

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

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

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 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 | What is meant by hot spot rating in electrical machines?  | (5) |
| 2 | Compare the reluctance of slotted armature with that of smooth armature surface.  | (5) |
| 3 | Derive the output equation of DC machine.   | (5) |
| 4 | Explain different types of cooling systems used in synchronous machines.  | (5) |
| 5 | List out and explain the factors to be considered for selection of specific electric loading in 3-phase induction motors. | (5) |
| 6 | State the main constructional differences between cage induction motor and slip ring induction motor.                     | (5) |
| 7 | Explain synthesis method for computer aided design of electrical machines   | (5) |
| 8 | Explain on few softwares used for designing electrical machines?  | (5) |

**PART B**

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

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|----|---|-----|
| 9  | a) Examine any four components of armature leakage flux.  | (4) |
|    | b) Derive the relation between real and apparent flux densities.  | (6) |
| 10 | a) Derive the output equation for 3 phase core type transformer.  | (4) |
|    | b) Determine the dimensions of core and yoke for a 200KVA 50Hz single phase core type transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6 times width of core laminations. Assume voltage per turn 14 V, maximum flux density $1.1 \text{ Wb/m}^2$ , window space factor 0.32, current density $3 \text{ A/mm}^2$ and stacking factor 0.9. The net iron area is $0.56d^2$ in a cruciform core where d is the diameter of circumscribing circle and width of largest stamping is $0.85d$ . | (6) |
| 11 | a) Explain unbalanced magnetic pull in rotating electrical machines.  | (5) |
|    | b) Derive the ratio of gross core area to area of circumscribing circle for a square core of a transformer.   | (5) |

**PART C**

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

- 12 a) Explain the flux pulsation produced in dc machine. (5)  
b) Explain step by step design procedure of brushes and commutator in a DC machine. (5)
- 13 Find the main dimensions of a 100 MVA, 11kV, 50 Hz, 150 rpm, 3 phase water wheel generator. The average gap density is  $0.65 \text{ Wb/m}^2$  and the ampere conductors per meter is 40000. The peripheral speed should not exceed 65m/s at normal running speed in order to limit the run away peripheral speed. Assume the winding factor to be 0.955. (10)
- 14 a) Explain step by step design procedure for armature of a dc machine. (5)  
b) Find the main dimensions of a 2500 kVA, 187.5 rpm, 50 Hz, 3 phase, 3 kV, salient pole synchronous generator. The generator is to be vertical, water wheel type. The specific electric loading is 34000 A/m and  $B_{av}$  is  $0.6 \text{ Wb/m}^2$ . Use circular poles with ratio of core length to pole pitch to be 0.65. Specify the type of pole construction used if the run-away speed is about 2 times the normal speed. (5)

**PART D**

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

- 15 a) How do the iron losses affect selection of  $B_{av}$ ? (5)  
b) Explain cogging and crawling in 3-phase induction machines. (5)
- 16 a) Explain on Analysis method of solving electrical machine using CAD with a flow chart. (6)  
b) What are the advantages of analysis method? (4)
- 17 a) 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)  
b) Explain the steps involved in the computer aided design and analysis of electrical machines. (5)

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