Reg. No. : | | | | | | | | | | |

Question Paper Code: 99303

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2024

Professional Elective

Electrical and Electronics Engineering

19UEE903- DESIGN OF ELECTRICAL MACHINES

(Regulations 2019)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (5 x 20 = 100 Marks)

1.	(a)	Derive heating and cooling co-efficient of electrical machines.	CO1- U	(20)
		Or		
	(b)	Explain the types of duties and ratings	CO1- U	(20)
2.	(a)	A 4 pole, 400V and with 960 rpm, shunt motor has an armature diameter of 0.3m and length of 0.2m. Determine full details of suitable winding including number of coils and conductors for a B_{av} of 0.55 Wb/m^2.	CO3 - App	(20)
		Or		
	(b)	Determine the diameter and length of armature core for a 55 kW, 110V, 1000 rpm, 4 pole shunt generator, and assuming specific electric and magnetic loadings of 26000 amp. cond./m and 0.5 Wb/m^2 respectively. The pole arc should be about 70% of pole pitch and length of core about 1.1 times the pole arc. Allow 10 ampere for the field current and assume a voltage drop of 4 volts for the armature circuit. Specify the winding used and also determine suitable values for the number of armature conductors and number of slots.	CO3 - App	(20)
3.	(a)	A 250 kVA, 6600/400V, 3-phase core type transformer has a total loss of 4800 watts on full load. The transformer tank is 1.25m in height and 1 m x 0.5m in plane. Design a suitable scheme for	CO4 -App	(20)

cooling tubes if the average temperature rise is to be limited to 35°C. The diameter of the tube is 50 mm and is spaced 75mm from each other. The average height of the tube is 1.05m.

Or

(b) A 1000 kVA, 6600/440V, 50Hz, 3 phase, delta/star, core type, oil immersed natural cooled transformer. The design data of the transformer is: distance between centres of adjacent limbs = 0.47m, outer diameter of high voltage winding = 0.44 m, height of frame = 1.24 m. core loss = 3.7 kW and I^2R loss = 10.5 kW. Design a suitable tank for the transformer. The average temperature rise of oil should not exceed 35°C. The specific heat dissipation from the tank walls is 6 W/m^2-°C. and 6.5 W/m^2-°C due to radiation and convection respectively. Assume that the convection is improved by 35% due to convection — CO4 -App — (20)

4. (a) Estimate stator core dimensions, number of stator slots, number of stator conductors per slot for a 100kW, 3300V, 50 Hz, 12 pole star connected slip ring induction motor. B_{av}=0.4 Wb/m^2, ac = 25000 amp-cond./m, efficiency = 0.9, p.f = 0.9. Choose dimensions to get best power factor. Slot loading should not exceed 500 Amp-conductors. — CO5 -App — (20)

Or

(b) Determine the D and L of a 70 Hp, 415V, 3 phase, 50Hz, star connected, 6 pole induction motor for which ac = 30000 amp. Cond./m and B_{av} = 0.51 Wb/m^2. Take η = 90% and pf 0.91. Assume τ = L. Estimate the number of stator conductors required for a winding in which the conductors are connected in 2-parallel paths. Choose a suitable number of conductors per slot, so that the loading does not exceed 750 amp. Cond. — CO5 -App — (20)

5. (a) i) Calculate the mmf required for air gap of the machines having core length 0.32m including four ducts of 10mm each. Pole arc is 0.19m, slot pitch is 65.4mm, slot opening is 5mm, flux per pole is 52 mwb. Carter's coefficient is 0.18 for opening/gap =1. Carter's coefficient is 0.28 for opening/gap =2. Air gap length is 5mm. — CO6 -App — (20)

ii) Determine the air gap length of a DC machine from the following details. Gross core length =0.12m. Number of ducts =

1, each of 10mm wide, slot pitch is 25mm, slot width = 10mm. $K_{cs} = K_{cd} = 0.32$. Gap density at pole centre is 0.7 wb/m^2. Field mmf/pole = 3900 AT. Mmf for iron part is 800AT.

Or

(b)	A 1250 kVA, 3 phase, 50 Hz, 3300V, 300rpm synchronous generator with a concentric winding has the following design data: specific magnetic loading = 0.58 Wb/m^2, Specific electric loading = 3300 A/m, gap lenth = 5.5mm, field turns per pole = 60, short circuit ratio = 1.2. The effective gap area is 0.6 times the actual area. Peripheral speed is 30 m/s. Find stator core lenth, stator bore, turns per phase, mmf for air gap, armature mmf per pole, and field current for no load and rated voltage.	CO6 -App	(20)