Dhanalakshmi Srinivasan Engineering College - Perambalur
Department of EEE

QUESTION BANK

POWER SYSTEM ANALYSIS

UNIT I
The power system-an overview and modelling

Part-A

1. What are the components of power system?
2. What is single line diagram?
3. Define per unit value.
4. Write the equation for converting the p.u impedance expressed in one base to another?
5. Draw the symbols used to represent various components in a power system.
6. What is the need for base values?
7. What are the advantages of per unit computations?
8. Draw the equivalent circuit of a 3 phase generator.
9. Draw the single phase equivalent circuit of a 3 winding transformer.
10. A generator rated at 30 MVA, 11 kV has a reactance of 20%. Calculate its p.u. reactances for a base of 50 MVA 10 kV.
11. A Y-connected generator rated at 300 MVA, 33 kV, has a reactance of 1.24 p.u. Find the ohmic value of reactance.
12. The base kV and base MVA of a 3-phase transmission line is 33 kV and 10 MVA respectively. Calculate the base current and base impedance.
13. What is impedance and reactance diagram?
14. Give equations for transforming base kV on LV side to HV side of transformer and vice-versa.
15. What are the approximations made in reactance diagram?
16. What are the approximations made in impedance diagram?

Part-B

1. A 50 kW, three phase, Y connected load is fed by a 200 kVA transformer with voltage rating 11 kV/400V through a feeder. The length of the feeder is 0.5 km and the impedance of the feeder is 0.1+j0.25Ω/km. If the load p.f. is 0.8, calculate the p.u. impedance of the load and feeder.
2. The three-phase ratings of a three winding transformer are

   Primary : Y-connected, 110kV, 20MVA
   Secondary : Y-connected, 13.2kV, 15 MVA
   Tertiary : Δ-connected, 2.1kV, 0.5MVA

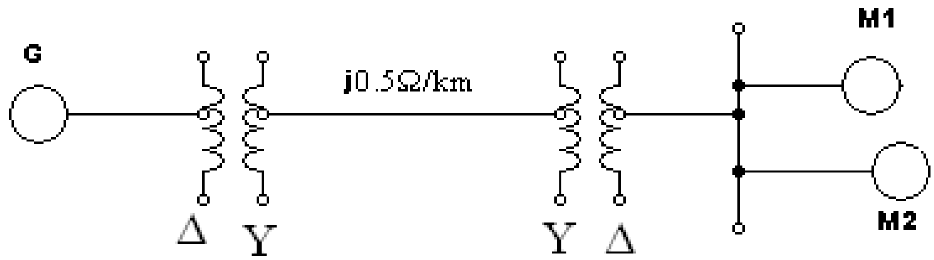
   Three short-circuit tests performed on this transformer yielded the following results

   (i) Primary excited, Secondary shorted : 2290 V, 52.5 A
   (ii) Primary excited, Tertiary shorted : 1785 V, 52.5 A
   (iii) Secondary excited, Tertiary shorted : 148 V, 328 A

   Find the p.u. impedances of the star-connected single-phase equivalent circuit for a base of 20 MVA, 110 kV in the primary circuit. Neglect resistances.

3. A 120 MVA, 19.5 KV generator has a synchronous reactance of 0.15 p.u and it is connected to a transmission line through a transformer rated 150MVA, 230/18 KV (star/delta) with X = 0.1 p.u.
   (i) Calculate the p.u reactance by taking generator rating as a base values (5)
   (ii) Calculate the p.u reactance by taking transformer rating as a base values. (5)
   (iii) Calculate the p.u reactance for a base value of 100 MVA and 220 KV on H.T side of transformer. (6)

4. A 300 MVA, 20 kV, 3Φ generator has sub transient reactance of 20%.The generator Supplies 2 synchronous motors through a 64km transmission line having transformers at both ends as shown in fig. In this, T1 is a 3Φ transformer & T2 is made of 3 single phase transformer of rating 100 MVA, 127/13.2 kV, 10% reactance. Series reactance of the transmission line is 0.5Ω/km. Draw the reactance diagram with all the reactance's marked in p.u. Select the generator rating as base values. The ratings of 2 motors are: M1=200 MVA, 13.2 kV, 20% & M2=100 MVA, 13.2 kV, 20%



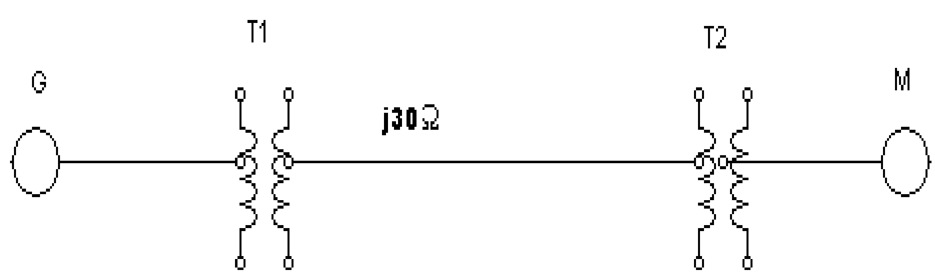
5. Draw the reactance diagram for the power system shown in Fig. Use a base of 50 MVA 230 kV in 30 **Ω** line. The ratings of the generator, motor and transformers are:

Generator = 20 MVA, 20 kV, X=20

Motor = 35 MVA, 13.2 kV, X=25%

T1 = 25 MVA, 18/230 kV (Y/Y), X=10%

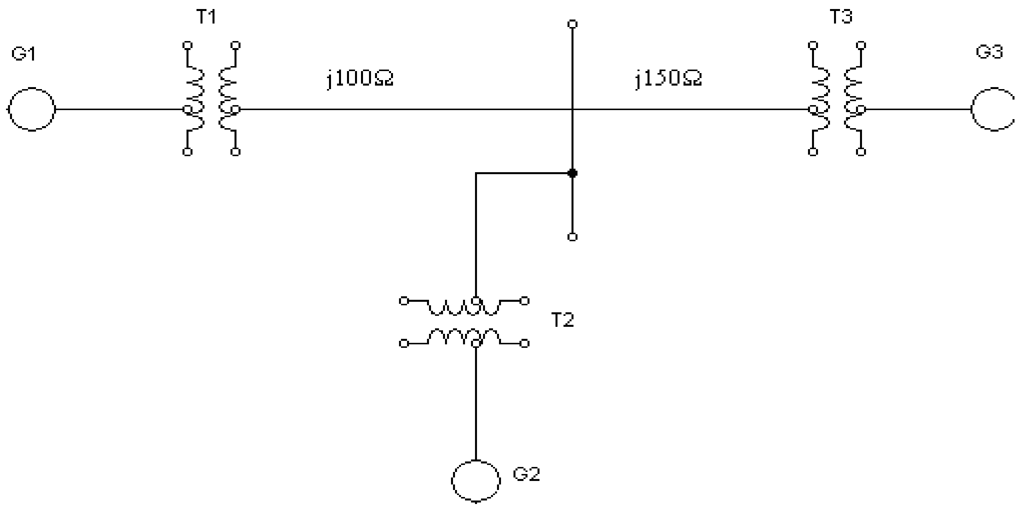
T1 = 45 MVA, 230/13.8 kV (Y/Δ), X=15%



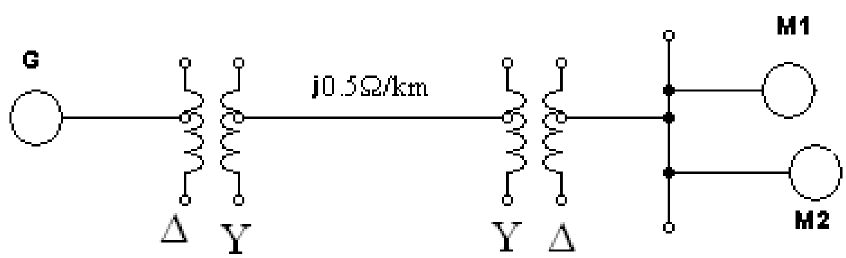
6. The single line diagram of an unloaded power system is shown in Fig. The generator transformer ratings are as follows.

G1=20 MVA, 11 kV, X''=25%
G2=30 MVA, 18 kV, X''=25%
G3=30 MVA, 20 kV, X''=21%
T1=25 MVA, 220/13.8 kV (Δ/Y), X=15%
T2=3 single phase units each rated 10 MVA, 127/18 kV(Y/Δ), X=15%
T3=15 MVA, 220/20 kV(Y/Δ), X=15%

Draw the reactance diagram using a base of 50 MVA and 11 kV on the generator1.



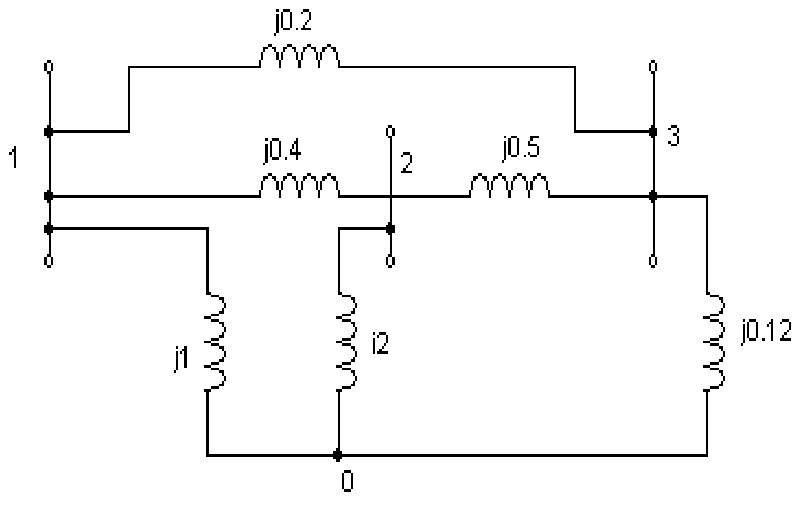
7. A 500 MVA, 20 kV, 3Φ generator has sub transient reactance of 10%.The generator supplies 2 synchronous motors through a transmission line having transformers at both ends as shown in fig. In this, T1 is a 3Φ transformer 250 MVA, 20/230 kV, 15% reactance & T2 is made of 3 single phase transformer of rating 500 MVA, 3.2/127 kV, 20% reactance. Series reactance of the transmission line is 100Ω. The ratings of 2 motors are: M1=150 MVA, 13.2 kV, 15% & M2=200 MVA, 13.2 kV, 20%.Draw the reactance diagram with all the reactance's marked in p.u. Select the generator rating as base values.



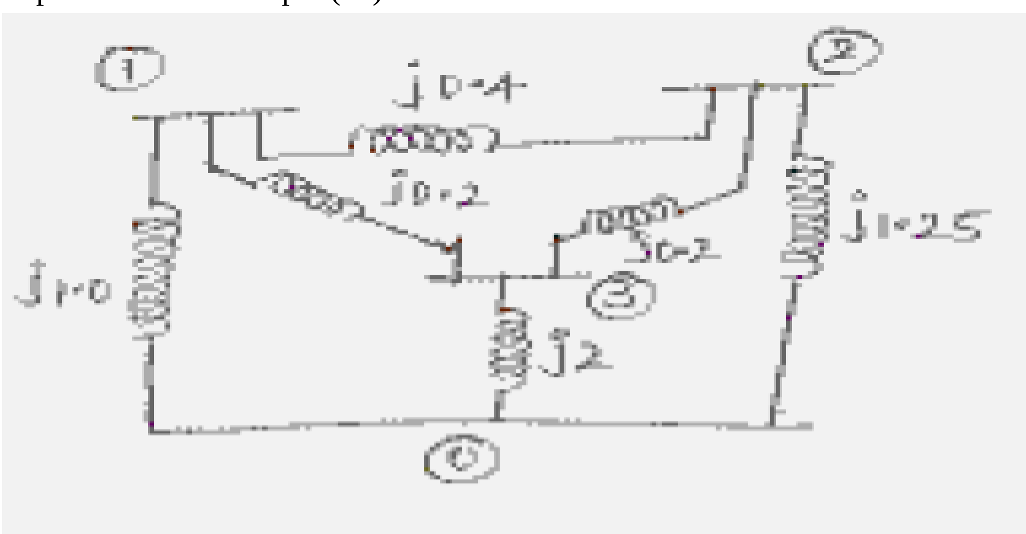
8. Form Y bus by inspection method and singular transformation method for the line specification as given below.

Line p-q	Impedance
0-1	0.1+j0.8
0-2	0.2+j0.6
0-4	0.3+j0.5
1-2	0.4+j0.2
2-3	0.3+j0.1
3-4	0.4+j0.5
1-4	0.1+j0.5

9. Form Y bus by inspection method and singular transformation method for the Power system network shown in Fig.



10. Using Singular transformation method, Determine YBUS for the network shown in Fig. Where the impedance labeled in p.u (16)



11. (i) Explain the formation of YBUS by Singular transformation with one example. (12)
(ii) Draw a one line diagram of a sample power system using synchronous machines, transformers, and transmission lines. (4)

UNIT II
Power flow analysis

Part-A

1. What is a bus?
2. What is bus admittance matrix?
3. What is power flow study?

4. What is the need for load-flow study?
5. What are the different types of buses in a power system?
6. What are the quantities that are associated with each bus in a system?
7. Define voltage controlled bus?
8. What is load bus?
9. What is slack bus?
10. What are the iterative methods mainly used for the solution of load flow problems?
11. Why do we go for iterative methods to solve load flow problems?
12. What are the advantages of Gauss – seidal method?
13. What are the disadvantages of Gauss – seidal method?
14. What are the advantages of Newton - Raphson method?
15. What are the disadvantages of Newton - Raphson method?
16. What are the advantages of Fast Decoupled method?
17. What are the disadvantages of Fast Decoupled method?
18. Compare the G.S. and N.R. methods of load flow solutions?

Part-B

1. Draw the flow chart and explain the algorithm for Gauss seidel iterative method for load flow analysis.
2. With a neat flow chart, explain the computational procedure for load flow solution using Newton Raphson iterative method when the system contains all **types of buses.**

3. a. Derive static load equations for 'n' bus system. (10)

b. Compare Gauss seidel, Newton raphson and fast decoupled for load flow solution. (6)

4. The following is the system data for a load flow solution:

Bus code	Admittance
1-2	2.0 -j8.0
1-3	1.0 – j3.0
2-3	0.6 – j2.0
2-4	1.0 –j4.0
3-4	2.0 –j8.0

The schedule of active and reactive power is

Buscode	P	Q	V	Remarks
1	-	-	1.05+j0.0	Slack
2	0.5	0. 2	1.0+j0.0	PQ
3	0.4	0.3	1.0+j0.0	PQ
4	0.3	0.1	1.0+j0.0	PQ

Determine the voltage at the end of first iteration using Gauss – Seidel method. Take acceleration factor = 1.4. (16)

UNIT III
Fault analysis-balanced fault

Part-A

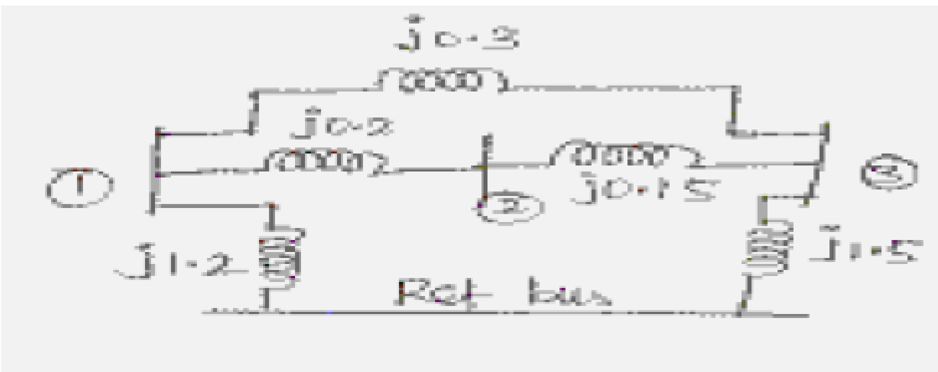
1. What is meant by a fault?
2. How the faults are classified?
3. List the various types of shunt and series fault?
4. .List the symmetrical and unsymmetrical fault?

5. What are symmetrical and unsymmetrical fault?
6. Write the relative frequency of occurrence of various types of faults.
7. What is the need for fault analysis?
8. What is synchronous reactance?
9. Define sub transient reactance.
10. Define transient reactance.
11. What is momentary current rating of circuit breaker?
12. What is impedance matrix?

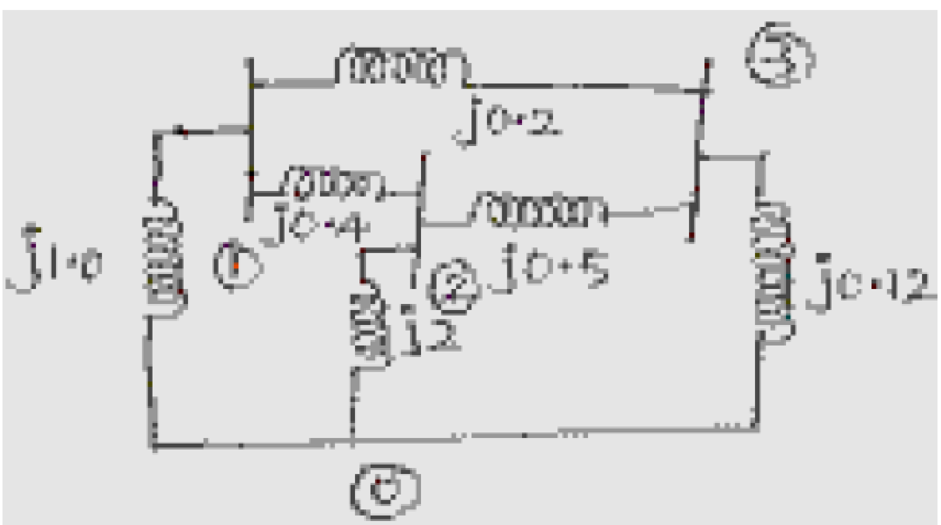
Part-B

1. Explain the step by step procedure of the formation of ZBUS by bus building algorithm. (16)

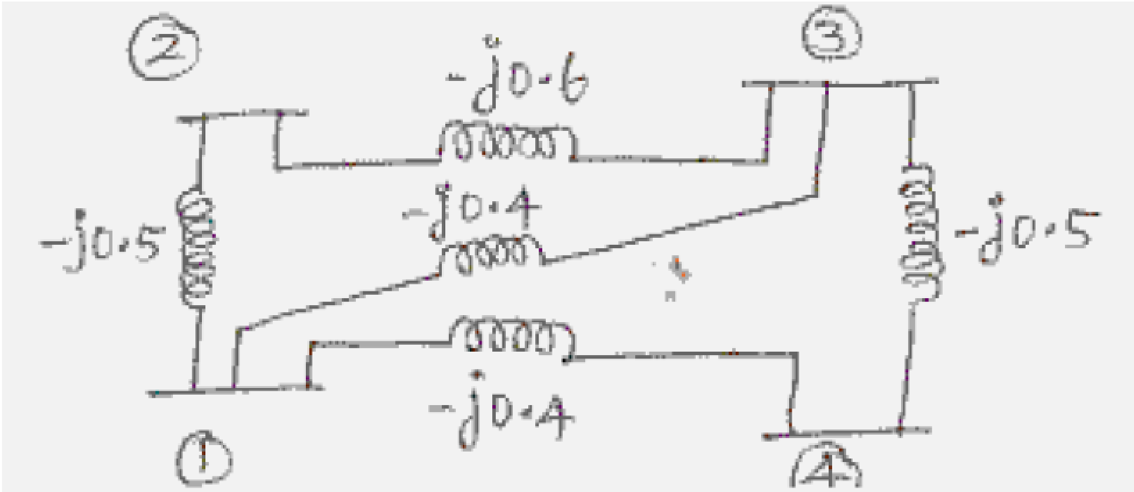
2. Determine the Z bus for the system whose reactance diagram is shown in the Fig. where the impedance is given in p.u. (16)



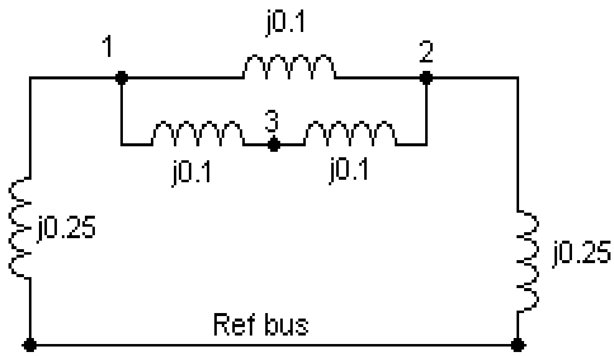
3. Using building algorithm method, determine ZBUS for the network shown in Fig where the impedances are labeled are shown in per unit. (16)



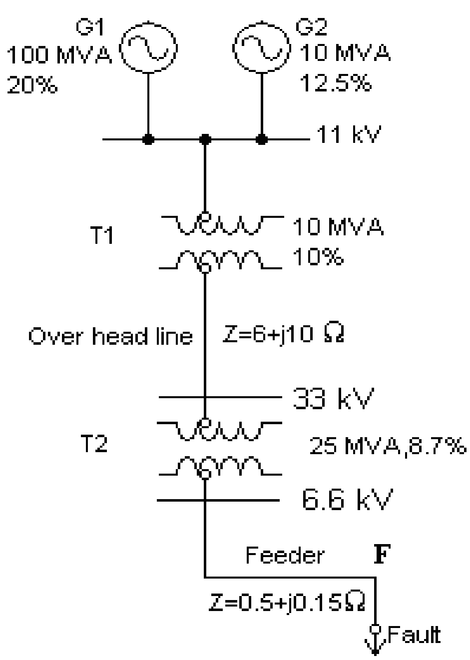
4. For the network shown in fig. form the bus admittance matrix. Determine the reduced admittance matrix by eliminating node 4. (16)



5. Using building algorithm method, determine Z_{BUS} for the network shown inFig. where the impedances are in p.u.



6. For the radial network shown in Fig.Q-14, a 3Φ fault occurs at point F. Determine the fault current.



UNIT IV

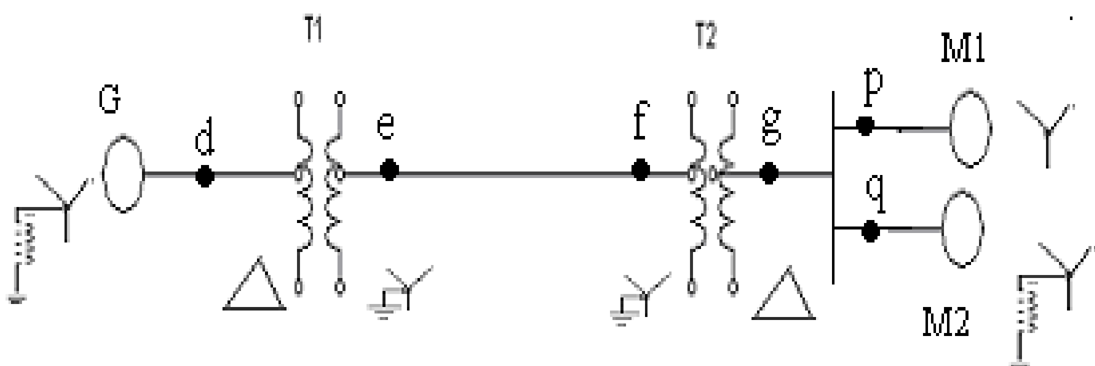
Fault analysis-symmetrical components and unbalanced fault

Part-A

1. Name the various unsymmetrical faults in a power system.
2. What are symmetrical components?
3. Write the symmetrical components of three phase system.
4. What are positive sequence components?
5. What are negative sequence components?
6. What are zero sequence components?
7. Define an operator "a"
8. Express the unbalanced voltages in terms of symmetrical components.
9. Express the symmetrical components in terms of unbalanced voltages.
10. What are sequence impedance and sequence networks?
11. What is meant by positive, negative and zero sequence impedances?
12. What is meant by positive, negative and zero sequence reactance diagram?
13. Draw the zero sequence network of a generator when the neutral is grounded andwhen it is ungrounded?
14. Draw the zero sequence network of Y/Δ with neutral of star grounded and Δ/Y transformers.

Part-B

1. A 25 MVA,11 kV, three phase generator has a sub transient reactance of 20%. The generator supplies two motors over a transmission line with transformers at both ends as shown in Fig.The motors have rated inputs of 15 and 7.5 MVA,both 10 kV with 25% sub transient reactance. The three phase transformers are both rated 30 MVA, 10.8/121 kV, connection Δ-Y with leakage reactance of 10% each. The series reactance of he line is 100 ohms. Draw the positive, negative and zero sequence reactance diagram.



2. Determine the symmetrical components of three unbalanced voltages

$$V_a = 200\angle 0^o$$

$$V_b = 200\angle 245^o$$

$$V_c = 200\angle 105^o$$

3. Derive the expression for fault current in line to line fault on unloaded generator. Draw an equivalent network showing the interconnection of networks to simulate line to line fault.
4. Derive the expression for fault current in line to line fault on unloaded generator. Draw an equivalent network showing the interconnection of networks to simulate line to line ground fault.

5. Derive the expression for fault current in line to line fault on unloaded generator. Draw an equivalent network showing the interconnection of networks to simulate line to ground fault.

UNIT V
Power system stability

Part-A

1. Define stability.
2. Define steady state stability.
3. Define transient stability.
4. What is steady state stability limit?
5. What is transient stability limit?
6. How stability studies are classified?
7. Give the expression for swing equation.
8. Define Swing curve.
9. Define power angle.
10. Define critical clearing time.
11. Define critical clearing angle.
12. List the methods of improving transient stability limit of a power system.
13. State equal area criterion.
14. Derive Swing equation used for stability studies in power system.
15. Derive the expressions for critical clearing time and angle.
16. Write the computational algorithm for obtaining swing curves using Runge – Kutta method.
17. Write the computational algorithm for obtaining swing curves using Modified Euler method

Part-B

1. Find the steady state power limit of a system consisting of a generator with reactance 0.6 p.u. connected to an infinite bus through a reactance of 0.8 p.u. The terminal of the generator is 1.15 p.u. and the voltage of infinite bus is 1<0 p.u.
2. A synchronous generator having a reactance of 1 p.u. is connected to an infinite bus through a transmission system with a reactance of 0.7 p.u. The generator is running on no-load with a voltage of 1.1 p.u. Take H=4.5 MW-s/MVA. The voltage of infinite bus is 1<0 p.u. and its frequency is 50 Hz. Calculate the frequency of natural oscillations if the machine is suddenly loaded to (i) 60% and (ii) 75% of its maximum power limit. Neglect the resistance and machine damping.
3. Two power stations A and B are located close together. Station A has four identical generator sets each rated 100 MVA and having an inertia constant of 9 MJ/MVA whereas the station B has 3 sets each rated 200 MVA, 4 MJ/MVA. Calculate the inertia constant of a single equivalent machine on a base of 100 MVA.
4. A 2-pole 50 Hz, 11 KV turbo alternator has a ratio of 100 MW, power factor 0.85 lagging. The rotor has a moment of inertia of 10,000 kg m^2. Calculate H and M.
5. A 50 HZ 8 pole generator rated 80 MVA, 11 KV has an inertia constant of 7MJ/MVA. Find the moment of inertia M.