generator to give a square pole face. The full load terminal voltage being 220 V. The maximum gap density is 0.83 Wb/m^2 and the ampere conductors per meter is 30000. Assume that 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 | (7) |

- current. Ratio of pole arc to pole pitch is 0.67.
- 13 a) Distinguish between cylindrical pole and salient pole construction. (3)
b) Determine the main dimensions of a 2500 kVA 187.5 rpm, 50Hz 3 phase 3 kV, salient pole synchronous generator. The generator is to be a vertical, water wheel type. The specific magnetic loading is 0.6 wb/mm^2 and the specific electric loading is 34000 A/m . Use circular poles with ratio of core length to pole pitch = 0.65. Specify the type of pole construction used if the run away speed is about 2 times the normal speed. (7)
- 14 a) Explain the design procedure of interpoles in DC machines? (5)
b) Determine the main dimensions of a 500 kVA, 50Hz 3 phase alternator to run at 375 rpm. The average air gap flux density is 0.55 wb/mm^2 , the specific electric loading is 25000 A/m . The peripheral speed should not exceed 35 m/sec . (5)

PART D

Answer any two full questions, each carries 10 marks.

- 15 (a) With all details of the various parameters including the units derive the output equation of a 3 phase squirrel cage induction motor. (5)
(b) Design the main dimensions of a 25 kW, 3 phase, 415V, 50 Hz, 1475 rpm squirrel cage induction motor having an efficiency of 85 % and full load power factor of 0.86. Assume $B_{av} = 0.5 \text{ T}$, $a_c = 28000 \text{ A/m}$. The rotor peripheral velocity is 25 m/s at synchronous speed. (5)
- 16 a) Explain how finite element method is used for analysis of electrical machines. (6)
b) List out the advantages of FEM based methods over conventional design procedures. (4)
- 17 a) Explain the procedure for separation of D and L from D^2L product while designing induction motors. (5)
b) What is computer aided design? How does it help in designing electrical machines? (5)
