



Name :
Roll No. :
Invigilator's Signature :

CS/B.TECH(EEE)/SEM-7/EEE-702/2011-12

2011

ELECTRICAL MACHINE DESIGN

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

10 × 1 = 10

- i) Power transformer core should be made of
 - a) H. R. Steel
 - b) C R G O Steel
 - c) C R N O Steel
 - d) Mumetal.
- ii) Laminated core material is used to minimise
 - a) copper loss
 - b) iron loss
 - c) eddy current loss
 - d) histeresis loss.
- iii) Core flux of a transformer depends on
 - a) voltage ratio
 - b) load current
 - c) load power factor
 - d) permissible temperature rise.



- iv) Stepped core is used to
- a) reduce core loss
 - b) reduce copper loss
 - c) reduce cost
 - d) to reduce efficiencies.
- v) Sp magnetic loading is given by
- a) $\frac{P\phi}{\pi D}$
 - b) $\frac{P\phi}{\pi DL}$
 - c) $\frac{P\phi}{\pi D^2 L}$
 - d) $P\phi$ only,
- ($\phi \rightarrow$ flux/pole $P \rightarrow$ pole, $D \rightarrow$ diameter. $L -$ length)
- vi) Total electrical loading is given by
- a) $\frac{I_z z}{\pi DL}$
 - b) $\frac{I_z z}{\pi D}$
 - c) $I_z z$
 - d) $\frac{I_z z}{\pi D^2 L}$.
- vii) A transformer oil should have
- a) low flash point
 - b) high fire point
 - c) high thermal conductivity
 - d) low loss angle.
- viii) Skewing of rotor slot of a SQIM is used to
- a) reduce harmonic loss
 - b) avoid crawling
 - c) avoid logging
 - d) time harmonic effects.



- ix) Commutator material used in d.c. machine is
- a) brass
 - b) electrolytic copper
 - c) bar drawn electrolytic copper
 - d) steel.
- x) Window space factor is defined as
- a) A_c/A_w
 - b) A_w/A_c
 - c) $A_w/\text{Volume of iron}$
 - d) $\text{Volume of Cu}/\text{Volume of iron}$.
- (A_c & A_w = Area of Cu & Area of iron)

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Why cross-over type coil is used in h.v. winding and its current rating is limited within 30 ft. ?
3. Why mitre joint is preferred in large transformer construction ? Why sandwich type winding is used in low voltage high current application ?
4. Derive output equation of an a.c. machine and discuss the criteria for selection of B_{av} and a_c .
5. Why depth to width ratio of slot is limited within 2 - 4 for a d.c. machine ? What happened if minimum no. of commutator segment is taken lower than $EP/15$?
6. Why L/Y ratio of SQIM limited with in 1 - 2. Discuss the factor on which L/Y changes.



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. Develop the stator winding scheme of a 3-phase SQIM having 36 slots 4 pole with 240 turns/ph. connected in star. Calculate the voltage rating of the motor having 90 mm armature dia 110 mm core length taking average flux density 0.4 to 0.55 wb/m².
8. Calculate the core and window dimension of a single phase 50 kVA 400/220V transformer and also calculate the turns used for hV and LV winding.
[Assume 1.2 wb/m² flux density in the core and 2A/m² current density. cu space factor 0.30, stacking factor 0.95]
9. Design a rotor for a SQIM whose stator has 48 slots 4 pole winding having 14.8A current per phase. Stator full load power factor is 0.85. Turns per phase is 240. Stamping size is 210 mm stator OD 89 stator ID shaft hole – 35 mm stack length 1320 mm.
10. a) Why number slots in a wave wound d.c. machine should not be multiple of pole pair ? Why $Y_b - 1$ /coil side per slot should be taken as a integer value ?
b) Why diameter of commutator should be within 60 to 80 per cent of armature diameter and commutator pitch is greater than 4 mm ?
11. a) What are the factors those should be considered when estimating the length of air gap ? Explain.
b) Determine the main dimensions, turns per phase, number of slots, conductor cross-section and slot area of a 250 h.p, 3-phase, 50 Hz, 400 V, 1410 r.p.m. slip ring induction motor. Assume $B_{av} = 0.5$ wb/m², $ac = 30000$ A/m, efficiency = 0.9 and power factor = 0.9, winding factor = 0.955, current density = 3.5A/mm². The slot space factor is 0.4 and the ratio of core length to pole pitch is 1.2. The machine is delta connected. 7 + 8