U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Electrical and Electronics Engineering **Duration: 3 hrs.**
Course Code: 23EE6PE2ED **Max Marks: 100**
Course: Electrical Machine Design and Drawing

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	***CO***	***PO***	**Marks**
1	a)	What are the latest methods employed in the manufacturing of machines? Explain.	*CO1*	*PO2*	**04**
	b)	List and explain the limitations in design.	*CO1*	*PO2*	**08**
	c)	Which factors should be taken into account while designing electrical machines, and why are they important?	*CO1*	*PO3*	**08**
		OR			
2	a)	Explain the types and properties of insulating materials used in electrical machines. How does insulation affect machine life?	*CO1*	*PO2*	**08**
	b)	Explain the classification of magnetic material related to the value of permeability distinguish between soft and hard magnetic material.	*CO1*	*PO2*	**06**
	c)	State the properties that are typically preferred in magnetic materials for optimal performance.	*CO1*	*PO3*	**06**
		UNIT - II			
3	a)	Derive an expression for output equation of a three-phase core type transformer.	*CO2*	*PO3*	**08**
	b)	Calculate the active and reactive components of no-load current of 400V, 50 Hz, single phase transformer having the following particulars: Core of transformer steel; stacking factor = 0.9, density $=7.8\text{X}10^3$ kg/m^3, length of mean flux path 2.2m; gross iron area $=10\text{X}10^{-3}$ m^2, primary winding turns = 200, joints equivalents to 0.2 mm air gap use the following data for calculations	*CO3*	*PO4*	**12**

B_m Wb/m^2	0.9	1.0	1.2	1.3	1.4
mmf AT/m	130	210	420	660	1300
Iron loss w/kg	0.8	1.3	1.9	2.4	2.9

		OR			
4	a)	Describe how the choice of flux density influences transformer design. How is an appropriate flux density value selected?	*CO2*	*PO2*	**08**
	b)	Determine the dimensions of the core and yoke for a 100kVA, 50 Hz, single phase, core type transformer. A square core is used with distance between the adjacent limbs equal to 1.6 times width of the laminations. Assume voltage per turn of 14V. maximum flux density 1.1wb/m^2, window space factor 0.32 and the current density 3A/mm^2. Take Stacking factor =0.9. flux density in the yoke to be 80% of flux density in the core.	*CO3*	*PO5*	**12**
		UNIT - III			
5	a)	Derive an expression for the output equation of a DC machine.	*CO3*	*PO2*	**08**
	b)	Find the main dimensions and number of poles of a 38.68kW, 230V, 1400 rpm shunt motor so that a square pole face is obtained. B_{av} in the gap is 0.5 wb/m² and the amp-conductors per m. are 22,000. The ratio of pole arc to pole pitch is 0.7. Assume the efficiency of the machine as 90 percent.	*CO3*	*PO5*	**12**
		OR			
6	a)	Explain the factors to be consider for selecting the number of poles of D.C. machines and write any three advantages of higher values of number of poles of D.C. machine.	*CO2*	*PO3*	**08**
	b)	A design is required for a 50 kW, 4 pole, 600 rpm, dc shunt generator, with a terminal voltage of 220 V. If maximum gap density is 0.83 Wb/m² and the armature ampere conductors/meter are 30,000. Calculate the suitable dimensions of armature core to give a square pole face. Assume that full load armature voltage drop is 3% of rated terminal voltage and that of field current is 1% of rated full load current. Ratio of pole arc to pole pitch is 0.67.	*CO3*	*PO4*	**12**
		UNIT - IV			
7	a)	Discuss the factors affecting the choice of average flux density and specific electric loading in electrical machine design.	*CO2*	*PO2*	**08**
	b)	Determine the main dimensions, turns per phase number of slots, conductor cross section and slot area of a 250h.p, 3-phase, 50Hz, 400V 1410rpm, cage induction motor. Assume Bv= 0.5 wb/m², ac= 30000A/m, efficiency = 0.9 and p.f = 0.9, winding factor = 0.955, current density = 3.5A/mm², slot space factor is 0.4 and	*CO3*	*PO5*	**12**

			ratio core length to pole pitch = 1.2 take 5 slots per pole per phase motor is delta connected.			
			OR			
	8	a)	Explain the rules followed in selecting number of rotor slots.	*CO3*	*PO1*	**08**
		b)	Calculate (i) diameter (ii) length (iii) number of turns per phase (iv) full load current and cross-section of conductors, and (v) total I^2R loss of stator of 3 phase, 120 kW, 2200 Volts, 50 Hz, 750 rpm, (synchronous speed), star connected induction motor from the following particulars: -B_{av} = 0.48 Tesla, ac = 26000 amp. cond. per meter, Efficiency = 92%, power factor = 0.88, L =1.25 τ, Kw = 0.955, current density = 5A/mm², mean length of stator conductors = 75 cm., resistivity of copper (ρ) = 0.021 ohm per m. and mm².	*CO3*	*PO5*	**12**
			UNIT - V			
	9	a)	Explain the different types of substations used in power systems. Discuss their purposes and typical applications.	*CO4*	*PO6*	**10**
		b)	Describe the main components and essential equipment involved in high-voltage substation design, highlighting the purpose and function of each.	*CO4*	*PO3*	**10**
			OR			
	10	a)	Discuss the importance of substation earthing. Explain the methods used for effective earthing in substations.	*CO4*	*PO7*	**8**
		b)	Draw and explain the single line diagram for a 400 kV/220 kV substation, indicating all major components.	*CO4*	*PO10*	**8**
		c)	List any four standard electrical symbols and state their significance in electrical schematic diagrams	*CO4*	*PO10*	**4**

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