

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-III Examination December 2009

Subject code: 131701

Date: 23 / 12 / 2009

Subject Name: Electrical Machines

Time: 11.00 am – 1.30 pm

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 (a) Explain the working of a 1-phase transformer. Also derive its e.m.f. equation. **07**

(b) A single phase transformer has 350 primary and 1050 secondary turns. The primary is connected to 400 V, 50 a.c. supply. If the net cross sectional area of the core is 50 cm^2 , calculate the maximum flux density in the core and induced e.m.f. in the secondary winding. **04**

(c) Explain how 3-phase supply can be converted into 2-phase supply using Scott connection. **03**

Q.2 (a) Differentiate between single excited and multiple excited systems. Derive the expression for magnetic field energy stored in a singly excited system. **07**

(b) Define energy and co-energy. Derive the expression for force developed for current excited and voltage controlled systems **07**

OR

(b) Attempt the following: **07**

(i) State: (a) regulation of a transformer (b) types of electromechanical energy conversion and (c) advantages of open delta (V-V) connections of transformers.

(ii) Develop equivalent circuit of a 1-phase transformer. Draw the phasor diagrams for no-load and load conditions.

Q.3 (a) Discuss types of 3-phase induction motor based on rotor construction and explain its working. **07**

(b) With reference to 3-phase Induction motor, attempt the following:

(i) Define slip of an induction motor. Explain its slip-torque characteristic. **04**

(ii) Briefly explain various methods of speed control of a 3-phase induction motor. **03**

OR

Q.3 (a) The following test results refer to a 14.92 kW, 6 pole, 50 Hz, 400 V, 3-phase induction motor: **07**

No-load test (Line values): 400 V, 11 A, p.f. = 0.2

Blocked rotor test (Line values): 100 V, 25 A, p.f. = 0.4

Draw the circle diagram and determine the full load power factor, slip and efficiency. Rotor copper loss at standstill is half the total copper loss.

- (b) With reference to induction motor, attempt the following:
- Explain “cogging” and “crawling” in a 3-phase induction motor with their remedies. **03**
 - Why single-phase induction motor is not self-starting? Explain any one method to make it self-starting. **04**
- Q.4 (a)** State various advantages of stationary armature in an alternator. Also differentiate between salient pole and non-salient pole synchronous machines. **07**
- (b)** Define regulation of an alternator (synchronous generator). **07**
 A 3-phase star connected alternator supplies a load of 1000 kW at a power factor of 0.8 lagging with a terminal voltage of 11 kV. Its armature resistance is 0.4 ohm per phase while synchronous reactance is 3 ohm per phase. Calculate the regulation at this load.
- OR**
- Q.4 (a)** Discuss the conditions to be satisfied before a 3-phase alternator is synchronized with infinite bus. **07**
 Two 3-phase alternators operate in parallel. The rating of one machine is 50 MW and that of the other is 100 MW. Both alternators are fitted with governors having a droop of 4 %. How will the machines share a common load of 100 MW?
- (b)** Discuss power angle characteristic of an alternator. Also discuss its operation at constant load with variable excitation. **07**
- Q.5 (a)** Describe different parts of a d.c. machine; their material and functions with the help of a neat diagram. **07**
- (b)** Explain the phenomenon of armature reaction in a d.c. machine. Explain different methods to neutralize the effect of armature reaction. **07**
- OR**
- Q.5 (a)** Differentiate between self-excited and separately excited d.c. machines. Draw the load characteristics of shunt, series and compound generators. **07**
- (b)** Discuss load characteristics (current-torque) of d.c. shunt, series, and compound motors. Also state their applications. **07**
