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B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Sixth Semester

Electrical and Electronics Engineering

EE 6604 – DESIGN OF ELECTRICAL MACHINES

(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. What are the causes of failure of insulation ?
2. What are the factors that decide the choice of specific magnetic loading ?
3. How the ampere turns of the series field coil is estimated ?
4. Write down the expression for brush friction losses
5. Define windows space factor.
6. The voltage pre turn of a 500 KVA, 11KV, Δ/Y three phase transformer is 8.7 V, calculate the number of turns per phase of LV and HV windings.
7. What are the typical values of SCR for salient pole and turbo alternators ?
8. State different losses in the induction motor.
9. Mention the uses of damper windings in a synchronous machine.
10. What is the limiting factor for the diameter of synchronous machine ?

PART – B (5×13=65 Marks)

11. a) i) What are the electrical properties of insulating materials ? Classify the insulating materials based on thermal consideration. (7)

ii) Write short notes on standard specifications. List the parameters involve in marking standard specifications. (6)

(OR)

b) i) Derive the heating and cooling curve of an electrical machine. (7)

ii) For a certain d.c. generator the core loss is 1000 W and the armature resistance is 0.025 ohm. The core and windings form a cylinder 0.25 m long and 0.25 m in diameter. Specific loss dissipation is 230 W/m² – C. Calculate the specific electric loading which would result in windings and core having a temperature rise of 40C. The machine is wave wound with 270 armature conductors. (6)

12. a) i) Draw the magnetic circuit of dc machine. (6)

ii) Calculate the main dimensions of a 20 Hp, 1000 rpm, 400 V, dc motor. Given that b_{av} = 0.37 Wb/m² and ac = 16000 amp.cond./m. Assume an efficiency of 90%. (7)

(OR)

b) Design the shunt field winding of a 6 pole, 440 V, dc generator allowing a drop of 15% in the regulator. The following design data are available. MMF per pole = 7200; mean length of turn = 1.2 m; winding depth = 3.5 cm; Watts per sq.m. of cooling surface = 650. (13)

13. a) i) How to calculate no-load current of a transformer ? (6)

ii) Determine the dimension of the core, the number of turns, the cross-section area of conductors in primary and secondary windings of a 100 KVA, 2200/480 V, 1-phase, core type transformer, to operate at a frequency of 50 Hz, by assuming the following data. Approximate Volt/turn = 7.5 Volt. Maximum flux density = 1.2 Wb/m². Ratio of effective cross-sectional area of core to square of diameter of circumscribing circle is 0.6. Ratio of height to width of window is 2. Window space factor = 0.28. Current density = 2.5 A/mm². (7)

(OR)

b) A 250 KVA, 6600/400 V, 3-phase core type transformer has a total loss of 4800 watts on full load. The transformer tank is 1.25 m in height and 1m × 0.5 m in plan. Design a suitable scheme for cooling tubes if the average temperature rise is to be limited to 35°C. The diameter of the tube is 50 mm and are spaced 75 mm from each other. The average height of the tube is 1.05 m. (13)

14. a) i) What are the factors to be considered for estimating the length of air gap ? **(6)**

ii) Determine the approximate diameter and length of stator core, the number of stator slots and the number of conductors for a 11 KW, 400 V, 3ϕ, 4-pole, 1425 rpm, delta connected induction motor. B_{av} = 0.45 Wb/m^2, ac = 23000 amp, cond/m, full load efficiency = 0.85, pf = 0.88, L/τ = 1. The stator employs a double layer winding. **(7)**

(OR)

b) Design a cage rotor for a 40 HP, 3-pahse, 400V, 50 Hz, 6 pole, delta connected induction motor having a full load η of 87% and a full load pf of 0.85. Take D = 33 cm and L = 17 cm. Stator slots – 54, conductors/slot = 14. Assume suitable the missing data if any. **(13)**

15. a) i) Derive the output equation of synchronous machine. **(6)**

ii) A 600 rpm, 50 Hz, 10000 V, 3 phase, synchronous generator has the following design data. B_{av} = 0.48 Wb/m^2, δ = 2.7 amp /mm^2, slot space factor = 0.35, number of slots = 144, slot size = 120×20 mm, D = 1.92 m and L = 0.4 m. Determine the KVA rating of the machine. **(7)**

(OR)

b) i) What is short circuit ratio ? How the value of SCR affects the design of alternator ? **(6)**

ii) How is cylindrical pole different from salient pole in a synchronous machine ? **(7)**

PART – C **(1×15=15 Marks)**

16. a) i) List some leakage fluxes available in the rotating machine. **(7)**

ii) How the temperature rises in transformers ? **(8)**

(OR)

b) Determine the output coefficient for a 1500 KVA, 2200 V, 3 phase, 10 pole, 50 Hz star connected alternator with sinusoidal flux distribution. The winding has 60° phase spread and full pitch coils. ac = 30,000 ac/m, B_{ag} = 0.6 T. If the peripheral speed of the rotor must not exceed 100 m/sec and the ratio pole pitch to core length is to be between 0.6 and 1. Find D and L. Assume an air gap length of 6 mm, find also the approximate number of stator conductors. **(15)**