Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(EE-N)/SUPPLE/SEM-8/EE-801B/2010

2010

POWER SYSTEM DYNAMICS AND CONTROL

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 : 10 × 1 = 10

i) Small signal stability is defined as the ability of the power system to maintain

a) synchronism b) asynchronism

c) both of these d) none of these.

ii) Inter-area mode oscillations are

a) 0·8 – 1·75 Hz small magnitude oscillations

b) 0·25 – 0·75 Hz small magnitude oscillations

c) 8 – 17·5 Hz small magnitude oscillations

d) 25 – 75 Hz small magnitude oscillations.

iii) If the generator voltage regulator gain is increased, there would be much improvement on

a) Transient stability

b) Dynamic stability

c) Steady state stability

d) all of these.

iv) Series capacitors can cause self-excited oscillations at

a) sub-synchronous frequencies

b) synchronous frequencies

c) super-synchronous frequencies

d) both (a) & (b).

v) Automatic voltage regulators (AVR) have

a) high gain, low time constant

b) low gain, high time constant

c) high gain, high time constant

d) low gain, low time contant.

vi) Large gain AVR amplifies its

a) negative damping b) positive damping

c) both (a) and (b) d) either (a) or (b).

vii) On a long high voltage transmission line under heavy load condition, *var* compensation can be provided by installing

a) series inductive reactors

b) series capacitors

c) shunt inductive reactors

d) none of these.

viii) Good regulation means

a) less fluctuations from no load to full load

b) more fluctuations from no load to full load

c) less fluctuations from full load to no load

d) none of these.

ix) Voltage collapse typically occurs in power systems which are usually

a) heavily loaded b) faulted

c) lightly loaded d) both (a) and (b).

x) A static var compensator (SVC) is

a) voltage controlled shunt compensation device

b) current controlled device

c) both (a) and (b)

d) none of these.

xi) Reactive power sensitivity can be defined as

a) $\frac{\partial |v|}{\partial \theta}$ b) $\frac{\partial \theta}{\partial |v|}$

c) $\frac{|v| \partial \theta}{\partial |v|}$ d) none of these.

xii) FACTS devices control

a) both active and reactive powers

b) reactive power only

c) loadability of lines

d) both (a) and (c).

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Why do small oscillations appear in power system network ? What are the main governing factors in generating small oscillations ? 2 + 3

3. Explain the mechanism of the line oscillations.

4. Write a short note on modelling of electical loads.

5. What do you mean by voltage stability ? Define voltage stability limit.

6. Define FACTS controllers. Mention the advantages of FACTS devices.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. A generator supplies power in steady state to an infinite bus (*fig. 1* on Page 6). Due to some contingencies line 2 gets tripped. Find the following :

   i) Damped frequency of oscillation

   ii) Damping ratio

   iii) Undamped natural frequency and

   iv) Eigenvalues.

For different damping co-efficients like 0, 5 and - 5, the *p.u.* values of the given system on a 1500 MVA, 25 kV base are as follows :

$P = 1$ *p.u.*, $Q = 0{\cdot}3$ *p.u.*, $V = 1 \angle 17^\circ$, $E_0 = 0{\cdot}99 \angle 0^\circ$, $|x L_1| = |x L_2| = 0{\cdot}5$, $|xtr| = 0{\cdot}2$, $|xd'| = 0{\cdot}25$, $H = 3$ *MWS*/mVA, $f = 50$ Hz.

All voltage magnitudes and reactances are expressed in *p.u.*

Fig. 1

8. For an uncompensated long transmission line show that reactive power requirement is governed by $Q_R = -Q_S$ under certain simplifying assumptions. Hence, show that at SIL reactive power flow becomes zero.

9. Derive an expression of receiving end bus voltage and power angle at voltage stability limit.

10. Develop the concept of dynamic compensation at the middle of a transmission line.