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: 214504 — Time: 3 Hours
Date: 28-04-2008 — Session: AN

PART – A (10 x 2 = 20)

Answer All the Questions

1. What is meant by per unit quantity? Why is the per unit method considered superior to percent method for short circuit calculations?
2. Draw a general circuit which can be used to determine the zero sequence network of a two winding transformer. Using this circuit draw the zero sequence network of a star - star transformer with star point grounded.
3. What is off nominal transformer ratio?
4. Write the importance of load flow, studies in power system analysis.
5. What is short circuit KVA?
6. What is the use of reactor in power system? Discuss different types of reactors.
7. Distinguish between a balanced and unbalanced system by means of symmetrical components of vectors.
8. Draw a diagram showing inter connection of sequence networks for a double line fault.
9. Distinguish between transient and steady state stability of a power system.
10. Discuss why an early fault clearing means better chances of maintaining system stability.

PART – B (5 x 12 = 60)

Answer All the Questions

11. (a) Figure shows a generator feeding two motors through transformer and line. The rating and reactance are as follows.

Generator : 100 MVA, 11 KV, 3 PHASE, X = 20%

Transformer T_1 : 3 Phase, 100 MVA, 11/132 KV, X = 5%

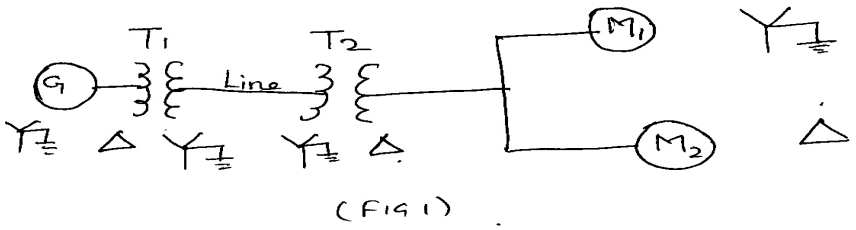
Transformer T_2: Bank of three single phase transformers, each rated at 35 MVA,, 66/11KV, X = 4%

Motor M_1 : 40MVA, 3 PHASE, 10 KV, X = 20%

Motor M_2 : 60 MVA, 3 PHASE, 11 KV, X = 15%

The line reactance is 80 ohm. Select suitable base values. Draw reactance diagram. Indicate per unit reactance in the diagram.(fig1)

(8)



(FIG 1)

(b) Explain about sequence impedances in a power system network.

(4)

(or)

12. (a) Discuss the step by step method formation of Y bus. (5)

(b) The parameters of a 4-bus system are as follows. (7)

Bus Code	Line Impedance (P.U)	Changing Admittance(P.U) ($Y_{pq}/2$)
1-2	0.2 + j0.8	j0.02
2-3	0.3 + j0.9	j0.03
3-4	0.25 + j1	j0.04
3-4	0.2 + j0.8	j0.02
1-3	0.1 + j 0.4	j0.01

Draw the network and find bus admittance matrix.

13. (a) Give a flow chart for the load flow study on a power system having only PQ buses using GS method. (5)

(b) A 4 buses system has the following line reactance (the resistance are negligible).

	Line Code	Reactance
Bus	1-2	j0.5 pu
	2-3	j 1.0pu
	3-4	j11.0pu
	1-4	j 0.5pu

The Bus specification and values of injected powers are as under

Bus	P	Q	V	Bus Specifications
1	-	-	1.05 pu	Slack
2	-0.1 pu	Zero	-	Load bus
3	0.5 pu	0.02pu	-	Generator bus
4	-0.4 pu	-0.05 pu	-	Load bus

Use G-S method and find values of V_2, V_3 & V_4 after one iteration.

(7)

(or)

14. Give reasons why a) NR method is preferred to GS. b) A majority of buses in PS are load buses. c) One of the buses is taken as slack bus in load flow studies. D) Order of Jacobias in NR method using polar coordinates is smaller then that in NR method using rectangular coordinates) A direct solution of load flow problem ins not possible) An acceleration factor is commonly used in load flow studies using GS method.

15. (a) Draw the diagram showing the short circuit current as a function of time for a synchronous generator and explain the terms synchronous reactance transient reactance and sub transient reactance. (5)

(b) A 30 MVA, 11 KV generator has $Z_1 = Z_2 = j0.2$pu, $Z_0 = j0.05$ pu. A 3 PHASE fault occurs on the generator terminals. Find fault current. Assume that the generator neutral is study grounded and that the generator is operating at no load and rated voltage at the occurrence of fault. (7)

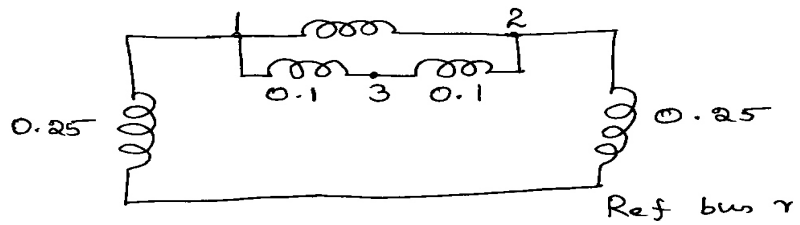
(or)

16. (a) A synchronous generator feeds bus 1 of a system. A power network feeds bus 2 of the system. Buses 1 and 2 are connected through a transformer and a transmission line. Per unit reactances of various components are,

Generator (connected to bus bar 1)	0.25
Transformer	0.12
Transmission line	0.28

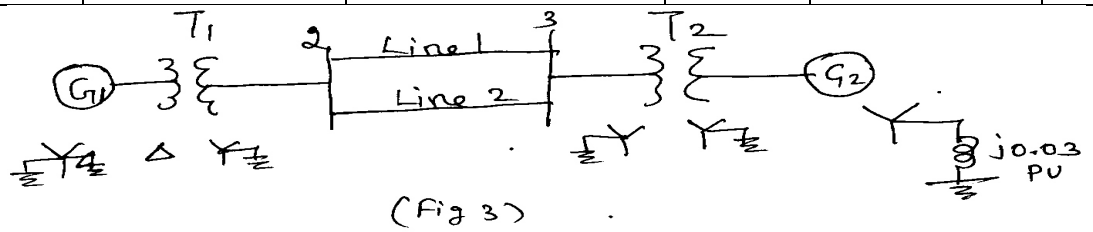
The power network can be represented by a generator with a reactance in series. With the generator on no load and with 1 pu voltage at each bus under operating condition, a 3 PHASE short circuit occurring on bu 1 causes a current of 5 pu tp flow into the fault. Determine the equivalent reactance of the power network.

(b) For the 3 bus network shown build Z bus (Fig 2)



17. Draw the sequence, - ve sequence and zero sequence network for the system data is as follows:

Equipment	MVA rating	Voltage rating	XI	X2	X0
G1	100	11KV	0.25	0.25	0.05
G2	100	11KV	0.2	0.2	0.05
T1	100	11/220KV	0.06	0.06	0.06
T2	100	11/220KV	0.07	0.07	0.07
Line 1	100	220KV	0.1	0.1	0.3
Line 2	100	220KV	0.1	0.1	0.3



(Fig 3)

(or)

18. A 25 MVA, 11 KV, 3 phase synchronous generator with solidly grounded neutral has sub transient reactance of 0.25pu. The –ve and zero sequence reactances are 0.35pu and 0.1 pu respectively. Determine the generator and line to line voltage when a single line to ground fault occurs at the terminals of an unloaded generator operating at rated voltage. Resistance may be neglected.

19. (a) Explain clearly the application of equal area criterion for studying the transient stability of a power system. (5)
(b) The steady state limit of a power system is 100MW. A generator with constant excitation is supplying 50MW to the system. Estimate the maximum permissible sudden increase in generator output without causing instability. (7)

(or)

20. (a) What is meant by "Power – angle" diagram? Show how this may be used to determine the stability of a simple system under a transient fault condition. (5)
(b) A 50 Hz turbo generator in delivering 50% of power that is capable of delivering through a transmission line to an infinite bus. A fault occurs that increases the reactance between generator and infinite bus to 400% of the value before the fault. When the fault is isolate, the maximum power that can be delivered is 75% of the original maximum value. Determine critical clearing angle for the conditions given above.