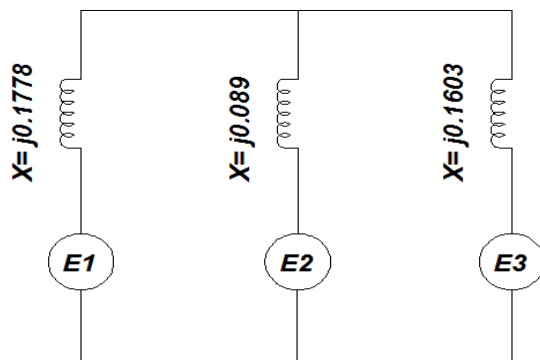


Department of Electrical Engineering
Pashchimanchal Campus
Power System (BEL/BEX-II/II)
Tutorial-2

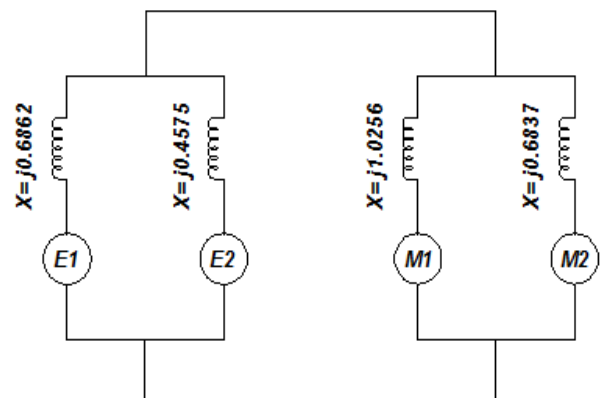
Note:

1. Per unit KVA = $\frac{\text{actual KVA}}{\text{base KVA}}$
2. Per unit impedance = $\frac{\text{actual impedance } (\Omega)}{\text{base impedance } (\Omega)}$
3. Base impedance = $\frac{(\text{base KV})^2}{\text{base KVA}} 1000 \text{ ohm}$
4. $Z_{\text{pu,new}} = Z_{\text{pu,old}} * \left(\frac{\text{base KV,old}}{\text{base KV,new}} \right)^2 * \left(\frac{\text{base KVA,new}}{\text{base KVA,old}} \right)$
5. Base voltage of Tx. Line = (base voltage of generator or motor) * Transformation ratio of Tr.

1. Base voltage = 1100 Volts, Base KVA = 10^6 . What is the base impedance? Ans= 0.00121Ω
2. If the resistance in ohm is 5Ω , find the per unit value. Given base KVA =10 and base KV=11. Ans= 0.000413 pu
3. An 11/0.4 KV, 200 KVA transformer has an equivalent impedance of $(2.4 + j12.4)$ ohm referred to HV side. Determine the pu impedance. Ans = $(0.00396+j0.0205)$
4. A single phase transformer is rated as 2.5 KVA, 11/0.4 KV. If the leakage reactance is 0.96 ohm when referred to low voltage side, then determine its leakage reactance in pu. Ans = 0.015 pu
5. Determine the pu impedance of a transmission line having an impedance of $(30+j110)$ ohm on 100 MVA and 132 KV base voltage. Ans= $(0.172+j0.631)$ pu
6. A 30 MVA, 11 KV generator has a reactance of 0.2 pu referred to its rating as bases. Determine the per unit reactance when referred to base KVA of 50,000 KVA and base KV of 33 KV. Ans = 0.037 pu
7. Three generators are rated as follows:
G1 = 100 MVA, 33 KV, X= 10%
G2 = 150 MVA, 32 KV, X= 8%
G3 = 110 MVA, 30 KV, X= 12%
Choosing 200 MVA and 35 KV as base quantities, compute per unit reactance of the three generators referred to these base quantities. Draw reactance diagram and mark per unit reactances. The three generators are connected to common busbars. Ans



Ans(7):Reactance diagram



Ans(8):Reactance diagram

8. Two generators rated at 10 MVA, 13.2 KV and 15 MVA, 13.2 KV respectively are connected in parallel to a bus. The bus feeds two motors rated at 8 MVA and 12 MVA respectively. The rated

voltage of motors is 12.5 KV. The reactance of each generator is 15 % and that of each motor is 20% on its own rating. Assume 50 MVA, 13.8 KV base and draw reactance diagram.

9. Simple power system is shown in fig9. Redraw this system where pu impedances are represented on a common 5000 VA and common system base voltage of 250 V

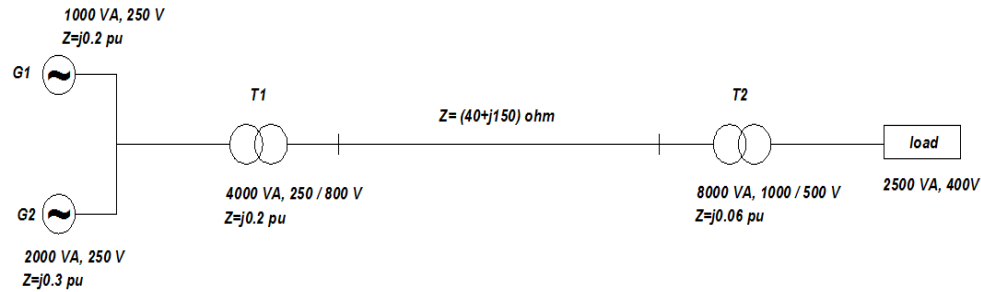
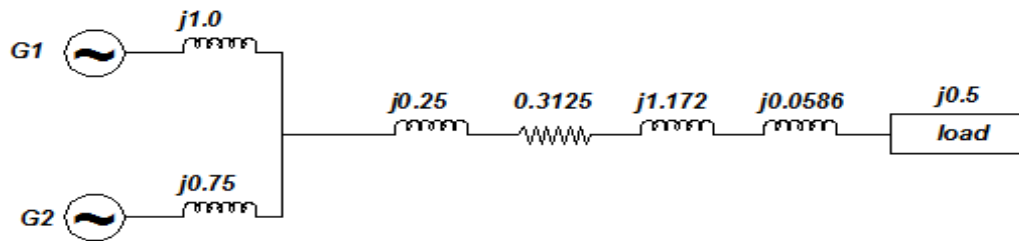


Fig:9

Ans:



Ans(9): Reactance Diagram

10. Draw reactance diagram of following system. Take generator rating as base

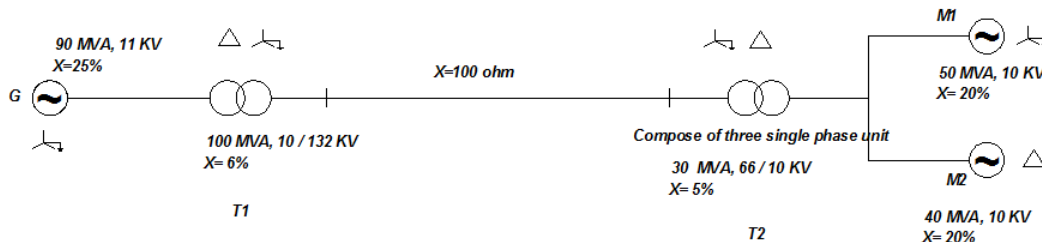
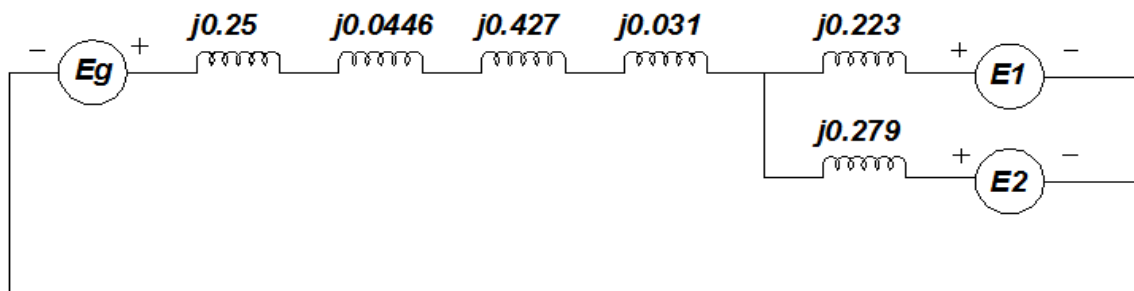


Fig:10

Ans:



Ans(10): Reactance Diagram

11. Draw pu impedance diagram. Neglect resistance and use a base of 100 MVA, 220 KV in 50 ohm line

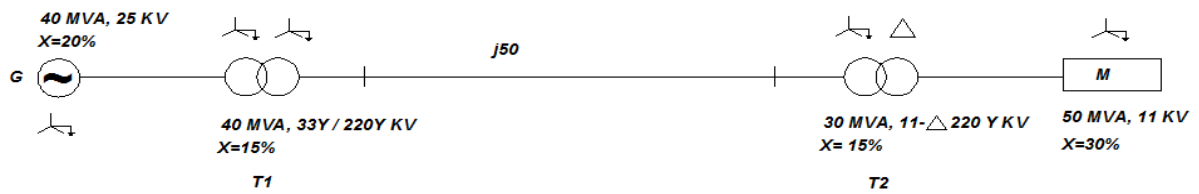
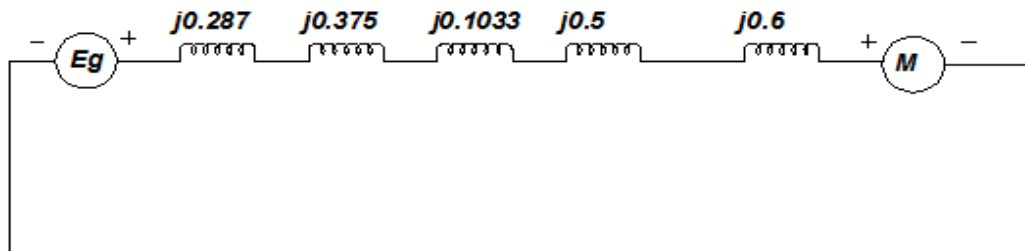


Fig:11

Ans:



Ans(11): Reactance Diagram

12. Draw reactance diagram of following.

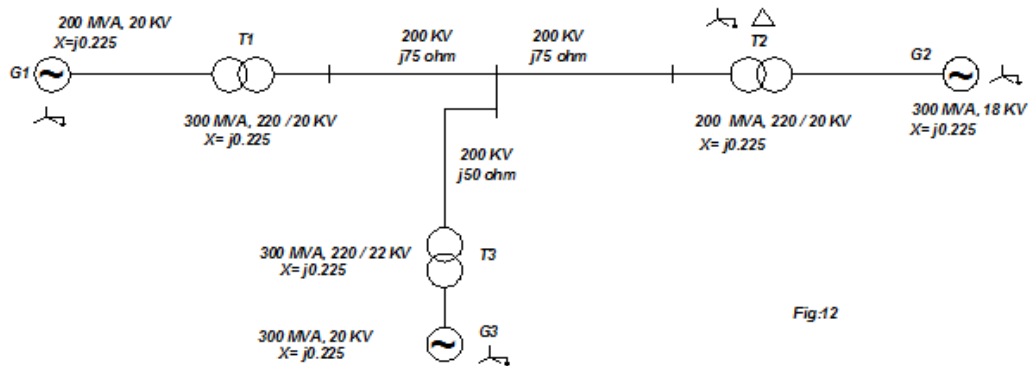
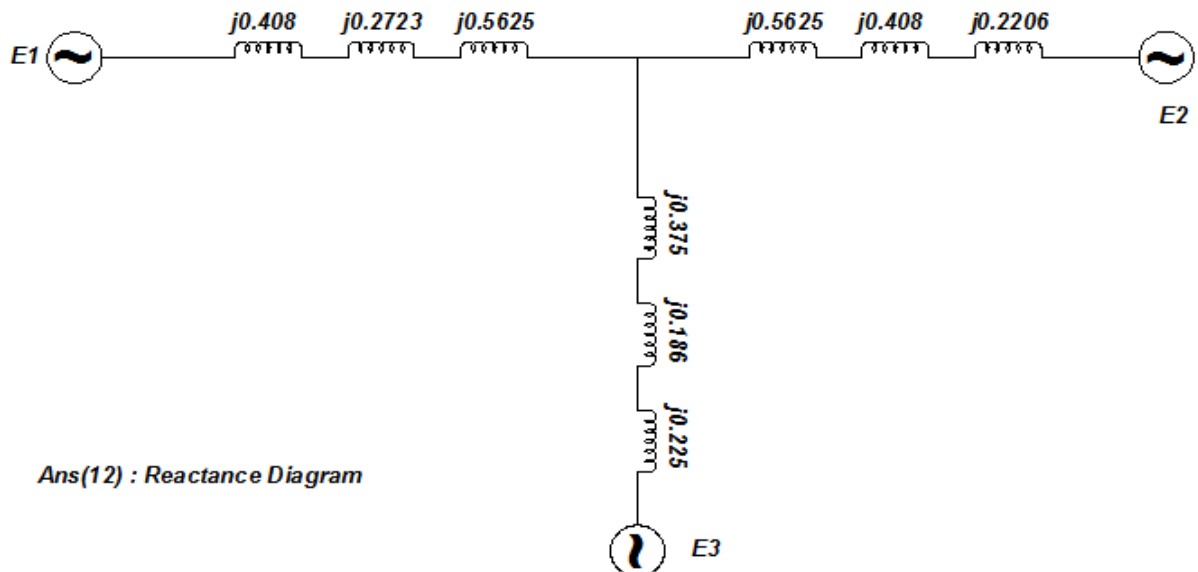


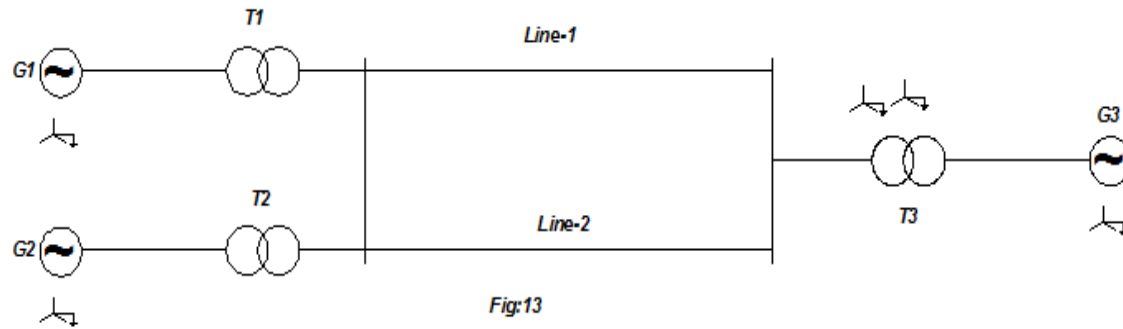
Fig:12

Ans: let us assume that, base MVA=300 MVA and base KV= 200 KV of Tx line



Ans(12) : Reactance Diagram

13. Draw the Reactance diagram of the following.



Equipment	MVA Rating	KV Rating	X
Generator (G1)	100	11 KV	25%
Generator (G2)	100	11 KV	20%
Generator (G3)	100	11 KV	20%
Transformer (T1)	100	11 / 220 KV	6%
Transformer (T2)	100	11 / 220 KV	7%
Transformer (T3)	100	220 / 11 KV	7%
Line -1	100	220 KV	10%
Line -2	100	220 KV	10%

Take base MVA=100 MVA and base voltage = 11 KV for generator. Compute the reactance diagram