Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(EEE)/SEP. SUPPLE/SEM-7/EEE-702/2012

2012

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 any *ten* of the following : 10 × 1 = 10

i) Transformer Oil should have

a) low viscosity b) low di-electric strength

c) low flash point d) none of these.

ii) Air gap for a 3 phase induction motor is kept small for

a) reducing crawling

b) obtaining high starting torque

c) reducing noise

d) reducing magnetising current.

iii) When a capacitive load is connected to a transformer the output voltage is

a) less than the equivalent primary

b) more than the equivalent primary

c) remain unchanged

d) none of these.

iv) For minimum cost of induction m/c the ratio of core length to pole pitch is kept between

a) 1·5 – 2·0 b) 2·5 – 3·0

c) 1·0 – 1·5 d) 2·0 – 2·5.

v) Higher value of ampere conductors per metre of induction m/c indicates

a) low value of overload capacity

b) high value of overload capacity

c) no relation with overload capacity

d) none of these.

vi) Power factor of induction machine reduces with

a) greater air gap b) lesser air gap

c) more net iron length d) none of these.

vii) For rotating machines the volume of active parts is inversely proportional to

a) flux density in teeth

b) output co-efficient C_o

c) average flux density

d) none of these.

viii) A higher value of '*ac*' in DC machines denote

a) high temperature rise of windings

b) low temperature rise of windings

c) high speed of the machine

d) none of these.

ix) For a 500 kW DC machine the gap flux density is

a) 0·5 – 0·9 tesla

b) 1·0 – 1·5 tesla

c) 1·5 – 2·5 tesla

d) 2·0 – 2·5 tesla.

x) Changing of tapping when a transformer is disconnected from supply is called

a) off-circuit tap changing

b) on load tap changing

c) tap changing

d) none of these.

xi) Tappings in case of transformer is done on

a) high voltage winding

b) low voltage winding

c) tertiary winding

d) none of these.

xii) In DC machines, the distribution of air-gap flux density wave at no load is

a) sinusoidal b) co-sinusoidal

c) flat-topped d) rectangular.

GROUP – B

(Short Answer Type Questions)

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

2. a) What is overload capacity ?

b) What is its impact if the "a.c." values are higher ?

c) Deduce the output equation of any induction machine in terms of specific magnetic and electric loadings.

$1\frac{1}{2} + 1\frac{1}{2} + 2$

3. a) What are the main dimensions of induction motor ?

   b) What are the desired values of L/ζ, peripheral speed and width of ventilation ducts ? $2\frac{1}{2} + 2\frac{1}{2}$

4. a) Which type of material is used for core laminations ?

   b) What is the advantage of using mitred joints in core construction ? $2\frac{1}{2} + 2\frac{1}{2}$

5. a) What is a three winding transformer ?

   b) What are the methods of cooling of transformer ?

   c) What are the functions of breather and conservator in transformer ? $1\frac{1}{2} + 1\frac{1}{2} + 2$

6. a) What are the factors that are to be considered for choice of ampere conductors in D.C. machines ?

   b) What are the guiding factors for choice of number of poles ?

   c) Find an expression for estimation of air gap length.

   $1\frac{1}{2} + 1\frac{1}{2} + 2$

GROUP – C
(Long Answer Type Questions)

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

7. Calculate the window dimensions and winding details of a 100kVA, 2000/400V, 50 HZ, single phase shell type oil immersed, self cooled transformer.

   [Assume : flux density in core : 1.1 Wb/m^2, Voltage per turn = 10 volts, Window space factor : 0·33, Ratio of window height to window width and ratio of core depth to width of central limb = 2·5. Stacking factor = 0·90.]

8. Determine the stator core dimensions, number of stator slots and number of stator conductors per slot for a 100 kW, 3300V, 50 Hz, 12 pole star connected slip ring induction motor.

   [Assume : Average gap density : 0·4 Wb/m ^{2}, Conductor per metre : 25,000A/m, Effn : 0·9, Power factor : 0·9, Winding factor : 0·96. Slot windings should not exceed 500 ampere conductors and choose main dimensions for best power factor.]

9. a) What are the methods used for reduction of harmonic torques in 3 phase induction machine ?

   b) Calculate the order of slot harmonics produced by a 3 phase, 4 pole induction pole having 24 slots. Find the angle through which the bars must be skewed to completely eliminate the higher order slot harmonics.

10. Calculate suitable dimensions of armature core to give a square pole face for a 50 kW, 4 pole , 600 rpm DC shunt generator whose full load terminal voltage is 220V. The maximum gap density is 0·83 Wb/m ^{2} and armature ampere conductors per metre is 30,000.

    [Assume : Full load armature voltage drop in 3 per cent of the rated terminal voltage and field current is 1 per cent of rated full load current. Ratio of pole arc to pole pitch is 0·67].

11. Write short notes on any *three* of the following : 3 × 5

a) Crawling and Cogging in 3 phase induction motor

b) Efficiency and losses of a DC machine

c) Methods for improvement of starting torque in induction machine

d) Armature winding insulation of DC machine

e) Continuous Disc type windings of transformers.