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Code No. : 18331 N/O

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD

Accredited by NAAC with A++ Grade

B.E. (E.E.E.) VIII-Semester Main & Backlog Examinations, May-2023

Electrical Machine Design (PE-V)

Time: 3 hours

Max. Marks: 60

Note: Answer all questions from Part-A and any FIVE from Part-B

Part-A (10 × 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	Discuss the advantage and disadvantage of choosing higher current density for conductors.	2	2	1	1,2,3,4
2.	A field coil has a heat dissipating surface of 0.15 m^2 and a length of mean turn of 1m. It dissipates loss of 150 W, the emissivity being $34 \text{ W/m}^2\text{-}^\circ\text{C}$. Estimate the final steady temperature rise of the coil and its time constant if the cross section of the coil is $100 \times 50 \text{ mm}^2$. Specific heat of copper is $390 \text{ J/kg-}^\circ\text{C}$. the space factor is 0.56. Copper weighs 8900 kg/m^3	2	3	1	1,2,3,4
3.	Consider two transformers A and B of same type with all their linear dimensions in the ratio x:1. What is the ratio of output of two transformers	2	2	2	1,2,3,4
4.	Calculate the voltage per turn of a 25 kVA, 11000/433 V, 50 Hz, 3 phase delta /star, core type oil immersed natural cooled distribution transformer. Assume $K=0.45$.	2	3	2	1,2,3,4
5.	A 11kW, 3 ϕ , 6 pole, 50 Hz, 220V star connected Induction Motor has 54 slots each containing 9 conductors. Calculate stator mmf	2	3	3	1,2,3,4
6.	Determine the stator turns per phase of a delta connected 415 V 3 phase Induction Motor with flux per pole 5.5 mWb.	2	3	3	1,2,3,4
7.	A 500 kVA, 6.6 kV, 50 Hz, 3 phase, 12 pole, star connected salient pole alternator has Specific magnetic and electric loadings as 0.56 Tesla and 26000 ampere conductor per meter respectively. Determine the volume of the machine (Assume Kw as 0.955)	2	3	4	1,2,3,4
8.	A synchronous machine has a gross core length of 38 cm, Estimate the net iron length of the core if there are 4 ventilating ducts each with a width of 10 mm. Take stacking factor as 0.92	2	3	4	1,2,3,4
9.	Draw the flow chart for analysis method of computer aided machine design	2	1	5	1,2,3,4,5
10.	Describe the advantages of claw pole alternator over conventional alternator.	2	1	5	1,2,3,4
Part-B (5 × 8 = 40 Marks)					
11. a)	Determine the rated current of transformer for the following duty cycle: 500A for 3 minutes, a sharp increase of 1000A and constant at this value for 1 minute, gradually decreasing for 2 minutes to 200 A and constant at this value for 2 minutes gradually increasing to 500 A during 2 minutes and the repetition of the cycle	4	3	1	1,2,3,4
b)	Prove that for the same volume of conducting material, the I^2R losses in a machine using aluminum conductors is 1.62 times that in a machine using copper conductors	4	1	1	1,2,3,4

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12. a)	Explain the steps involved in determining the number of tubes required to limit the temperature rise in transformer to a specified value.	4	1	2	1,2,3,4
b)	Determine the main dimensions of the core and window for a 500 kVA, 6600/400V, 50Hz, Single phase core type, oil immersed, self cooled transformer. Assume: Flux density = 1.2 T, Current density = 2.75 A/mm ² , Window space factor = 0.32, Volt / turn = 16.8, type of core: Cruciform, height of the window = 3 times window width. Also calculate the number of turns and cross-sectional area of the conductors used for the primary and secondary windings.	4	3	2	1,2,3,4
13. a)	Derive the output equation of 3 phase Induction motor.	4	1	3	1,2,3,4
b)	Calculate a) diameter b) length c) number of turns per phase d) cross section of stator conductors for a 3 phase 120 kW, 220 volt, 50 Hz, 750 rpm delta connected slip ring induction motor with the following data B=0.48 Tesla, ampere conductors = 26000/m η = 0.92 pf = 0.88, L = 1.25 τ and Kw = 0.955 current density 5 A/mm ²	4	3	3	1,2,3,4
14. a)	Determine the main dimensions for a 1000 kVA, 50 Hz, 3 phase, 375 rpm alternator. The average air gap flux density is 0.55 wb /m ² and the ampere conductors per meter are 28,000. Use rectangular poles and assume L/ τ as 2 and permissible peripheral speed is 50 m/s. The runaway speed is 1.8 times the synchronous speed	4	3	4	1,2,3,4
b)	Discuss the factors affecting the choice of specific magnetic loading and electric loading in synchronous machine	4	2	4	1,2,3,4
15. a)	Draw the flow chart for synthesis method of design and discuss the advantages and disadvantages of the method.	4	2	5	1,2,3,4
b)	Explain the steps involved in Finite Element Analysis in estimating the electromagnetic field of machine.	4	2	5	1,2,3,4,5
16. a)	Explain the method of average power loss in determining the rating of machines.	4	1	1	1,2,3,4
b)	Determine the dimensions of core and yoke for a 200 kVA, 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, maximum flux density 1.1 wb/m ² , window space factor 0.32, current density 3 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 the width of largest stamping is 0.85d.	4	3	2	1,2,3,4
17.	Answer any <i>two</i> of the following:				
a)	Discuss the end ring design of squirrel cage induction motor.	4	2	3	1,2,3,4
b)	Explain the factors affecting the choice of number of stator slots in synchronous machine.	4	2	4	1,2,3,4
c)	Explain general procedure for optimization of computer aided electrical machine design.	4	2	5	1,2,3,4,5

M : Marks; L: Bloom's Taxonomy Level; CO; Course Outcome; PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	40%
iii)	Blooms Taxonomy Level – 3 & 4	40%
