Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-III Examination December 2009

Subject code: 130904 **Subject Name: Electrical Machines - I**

Date: 23 / 12 /2009 **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)** **Write the correct answer of the following** **04**

(I) The d.c. series motor should always be started with load because

(A) At no load, it will rotate at dangerously high speed

(B) It will fail to start.

(C) It will not develop high starting torque.

(D) All are true.

(II) The frequency of the rotor current in a 3 phase 50 Hz, 4 pole induction motor at full load speed is about

(A) 50 Hz. (B) 20 Hz.

(C) 2 Hz. (D) Zero.

III) An alternator is delivering rated current at rated voltage and 0.8 power-factor lagging case. If it is required to deliver ratedcurrent at rated voltage and 0.8 power-factor leading, the required excitation will be

(A) less. (B) more.

(C) more or less. (D) the same

(IV) A transformer operates most efficiently at 3/4th full load. Its iron P_I) and copper loss ($P_{C)}$, are related as:

(A) PI / P Cu =16/9 (B) PI / P Cu =4/3

(C) PI / P Cu =3/4 (D) PI / P Cu = 9/16

(b) Draw the per phase approximate equivalent circuit of a 3 – phase Induction motor at slip's' and derive the expression for electromagnetic torque developed by the motor. Derive also the condition for maximum torque and the expression for the maximum torque **06**

(c) Draw the characteristic curves and state two applications for **04**

(i) a dc shunt motor

(ii) a dc series motor

Q.2 **(a)** What are the two types of constructions that are employed in synchronous machines? Explain the two machines and give with reasons which of them are simple to model and analyze **07**

(b) A 230 V d.c. series motor has an armature resistance of 0.2 Ω and Series field resistance of 0.10 Ω . Determine: **07**

(i) The current required to develop a torque of 70 Nm at 1200 rpm

(iii) percentage reduction in flux when the machine runs at 2000 rpm at half the current.

OR

(b) A 4-pole, 3 phase, 400 V, 50 Hz, induction motor has the following parameters for its circuit model (rotor quantities referred to the stator side) on an equivalent-star basis: $R_1 = 1.6\ \Omega$, $X_1 = 2.4\ \Omega$, $R'_2 = 0.48\ \Omega$, $X'_2 = 1.2\ \Omega$, and $X_m = 40\ \Omega$. Rotational losses are 720 W. Neglect Stator copper losses. For a speed of 1470 rpm, calculate the input current, input power factor, net mechanical power output, torque and efficiency **07**

Q.3 **(a)** Comparison of Induction Motor with a transformer **04**

(b) Explain briefly the construction and working principle of the transformer **06**

(c) Calculate the voltage regulation of a transformer in which ohmic drop is 2% and the reactance drop in 5% of the voltage at 0.8 lagging power factor. **04**

OR

Q.3 **(a)** Draw the torque-speed characteristics of a single phase induction motor and explain how it can be obtained **03**

(b) Explain the process of building up of voltage in d.c. shunt generator and give the conditions to be satisfied for voltage built- up. **04**

(c) When a 250-V, 50 hp, 1000 rpm d.c shunt motor is used to supply rated output power to a constant torque load, it draws an armature current of 160A. The armature circuit has a resistance of 0.04 Ω and the rotational losses are equal to 2 KW. An external resistance of 0.5Ω is inserted in series with the armature winding. For this condition compute (i) the speed (ii) the developed power (iii) the efficiency assuming that the field loss is 1.6 KW **07**

Q.4 **(a)** Why does the induction motor not rotate at synchronous speed? **02**

(b) Describe Rotating Magnetic Field **06**

(c) The effective resistance of a 3 – phase, Y – connected 50 Hz, 2200 V Syn. generator is 0.5 [redacted] per phase. On short circuit a field current of 40 A gives the full load current of 200 A. An emf (line to line) of 1100 V is produced on open circuit with the same field current. Determine the syn. impedance. Also compute the power angle and Voltage regulation at full –load 0.8 lagging p.f. **06**

OR

Q.4 **(a)** Explain briefly how speed control is achieved for DC shunt motors. ? **04**

(b) Explain how the circuit model of an induction motor is obtained from No-load and block-rotor tests? **06**

(c) If the motor is fed from a 50 Hz 3 phase line, calculate: **04**
(i.) number of poles (ii) slip at full load (iii) frequency of rotor voltage
(iv) speed of rotor field wrt rotor (v) speed of rotor field wrt to stator
(vi)speed of rotor field wrt stator field (vii) speed of rotor at a slip of 10 %

Q.5 **(a)** Write notes on the following:- **10**
(i) Parallel operation of transformers.
(ii) Speed control of induction motors.

(b) Explain the following **04**
1. Why pole shoe section of a D.C machine made larger than its body.
2. Why are the graphite or carbon brushes preferred over copper Brushes for use in D.C machines?

OR

Q.5 **(a)** Write different Applications of induction machines **04**

(b) Justify the following **10**

1. It is desirable that the starting lever of a motor starter should fall back to off positions when the power fails why?
2. Why Swinburne test cannot be performed on D.C series machine.
3 Two single transformers A&B of identical voltage and turn ratio operate in parallel , the impedances of the two transformers are equal while resistance reactance ratio of A is higher than that of B. What would be the magnitudes of I_A & I_B and their phase position?
4. Why is short circuit characteristics of alternator linear ?
5. Why does syn. impedance method give a poorer voltage regulation ?

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