Ex/PE/T/425A/108/2009

BACHELOR OF POWER ENGINEERING FINAL EXAMINATION, 2009

(4th Year–2nd Semester)

COMPUTER AIDED POWER SYSTEM ANALYSIS AND OPERATION

Time : Three hours Full marks' 100

Answer question no. 1 and any four from the rest

1. a) Which of the following are the advantages of interconnected operation of power systems?
1. Less reserve capacity requirement
2. More reliability
3. High power factor
4. Reduction in short-circuit level

Codes:
(i) 1 and 2 (ii) 2 and 3 (iii) 3 and 4 (iv) 1 and 4 2

b) In a power system, each bus or node is associated with four quantities, namely
1. real power
2. reactive power
3. bus voltage magnitude
4. phase angle of the bus voltage

For load-flow solution, among these four, the number of quantities to be specified is
(i) any one (ii)any two (iii) any three (iv) all the four 2

c) Load frequency control is achieved by properly matching the individual machine's
i) reactive power (ii) generated voltages (iii) turbine inputs (iv) turbine and generator ratings 2

d) If a generator bus is treated as a load bus, then which one of the following limits would be violated?
(i)voltage (ii) active power (iii) reactive power (iv) phase angle 2

[Turn over

e) Single control area fitted with proportional plus integral controller
(i) isochronous and unstable
(ii) isochronous and stable
(iii) non-isochronous and unstable
(iv) non-isochronous and stable 2

f) The incremental cost characteristics of the two units in a plant are

$(IC)_1 = 0.1P_1 + 8.0 Rs/MWh$
$(IC)_2 = 0.15P_2 + 3.0 Rs/MWh$

When the load is 100 MW, the optimum sharing load is

(i) 40 and 60 (ii) 33.3 and 66.7 (iii) 60 and 40 (iv) 66.7 and 33.3 4

g) In respect of control of power systems, India has been divided into _____.

h) A power system has two synchronous generators. The governor-turbine characteristics corresponding to the generators are

$P_1 = 50(50 - f)$ and $P_2 = 100(51 - f)$

Where f denotes the system frequency in Hz, and P_1 and P_2 are respectively the power outputs in MW. Assuming the generators and transmission network to be lossless, the system frequency for a total load of 400MW is

(i) 47.5 Hz (ii) 48.0 Hz (iii) 48.5 Hz (iv) 49.0 Hz 4

(i) The synchronizing coefficient between two areas of a two-area power system is

(i) $\frac{\partial P}{\partial |V|}$ (ii) $\frac{\partial P}{\partial \delta}$ (iii) $\frac{\partial P}{\partial f}$ (iv) $\frac{\partial P}{\partial Q}$ 2

2) Explain clearly with a flow chart the computational procedure for load flow solution using Newton Raphson method when the system contains all types of buses. 20

3. a) Show the block diagram of Two-area Load Frequency control of power system with single tie-lines connecting them. Assume each area being provided with P-I controllers. Explain the different parameters of control. 10

b) Two thermal generating units are operating in parallel at 60 Hz to supply a total load of 700 MW. Unit 1, with a rated output of 600 MW and 4% speed droop characteristic, supplies 400 MW and unit 2, which has a rated output of 500 MW and 5% speed droop, supplies the remaining 300 MW of load. If the total load increases to 800 MW, determine the new loading of each unit and the common frequency change before any supplementary control action occurs. 10

4.(a)Why the input-output characteristic of large steam turbine generator is not smooth? 3

b) In a two-bus system load is located at bus 2.

When 100 MW is transmitted from plant 1 to the load, a transmission loss of 10 MW is incurred. Find the required generation for each plant and the power received by the load when the system λ is Rs 25/MWh. The incremental fuel costs of the two plants are given below:

$$\frac{dC_1}{dP_{G1}} = 0.02P_{G1} + 16.0 Rs/MWh$$

$$\frac{dC_2}{dP_{G2}} = 0.04P_{G2} + 20.0 Rs/MWh$$

Considering a load of 237.04 MW at bus 2, find the optimum load distribution between the two plants when losses are included but not coordinated. Also find the savings in Rs/hr when losses are coordinated. 17

5. Find the critical clearing angle for the system shown in Fig. 5 for a three-phase fault at the point P. The generator is delivering 1.0 p.u. power under prefault condition. 20

[Turn over

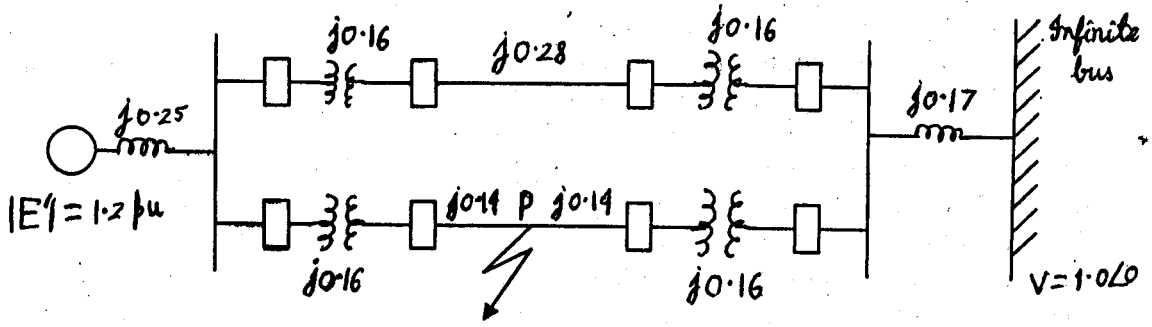

Fig. 5

6. Consider the three-bus power system shown in Fig. 6. Each of the three lines has a series impedance of 0.026 + j0.11 p.u. and a total shunt admittance of j0.04 p.u.. The specified quantities at the buses are shown in Table 1. 20

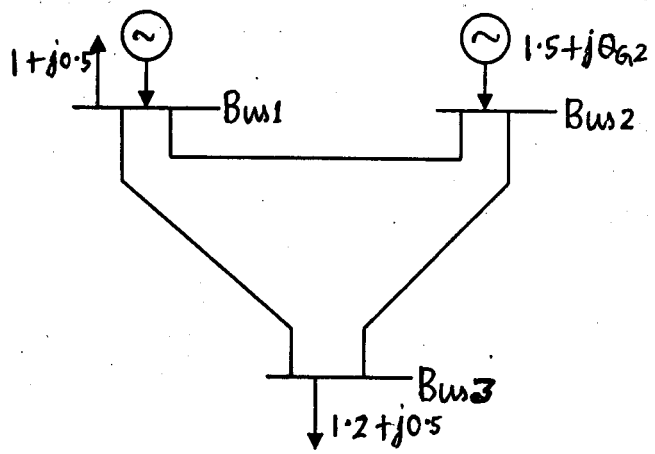

Fig. 6

For bus 2 the minimum and maximum reactive power limits are 0 and 0.8 pu. Find the load flow solution using Gauss-Seidel method.

Table 1

Bus. No.	P_G	Q_G	P_D	Q_D	Voltage specification
1	Unspecified	Unspecified	1.0	0.5	$V_3 = 1.02 + j0$ (slack bus)
2	1.5	Unspecified	0	0	$\|V_2\| = 1.04$ (PV bus)
3	0	0	1.2	0.5	Unspecified (PQ bus)

7. a) Discuss the advantages of interconnected operation of power systems. 5
b) What is load-forecasting? 4
c) Describe connected load method. 11