

JADAVPUR UNIVERSITY
Department of Power Engineering

B. Power Engineering, 3rd year, 2nd Semester, 2022

Power System Analysis and Operation

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 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) Discuss the merits and demerits of Newton-Raphson method for load flow solution. 6
- b) Consider the three bus system shown in figure 2(b). The series impedance and shunt admittance of each line are $0.026+j0.11$ p.u. and $j0.04$ p.u. The specified quantities at the buses are given in Table-1. For bus 2 the minimum and maximum reactive power limits are 0 and 0.08 p.u. Find the load flow solution using Fast Decoupled method. 14

Table-1

Bus	P_G	Q_G	P_D	Q_D	Bus voltage
1	Unspecified	Unspecified	1.0	0.5	1.0+j0 (slack bus)
2	1.5	Unspecified	0	0	$ V =1.03$ (PV bus)
3	0	0	1.2	0.5	Unspecified (PQ bus)

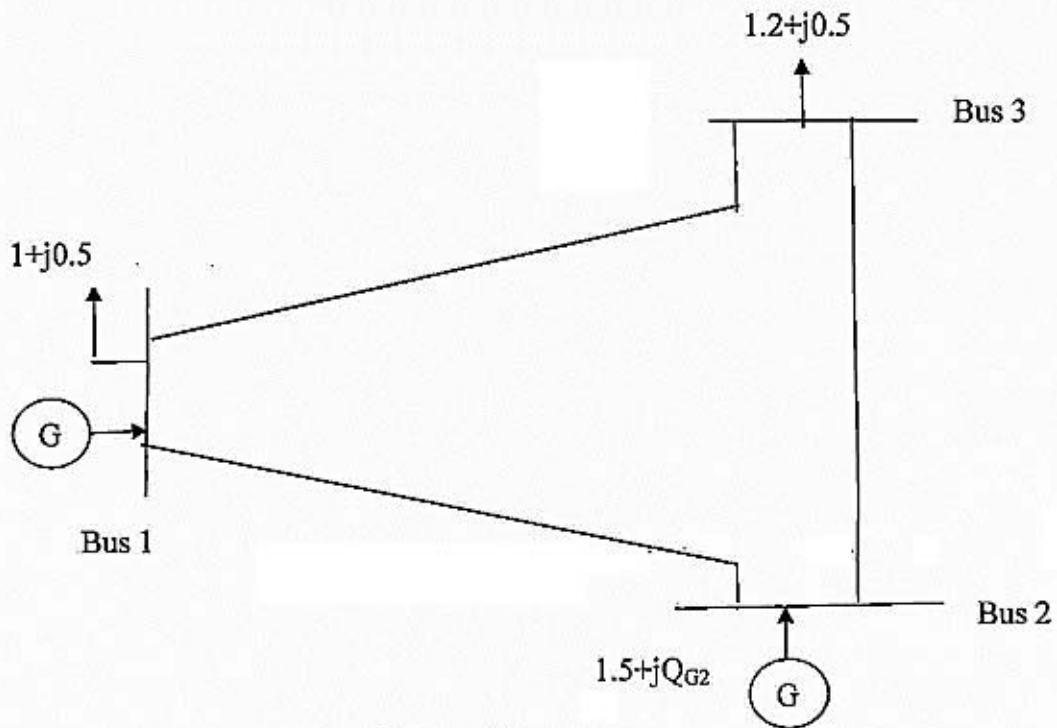


Figure 2(b)

3) Find the critical clearing angle for the system shown in figure 3 for a three-phase fault at the point P. The generator is delivering 1.0 p.u. power under pre-fault condition. 20

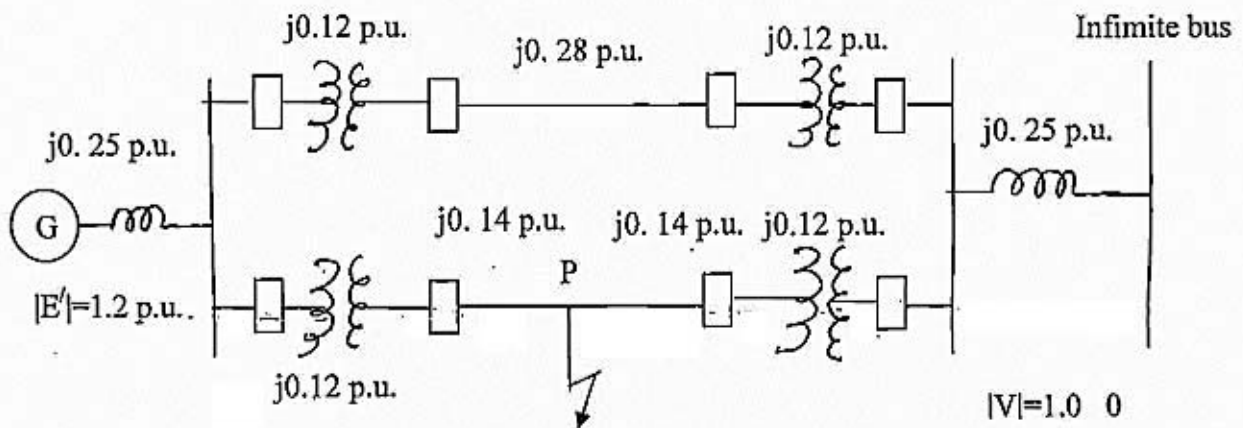


Figure 3

4. a) Discuss the advantages of interconnected operation of power systems. 4

b) Two power systems A and B having a regulation @ of 0.05 on their respective capacity buses and their stiffness (damping coefficient) of 0.75 p.u. are connected through a tie line, initially carrying no power. The capacity of the system A is 2000 MW and that of system B is 3000MW. If there is an increase in load of 200MW in system A, what is the change in steady state and power transfer. 8

c) 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. 8

5. a) Define the terms penalty factor. 2

b) Why the input-output characteristic of large steam turbine generator is not smooth. 4

c) A two bus system where 100MW is transmitted from plant 1 to the load, a transmission loss of 5 KW is incurred. Find the required generation for each plant and the power received by the load when the system λ is Rs 25/MWh. 14

$$\frac{dF_1}{dP_{G1}} = 0.02P_{G1} + 16 \text{ Rs/MWh}$$

$$\frac{dF_2}{dP_{G2}} = 0.04P_{G2} + 20 \text{ Rs/MWh}$$

6) Define the following terms.

a) Must-run units b) Minimum up-time and minimum down-time c) Crew Constraints on plants
d) Ramp rate limits constraints e) Start-up cost 5x4

7) Give a brief description on optimal power flow 20

8) Describe short-term and long-term load forecasting 20