Total number of printed pages – 7 B. Tech

CPEE 5401

Seventh Semester Examination – 2008

POWER SYSTEM OPERATION AND CONTROL

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (i) What is meant by "compact storage scheme" in load flow analysis ?

   (ii) What is meant by terms 'Jacobian' ?

   (iii) Why a direct solution of load flow is not possible ?

P.T.O.

(iv) Why a majority of buses in power systems are load buses ?

(v) Differentiate between stability and loss of synchronous.

(vi) What is transfer reactance ?

(vii) A power system network consists of three elements 0-1, 1-2 and 2-0 of per unit impedances 0.2, 0.4, and 0.4 respectively. What is its bus impedance matrix ?

(viii) Principle of Equal-area criterion is to be applied to determine, for a given initial load P_1, the maximum amount of sudden increase in load ΔP, to maintain transient stability of a cylindrical rotor synchronous motor operating from an infinite bus. Applying this criterion (in each case the area A_1 = area A_2), draw the correct diagram.

(ix) With 100% inductive shunt compensation the voltage profile will be flat for what percentage loading of line. Briefly explain your answer.

(x) What are the effects of series capacitance compensation ?

2. (a) Analytically establish the role of reactive power on receiving end voltage and voltage regulation of the load bus. 4

(b) What is reactive compensation and what are the benefits ? 2

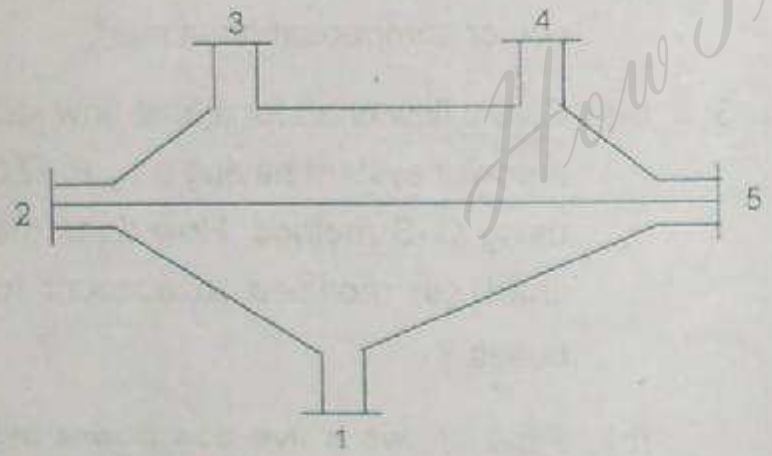
(c) Describe different types of reactive power compensation in brief. 4

3. (a) Give a flow chart for a load flow study on a power system having only P-Q buses using G-S method. How does the flow chart get modified to account for PV buses ? 4

(b) Fig.1 shows a five bus power system. Each line has an impedance of

0.05 +j0.15 pu. The line shunt admittances may be neglected. The bus power and voltage specifications are given below :

Bus	P_L	Q_L	P_G	Q_G	V	Bus Specification
1	1.0	0.5	Not Specified	Not Specified	1.02<0	Slack Bus
2	0	0	2	Not Specified	1.02	PV Bus
3	0.5	0.2	0	0	Not Specified	PQ Bus
4	0.5	0.2	0	0	Not Specified	PQ Bus
5	0.5	0.2	0	0	Not Specified	PQ Bus



(i) Form Y_{bus}

(ii) Find Q_2, δ_2, V_3, V_4 and V_5 after the first iteration using Gauss-Seidel method. Assume $Q_{2min} = 0.2$ pu and $Q_{2max} = 0.6$ pu. 6

4. (a) Distinguish between steady state, transient and dynamic stability. Derive power angle equation. 5

(b) Using equal area criterion, derive an expression for critical clearing angle for a system having a generator feeding a large system through a double circuit line. 5

5. A 50 HZ generator of reactance 0.8 pu is connected to an infinite bus through a line of 0.4 pu reactance. E = 1.05 pu, V = 1.0 pu. The inertia constant is 4 MJ/MVA The generator is loaded to 70% of the maximum power limit. Find the frequency of natural oscillations. Derive the formula used. 10

6. A single area consists of two generating units, rated at 400 and 800 MVA, with speed regulation of 4% and 5% on their respective ratings. The units are operating in parallel, sharing 700 MW. Unit 1 supplies 200 MW and unit 2 supplies 500 MW at 1.0 per unit (60 Hz) frequency. The load is increased by 130 MW. 10

(a) Assume there is no frequency dependent load, i.e., D = 0. Find the steady-state frequency deviation and the new generation on each unit.

(b) The load varies 0.804 percent for every 1 percent change in frequency, i.e., D = 0.804. Find the steady state frequency deviation and the new generation on each unit.

7. On a system consisting of two generating plants the incremental costs in rupees per megawatt-hour with P_1 and P_2 in megawatts are

$$\frac{dF_1}{dP_1} = 0.00P_1 + 8.0 \text{ and } \frac{dF_2}{dP_2} = 0.012P_2 + 9.0$$

The system is operating on economic dispatch with $P_1 = P_2 = 500$ MW and $\delta P_1 / \delta P_2 = 0.2$. Find the penalty factor of plant 1. 10

8. Write short note on : 5×2

(a) Methods of improvement of transient stability.

(b) Economic dispatch controller.
