[Total No. of Questions: *12*] [Total No. of Printed Pages: 6]

UNIVERSITY OF PUNE

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T. E. (Electrical) Examination - 2013

DESIGN OF ELECTRICAL MACHINES

(2008 Course)(303148)

[Time: *3* Hours] **[Max. Marks: 100]**

Instructions:

1 ***Answer** three questions from section I and three question from section ii.*

2 *Answers to the **two sections** should be written in **separate answer-books**.*

3 *Black figures to the right indicate full marks.*

4 *All question are compulsory.*

5 *Neat diagrams must be drawn wherever necessary.*

6 *Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.*

7 *Assume suitable data, if necessary.*

SECTION -I

Q.1 A Explain the carter's fringe curve. And its applications [8]

B The hysteresis loss in a sample of iron was found to be 4.9 w/kg at a frequency of 50Hz and at a maximum flux density of 1.0 wb/m^2 i) calculate there from the coefficient η in the expression, loss per cycle $= \eta\ Bm^{1.7}$, J/m^3 the specific gravity of iron is 7.5 (ii) calculate the loss per kg at a frequency of 25 Hz and at a maximum flux density of 1.8 wb/m^2. [8]

OR

Q.2 A Calculation of mmf in teeth is a complex problem. Explain why. What are the methods used to determine the mmf in teeth. Which method gives more accurate results why. [8]

B Explain the various leakage fluxes produced in the rotating machines. [8]

Q. 3 A Define Heating time constant'. Draw the temperature rise curve and derive the equation for temperature rise at any time t, °c in terms of final steady temperature rise while heating and heating time constant. [8]

B Derive the equation for the width of window which gives the maximum output of transformer. W_w=0.7d. Where W_w= Width of window and d= Diameter of Circumscribing circle. [8]

OR

Q. 4 A The temperature rise of a transformer is 25°c after one hour and 37.5^{0}C after two hours of starting from cold conditions. Calculate its final steady temperature rise and heating time constant. If its temperature falls from final steady value to 40°c in 1.5 hour when disconnected, calculate its cooling time constant the ambient temperature is 30°c [8]

B Calculate the main dimensions of 100 kVA, 6.6/0.4KV frequency of 50Hz. Assume following data- voltage per turn =7.5 volts, Bm=1.2 wb/m^2, Ai/d^2=0.6, Hw/ww=2, Window space factor=0.28, current [8] density=2.5 A/mm^2.

Also determine the size of conductors and the number of turns in both the windings of transformer.

Q. 5 A Explain why tappings are provided on h.v. winding transformer. [8]

Also explain following-

i) Reference tappings

ii) Negative tappings

iii)Positive tappings.

B A 250 KVA,6.6/0.4KV, 3phase, core type transformer has a total loss of 4800w at fall load. The transformer tank is 125cm in height and 100cm ×50cm in plan. calculate the number of cooling tubes, it the average temperature rise is to be limited to 35°c The diameter of each tube is 5cm and the average height is 105 cm. the specific heat radiation =6w/ m^2/°c the specific heat dissipation due to convection= 6.5 w/m^2/°c. Assume convection is improved by 35% due to provision of cooling tubes. [10]

OR

Q. 6 A Explain why the distribution transformers are designed for high all day efficiency. [6]

B List the assumptions making while deriving the equation for leakage reactance for 3-phase core type transformer. [6]

C A 1MVA, 11000/3300v, three phase, delta-star transformer has- [6]

i) Width of Hv = 68mm

ii) Width of Lv winding =17mm

iii) Height of both the windings = 594 mm

iv) Length of mean turn of the windings = 1165 mm

v)Width of duct between Lv and Hv windings =15 mm

vi) Number of turns on Lv winding =93

calculate the percentage reactance referred to Hv winding.

SECTION II

Q. 7	A	Explain the factors to be considered while selecting the value of specific electrical loading for the design A 3-phase induction motor.	[8]
	B	Determine the main dimensions, turns per phase, number of slots, conductor cross-section and slot area of a 250hp, 3-phase 50Hz, 400v, 1410 rpm slip ring induction motor, Assume Bav=0.5 wb/m^2, ac= 30,000A/m, efficiency =0.9 and power factor =0.9, winding factor =0.955, current density =3.5 A/mm^2. Slot space factor=0.4 and ratio L/τ=1.2. The machine is delta connected Assume 5 slots per pole per phase.	[10]

OR

Q. 8	A	Explain the factors which are to be considered while selecting the number of stator slots in an induction motor.	[6]
	B	Compare squirrel cage rotor with would rotor used in induction motors.	[6]
	C	Derive the equation for output in an induction motor.	[6]

Q. 9	A	Explain briefly how the number of slots in a cage rotor are decided to avoid crowling and cogging. What is the effect of skewing of slots.	[6]
	B	A 3-phase, 2-pole,50Hz squirrel cage induction motor has rotor diameter 0.20 m and core length 0.12 m The peak density in the air –gap is 0.55 wb/m^2. The rotor has 33 bars, each of resistance 125$\mu\Omega$ and leakage inductance 2μH. The slip is 6% Calculate (i) The peak value of current in each bar (ii) rotor I^2R loss (iii)rotor output and (iv)torque excerted. Neglect resistance of end rings.	[10]

OR

Q. 10	A	Derive the equation for end-ring current in an induction motor. Also show that end-ring current is also sinusoidal.	[5]
	B	Explain the methods which are used to eliminate the harmonic torques in an induction motor.	[3]
	C	A 90kw, 500v, 50Hz, 3-phase, 8-pole induction motor has a star connected stator winding accommodated in 63 slots with 6 conductors per slot. If the slip-ring voltages on open circuit is to be about 400v, find a suitable rotor winding, stating: i) Number of slots(ii)number of conductors per slot (iii)coil span (iv) slip ring voltage on open circuit (v)approximate full load current per phase in rotor. Assume efficiency=0.9, power factor= 0.86, slots per pole per phase = 3, rotor mmf is 86% of stator mmf.	[8]

Q. 11	A	What is dispersion coefficient. Explain its effect on overload capacity of the induction motor.	[8]
	B	A 75 kw, 3300v, 50Hz ,8-pole , 3phase star connected induction motor has a magnetizing current which is 35% of the full load current. Calculate the value of stator turns per phase it the mmf required for flux density at 30° from pole axis is 500A Assume winding factor=0.95, and full load efficiency and power factor 0.94 and 0.86 respectively.	[8]

OR

Q. 12	A	Explain the method of estimating magnetising current in an induction motor.	[6]
	B	Explain the effect dispersion coefficient on maximum power factor.	[6]
	C	Explain the effect of saturation of magnetic circuit on the performance of induction motor	[4]