Ref. No. : Ex/PE/T/425D/2017 (Old)

B. E. POWER ENGG. 4TH YEAR 2ND SEMESTER EXAMINATION (Old), 2017

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

e) 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

f) A synchronous generator connected to an infinite bus is overexcited. Considering only the reactive power, from the point of view of the system, the machine acts as

(i) a capacitor (ii) an inductor (iii) a resistor (iv) none of the above 2

g) 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

(h) Consider a power system with three identical generators. The transmission losses are negligible. One generator (G1) has a speed governor which maintains its speed constant at the rated value, while other generators (G2 and G3) have governors with a droop of 5% if the load of the system is increased, then on steady

(i) generation of G2 and G3 is increased equally while generation of G1 is unchanged
(ii) generation of G1 alone is increased while generation of G2 and G3 is unchanged
(iii) Generation of G1, G2 and G3 is increased equally
(iv) Generation of G1, G2 and G3 is increased in the ratio 0.5 : 0.25 : 0.7 2

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

b) In a two-bus system 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

3. a) Compare the merits and demerits of "Gauss-Seidel method" method with those of "Newton-Raphson" method.

b) Consider the three-bus system shown in Fig. 3(b). Each of the three lines has a series impedance of 0.02 + j0.08 p.u. and a total shunt admittance of j0.02 p.u.

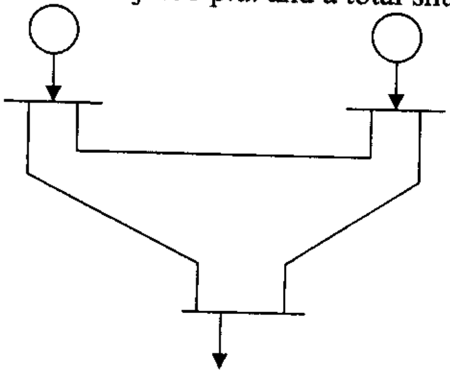

Fig. 3(b)

The specified quantities at the buses are given in Table 1. Controllable reactive power source is available at bus 3 with the constraint $0 \le Q_{G3} \le 1.5$ p.u. Use Fast Decoupled method to obtain one iteration of the load flow solution. 15

Table 1

Bus. No.	P_G	Q_G	P_D	Q_D	Voltage specification
1	Unspecified	Unspecified	2.0	1.0	$V_1 = 1.1 + j0$
2	0.5	1.0	0	0	Unspecified
3	0	$Q_{G3} = ?$	1.5	0.6	$\lvert V_3 \rvert = 1.04$

4) 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

5. 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.

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b) Two power systems A and B each having a regulation (R) of 0.05 pu on their respective capacity bases and a stiffness (damping co-efficient) of 0.75 pu are connected through a tie-line, initially carrying no power. The capacity of system A is 2000 MW and that of system B is 3000 MW. If there is an increase in load of 200 MW in system A, what is the change in steady state and power transfer. 10

6. a) Discuss various factors that affect power system transient stability. 6

b) The generator shown in Fig. 6(b) is delivering 1.0 pu power to the infinite bus ($|V| = 1.0pu$) with generator terminal voltage of $|V_t| = 1.0pu$.

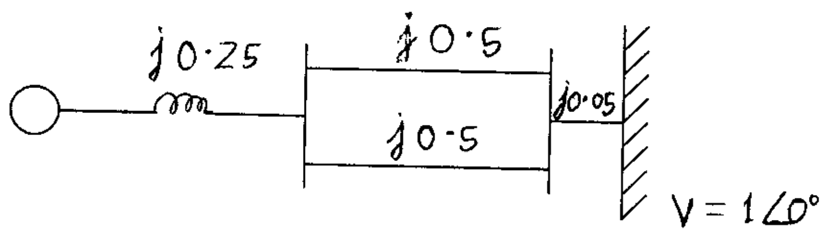

Fig. 6(b)

Calculate the generator emf behind transient reactance. Find the maximum power that can be transferred under the following conditions:

(i) System healthy

(ii) One line shorted (3-phase) in the middle

(iii) One line open

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7. a) Discuss the advantages of interconnected operation of power systems. 5

b) What is load-forecasting? 4

c) Describe connected load method. 11