ELECTRICAL MACHINE (SEMESTER - 4)

CS/B.TECH(EE(O)/PWE)/SEM-4/EE-401/09

1. .....
Signature of Invigilator

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

Reg. No. | | | | | | | | | | | | | | |

Roll No. of the Candidate | | | | | | | | | | | | | | |

CS/B.TECH(EE(O)/PWE)/SEM-4/EE-401/09

ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

ELECTRICAL MACHINE (SEMESTER - 4)

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				
Question Number																	***Total Marks***	***Examiner's Signature***
Marks Obtained																		

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Head-Examiner/Co-Ordinator/Scrutineer

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GROUP – A

(Multiple Choice Type Questions)

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

i) The tertiary winding of three winding transformer carries

a) the third harmonic current b) the fifth harmonic current

c) the negative sequence current d) the 7th harmonic current. ☐

ii) In a Yd 6 connected three phase transformer the phase shift is

a) 60° b) 120°

c) 180° d) 270°. ☐

iii) A 3% change in supply voltage across an induction motor will cause a change of

a) 3% in the rotor torque b) 6% in the rotor torque

c) 9% in the rotor torque d) 27% in the rotor torque. ☐

iv) If the brushes are aligned along GNA, then the armature reaction has

a) demagnetising effect b) cross-magnetising effect

c) both (a) & (b) d) no effect. ☐

v) The power factor of a squirrel cage induction motor is

a) low at light loads only

b) low at heavy loads only

c) low at both light & heavy loads

d) low at rated loads only. ☐

vi) A wound rotor induction motor can be distinguished from squirrel cage induction motor by

a) size b) direction of rotation

c) diameter of shaft d) presence of slip-ring. ☐

vii) In an induction motor if p is the power delivered to the rotor & s is the slip, then the power lost in rotor as copper loss, will be

a) $\frac{p}{s}$ b) $\frac{p}{s^2}$

c) sp d) $s^2 p$. ☐

viii) The phenomenon of crawling occurs in induction motor due to

a) low valtage

b) high load

c) jammed bearing

d) hormonics developed in the motor. ☐

ix) The commutator pitch for a simplex lap winding is equal to

a) number of poles of the machine

b) pole pairs

c) 1

d) 2. ☐

x) The armature resistance of a 6-pole lap wound *dc* machine is 0·05 ohm. If the armature is rewound using wave winding, then the armature resistance will be

a) 0·45 b) 0·30

c) 0·15 d) 0·10. ☐

xi) In a 3-phase transformer, the phase sequence of the fundamental *emf* is *ABC*. Then the phase sequence of the fifth & seventh harmonic *emfs* are respectively

a) *ABC, ABC* b) *ABC, ACB*

c) *ACB, ABC* d) *ACB, ACB*. ☐

xii) Poles of the *dc* machine are often laminated to

a) reduce pulsation loss b) reduce armature reaction

c) reduce iron weight d) dissipate more heat. ☐

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. "A self excited *d.c.* generator fails to build up its voltage." Explain. How can it be rectified ?

3. Explain the phenomenon of cogging & crawling of a 3-phase squirrel cage induction motor.

4. Draw and explain the circuit diagram of a transformer arrangement for converting a 3-phase to 2-phase supply.

5. Derive an expression for developed torque in a 3-phase induction motor & state the condition for maximum torque.

6. State the necessary & desirable conditions for parallel operation of two three-phase transformers.

GROUP – C

(Long Answer Type Questions)

Answer any *three* questions. 3 × 15 = 45

7. a) Explain the consequence of switching a *dc* motor without being started on full supply voltage.

   b) When a *d.c.* shunt generator is loaded its terminal voltage falls. Explain the same with the help of external characteristics of the generator.

   c) A long shunt dynamo running of 1000 rpm supplies 22 kW at a terminal voltage of 220 V. The resistances of the armature, shunt field & the series field are 0·05Ω, 110Ω & 0·06 Ω respectively. The overall efficiency at the above load is 88%. Find (i) Cu losses (ii) iron & friction losses (iii) the torque exerted by the prime mover. 3 + 4 + 8

8. a) Discuss different methods of speed control of shunt motors.

   b) A *d.c.* series motor having a resistance of 1Ω drives a fan for which the torque varies as the square of the speed. At 220 V, the set runs at 350 rpm and takes 25A. The speed is to be raised to 500 rpm by increasing the voltage. Determine the necessary voltage & the corresponding current assuming the field to be unsaturated. 9 + 6

9. a) Draw & explain the equivalent circuit of an induction motor.

b) What happens if single phasing occurs when motor is running ?

c) A 3-phase induction motor has a 4-pole, *Y*-connected stator winding. The motor runs on a 50 Hz supply with 200 V between lines. The rotor resistance & standstill reactance per phase are 0·1 Ω & 0·9 Ω respectively.

Calculate :

i) the total torque at 4% slip.

ii) the maximum torque.

iii) the speed at maximum torque if the ratio of the rotor to stator turns is 0·67.

Neglect rotor impedance. 5 + 2 + 8

10. a) Explain with reasons why a delta-delta transformer cannot be parallelled with a delta-star transformer.

b) Discuss effects of unbalanced loading in a 3-phase transformer.

c) A load of 500 kVA at 0·8 power factor lagging is to be shared by two three phase transformers *A* & *B* of equal ratings. If the equivalent data impedances as referred to secondary are (2 + *j*6) Ω for *A* & (2 + *j*5) Ω for *B*, calculate the load supplied by each transformer. 3 + 6 + 6

11. a) Why is the rotor of a 3-phase induction motor forced to rotate in the same direction as the rotating magnetic field ?

b) State under what conditions in a 3-phase induction motor.

i) the rotor & the stator frequencies are the same.

ii) the rotor frequency is smaller than the stator frequency.

iii) the rotor frequency is greater than the stator frequency.

c) The rotor resistance & stanstill reactance of a 3-phase induction motor are respectively 0·015 Ω & 0·09 Ω per phase.

i) What is the p.f. of the motor at start ?

ii) What is the p.f. at a slip of 4% ?

iii) If the number of poles are 4, the supply frequency is 50 Hz & the standstill *emf* per rotor phase is 110V, find out the full-load torque. Take full-load slip as 4%. 4 + 4 + 7

END