Note-: Red colour indicates very important questions

UNIT I-: Principles of Electrical Machine Design

1) What are the limitations in the design of Electrical Machines? Explain them?
2) What are the considerations to be made while designing of electrical machines?
3) Explain in brief the various the limitations in the design of Electrical Machines.
4) What are the brief study of Magnetic, Electric, Dielectric material?
5) Explain the modern trends in the design of Electrical machine?
6) Explain important and advantages of Computer Aided Designing of transformer and rotating machines
7) Explain various approaches of Computer Aided Designing.
8) Explain important properties of Insulating materials
9) Define dielectric breakdown and dielectric strength of the dielectric material and Mention the various breakdown mechanisms
10) What is the importance and purpose of specification in design and manufacturing of electrical machines? State the standard specification of transformer
11) Explain the key principles of design. How do these principles impact user experience and overall success of a design?

UNIT II-: Design of Simple Electrical Apparatus & AC and DC Windings

UNIT II-A: Design of Simple Electrical Apparatus

1) Derive expression of design of heating elements.
2) Explain the design procedure for chokes (Small Inductors).
3) Describe the functions of motor starter
4) Explain standard Rating of Electrical Machines

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5) Solve design problems on basis of heating coils, starters.
6) Derive expression of design starters for DC shunt motors.
7) Derive expression of design starters for DC series motors.
8) Explain the design procedure for lifting magnet.

UNIT II-B: AC and DC Windings

1) What is the concentric winding and what are the types?
2) What is the role of equalizer connection? Why do we dispose equalizer connection in case of simplex wave windings?
3) Solve design problems on basis of simple/duplex lap and wave winding.
4) Define the following terms 1) Turn (2) lap winding (3) wave winding (4) Coil Span Factor(5) Distribution Factor (6) Winding factor
5) What is the difference between AC and DC winding?
6) Define the concept of multiplex winding and give reasons for choosing them

UNIT III-: Design of Induction Motor (Stator)

1) Derive the output equation of three phase induction motor.
2) Explain specific electric & magnetic loading factor for induction motor.
3) Write expression for Calculation of Ampere-Turns for flux distribution in rotating machines
4) Solve design problems on basis of main dimensions & stator design parameters of rotor for three phase induction motor.

UNIT IV-: Design of Induction Motor (Rotor)

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1) Explain Selection of length of air gap and explain factors affecting length of air gap, design of for three phase induction motor?
2) Explain design steps of squirrel cage rotor for induction motor.
3) Explain design steps of wound rotor for induction motor.
4) Explain with neat diagram harmonic field effect on the performance of 3-phase induction motor
5) Explain the factors on which selection of rotor slots depends

UNIT V-: Heating and Ventilation of Electrical Machines

1) Explain different mode of heat dissipiatation.
2) Explain Methods of cooling/ventilations for rotating & stationary electrical apparatus.
3) Derive the equation of temperature rise of a machine when it is run under steady load conditions starting from cold condition? (Heating Time-Constant & Heating - Curve)
4) Derive the equation of temperature rise of a machine when it is run under steady load conditions up to cold condition? (Cooling Time-Constant & Cooling - Curve)
5) Derive the expression for quantity of cooling medium (air, water, oil, hydrogen coolant) with their advantages & properties.
6) Solve design problems on basis of heating & cooling time constant.

UNIT VI-: Design of Transformer

1) Derive the output equation of 1 phase & 3 phase transformer.

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2) For a Transformer show that Emf per turn Et is given by $Et = K\sqrt{Q}$ where Q= KVA Capacity of Transformer
3) Compare between Distribution Transformer and Power Transformer
4) Derive expression for design of tank with tubes.
5) Explain the mechanical forces produced in transformer. Derive an expression for the avg. radial force produced in core type transformer in normal operating conditions?
6) Derive overall dimensions of 1 phase & 3 phase transformer.
7) Solve design problems on overall dimensions of transformer.

Numericals

1) Determine the main dimensions of the core the no. of turns and the cross section of the conductors for a 5 KVA, 11000/400V, 50 Hz, single phase core type distribution transformer. The net conductor area in the window is 0.6 times the net cross section of iron in the core. Assume a square cross section for the core, a flux density $1\ Wb/m2$ window space factor 0.2, current density 1.4 $A/mm2$ the height of window is 3 times its width.
2) A single phase 400V, 50 Hz, transformer is built from stampings having a relative permeability of 1000. The length of the flux path is 2.5m, the area of cross section of the core is 2.5×10^-3 sq. meter & the primary winding has 800 turns. Estimate the maximum flux & no load current of transformer. The iron loss at the working flux density is 2.6W/kg. Iron weighs 5.8× 10^3 kg/Cubic meter. Stacking factor is 0.9
3) Determine the main dimensions no. of radial ventilating ducts of a 3.7 Kw, 3 phase, 4-pole, 50 Hz, squirrel cage induction motor to be started by star delta starter. Assume average flux density in the gap = 0.45 Wb/m^2 ampere conductors per meter= 23000, efficiency= 0.85, winding factor 0.955 & power factor 0.84.

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4) Calculate the diameter & length of armature for a 7.5 kw, 4 pole 1000 rpm, 220V shunt motor. Given Full load efficiency =0.83, maximum gap flux density= 0.9 T, Sp. Electric loading= 30000Amp. Cond./ meter, field form factor=0.7, Assume maximum efficiency occurs at full load & field current is 2.5% of rated current. The pole face is square.
5) Determine the dimensions of core & yoke for a 200KVA, 50 Hz, single phase core type transformer. A cruciform core is used with distance between adjacent limbs equal to 1.6 times the width of core laminations. Assume voltage per turn 14 V, max. Flux density 1.1 $Wb/m2$ window space factor 0.32, current density 3 $A/mm2$ & stacking factor= 0.9 the net iron area is 0.56 $d2$ in a cruciform core. Also the width of largest stamping is 0.85 d.
6) A 6 pole, 3 phase squirrel cage induction motor has 72 stator slots with 15 conductors in each slot. There are 55 rotor slots. The coil span is 11 slots & the phase spread is 60 deg. Determine the current in the rotor bars & in end rings if the stator current is 24.1A & the power factor is 0.83.
7) A 500 kVA, 6600/400 V, single phase core type oil immersed self cooled transformer having flux density= 1.2 T, current density= 2.75 A/sq. mm, window space factor=0.32, Volt/turn=16.8, cruciform core, height of window= 3 times window width. Calculate the main dimensions & also calculate no. of turns & cross sectional area of the conductors for the primary & secondary winding?
8) A single phase 400V, 50 Hz, transformer is built from stampings having a relative permeability of 1000. The length of the flux path is 2.5m, the area of cross section of the core is 2.5×10^-3 sq. meter & the primary winding has 800 turns. Estimate the maximum flux & no load current of transformer. The iron loss at the working flux density is 2.6W/kg. Iron weighs 5.8× 10^3 kg/Cubic meter. Stacking factor is 0.9
9) Calculate diameter & length of armature core of 70 Kw, 240V, 900 rpm, 4 pole dc shunt generator. The average flux density is 0.70 T specific electric loading is 34000. Core length to pole pitch ratio is 0.80. Full load armature voltage drop is 9.6V & field current is 3 A.
10) Grade the resistance of 5 section starter for a 9.5 kW, 250V, 700rpm, and DC shunt motor from the following. Maximum torque during starting period = 2.5 times full load torque. Full load

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effi. =87%. Armature circuit copper loss is 60% of total loss. Field current = 3.6A. Find the speed at each stud when the notching takes place.

11) Estimate the number of resistance sections & resistance of each section for the starter of a 8.2kW, 500V, DC series motor. The starting current varies from 1.6 to 2.2 times full load current. The efficiency = 82% & resistance of machine measured between terminal is 2.1Ω. Assume that the flux increased by 12% as the current rise from 1.6 to 2 times full load current.
12) Determine the main dimensions of core for a 125KVA, 6600/460V, 50Hz, single phase core type transformer. The maximum flux density in core and yoke is 1.2 wb/m^2 and current density is 2.5 A/mm^2. Assume a square cross-section of the core allowing 10% for insulation between the limbs, a winding space factor of 0.3 & window proportions (Height/Weight) in the ratio 3:1. The net gross section of copper in the following os 0.225 times of net cross-section of iron in the core.
13) The temperature rise of transformer is 25^0C after 1 Hr. & 35^0C after 2 Hr. of starting from cold conditions. Cal it's final steady temp rise and the heating time constant. If it's temp falls from the final steady value to 35^0C in 2.5 Hr. when disconnected, cal it's cooling time constant. The ambient temperature is 40^0C.
14) The losses of a 50 MW hydrogen cooled alternator on full load amount to 800 kW . The flow of hydrogen from the cooler is 15m/s at 2500 mm of mercury pressure above atmosphere, which is 760 mm of mercury. The temperature of hydrogen leaving the coolers is 25^0C. Determine the temperature rise of hydrogen assuming specific heat of hydrogen at constant pressure to be 13500 J/kg. ^{0}C and weight of 13.2 m^3 of hydrogen at 0^0C and 760mm of mercury to be 1 kg.

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