Ref. No. : Ex/PG/PE/T/112B/2024

MASTER OF POWER ENGG. EXAMINATION, 2024

(1ST SEMESTER)

ADVANCED POWER SYSTEM PRINCIPLES

TIME: THREE HOURS FULL MARKS: 100

Answer any five questions

1. a) What is load flow solution? Explain its significance in power system analysis. 5

b) Discuss various types of buses in a power system for load flow studies. Justify the classification. 9

c) Discuss the merits and demerits of Gauss-Seidel method for load flow solution. 6

2.a) Compare the merits and demerits of "Fast Decoupled" method with those of "Newton-Raphson" method. 5

b) Consider the three-bus power system shown in Fig. 2. 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.

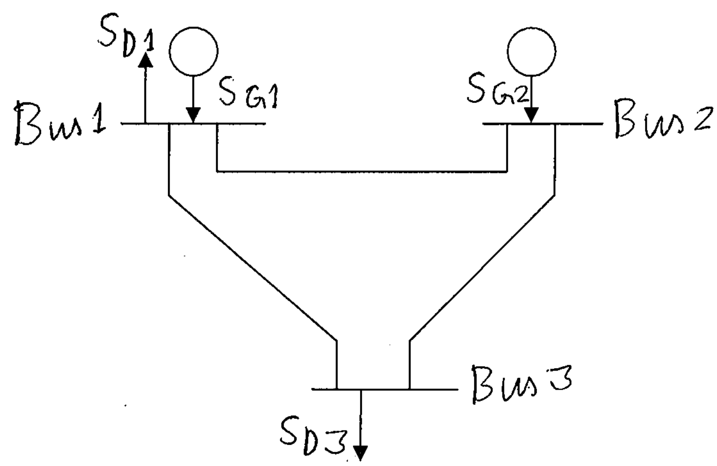

Fig. 2

For bus 2 the minimum and maximum reactive power limits are 0 and 0.8 pu. Find the load flow solution using Fast Decoupled method. 15

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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	$\lvert V_2 \rvert = 1.04$ (PV bus)
3	0	0	1.2	0.5	Unspecified (PQ bus)

3. a) Discuss various factors that affect power system transient stability. 5

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. 15

4. 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 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

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

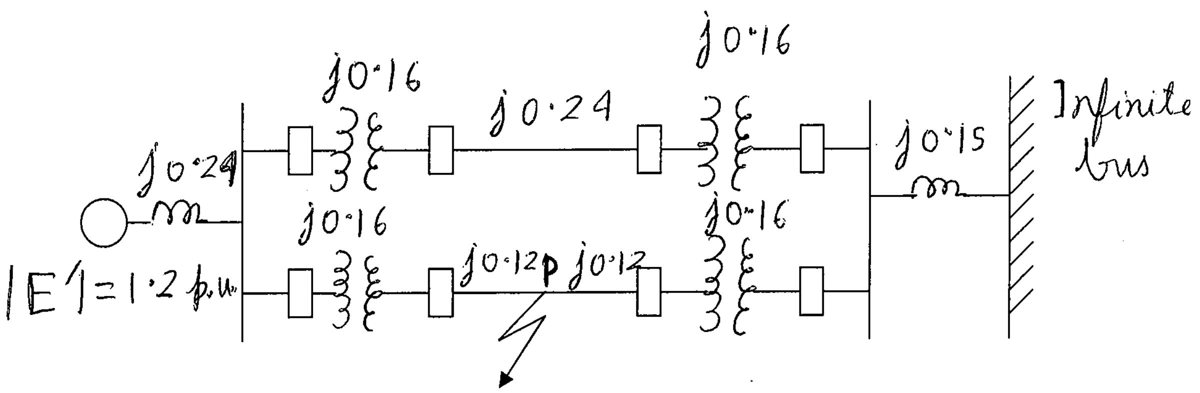

Fig. 5

6) Derive swing equation for a multi-machine system and explain its solution procedure. 20

7) Give a brief description of contingency analysis. 20

8) The power system shown in Fig. 8 has a dead short circuit at the mid point of the transmission line. Find the fault current for a single line-to-ground fault. Both generator G and motor M are operating at their rated voltage. Neglect prefault current. Reactances are given in pu on the same base. 20

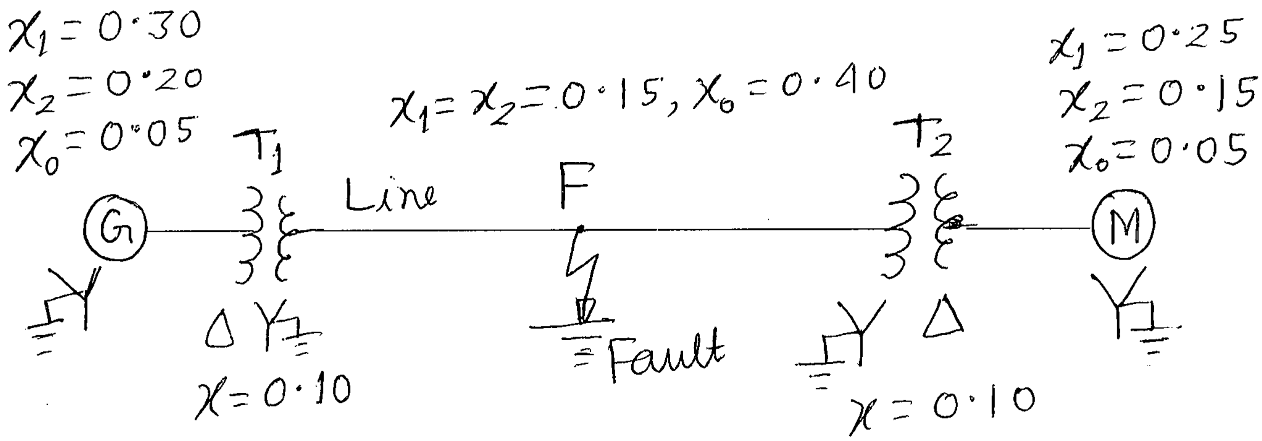

Fig. 8