Ref. No. : Ex/PE/T/424D/2018

B. E. POWER ENGG. 4TH YEAR 2ND SEMESTER EXAMINATION, 2018

COMPUTER AIDED POWER SYSTEM ANALYSIS AND OPERATION

TIME: THREE HOURS FULL MARKS: 100

1.a) In a load flow problem solved by Newton-Raphson method with polar co-ordinates, the size of the Jacobian is 100x100. If there are 20 PV buses in addition to PQ buses and a slack bus, the total number of buses in the system is ____________. 3

b) Two generating units rated 300 MW and 400 MW have governor speed regulation of 6% and 4% respectively from no load to full load. Both the generating units are operating in parallel to share a load of 600 MW. Assuming free governor operation, the load shared by the larger unit is ________. 4

c) A cylindrical rotor generator delivers 0.5 pu power in the steady state to an infinite bus through a transmission line of reactance 0.5 pu. The generator no load voltage is 1.5 pu and the infinite bus voltage is 1 pu. The inertia constant of the generator is 5 MWs/MVA and the generator reactance is 1 pu. The critical clearing angle, in degrees, for a three phase dead short fault at the generator terminal is __________. 5

d) The fuel cost functions of two power plants are

Plant 1: $C_1 = 0.05P_{g1}^2 + AP_{g1} + B$

Plant 2: $C_2 = 0.10P_{g2}^2 + 3AP_{g2} + 2B$

Where P_{g1} and P_{g2} are the generated powers of two plants, and A and B are the constants. If the two plants optimally share 1000 MW load at the incremental fuel cost of 100 Rs/MWh, the ratio of load shared by plants 1 and 2 is ________. 5

e) In load-flow analysis, a generator bus is treated as a load bus if __________ limit is violated. 2

f) The angle δ in the swing equation of a synchronous generator is
(i) angle between stator voltage and current
(ii) angular displacement of the rotor with respect to the stator

(iii) angular displacement of the stator mmf with respect to a synchronously rotating axis
(iv) angular displacement of an axis fixed to the rotor with respect to a synchronously rotating axis

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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.
13

3. a) Compare the merits and demerits of "Gauss-Seidel method" method with those of "Newton-Raphson" method.
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b) Consider the three-bus system shown in Fig. 3(b). Each of the three lines has a series impedance of 0.03 + j0.10 p.u. and a total shunt admittance of j0.025 p.u. 12

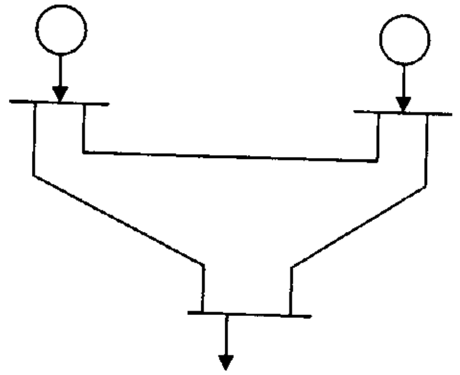

Fig. 3(b)

The specified quantities at the buses are given in Table 1. Controllable reactive power source is available at bus 3 with the constraint $0 \le Q_{G3} \le 2$ p.u. Use Fast Decoupled method to obtain one iteration of the load flow solution.

Table 1

Bus. No.	P_G	Q_G	P_D	Q_D	Voltage specification
1	Unspecified	Unspecified	2.5	1.5	$V_1 = 1.06 + j0$
2	1.5	1.0	0	0	Unspecified
3	0	$Q_{G3} = ?$	1.5	1.0	$\lvert V_3 \rvert = 1.04$

OR

3) 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. 16

4) Give a note on optimal load flow. 16

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. 10

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

OR

5. a) Give a note on controlling of generator power output 5

b) Find the critical clearing angle for the system shown in Fig. 5(b) for a three-phase fault at the point P. The generator is delivering 1.0 p.u. power under prefault condition. 11

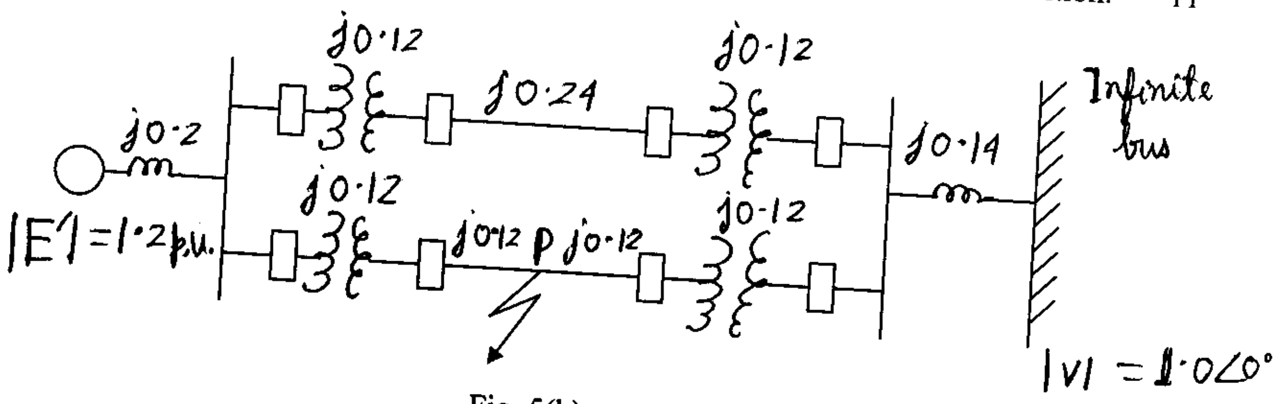

Fig. 5(b)

6. a) Discuss the advantages of interconnected operation of power systems. 3
b) What is load-forecasting? 3
c) Describe connected load method. 10