Tutorial 5.2

1)

Generator	T1	T2	Load
5MVA	3MVA	2MVA	1.5MVA
$Z_G = 10\%$	$Z_{T1} = 6\%$	$Z_{T2} = 6\%$	
$V_G = 11KV$	V = 11/66KV	V = 66KV/22KV	22KV

(a) $V_b = 11KV, 66KV, 22KV$

(b) $S_b = 5MVA$

Generator = $\frac{S}{S_b}$

$= \frac{5MVA}{5MVA}$

$= 1.0pu$

$T1 = \frac{3}{5}$

$= 0.6pu$

$T2 = \frac{2}{5}$

$= 0.4pu$

(c) Convert impedance

$Z_G = 0.1pu$

$Z_{T1} = Z_{pu} \times \frac{S_{bnew}}{S_{bold}}$

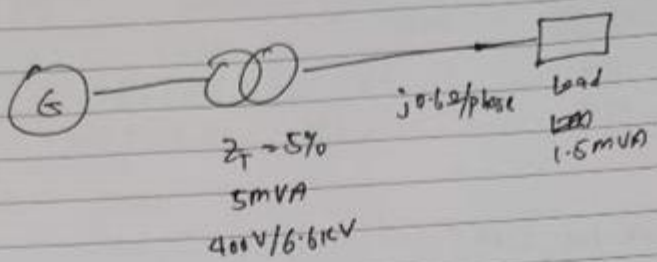
$= 0.06 \times \frac{5}{3}$

$= 0.1pu$

$Z_{T2} = 0.06 \times \frac{5}{2}$

$= 0.15pu$

2) 2MVA
400V
50Hz
$Z_G = 10\%$



(ii) $S_b = 1MVA$

$Z_G = 0.1pu$

$Z_T = 0.05 \times \frac{2}{5}$

$= 0.02pu$

$Z_b = \frac{V_b^2}{S_b}$

$= \frac{(6.6\times10^3)^2}{2\times10^3}$

$= 21.78$

$Z_{cable} = \frac{j0.6}{21.78}$

$= j0.0275\ pu$

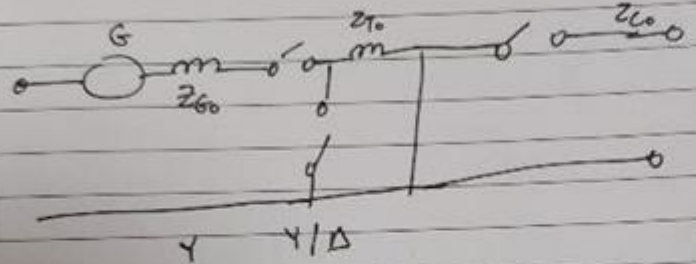
$I_{FL} = \frac{S_b}{\sqrt{3}V_b}$

$= \frac{1.5\times10^6}{\sqrt{3}\times6.6\times10^3}$

$= 131.216\ A$

(iii) 3-phase fault at load-end

	Positive Sequence	Negative Sequence	Zero Sequence
Z_G	0.1	0.1	0
Z_T	0.02	0.02	0
Z_L	j0.0275 ~~j0.1475~~	j0.0275 ~~j0.1475~~	0



Total per sequence $= 0.1 + 0.02 + j0.0275$

$= j0.1475$

$I_b = \frac{S_b}{\sqrt{3} \times 6.6 \times 10^3}$

$= 174.95A$

$I_f = \frac{1}{j0.1475} \times 174.95$

$= 1186A$

(b) $I_b \cdot Z_{b(gen)} = \frac{V_b^2}{S_b}$

$= \frac{400^2}{2MVA}$

$= 0.008$

$Z_{sc} = j0.1475 \times 0.008$

$= j0.00118$

$I_{sc} = \frac{V_a}{\sqrt{3} Z_{sc}} = \frac{400}{\sqrt{3} \times 0.00118}$

$= 1957kA$

3) Select $S_b = 1MVA$

$V_b = 400V$

$$Z_b = \frac{V_b^2}{S_b}$$

$$= \frac{400^2}{1MVA}$$

$$= 0.16\Omega$$

$$Z_{source} = \frac{1}{25}$$

$$= 0.04 pu$$

$$\frac{X}{R} = 5 \qquad Z = \sqrt{R^2+X^2} \qquad Z = R\sqrt{26}$$

$$R = \frac{Z}{\sqrt{26}}$$

5)

R $Z_{source} = \frac{0.04}{\sqrt{26}}$

$$= 0.00784 pu$$

$$= 0.002544\Omega$$

$$Z = j0.0392$$

$$= j0.006272\Omega$$

$$Z_{cable(ESD)} = \frac{(0.074 + j0.157) \times 20}{\sqrt{3} \times 1000}$$

$$= 0.000854448 + j0.001559$$

$$Z_T = Z_S + Z_C$$

$$= 0.002211 + j0.007831$$

$$= 0.008111 \angle 75^\circ$$

$$I_f = \frac{230}{0.00811}$$

$$= 28.360 kA$$