B.E. (EE) Part-IV 7th Semester Examination, 2007

Electrical Machine-IV

(EE-701)

Time : 3 hours **Full Marks : 100**

Use separate answerscript for each half.
Answer SIX questions, taking THREE from each half.
Two marks are reserved for neatness in each half.

FIRST HALF

1. a) Using two reaction theory draw the phasor diagram of a salient-pole synchronous generator under under-excited condition. From the phasor diagram find the expression for '$\tan\delta$' and 'E_0', where the symbols have usual significance.

   b) A 3-phase synchronous generator has a direct-axis synchronous reactance of 0.8 pu and a quadrature-axis synchronous reactance of 0.5 pu. The generator is supplying full load at 0.8 lagging pf at 1.0 pu terminal voltage. Calculate the power angle and the noload voltage if the excitation remains unchanged. **(8+8)**

2. a) Find an expression for power in terms of the load angle 'δ' for a salient-pole synchronous motor working at a leading power factor. Armature resistance may be neglected.

   b) State the disadvantages when a well-designed induction motor is used as a synchronous induction motor and comment on the performance of a wound rotor motor when running synchronously.

   c) Two dc compound generators G_1 and G_2 (fitted with an equalizing bar) operating in parallel supply a load of 475 A. The data of these generators are as follows :

	G_1	G_2
Generated e.m.fs,	250	254
Series field resistance, Ohms	0.004	0.006
Armature resistance, Ohms	0.02	0.04

   Determine :

   i) Current in each armature
   ii) Current in each series winding
   iii) The current flowing in the equalizing bar
   iv) The bus bar voltage.

   Neglect the shunt field currents. **(5+5+6)**

3 a) Show that the locus of the tip of armature current phasor for a synchronous generator at leading power factor is a circle when electromagnetic power is constant. Hence, show that the zero power circle passes through origin.

b) Show that the maximum power line or the line of stability is a straight line parallel to the E_t phasor and passing through the centre of the circle which are current loci for constant excitation.

c) Derive an expression for the synchronising torque of a non-salient pole alternator connected to infinite bus. **(6+4+6)**

4. a) Describe methods of starting synchronous motors against light load torque. Explain, why at the time of starting synchronous motor with the help of damper winding, field winding terminals should be shorted through high resistance.

b) Show that for alternators running in parallel, the division of load between them is governed mainly by the speed load characteristics of their prime movers.

c) The field current of one of the two alternators running in parallel on load is changed. Show that this change atters their operating p.fs. only and not the division of active power between them. **(8+4+4)**

5. a) Explain how X_d and X_q of a salient pole synchronous machine are determined experimentally?

b) Explain why will two dc series generators operating in parallel be in unstable equilibrium when no equalizer is used?

c) Explain the procedure of paralleling two dc shunt generators. **(7+4+5)**

SECOND HALF

6. a) Using double revolving field theory explain the torque-slip characteristic of a single phase induction motor and prove that it can not produce any starting torque.

b) Derive the equivalent circuit of a single phase induction motor with the help of double revolving field theory and discuss the experimental procedure to obtain its parameters. **[8+(4+4)]**

7. Justify the correctness of the following statements :

a) A single-phase induction motor, if provided with a three-phase slip-ring type rotor connected to a starting resistance, results in a large starting torque.

b) Single-phase induction motor must have two stator windings.

c) Reversal of rotation of single-phase induction motors is never a problem. (6+5+5)

8. a) Mention the problems usually encountered when a d.c. series motor is operated on a.c. supply. What design modifications are to be incorporated for its satisfactory operation on a.c. supply? Compare the speed for d.c. and a.c. operations.

b) The resistance and total inductance of a single phase fractional horsepower series motor are 30Ω and 0.5H respectively. It draws 0.8 A current and runs at 2,000 r.p.m. when connected to a 250 V d.c. supply. Calculate the speed and power factor when connected to a 250 V, 50 Hz supply and takes the same load current. How much voltage is required for getting 2,000 r.p.m. with a.c supply. Assume resistance and inductance remain constant. [(3+3+5)+5]

9. a) Why in Schrage-motor primary winding is proved on its rotor and secondary on stator?

b) How in a Schrage motor super-synchronous speed and power factor improvements are obtained?

c) Give the constructional features, working principle and applications of a.c Tachogenerator. (5+5+6)

10. a) What is cross-field machine? Explain the working principle of amplidyne. Give any two applications of amplidyne.

b) A cross-field generator driven at constant speed supplies a resistive load of 1250 W at 250 V under steady-state condition and has the following constants :

Control field resistance, $\gamma_f = 25$ ohms.
Armature resistance, $\gamma_{aq} = \gamma_{ad} = 5$ ohms.
Voltage constants, $K_{qf} = 300$ Volts/amp.
$K_{qd} = K_{dq} = 200$ Volts/amp.

Find the power amplification of the machine for i) no compensation and ii) full compensation. [(2+7+2)+5]

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