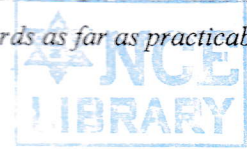


TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2082 Chaitra

Exam.	Regular (New Course)		
Level	BE	Full Marks	60
Programme	BEL	Pass Marks	24
Year / Part	III / I	Time	3 hrs.

Subject: - Electric Machine Design (ENEE 306)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**
- ✓ Assume suitable data if necessary.



1. a) Differentiate between soft magnetic materials and hard magnetic materials in brief with necessary diagrams. [4]
- b) What is ageing of core of electrical machine? What are the advantages and disadvantages of adding silicon with iron? [4]
2. a) Define hot spot in relation to electrical machine. Taking the example of a plate of thickness t derive the necessary expression of temperature of the hottest spot. [5]
- b) A 40 kVA, 11000/400 V, 3-phase transformer is working in an ambient temperature of 35°C on full load. Its oil temperature is recorded as follows: [4]
 - 59°C after 1.5 hours
 - 71°C after 3 hours

Its full-load copper losses are 2 times the iron losses

Calculate:

- i) Heating time constant
- ii) Final steady temperature rise
- iii) 1-hour rating

3. a) For a 500 kVA, 50Hz, 6600/400, single phase core type, oil immersed, natural cooled power transformer, the design parameters are: [16]

Constant for output voltage per turn (K) = 0.8
 Resistivity of copper = $0.021 \Omega\text{-mm}^2/\text{m}$
 Maximum flux density in core (B_m) = 1.5 Wb/m^2
 Current density = 2.75 A/mm^2
 Core type = Cruciform
 Window space factor (k_w) = 0.27
 Stacking factor (K_i) = 0.9
 Ratio of height to width of windows (H_w/W_w) = 2.5
 Ratio of yoke height to width (H_y/D_y) = 1
 Axial depth of LV winding = 402 mm
 Axial depth of HV winding = 377.5 mm
 Inside diameter of LV winding = 310 mm
 Outside diameter of LV winding = 348 mm
 Inside diameter of HV winding = 360 mm
 Outside diameter of HV winding = 418 mm
 Taking iron loss = 1460 W,
 Copper loss = 3865 W at full load,
 Height of tank = 1.6 m,
 Length of tank = 1.05 m,
 Width of tank = 0.62 m, find the temperature rise. If
 the mean rise of oil is not to rise 35°C , find the necessary number of tubes and show
 its arrangement.

- b) Compare power transformer with distribution transformer. [3]

4. a) What are the factors that must be considered while selecting the length of air gap in induction motor? [6]
- b) For a 2.2 kW, 440 V, 3-phase, 50 Hz, 1430 rpm squirrel cage induction motor having efficiency of 0.8 and p.f. 0.85 designed for its best power factor. Given $B_{av} = 0.44 \text{ Wb/m}^2$, $A_c = 21,000 \text{ A/m}$, slot space factor = 0.4, ratio of slot depth to width = 4, stator slot pitch = 12 to 15 mm, $\delta_s = 4 \text{ A/mm}^2$. Calculate: [8]
- Main dimensions
 - T_s (Turns per phase of stator conductor)
 - A_s (Area of stator conductor)
 - No. of stator slots
 - Area and dimension of each stator slot
 - Minimum width of stator teeth
 - Find stator slot loading.
- Note: For best power factor, $\tau = \sqrt{(0.18 L)}$
5. a) Explain the factors to be considered for the choice of ampere conductors per meter (AC) in DC machine. [5]
- b) A design is required for a 30 kW, 4 pole, 900 rpm DC shunt generator, the full load terminal voltage being 240 V. Assume that the full load armature voltage is 3% of the terminal voltage. Calculate the main dimensions of the machine if the maximum gap density is 0.85 Wb/m^2 , specific electrical loading of 20,000 ampere conductor/meter and field resistance is 120Ω . The ratio of pole arc to pole pitch is 0.7. The pole face is square. [5]
