

DESIGN OF ELECTRICAL MACHINES
- C. GOKUL, AP/EEE

UNIT-1:

PROBLEM 1.2 (P-1.25) Calculate the specific electric and magnetic loading of 100HP, 3000V, 3 ϕ , 50Hz, 8 pole, star connected flame proof induction motor having stator core length 0.5m and stator bore 0.66m. Turns/phase=286. Assume full load efficiency=0.938 and power factor=0.86. [DEC-2013 (8 mark)]

Problem Model - I

GIVEN: $P = 100 \times 0.746 = 74.6 \text{ kW}$, $f = 50 \text{ Hz}$, $p = 8$, $D = 0.66 \text{ m}$, $L = 0.5 \text{ m}$, $V_L = 3000 \text{ V}$

$$V_{ph} = \frac{V_L}{\sqrt{3}} = 1732.05 \text{ V} \quad \eta = 0.938, \quad T_{ph} = 286 \quad \cos \phi = 0.86 \quad \text{ac?} \quad B_{av}?$$

Soln:

step 1: find I_2

current passing

$$I_2 = I_1 = I_{ph} = \frac{P \times 10^3}{\sqrt{3} V_L \eta \cos \phi}$$

$$= 17.79 \text{ A}$$

through each conductor

step 2: find ac - T_{ph} given

$$\text{spec. ac electric loading} = \frac{I_2 \cdot Z}{\pi \cdot D}$$

$$= 14730.57 \text{ amp/m cond}$$

step 3: find ϕ

$$\text{Flux per pole } \phi = \frac{F_s}{4.44 f k_{ws} T_{ph}}$$

$$= 0.028 \text{ Wb}$$

step 4: find B_{av}

spec. magnetic loading

$$B_{av} = \frac{p \phi}{\pi D L}$$

$$= 0.216 \text{ Wb/m}^2$$

PROBLEM 1.1 (P-1.23) A 400KW, 500V, 450 rpm, 6 pole DC generator is built with an armature diameter of 0.87m and core length is 0.32m. The lap wound has 660 conductors. Calculate the specific electric loading and magnetic loading.

GIVEN:

$P = 400 \text{ kW} = 400 \times 1000 \text{ watts}$, $V = 500 \text{ V}$, $N = 450 \text{ rpm}$, $p = 6$, $D = 0.87 \text{ m}$, $L = 0.32 \text{ m}$, $Z = 660 \text{ conductors}$, $a = p = 6$

step 1: find I_2

current passing through each conductor

$$I_2 = \frac{I_a}{a}$$

$$I_a = \frac{P_a}{V} = 800 \text{ A}$$

$$I_2 = 133.33 \text{ A}$$

step 2: find ac:

$$\text{spec. electric loading ac} = \frac{I_2 \cdot Z}{\pi \cdot D}$$

$$= 32196.8 \text{ ampcond/m}$$

step 3: find ϕ :

$$F_b = \frac{\phi Z N p}{60 a}$$

$$\phi = \frac{F_b \times 60 \times a}{Z N p}$$

$$\phi = 0.101 \text{ Wb}$$

step 4: find B_{av} :

$$\text{spec. magnetic loading} \quad B_{av} = \frac{p \phi}{\pi D L}$$

$$= 0.6928 \text{ Wb/m}^2$$

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