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: 614504 — Time: 3 Hours
Date: 24-04-2009 — Session: AN

PART – A (10 x 2 = 20)

Answer All the Questions

1. What is the relation between percentage value and per unit value?

2. Write the equation for per unit impedance.

3. Draw π model of a transmission line.

4. Distinguish between bus admittance matrix and bus impedance matrix.

5. Distinguish between symmetrical and unsymmetrical short circuits.

6. State the merit of using Z_{bus} matrix in short circuit analysis.

7. What are the applications of load flow analysis?

8. Write any two assumptions made to simplify the transient stability problem.

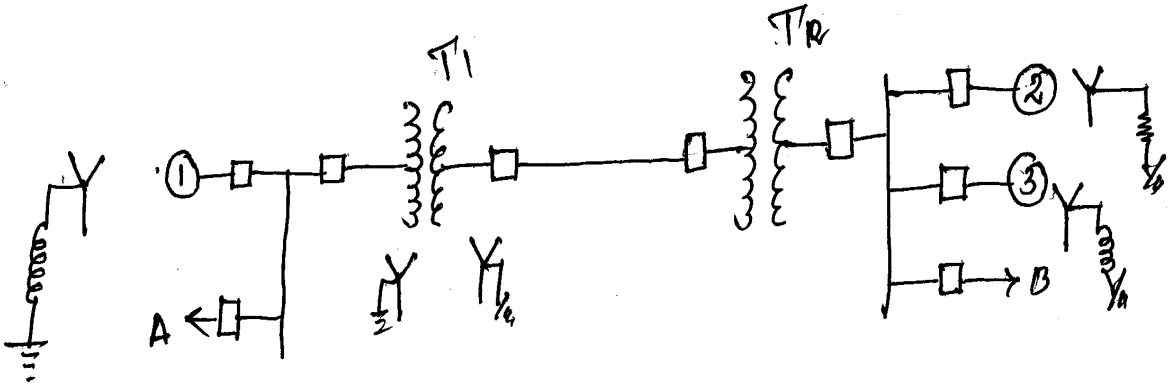
9. Write the power angle equation of an alternator connected to a synchronous motor through pure reactance network.

10. What is meant by steady state limit?

PART – B (5 x 12 = 60)

Answer All the Questions

11. Obtain the reactance diagram of the power system given below:



One line Representation of a Simple power System

(or)

12. Three motors rated 6.9 kV are connected to the same bus. The motors are
No.1 5000 H.P., 0.8 p.f. synchronous motor, x" = 17%.
No.2 3000 H.P., u p.f. synchronous motor, x" = 15%.
No.3 3500 H.P., induction motor, x" = 20%.
Express the sub transient reactance of these motors in per unit on a base of 10,000 kVA, 6.6 kV.

13. For the transmission system with the following line specifications, determine the Bus admittance matrix.

Bus code p – q Charging $Y'_{pq}/2$	Impedance Z_{pq}	Bus Code	Line
1 – 2	0.06 + j0.18	1	j0.05
1 – 3	0.02 + j0.06	2	j0.06
2 – 3	0.04 + j0.12	3	j0.05

(or)

14. The bus impedance matrix of a network is

	(1)	(2)	(3)	(4)
(1)	j0.105	j0.105	j0.045	j0.105
(2)	j0.105	j0.105	j0.045	j0.105
(3)	j0.045	j0.045	j0.105	j0.405
(4)	j0.105	j0.105	j0.405	j0.325

To this an element 2 – 3 with an impedance of j0.25 is added. Obtain the modified bus impedance matrix.

15. Two synchronous machines are connected through three-phase transformers to the transmission line as given below in fig.2. The ratings and reactance of the machines and transformers are Machines 1 and 2: 100 MVA, 20 kV; X"d = $X_1 = X_2 = 20\%$ $X_0 = 4\%$; $X_n = 5\%$. Transformers T_1 and T_2: 100 MVA, 20 Y/345 Y kV; X = 8% Both transformers are solidly grounded on two sides. On a chosen base of 100 MVA, 345 kV in the transmission line circuit the line reactance are $X_1 = X_2 = 15\%$ and $X_0 = 50\%$. The system is operating at nominal voltage per fault currents when a bolted ($Z_f = 0$) single line – to – ground fault occurs on phase A at bus (3). Using the bus impedance matrix for each of the three sequence networks, determine the sub transient current to ground at the fault.

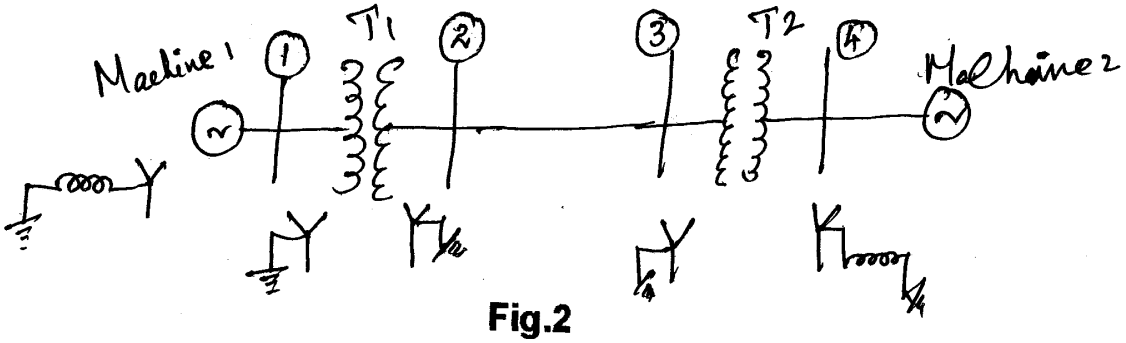


Fig.2

(or)

16. The line to ground voltage on the high voltage side of a step up transformer are 100 kV, 33 kV, and 38 kV on phases a, b and c respectively. The voltage of phase a leads that of phase b by 100°

and lags that of phase c by 176.5°. Determine the symmetrical components of voltage.

17. Derive the basic equation for the load flow study using gauss-seidal method. With respect to this method explain the following
    (a) Acceleration factor.
    (b) Convergence criteria.
    (c) Handling of PV buses.

(or)

18. The bus admittance matrix of a 3 bus power system is

$$Y_{Bus} = \begin{array}{c|ccc} & 1 & 2 & 3 \\ 1 & -j20 & j10 & j10 \\ 2 & j10 & -j15 & j5 \\ 3 & j10 & j5 & -j15 \end{array}$$

Bus No.	Bus Type	PG	QG	PL	QL
1	P – V	2.9034	-	-	-
2	P – Q	-	-	4.0089	1.7915
3	Slack	-	-	-	-

The latest solution is

$V_1 =$ 1.05 6.96°
$V_2 =$ 0.9338 -8.8°
$V_3 =$ 1.0 0°

Determine the bus voltage at the end of the next iteration using Newton Raphson method.

19. Derive Swing equation used for stability studies in power system.

(or)

20. The moment of inertia of a 4 pole, 100 MVA, 11 kV, 3 phase, 0.8 pf, 50 Hz turbo alternator is 10000 kg-m^2. Calculate H and M.