Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (EE-NEW)/SEM-8/EE-801B/2010

2010

POWER SYSTEM DYNAMICS & 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 : $10 \times 1 = 10$

   i) At natural loading of the power system transmission line the receiving end power factor is

      a) leading b) lagging

      c) unity d) either (b) or (c).

   ii) Synchronous motor can operate at

      a) lagging power factor only

      b) leading power factor only

      c) unity power factor only

      d) lagging, leading and unity power factor.

   iii) Which of the following compensators directly improves system load ability ?

      a) SVC

      b) Shunt capacitor

      c) Series capacitor

      d) Synchronous condenser.

iv) Voltage stability limit is obtained when

a) the Jacobian of load flow equation is singular

b) the Jacobian of load flow equation is non-singular

c) the Jacobian of load flow equation is monotonic

d) the Jacobian of load flow equation does not signify anything.

v) The deficit in reactive power can be encountered by

a) local reactive power support

b) generator terminal voltage increase

c) series capacitor installation

d) any of these methods.

vi) The intertia constant H of a machine of 200 MVA is 2·0 p.u. Its value corresponding to 400 MVA will be

a) 4·0 b) 2·0

c) 1·0 d) 0·5

vii) The intertia constant of two groups of machines which swing together are M_1 and M_2. The intertia constant of the system is

a) $\frac{M_1 M_2}{M_1 + M_2}$ b) $|M_1 + M_2|$

c) $M_1 + M_2$ d) $\frac{M_1 + M_2}{M_1 M_2}$.

viii) Which of the following is constant impedance load ?

a) Fluorescent lamp b) Incandescent lamp

c) Induction motor d) Synchronous motor.

ix) Type of surge impedance loading is

a) resistive b) inductive

c) capacitive d) none of these.

x) Shunt capacitor is used to

a) improve voltage b) improve P.F.

c) both of these d) none of these.

xi) Magnitude of power angle at voltage stability limit depends on

a) power factor angle b) receiving end voltage

c) sending end voltage d) none of these.

GROUP – B

(Short Answer Type Questions)

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

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

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

4. What is SVC ? How would you model it ?

5. What are the components of load compensation ? What are the principles of power factor correction ?

6. Which factors causing power system disturbances may lead to voltage collapse ? Find the capacity of static VAR compensator to be installed at bus with ± 5% voltage fluctuation. The short circuit capacity is 5000 MVA.

GROUP – C

(Long Answer Type Questions)

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

7. a) Describe the Heffron-Phillips model of single machine infinite bus problem in a power network of an SMIB system. 10

b) What are the implications of k_1-k_6 parameters in Heffron-Phillips model ? 5

8. What do you mean by power system modelling ? What is the necessity of modelling of the power system components ? Analytically model a three phase single circuit transmission line. Explain how the Y_{BUS} matrix of a two-bus system will be changed if a voltage regulating transformer is introduced in the system. 2 + 3 + 4 + 6

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

10. a) What do you mean by steady state dynamic voltage stability ? 3

    b) How do you define voltage stability limit ? Derive an expression for critical receiving end voltage for a two-bus system. 2 + 5

    c) Derive an expression of critical load bus voltage and critical power angle at voltage stability limit. 5

11. a) What are the compensating devices used for the improvement of voltage stability ? How do they work ? 3 + 5

    b) Describe the performance characteristics of static VAR controllers with reference to range of control and speed of response. 7

12. What is voltage regulation in a transmission system ? What is the importance of knowing voltage regulation ? Find out the relation between voltage regulation and reactive power in a transmission system and comment from the relation how voltage depends on reactive power in a power system. Find out the expression for reactive power requirement for an uncompensated transmission line. 1 + 2 + 6 + 6