

CS/B.Tech/Even/EE/EEE/4th Sem/EE-401/2014

2014

Electrical Machines - I

Time Alloted : 3 Hours

Full Marks : 70

***The figure 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) In dc machines the air gap flux distribution in space at no load is
- a) Sinusoidal
 - b) triangular
 - c) flat topped
 - d) pulsating
- ii) If the applied voltage to a dc machine is 230v, then the back emf for maximum power developed is-
- a) 115V
 - b) 200V
 - c) 230V

CS/B.Tech/Even/EE/EEE/4th Sem/EE-401/2014

- d) 460V
- iii) Swinburne test is not possible for
 - a) DC series motor
 - b) shunt motor
 - c) Induction motor
 - d) Cumulative Compound motor
- iv) A cumulatively compounded dc generation is supplying 20A at 200V. Now if the series field winding is short circuited, the terminal voltage
 - a) Will remain unaltered at 200V
 - b) Will rise to 220V
 - c) Will shoot up to very high value
 - d) Will become less than 200V
- v) A voltmeter gives 120 oscillations per minute when connected to the rotor of an induction motor. The stator frequency is 50 Hz. The slip of the motor is
 - a) 2%
 - b) 2.5%
 - c) 4%
 - d) 5%
- vi) The rotor power output of a three phase induction motor is 15KW. The rotor copper losses at a slip of 4% will be
 - a) 600W
 - b) 625W
 - c) 650W
 - d) 700W
- vii) Skew is used in induction motor in order to reduce .

CS/B.Tech/Even/EE/EEE/4th Sem/EE-401/2014

- a) Time harmonics
 - b) Space harmonics
 - c) Slot harmonics
 - d) None
- viii) Two transformers operating in parallel will share the load depending on their:-
- a) ratings
 - b) leakage impedances
 - c) efficiency
 - d) per unit impedance
- ix) In an induction motor if the length of the airgap is increased
- a) Speed will reduce
 - b) Efficiency will improve
 - c) Power factor will be lowered
 - d) Breakdown torque will be reduced.
- x) The absence of odd harmonics in magnetizing current of a 3-phase transformer will make the
- a) voltage wave sinusoidal
 - b) voltage wave non-sinusoidal
 - c) load current non-sinusoidal
 - d) none of these
- xi) The vector group of a transformer is designated as Dy11. The relationship between the primary and the secondary emf is that
- a) The primary emf lead the secondary emf by 30° .
 - b) The secondary emf leads the primary emf by 30° .
 - c) The secondary emf leads the primary emf by 60° .

CS/B.Tech/Even/EE/EEE/4th Sem/EE-401/2014

d) They are in phase

xii) As compared to Δ - Δ bank, the capacity of the V-V bank of the transformer is:

a) 57.7%

b) 56.6

c) 58.7%

d) 66.6%.

GROUP - B

(Short Answer Type Questions)

Answer any *three* of the following. 3x5=15

2. (a) What do you mean by critical resistance and critical speed?
- Explain these with the help of the O.C.C Curves of the separately excited D.C generator.
(b) What are the essential conditions to be fulfilled for "Build-Up" of voltage in case of a self excited DC shunt generator?
(3+2)
3. (a) In open-delta transformers, show that the secondary line voltages form a balanced 3-phase system of Voltages, in case the supply voltages are balanced.
(b) Explain how a three phase transformer Yd1 can be successfully operated in parallel with another transformer Dy11.
(3+2)
4. Explain briefly the detrimental effects of armature reaction in DC machines.
(5)
5. When a balanced 3-phase voltage is applied to balanced three phase distributed stator windings of a 3-Phase induction motor- 'Rotating Magnetic Field is developed' Explain using graphical

CS/B.Tech/Even/EE/EEE/4th Sem/EE-401/2014

approach.

(5)

6. At the time of starting of a 3-phase slip ring induction motor, external resistance is added with the rotor circuit. Explain the advantages obtained by doing so? Why the external resistance which was added with the rotor circuit at the time of starting is removed when the motor attains full load speed?

(5)

GROUP - C**(Long Answer Type Questions)**Answer any *three* of the following. 3x15=45

7. a) Derive an expression for the torque developed in the armature of a DC motor. Also derive the expression of back e.m.f developed in the armature of a DC motor.
- b) A 230V, DC shunt motor takes an armature current of 3.33 A at rated voltage and at a no-load speed of 1000 rpm. The resistance of the armature circuit are respectively 0.3Ω and 160Ω . The Line current at full load and at rated voltage is 40A. Calculate, at full load, the speed and the developed torque in case the armature reaction weakens the no load flux by 4%.
- [(3+3)+(4+5)]
8. a) Draw the external characteristics of a dc separately excited generator, shunt generator, series generator, Cumulatively compounded and differentially compounded generator. Use the same axes for all the curves.
- b) A shunt generator delivers 40KW at 240V when running at 450 rpm. The armature and field resistances are 0.03Ω and 60Ω respectively. Calculate the speed of the machine running as a shunt motor and taking 40KW Input at 240V. Allow 1V per brush for contact drop.
- c) Draw the operating characteristic curves

CS/B.Tech/Even/EE/EEE/4th Sem/EE-401/2014

- (i) armature torque Vs armature current
- (ii) speed Vs torque and
- (iii) speed Vs armature current of dc shunt and series motor.

(5+5+5)

9. a) Starting from the approximate equivalent circuit of a three phase induction motor, derive the expression for maximum torque developed in a three phase induction motor. Find the value of the rotor circuit resistance which is needed for obtaining the maximum torque at the time of starting the induction motor?
- b) Using the approximate equivalent circuit for a 3-phase induction motor, derive the following relation

$$\frac{T}{T_m} = \frac{2}{\frac{s_m}{s} + \frac{s}{s_m}} \quad \text{symbols used have their usual meaning.}$$

10. a) Show that the third harmonic current and its multiples are co-phasal.
- b) What do you mean by neutral shifting of a 3-phase transformer?
- c) Draw the phasor and connection diagrams of the following three phase transformers.
- (i) Dy1
 - (ii) Dd6
 - (iii) Dz6

11. Write short notes on any three of the following:

(3x5)

- a) Single excited system and double excited system

CS/B.Tech/Even/EE/EEE/4th Sem/EE-401/2014

- b) Pitch factor**
- c) Effect of Brush shifting in dc machines.**
- d) Scott connection**
- e) Open Delta connection**