ELECTRICAL MACHINE DESIGN (SEMESTER - 6)

CS/B.Tech(EE-Old)/SEM-6/EE-601/09
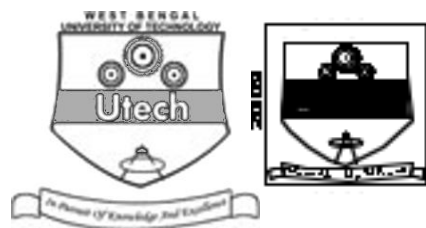
1. ....
   Signature of Invigilator

2. ....
   Signature of the Officer-in-Charge

Reg. No.

Roll No. of the Candidate

CS/B.Tech(EE-Old)/SEM-6/EE-601/09

ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

ELECTRICAL MACHINE DESIGN (SEMESTER - 6)

Time : 3 Hours]   [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.

2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.

   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.

3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.

4. Read the instructions given inside carefully before answering.

5. You should not forget to write the corresponding question numbers while answering.

6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.

7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**

8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.

9. Rough work, if necessary is to be done in this booklet only and cross it through.

   No additional sheets are to be used and no loose paper will be provided

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FOR OFFICE USE / EVALUATION ONLY
Marks Obtained

							Group – A									Group – B		Group – C						Total Marks	Examiner's Signature
Question Number																								**Total Marks**	**Examiner's Signature**
Marks Obtained																									

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Head-Examiner/Co-Ordinator/Scrutineer

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6654 ( 03/06 ) (O)
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ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009
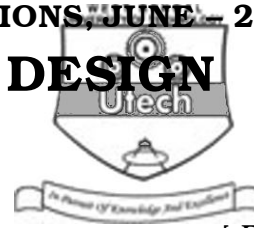
ELECTRICAL MACHINE DESIGN

SEMESTER - 6

Time : 3 Hours]　　　　　　　　　　　　　　　　　　　[Full Marks : 70

GROUP – A

(Multiple Choice Type Questions)

1.　Choose the correct alternatives for any *ten* of the following :　　　　10 × 1 = 10

　　i)　Which loss does not vary with load as well as flux desnity in a DC machine ?

　　　　a)　Copper loss　　　　　　　b)　Eddy current loss

　　　　c)　Hysteresis loss　　　　　　d)　Windage loss.

　　ii)　The air gap of a polyphase induction motor is kept small to

　　　　a)　reduce the possibility of crawling

　　　　b)　reduce the noise

　　　　c)　reduce the magnetizing current

　　　　d)　obtain high starting torque.

　　iii)　In a synchronous machine, the damper winding is used to

　　　　a)　reduce air-gap harmonic flux

　　　　b)　reduce oscillation

　　　　c)　increase stability limit

　　　　d)　resist moisture.

6654 (03/06) (O)

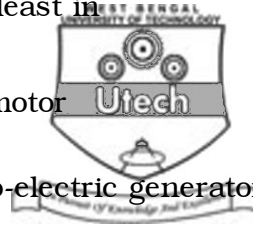iv) For the same voltage & output, the air gap is the least in

    a)   induction motor   b)   d.c. motor

    c)   turbo-generator   d)   hydro-electric generator.   ☐

v) Hard magnetic materials have

    a)   broad hysteresis loop   b)   narrow hysteresis loop

    c)   either (a) or (b)   d)   none of these.   ☐

vi) In transformer, the type of winding is

    a)   lap   b)   wave

    c)   distributed   d)   concentric.   ☐

vii) The gap contraction factor for slots depends upon

    a)   ratio of slot opening & tooth width

    b)   Carter's co-efficient

    c)   length of the gap

    d)   depth of armature.   ☐

viii) An increase in number of poles of an induction motor results in

    a)   decrease in maximum power factor

    b)   increase in maximum power factor

    c)   no change in maximum power factor

    d)   poor performance.   ☐

ix) In a D.C. machine the number of commutator segment is equal to

a) number of conductors   b) twice the number of poles

c) number of coils   d) number of brushes.

x) Multi-stepped core is used in a transformer to

a) increase the output   b) decrease the cost of core material

c) decrease the cost of copper   d) increase the efficiency.

xi) Which of the following is the least desired property in magnetic material for making electric machine ?

a) High electrical resistivity   b) High magnetic permeability

c) Low loss co-efficient   d) Large hysteresis loop.

GROUP – B
(Short Answer Type Questions)

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

2. What is cross fluxing ? What is the advantage of using mitred joints in core construction ?

3. Why a synchronous machine designed with higher value of short circuit ratio has a short air gap ?

4. For an Induction motor, show how its capacity & loss vary with its linear dimension.

5. Find the armature voltage drop of a 300 kW, 500 V, 6pole, lap connected

d.c. generator having 150 slots with 8 conductors per slot. Area of each conductor is

25 mm^2 & length of mean turn is 2·5 m. The resistivity is 0·021 Ω/m & mm^2 .

6. Why the flux density of a distribution transformer is always less than the value for power transformer ?

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.   3 × 15 = 45

7. Calculate approximate dimensions of a 220 kVA, 6600/440 V, 50 Hz, 3-Phase core type transformer. The following data may be assumed :

emf per turn = 10V

Maximum flux density = $1 \cdot 3 \, \text{Wb/m}^2$

Current density = $2 \cdot 5 \, \text{A/mm}^2$

Window space factor = $0 \cdot 3$

Overall height = overall width

Stacking factor = $0 \cdot 9$.

Use 3 stepped core. Any missing data may suitably be used.

8. a) Assuming sinusoidal distribution of currents in the bars of a squirrel cage induction motor over a pitch, show that the *rms* value of end ring current is

$$I_e = \frac{S_r \cdot I_b}{\pi p} \ .$$

Where, S_r = number of rotor slots, I_b = *rms* value of bar current and

p = number of poles.

b) Estimate the stator core dimension, number of stator slots and number of stator conductors per slot for a 100 kW, 3.3 kV, 50 Hz, 12-pole star connected slip ring induction motor. Assume : average gap density = 0.4 Wb/m^2, specific electric loading = 25000 A/m, efficiency = $0 \cdot 9$, power factor = $0 \cdot 9$ and winding factor = $0 \cdot 96$.

Choose the main dimension to give best power factor. The slot loading should not exceed 500 ampere conductor.   6 + 9

6654 (03/06) (O)

9. a) Find the main dimension of a 200 kW, 250 V, 6-pole, 1000 rpm d.c. generator. The maximum value of flux density in the gap is 0·87 Wb/m^2 & the ampere conductors per metre of armature periphery are 31000. The ratio of pole arc to pole pitch is 0·67 & the efficiency is 91%. Assume the ratio of length of core to pole pitch = 0·75. Assume any missing data.

b) What are the disadvantages of higher specific electric & magnetic loading ?

10 + 5

10. a) Deduce the output equation of the synchronous machine.

b) A 500 kVA, 33 kV, 50 Hz, 600 rpm 13 phase salient pole alternator has 180 turns per phase. Estimat the length of air gap, if the average flux density is 0·54 Wb/m^2, the ratio of pole arc to pole pitch 0·65, the short circuit ratio, 1·2 ; the gap contraction factor, 1·15 & the winding factor, 0·955. The mmf required for gap is 80% of no load field mmf & the winding factor 0·955.

7 + 8

11. a) The temperature rise of a transformer is 25°C after one hour & 37·5°C after two hours of starting from cold conditions. Calculate its final steady temperature rise & the heating time constant. If its temperature falls from its final steady value to 40°C in 2·5 hours when disconnected, calculate its cooling time constant. The ambient temperature is 30°C.

b) What is leakage flux ? Define leakage co-efficient. 10 + 5

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END