Code No: 07A70202 **R07** **Set No. 2**

IV B.Tech I Semester Examinations,NOVEMBER 2010
POWER SYSTEM ANALYSIS
Electrical And Electronics Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are the advantages of Z_{BUS} building algorithm?

   (b) $Z_{BUS}^{old} = \begin{bmatrix} 0.2 & 0 \\ 0 & 0.6 \end{bmatrix}$, find the modified Z_{BUS} if a branch having an impedance 0.4 p.u. is added from the reference bus (Bus - 1) to new bus? Also find the modified Z_{BUS} if a branch having an impedance 0.4 p.u. is added from existing bus (other than reference bus) to new bus? [4+12]

2. (a) How do you improve the rate of convergence of a GS-iterative method?

   (b) In a 2-Bus power system with Bus-1 as slack bus, $V_1 = 1.0\angle 0^0$ p.u., $P_2 = 1$ and $Q_2 = 0.5$ p.u. with $Z_{12} = 0.012+j0.16$ p.u. Using GS-method, determine V_2 after second iteration. Also find the line flow and line losses. [6+10]

3. (a) What are the applications of Y_{BUS}? Why do we use Y_{BUS} in Newton-Raphson method of power flow analysis?

   (b) Are Decoupled and Fast decoupled methods of power flow analysis mathematical methods? What are the assumptions for reducing the NR-method to DLF and FDLF methods? [6+10]

4. Consider the system as shown in figure 4. The percentage reactance of each alternator is expressed on its own capacity, determine the short circuit current that will flow into a three-phase short circuit at F. [16]

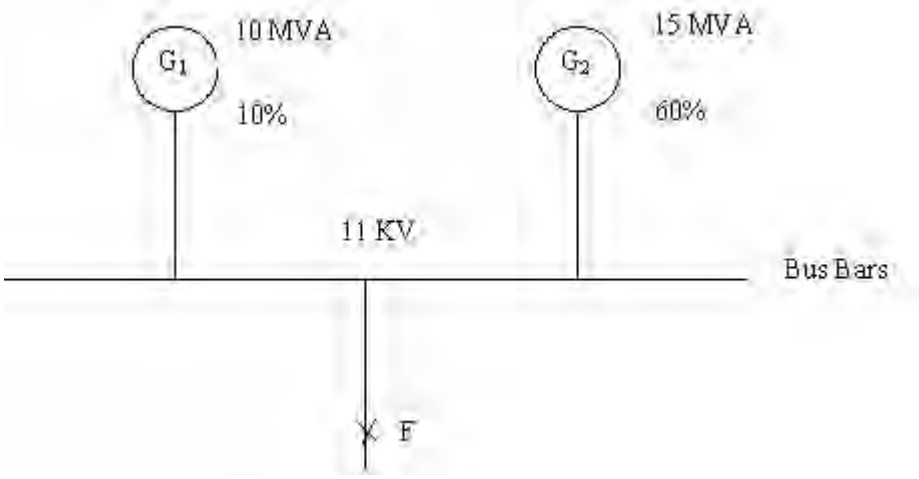

Figure 4

5. (a) Define the following terms with suitable examples
   i. Tree
   ii. Branches
   iii. Links
   iv. Co-Tree
   v. Basic loop
   vi. Path

   (b) Form Y_{BUS} for the given power system shown in figure 5 with reactance value in p.u.? Select arbitrary directions. [6+10]

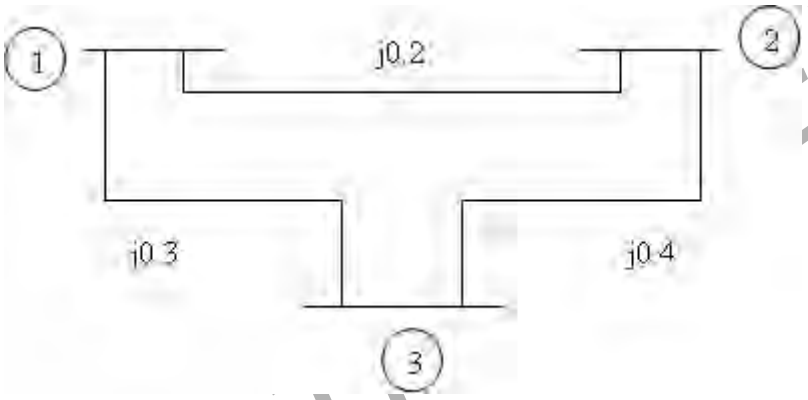

Figure 5

6. A 200 MVA, 2 pole, 50 Hz alternator has a moment of inertia of 50 X 10^3 Kg-m^2. What is the energy stored in the rotor at the rated speed ? Find the value of H and determine the corresponding angular momentum. [16]

7. A synchronous motor is receiving 25 percent of power that is capable of receiving from an infinite bus. If the load on the motor is doubled, determine the maximum value of load angle during the swinging of the rotor around its new equilibrium position. [16]

8. On the base of 25 MVA and 11kV in generator circuit, obtain the positive, negative and zero sequence networks of the system shown in figure 3. Before the occurrence of a solid LG at bus-g, the motors are loaded to draw 15 MW and 7.5 MW at 10 kv, 0.8 leading p.f. If prefault current is neglected, calculate the fault current and subtransient current in all parts of the system. [16]

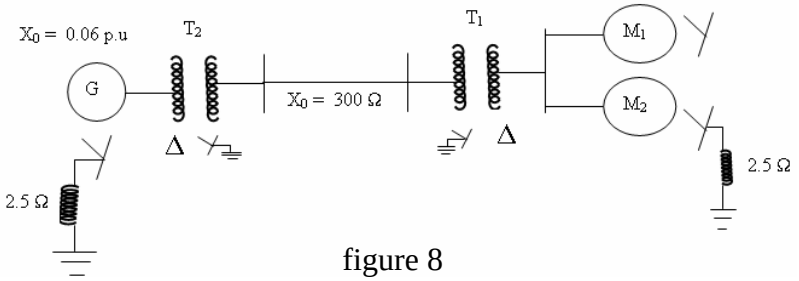

figure 8

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Code No: 07A70202 **R07** **Set No. 4**

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POWER SYSTEM ANALYSIS
Electrical And Electronics Engineering

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1. (a) Explain the relationship between
   i. The basic loops and links
   ii. Basic cut-sets and the number of branches
   (b) Find the Y_{BUS} by direct inspection method for the network shown in figure 4. [6+10]

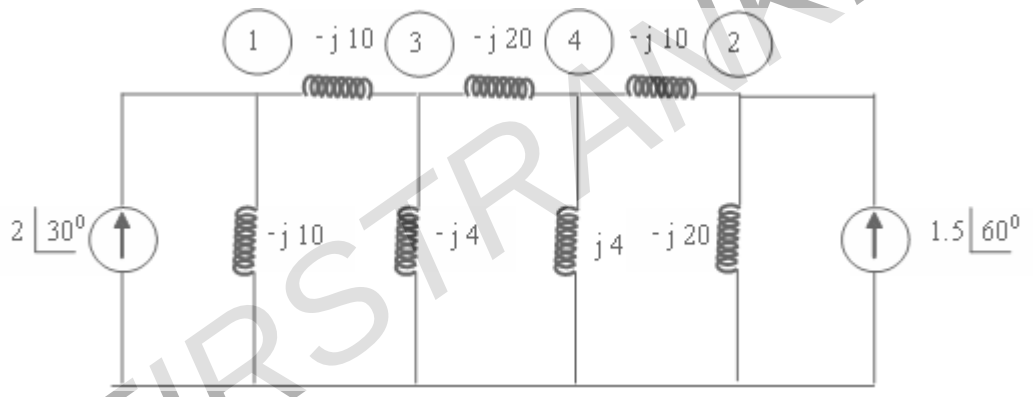

Figure 4:

2. (a) Why ZBUS is used for the short circuit analysis of a given power system?

(b) A Two - Bus system has $Z_{BUS} = \begin{bmatrix} j0.11565 & j0.0458 \\ j0.0458 & j0.13893 \end{bmatrix} p.u$ If an impedance Z_b = j0.4 p.u. is connected between buses 1 and 2, what is the new ZBUS? [4+12]

3. (a) What is acceleration factor? What is its role in GS-method for power flow studies?

(b) For the system shown in figure 5., the bus admittance matrix is

$$Y_{BUS} \begin{bmatrix} 3-j9 & -2+j6 & -1+j3 & 0 \\ -2+j6 & 3.666-j11 & -0.666+j2 & -1+j3 \\ -1+j3 & -0.666+j2 & 3.666-j11 & -2+j6 \\ 0 & -1+j3 & -2+j6 & 3-j9 \end{bmatrix} p.u$$

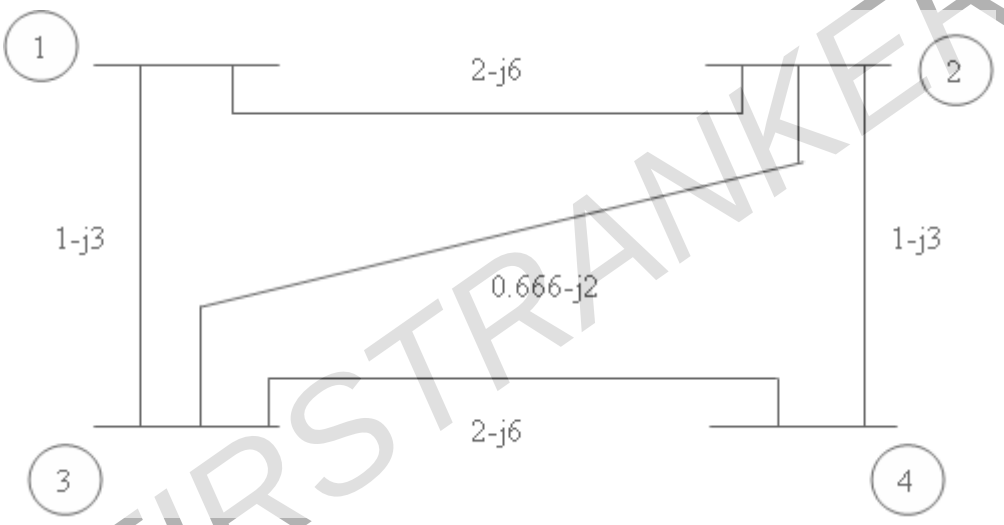

Figure 5:

With P_2 = 0.5 p.u., Q_2 = -0.2 p.u., P_3 = -1 p.u., Q_3 = 0.5 p.u. and P_4 = 0.3 p.u., Q_3 = -0.1 p.u. and $V_1 = 1.04\angle 0^0$ p.u. Determine the value of V_2 that is produced by the first iteration of the GS-method. [4+12]

4. (a) Compare GS-method, NR, decoupled and FDLF methods with respect to
   i. Number of equations
   ii. Memory
   iii. Time for iteration

(b) What are the assumptions made in reducing NR-method to decoupled method of power flow solution? [6+10]

5. (a) Explain the construction and operation of protective reactors.

(b) What are the advantages of using reactors? [6+10]

6. (a) Give the list of methods to improve transient stability limits and explain.

(b) Explain the use of automatic reclosing circuit breakers in improving system stability.

[8+8]

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7. A 45 MVA, 13.8 kv, 3-phase alternator has a subtransient reactance of 15% and negative and zero sequence reactances of 15% and 5% respectively. The alternator supplies two motors over a transmission line having transformers at both ends as shown shown in figure 6 on the One-line diagram. The motors have rated inputs of 20 MVA and 10 MVA both 12.5 kv with 25% and 10% respectively. Current limiting reactors of 2 Ω each are in the neutral of the alternator and the larger motor. The 3-phase transformers are both rated 35 MVA, 13.2-Δ/115-Y kv with leakage reactance of 10%. Series reactance of the line is 80Ω . The zero sequence reactance of the line is 200 Ω. Determine the fault current when an LL fault takes place at point P. Assume V_B=120kv. [16]

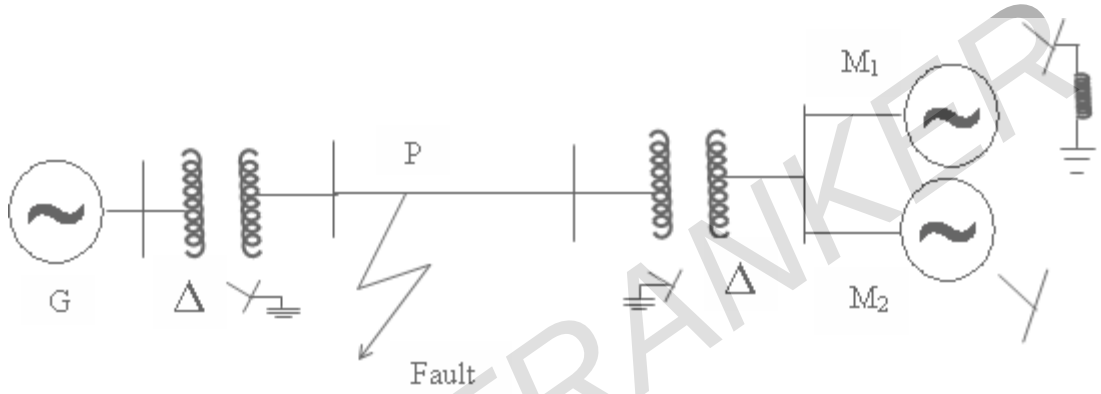

Figure 6:

8. (a) Explain the recent methods of maintaining stability
   (b) Discuss stability and instability of a system. [8+8]

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Electrical And Electronics Engineering

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Answer any FIVE Questions
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⋆ ⋆ ⋆ ⋆ ⋆

1. (a) Explain the relationship between
   i. The basic loops and links
   ii. Basic cut-sets and the number of branches
   (b) Explain how do you form YBUS by direct inspection with a suitable example? [6+10]
2. (a) Define the relationship for electric power 'P', torque 'T' and moment of inertia 'I'.
   (b) Derive the relationship for Angular momentum, kinetic energy and the inertia constant. [6+10]
3. (a) What are the disadvantages of NR-method over GS-method?
   (b) What are the advantages and disadvantages of polar and Rectangular form of NR- method? [4+12]
4. (a) Explain how do you model a generator and transformer?
   (b) Explain modeling of a Tap-changing transformer with mathematical equations? [6+10]
5. (a) Draw the zero sequence equivalent circuits of three phase transformer banks for Y- Y, Y-Δ, Δ - Δ connections when the neutrals are isolated, (or) earthed on one side (or) both sides of the transformer are shown in figure 7
   (b) Draw the zero sequence diagrams for the generators in shown figure. [8+8]

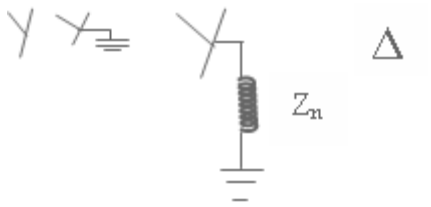

Figure 7:

6. (a) Derive the formula for calculating critical clearing angle.
   (b) Draw a diagram to illustrate the application of equal area criterion to study transient stability when there is a sudden increase in the input of generator. [8+8]

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7. The One-line diagram of a simple power system is shown in figure 8. Each generator is represented by an emf behind the transient reactance. A 3-phase fault occurs at Bus-1 a fault impedance of Z_f = j0.08 p.u.

   (a) Using Thevenins theorem, obtain the impedance to the point of fault and the fault current in p.u.

   (b) Determine the bus voltages and line currents during fault. [16]

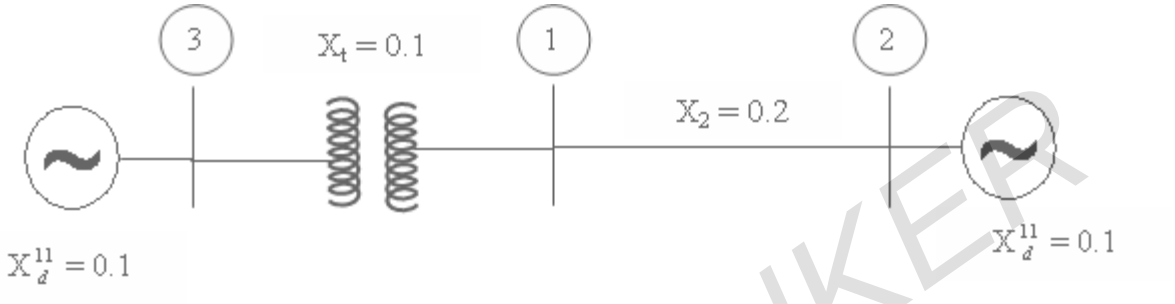

Figure 8:

8. Form Z_{BUS} by step-by-step method of building algorithm for the power system network data given in Table below: [16]

Bus Code	Self Impedance (p.u.)	Bus Code	Mutual Impedance (p.u.)
1 - 2	0.2		
2 - 3	0.3		
3 - 4	0.5	2 - 3	0.2
4 - 5	0.1		

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Code No: 07A70202 **R07** **Set No. 3**

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1. (a) What are the applications of Z_{BUS} in power system analysis?
   (b) Obtain the Z_{BUS} by building algorithm for the network as shown in figure 9 with reactance values in p.u. Take Bus - 1 as the reference Bus? [4+12]

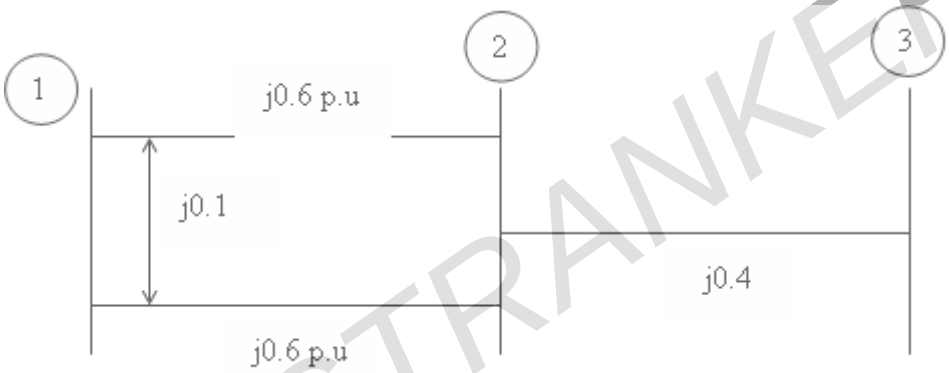

Figure 9:

2. (a) What are the initial conditions assumed for the power flow studies by GS-method?
   (b) For the system shown in figure 10, the bus admittance matrix is

$$Y_{BUS} = \begin{bmatrix} 3-j9 & -2+j6 & -1+j3 & 0 \\ -2+j6 & 3.666-j11 & -0.666+j2 & -1+j3 \\ -1+j3 & -0.666+j2 & 3.666-j11 & -2+j6 \\ 0 & -1+j3 & -2+j6 & 3-j9 \end{bmatrix} p.u$$

With $P_2 = 0.5$ p.u., Q_2 = -0.2 p.u., P_3 = -1 p.u., $Q_3 = 0.5$ p.u. and $P_4 = 0.3$ p.u., Q_3 = -0.1 p.u. and $V_1 = 1.04\angle 0^0$ p.u. Determine the value of V_2 that is produced by the first iteration of the GS-method. [4+12]

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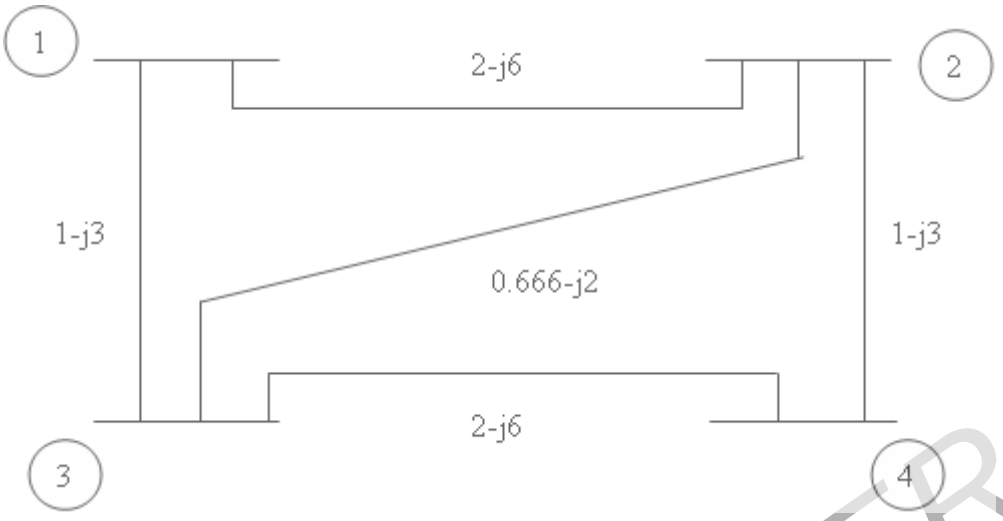

Figure 10

3. Explain in detail : (a) Steady state stability (b) Transient stability (c) Dynamic stability [5+5+6]

4.(a) Derive an expression for the fault current for a three phase to ground fault at an unloaded generator.

(b) The line currents in a 3-phase supply to an unbalanced load are respectively I_a=10+j20, I_b=-12+j10 and I_c=-3-j5 Amps. The phase sequence is ABC. Determine the sequence components of currents. [8+8]

5. (a) A power deficient area receives 50 MW over a tie line from another area. The maximum steady state capacity of the tie line is 100 MW. Find the allowable sudden load that can be switched on without loss of stability.

(b) Explain the use of automatic reclosing circuit breakers in improving system stability. [10+6]

6. (a) What are the advantages of per-unit system of representation? Explain

(b) Explain the impedance and reactance diagrams with an example power system. [8+8]

7. The magnitude of voltage at bus-1 is adjusted to 1.05 p.u. The scheduled loads at Buses 2 and 3 (PQ-Buses) are 2.566 p.u, 1.102 p.u and 1.386 p.u, 0.452 p.u. Using NR-method determine the phasor values of the voltage at the load buses 2 and 3. Given Y_{12}= 10 -j20 p.u., Y_{13}=10-j30 p.u., Y_{23}=16 -j32 p.u. Obtain the power flow solution using fast decoupled method. [16]

8. For the power system network shown in figure 11 take Bus - 6 as reference bus. Define a tree with transmission lines 1 - 6 and 2 - 5 as links. Form Y_{BUS} by singular transformation method. Select arbitrary directions. [16]

LineData

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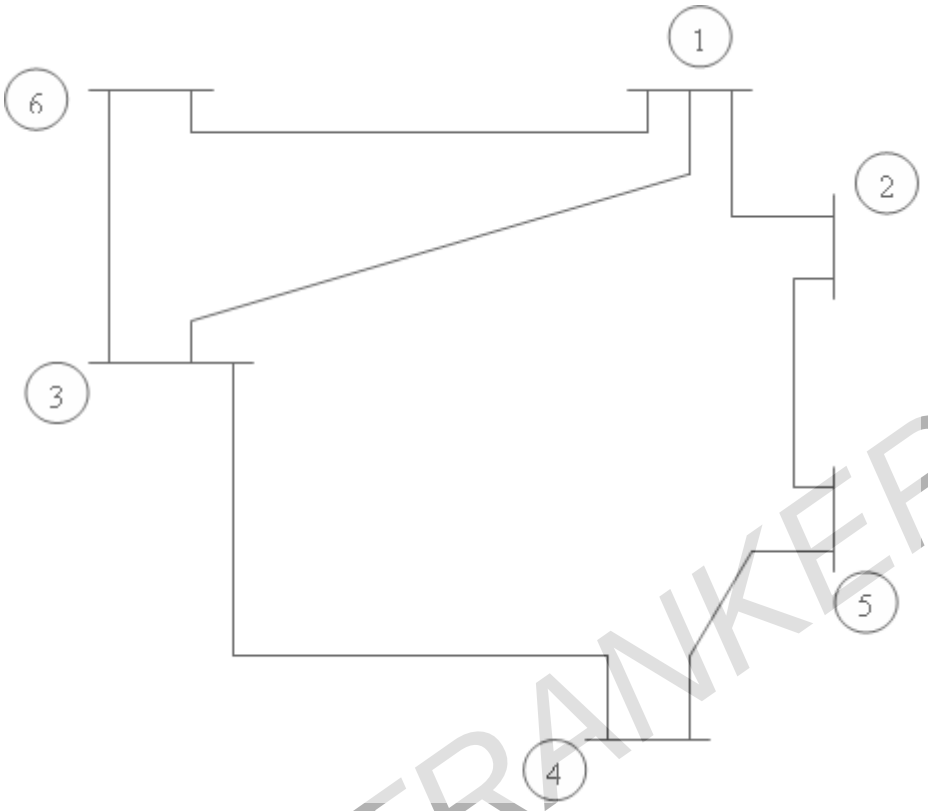

Figure 11:

Line	X
1 2	0.04
2 5	0.05
5 4	0.04
4 3	0.03
3 6	0.02
6 1	0.07
3 1	0.1

The line resistances and charging are neglected. [16]

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