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ID # 6985

Assignment :- 02

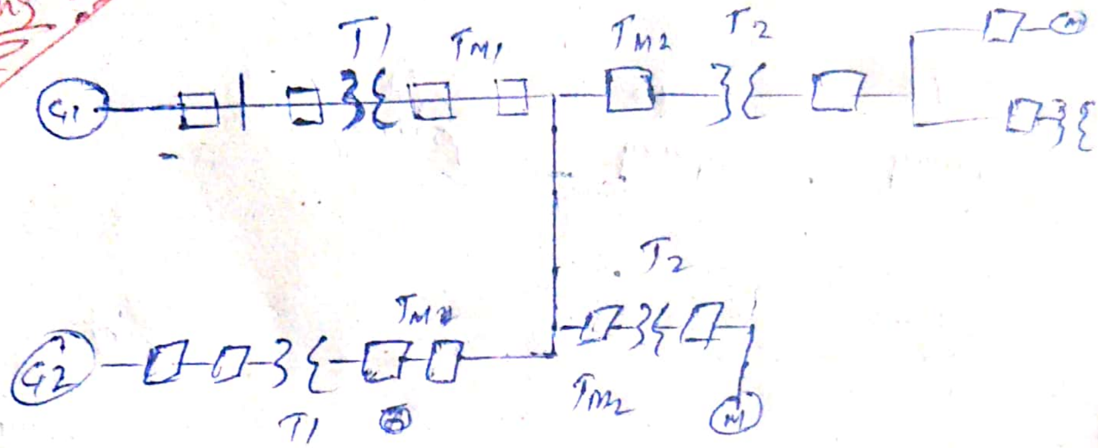
Subject :- ....Power system Analysis

Program :- .... B- thech (E)

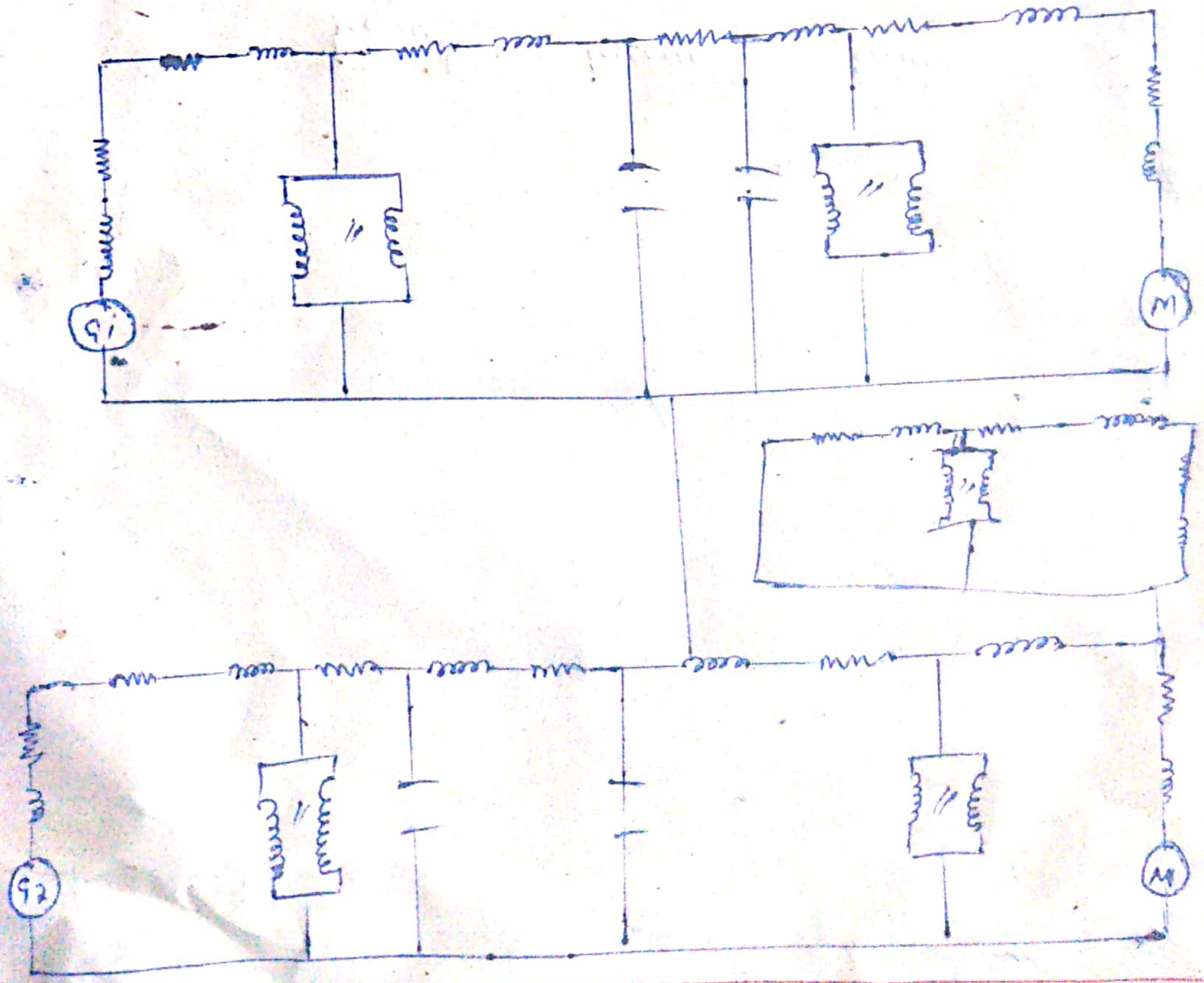
Submitted to ; Engr; Muhammad Aamir Aman

Q No 1 :-

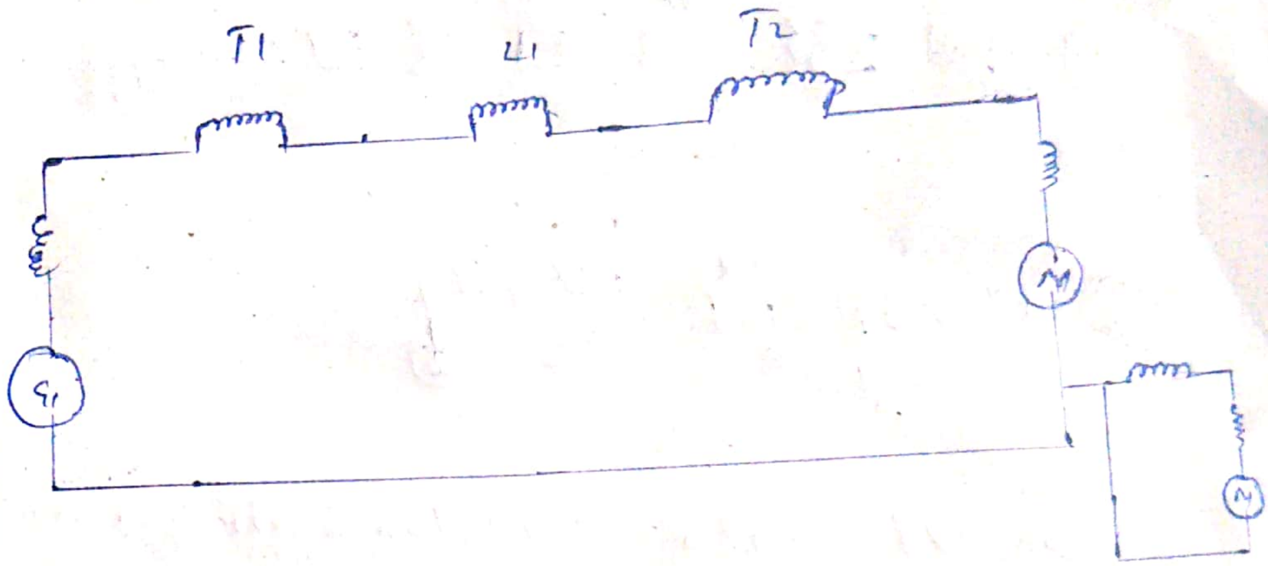
Ans :-

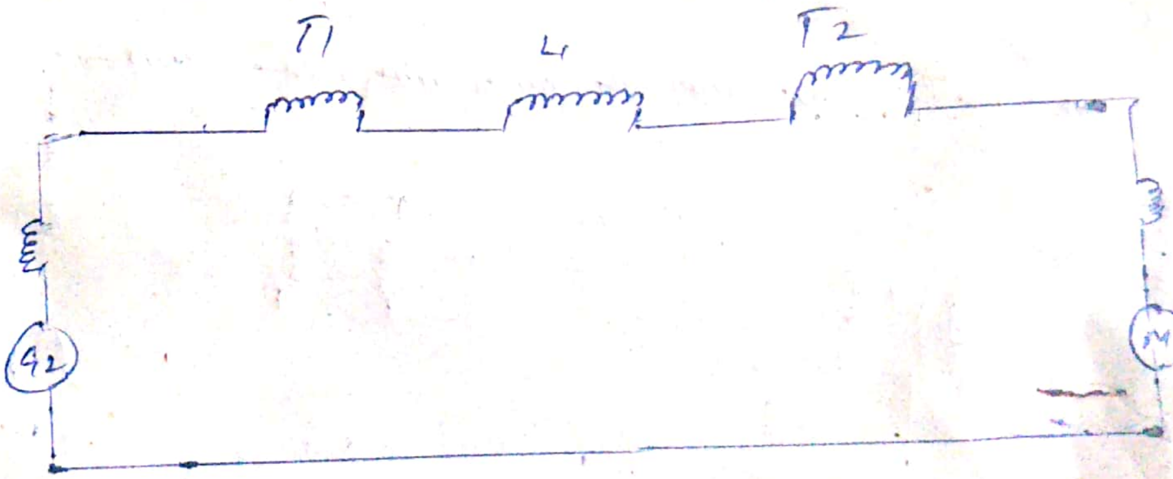


*, convert into impedance diagram.



* convert into Reactance diagram:





Q No :- (2)

Ans :-

Solution :-

$V_{p.u} = Z_{p.u} \times I_{p.u}$

$= 64 \times 350 = 22400$

$V_{p.u} = 22400$

$S_{p.u} = V \times I$

$22 \times 350 = 7700$

$S_{p.u} = 7700$

$Z_{p.u} = \frac{V^2 base}{S\ base}$

$= \frac{(22)^2}{7700}$

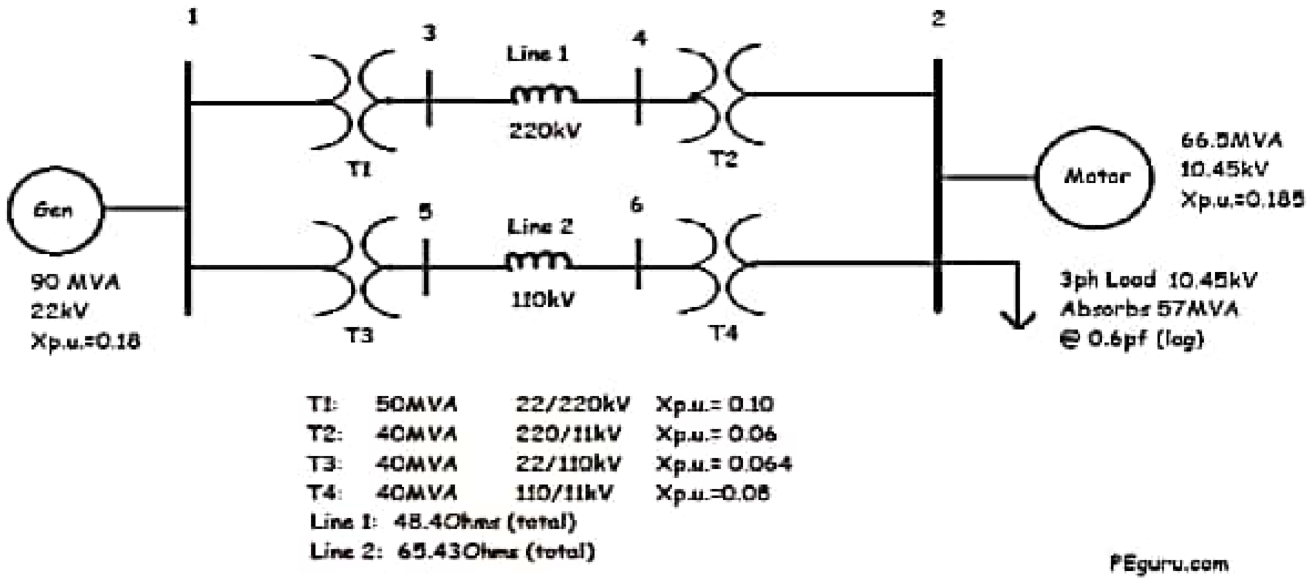
$\frac{484}{7700}$

0.0628 Ans

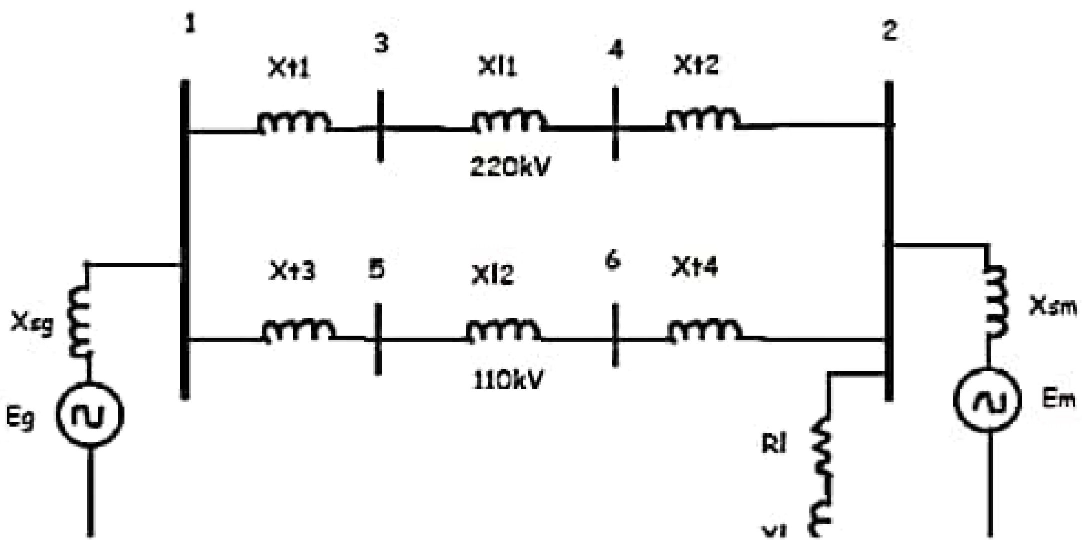
Scanned with CamScanner

Q.No:- 03

Ans:-



1: Oneline Diagram Of A Power System:-



2: Impedance Diagram Of A Power System:-

Step 1: Assume a system base

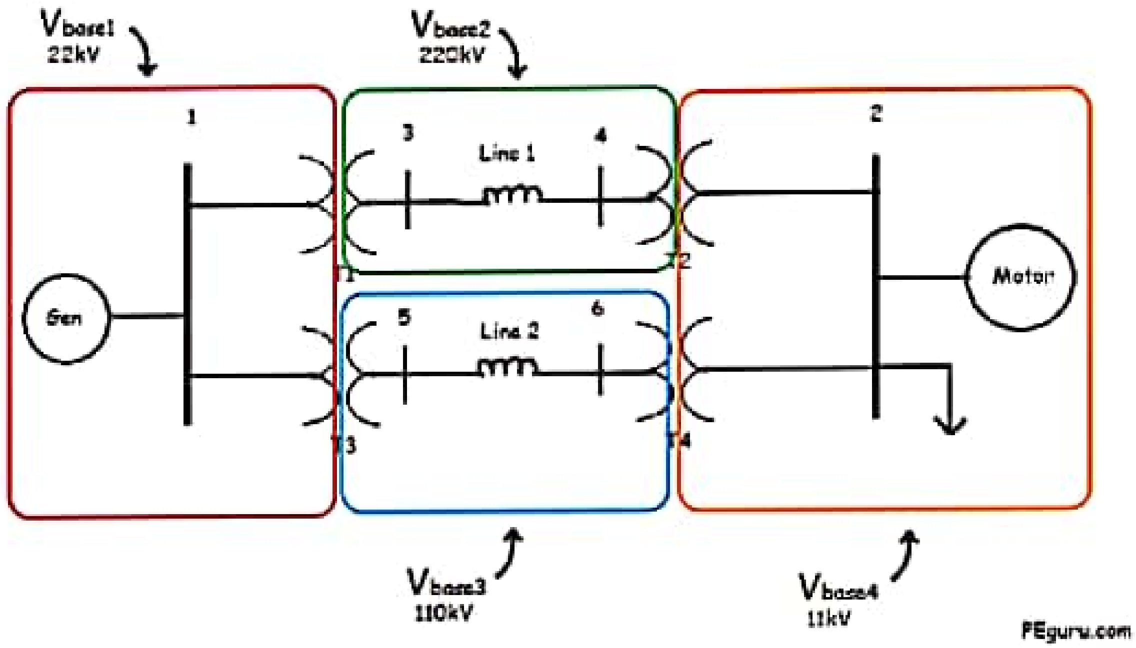
Assume a system wide S base of 100MVA. This is a random assumption and chosen to make calculations easy when calculating the per unit impedances.

So, S base= 100MVA

Step 2: Identify the voltage base

Voltage base in the system is determined by the transformer. For example, with a 22/220kV voltage rating of T1 transformer, the Vbase on the primary side of T1 is 22kV while the secondary side is 220kV. It does not matter what the voltage rating of the other components are that are encompassed by the V base zone.

See figure below for the voltage bases in the system



3: Voltage Base In The Power System:-

Step 3: Calculate the base impedance

The base impedance is calculated using the following formula:

Z base= kv base2/S baseMVAkV   Ohms.....(1)

For T-Line 1:Z base = (220) 2/ 100 = 484 Ohms

For T Line 2: Z base = (100)2/100 = 121 Ohms

For 3-Phase load : Z base = (11)2 / 100 = 1.21 Ohms

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For 3-Phase load : Z base = (11)2 / 100 = 1.21 Ohms

Step 4: Calculate the per unit impedance

The per unit impedance is calculated using the following formulas:

Z p.u. = Z actual / Z base .....(2)

Z p.u. new   =Z p.u. old (S base New / S base old) (V base Old)2/(V base new) 2 .....(3)

The voltage ratio in equation (3) is not equivalent to the transformers voltage ratio. It is the ratio of the transformer's voltage rating on the primary or secondary side to the system nominal voltage on the same side.

For T-line 1 using equation (2):

$X_{l1_{p.u.}} = \frac{48.4}{484}$ = 0.1 pu

For T-line 2 using equation (2):

$X_{l2_{p.u.}} = \frac{65.43}{121}$ = 0.5 pu

For 3-Phase load:

Power Factor: $\cos^{-1}(0.6) = \angle 53.13$

Thus, $S_{3\phi}(load) = 57\angle 53.13$

$Z_{act} = \frac{(V_{rated})^2}{S^*} = \frac{10.45^2}{57\angle -53.13}$

= 1.1495+j1.53267 Ohms

Per unit impedance of 3-phase load using equation (2)= $\frac{1.1495+j1.5326}{1.21}$ = 0.95+j1.2667 pu

For generator, the new per unit reactance using equation (3)

$$X_{sg} = 0.18(\frac{100}{90})(\frac{22}{22})^2$$

= 0.2 pu

For transformer T1: $X_{t1} =$ $0.1(\frac{100}{50})(\frac{22}{22})^2$ = 0.2 pu

For transformer T2: $X_{t2} =$ $0.06(\frac{100}{40})(\frac{220}{220})^2$ = 0.15 pu

For transformer T3: $X_{t3} =$

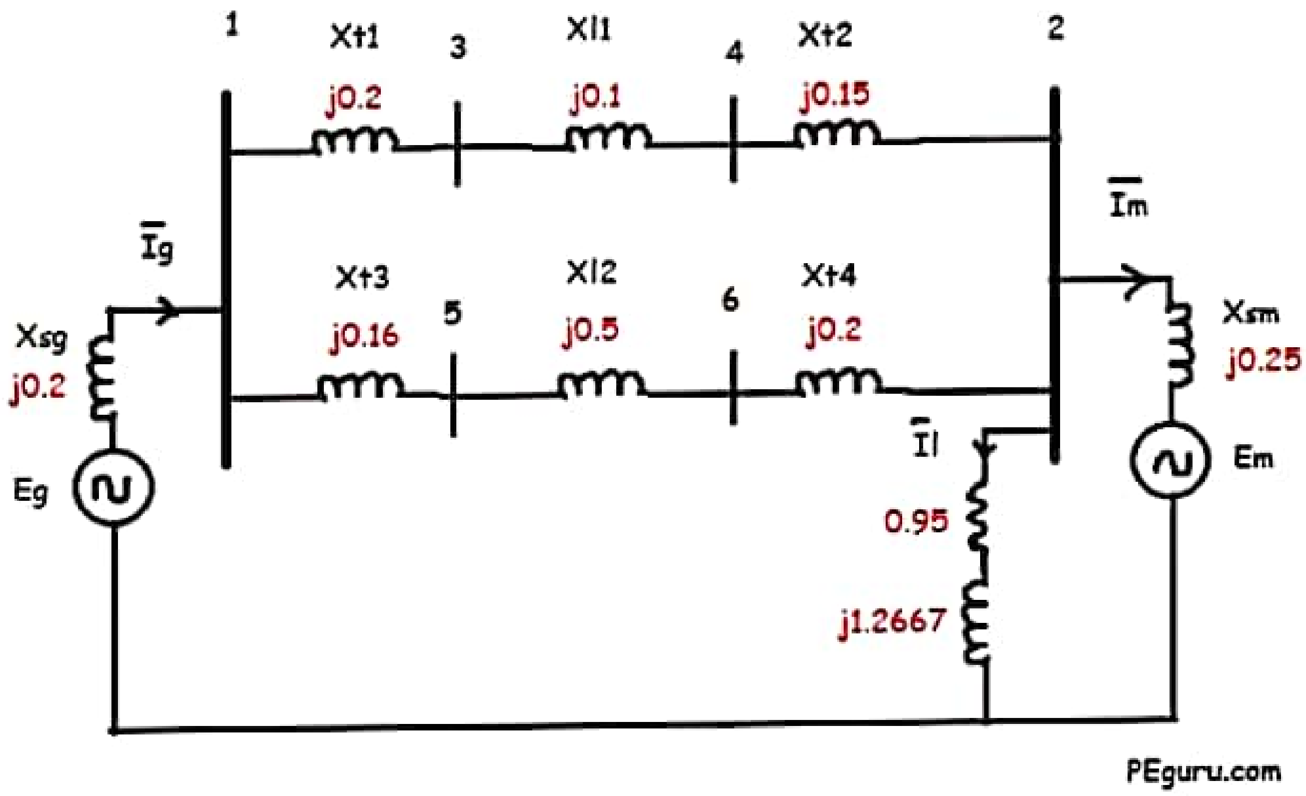
$0.064(\frac{100}{40})(\frac{22}{22})^2$ = 0.16 pu

For transformer T4: $X_{t4} =$

$0.08(\frac{100}{40})(\frac{110}{110})^2$ = 0.2 pu

For Motor, $X_{sm} = 0.185(\frac{100}{66.5})(\frac{10.45}{11})^2$

= 0.25 pu



Q No :- 04

1. Find the bus admittance matrix for the given network in Fig 2. Determine the reduced admittance matrix by eliminating node 4. The values are marked in p.u.

Ans:-

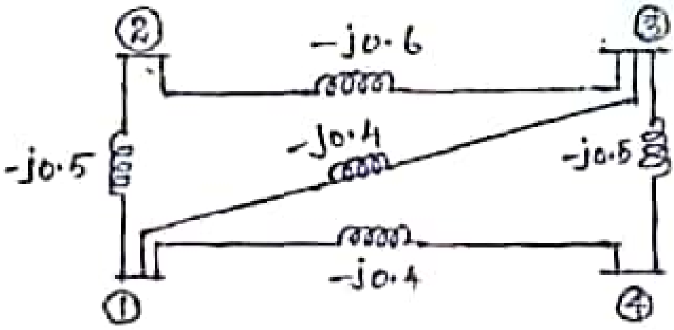


Fig 2

$$Y_{BUS}=\begin{bmatrix}Y_{11} & Y_{12} & Y_{13} & Y_{14}\\ Y_{21} & Y_{22} & Y_{23} & Y_{24}\\ Y_{31} & Y_{32} & Y_{33} & Y_{34}\\ Y_{41} & Y_{42} & Y_{43} & Y_{44}\end{bmatrix}$$

$$Y_{11}=y_{12}+y_{13}+y_{14}=-j0.5-j0.4-j0.4=-j1.3$$

$$Y_{22}=y_{12}+y_{23}=-j0.5-j0.6=-j1.1$$

$$Y_{33}=y_{32}+y_{31}+y_{34}=-j0.6-j0.4-j0.5=-j1.5$$

$$Y_{44}=y_{41}+y_{43}=-j0.4-j0.5=-j0.9$$

$$Y_{12}=-y_{12}=j0.5$$

$$Y_{13}=-y_{13}=j0.4$$

$$Y_{14}=-y_{14}=j0.4$$

$$Y_{21}=Y_{12}=j0.5$$

$$Y_{23}=-y_{23}=j0.6$$

$$Y_{24}=-y_{24}=0$$

$$Y_{31}=Y_{13}=j0.4$$

$$Y_{32}=Y_{23}=j0.6$$

$$Y_{34}=-y_{34}=j0.5$$

$$Y_{41}=Y_{14}=j0.4$$

$$Y_{42}=Y_{24}=0$$

$$Y_{43}=Y_{34}=j0.5$$

Elements of new bus admittance matrix after eliminating 4th row and 4th column

$$Y_{jk,new} = Y_{jk} - \frac{Y_{jn}Y_{nk}}{Y_{nn}}$$

N=4, j=1,2,3 k=1,2,3

$$Y_{11,new} = Y_{11} - \frac{Y_{14}Y_{41}}{Y_{44}} = -j1.3 - \frac{(j0.4)(j0.4)}{-j0.9} = -j1.12$$

$$Y_{12,new} = Y_{12} - \frac{Y_{14}Y_{42}}{Y_{44}} = j0.5 - \frac{(j0.4)(j0)}{-j0.9} = j0.5$$

$$Y_{13,new} = Y_{13} - \frac{Y_{14}Y_{43}}{Y_{44}} = j0.4 - \frac{(j0.4)(j0.5)}{-j0.9} = j0.622$$

$$Y_{21,new} = Y_{12,new} = j0.5$$

$$Y_{22,new} = Y_{22} - \frac{Y_{24}Y_{42}}{Y_{44}} = -j1.1 - \frac{(j0)(j0)}{-j0.9} = -j1.1$$

$$Y_{23,new} = Y_{23} - \frac{Y_{24}Y_{43}}{Y_{44}} = j0.6 - \frac{(j0)(j0.5)}{-j0.9} = j0.6$$

$$Y_{31,new} = Y_{13,new} = j0.622$$

$$Y_{32,new} = Y_{23,new} = j0.6$$

$$Y_{33,new} = Y_{33} - \frac{Y_{34}Y_{43}}{Y_{44}} = -j1.5 - \frac{(j0.5)(j0.5)}{-j0.9} = -j1.22$$

Reduced admittance matrix after eliminating 4 th row and 4th column\

$$Y_{BUS} = \begin{bmatrix} -j1.12 & j0.5 & j0.622 \\ j0.5 & -j1.1 & j0.6 \\ j0.622 & j0.6 & -j1.222 \end{bmatrix}$$

Q No :- 6

Ans :-

over current protective device must operate to isolate short ckt fault safely minimize demage to ckt element and avoid if possible shut down of plant an accurate knoalege fault current through out the system is essential for the corred application of protiective device and the design bus bar and Terminal arreigement to with stand convential mechanical & thermal stress.