SATHYABAMA UNIVERSITY

(Established under section 3 of UGC Act, 1956)

Course & Branch: B.E - EEE
Title of the paper: Power system Analysis
Semester: V — Max. Marks: 80
Sub.Code: 414504/514504 — Time: 3 Hours
Date: 11-11-2008 — Session: FN

PART – A (10 x 2 = 20)

Answer All the Questions

1. What is meant by a fault in a power system?
2. What are the assumptions made in drawing reactance diagram?
3. Define bus incidence matrix.
4. Draw π model of a transmission line.
5. Define symmetrical fault.
6. Name any two methods of reducing short circuit current.
7. Write the steps involved and assumptions in load flow solution.
8. How do you improve the steady state stability?
9. Write a short technical note on critical clearing angle.
10. State the assumptions made in solution of the swing equation.

PART – B (5 x 12 = 60)

Answer All the Questions

11. Fig. 1 shows a single-line diagram of a power system. The ratings of generators and transformers are:
    Generator G_1 : 20 MVA, 13.8 kV, jX = j0.2pu
    Generator G_2 : 30 MVA, 18 kV, jX = j0.2pu
    Generator G_3 : 30 MVA, 20 kV, jX = j0.2pu
    Transformer T_1: 25 MVA, 13.8 Δ - 220 Y kV, jX = j0.1 pu
    Transformer T_2: Single phase units each rated at 10 MVA, 127/18 kV, jX = j0.1pu
    Transformer T_3: 35 MVA, 22 Δ - 220 Y kV, jX = j0.1 pu
    Draw impedance diagram with all values in pu on a base of 50 MVA, 13.8 kV on the circuit of generator G_1.

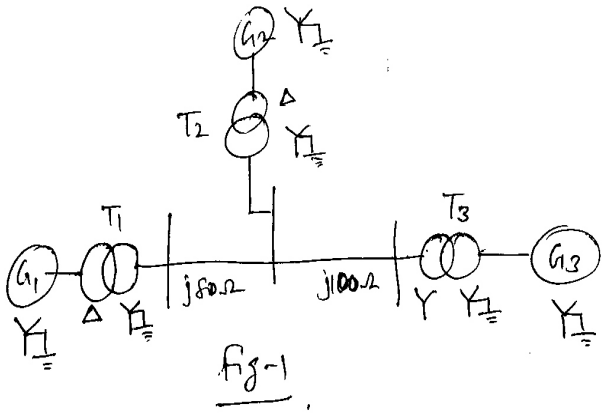

Fig-1

(or)

12. The parameters of a 4 – bus system are as follows.

Bus code	Line impedance (pu)	Half Line Charging admittance (pu)
1- 2	0.2 + j 0.8	j 0.02
2- 3	0.3 + j 0.9	j 0.03
2- 4	0.25 + j 1.0	j 0.04
3- 4	0.2 + j 0.8	j 0.02
1- 3	0.1 + j 0.4	j 0.01

Draw the network and find bus admittance matrix.

13. Two transformers (T_a & T_b) are connected in parallel to an impedance to neutral per phase of 0.8 + j0.6 per unit at a voltage of V = (1 + j0) per unit. Transformer T_a has a voltage ratio equal to the ratio of the base voltages on the two sides of the transformer. This transformer has an impedance of j0.1 per unit on the appropriate base. The second transformer T_b also has an impedance of j.01 per unit on the same base but has a step – up toward the load of 1.05 times that of T_a (Secondary windings on 1.05 tap). Find the complex power transmitted to the load through each transformer.

(or)

14. Fig.2 shows the one-line diagram of a simple three- bus power system with generators at buses 1 and 3. The line impedances are marked in per unit o a 100 MVA base. Find out the bus voltages after two iteration using Gauss seidel method.

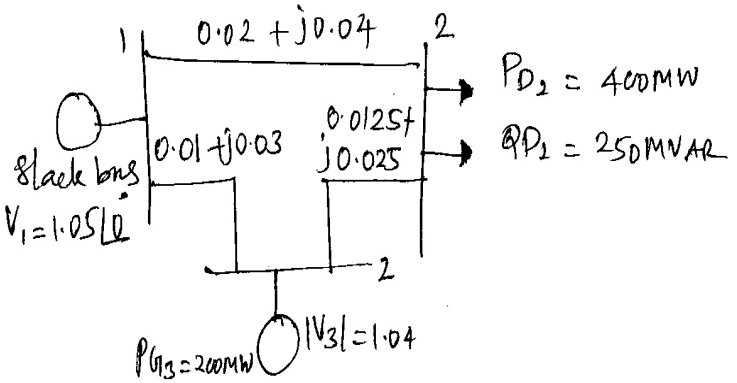

Fig-2.

15. The per unit bus impedance matrix of a four bus power system shown in Fig.3 is given by,

$$Z_{bus} = \begin{bmatrix} j0.15 & j0.075 & j0.14 & j0.135 \\ j0.075 & j0.1875 & j0.09 & j0.0975 \\ j0.14 & j0.09 & j0.2533 & j0.21 \\ j0.135 & j0.0975 & j0.21 & j0.2475 \end{bmatrix}$$

Calculate the fault current for a solid three phase symmetrical fault at bus 4. Also calculate the post fault bus voltages and line currents.

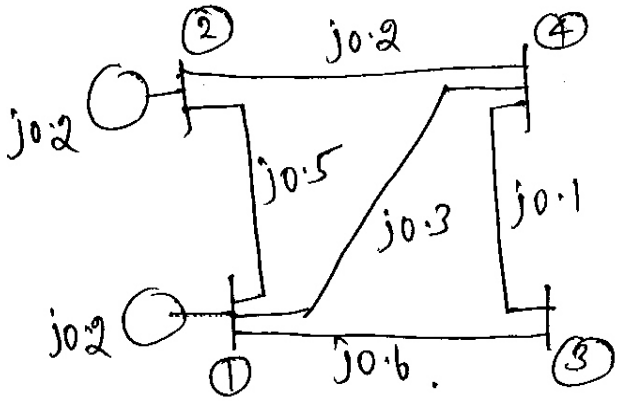

Fig-3. **[OR]**

(or)

16. (a) Derive the relationship for fault currents in phase a and b in terms of symmetrical components when there is a double line to ground fault on phase a and b

(b) Show that positive and negative sequence currents are equal in magnitude but out of phase by 180 deg. In a line-to-line fault.

17. A fault occurs at point P on the short line between breakers A and B of the system shown in the Fig.4 and cleared after time "t_c" by opening of the breaker of A. Analyse the transient stability of the system using equal area criterion clearly specifying the values of rotor angle, accelerating power and speed at significant operating points of the generator G during initial steady – state, during fault and post – fault periods.

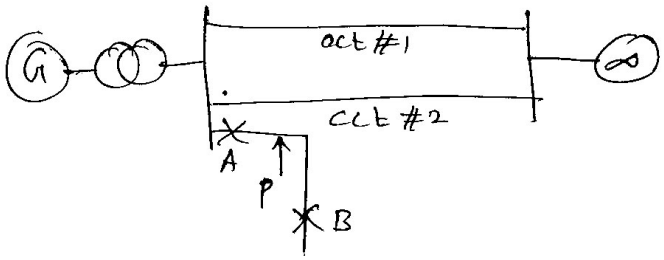

Fig-4.

(or)

18. (a) State and explain one limitations of equal criterion.
(b) State and explain whether stability limit is increased or decreased by (i) adding one or more transmission circuit in parallel and (ii) having fast acting circuit breakers.

19. The synchronous machine shown in Fig. 5 is generating 100 MW and 75 MVAR. The voltage of the infinite bus q is 1 + jo pu. The generator is connected to the infinite bus through a line of reactance 0.08 p.u. on a 100 MVA base. The machine transient reactance is 0.2 pu and the inertia constant is 4 pu on a 100 MVA base. A 3-ϕ fault occurs at bus 'p' for a duration of o.1 sec. Compute the rotor angle at t=0.02 sec (Δt = 0.02 sec) by applying Modified Eulers method. The frequency of the supply is 60Hz.

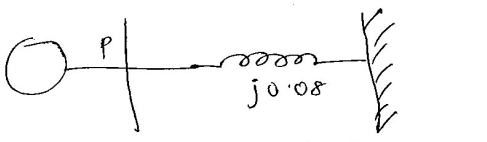

Fig-5

(or)

20. Derive the swing equation for a single machine connected to infinite bus system. Validate the nonlinearity of this equation.