

CS/B.Tech(PWE/NEW)/SEM-4/PWE-401/2013

2013

ELECTRICAL MACHINE

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 :

10x1 = 10

i) The armature control scheme for the speed control of dc motor is used for

a) controlling the speed above the base speed

b) controlling the speed below the base speed

c) both (a) and (b)

d) none of these.

ii) The speed-torque characteristic of a d.c. series motor is

a) a straight line passing through origin

b) a straight line having negative slope

c) hyperbolic in nature

d) parabolic in nature

iii) Which type of d.c. motor is suitable for traction drive ?

a) cumulatively compound d.c. motor

b) differentially compound d.c. motor

c) d.c. shunt motor

d) d.c. series motor.

iv) If the speed of a d.c. shunt motor is increased above the base speed, then its counter *emf*

a) increases

- b) decreases
 - c) remains unchanged
 - d) first increases then decreases.
- v) In a d.c. series generator, the terminal voltage with increase in load will
- a) decrease
 - b) increase gradually and then stay at rated voltage
 - c) increase to rated voltage and then may decrease
 - d) remain nearly constant.
- vi) The mmf produced by the rotor currents of a 3-phase IM
- a) rotates at the speed of rotor in the air gap
 - b) is at stand still w.r.t. stator mmf
 - c) rotates at slip speed w.r.t. stator mmf
 - d) rotates at synchronous speed w.r.f. rotor.
- vii) In a 3-phase IM, if P_g represents the air gap power, then rotor ohmic loss is given by
- a) sP_g
 - b) $(1 - s) P_g$
 - c) $(1 + s) P_g$
 - d) P_g/s .
- viii) If the air gap power of a 3-phase IM is 15 kW and slip is 4%, then internal developed mechanical power is
- a) 14.4 kW
 - b) 15.2 kW
 - c) 13.6 kW
 - d) 12.8 kW.
- ix) Transformer action requires a
- a) constant magnetic flux
 - b) increasing magnetic flux
 - c) alternating magnetic flux

- d) alternating electric flux.
- x) The symbol Yd11 represents a 3-phase transformer with h.v. line phasor
- a) leading the l.v. line phasor by 30°
 - b) leading the l.v. line phasor by 150°
 - c) lagging the l.v. line phasor by 30°
 - d) lagging the l.v. line phasor by 60° .
- xi) A 10 kVA step down auto-transformer has voltage ratio 0.7. The transformed and conducted kVA can be respectively
- a) 3, 7
 - b) 7, 3
 - c) 5.5
 - d) 3.5, 6.5.

GROUP – B

(Short Answer Type Questions)

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

2. Describe the working principle of a single phase induction regulator with necessary diagrams.
3. Write down the conditions for satisfactory parallel operation of two 3-phase transformers.
4. Describe the series-parallel armature control of *d.c* series motor used to control the speed with neat diagram.
5. Discuss about the constructional features of three phase induction motor with neat diagram.
6. Briefly discuss about the starting method of a *dc*-shunt motor using 3-point starter with necessary diagram.

GROUP – C

(Long Answer Type Questions)

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

7. a) Show that the maximum internal torque of a 3-phase

induction motor is independent of rotor resistance. 6

b) Prove that the torque-slip characteristics of 3-phase induction motor is linear near the synchronous speed. 4

c) Blocked-rotor test on a 3-phase, 40 kW, 400 V, 50 Hz, 6-pole star connected induction motor gave the following data :

200 V, 110 A, $\text{pf} = 0.4$.

Determine the starting torque for a 3-phase voltage of 380 V at 45 Hz. Neglect magnetizing current and assume stator and rotor ohmic losses equal. 5

8. a) Discuss about the detrimental effects of armature reaction in *dc* machine. 5

b) Write down the methods of limiting armature reaction. 5

c) A *dc* series motor, running a fan at 1000 rpm, takes 50 A from 250 V mains. The armature plus field resistance is 0.6 Ω . If an additional resistance of 4.4 Ω is inserted in series with armature circuit, find the motor speed in case the field flux is proportional to the armature current. 5

9. a) Why the generated emf vs. armature current characteristics of a *dc* shunt generator is drooping in nature ? 5

b) Write down the conditions for voltage build-up in *dc* shunt generator. 4

c) A 6-pole *dc* machine has 300 conductors and each conductor is capable of carrying 80 A without excessive temperature rise. The flux per pole is 0.015 Wb and the machine is driven as 1800 rpm. Compute the total current, emf, power developed in the armature and electromagnetic torque, if the armature conductors are :

i) wave connected

ii) lap connected. 6

10. a) Draw the connection diagram and phasor diagram of the following types of transformers :

i) Yd11

ii) Dy1

iii) Dd6. 6

b) Why the unbalanced operation of 3-phase Transformer is undesirable ? 5

c) How much cu is saved if we use a step down auto transformer instead of a 2-winding Transformer of same rating ? 4

11. Write short notes on any *two* of the following : $2 \times 7\frac{1}{2}$

a) Star-delta starting of 3-phase Induction motor

b) Ward-Leonard method of speed control of *dc* motor

c) Single phase Auto Transformer

d) Power flow diagram of a 3-phase Induction motor.

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