Q	Mark
1	9/15
2	30/30
3	11/15
SUM	50/60

University of Jordan

Electrical Eng. Dept

EE 0933481 Power Systems (1) First Exam.

6-3-2016

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Q1) The values shown on the system of Fig, 1 are pu reactance;

1.1-If the value j1.7 represent reactance of a transformer and the other values represent transmission lines, draw the single line diagram of the system. [6]

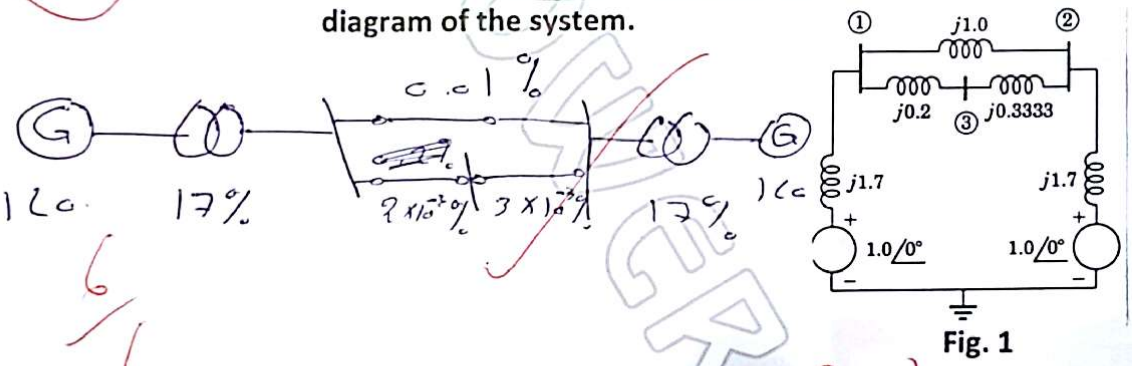


Fig. 1

1.2-By performing any necessary redrawing for the system, evaluate:

a-The elements of the second row of its Y_{bus} matrix. [5]

b-The first nodal equation. [4]

$$\frac{V_1 - 1}{j1.7} + \frac{V_1 - V_2}{j} + \frac{V_1 - V_3}{j0.2} \quad \text{--- (1)}$$

$$\left(\frac{1}{j} + \frac{1}{j0.2} + \frac{1}{j1.7}\right)V_1 - \left(\frac{1}{j}\right)V_2 - \left(\frac{1}{j0.2}\right)V_3 =$$

(a) $\frac{-1}{j}$, $\frac{1}{j} + \frac{1}{j0.33} + \frac{1}{j1.7}$, $-\frac{1}{j0.33}$

Q2) For the system shown in Fig. 2:

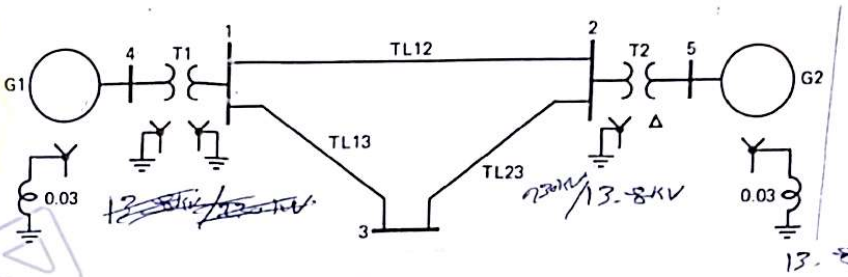


Fig. 2

2.1 If transformer T2 is rated at (13.8 kV Δ/230 kV Y) and N_1 of Y=100 turns, evaluate N_2 of Δ. [6]

$$\frac{V_{LL}}{V_{ll}} = \frac{230K}{13.8K} = 16.6667 = \frac{N_1}{N_2/\sqrt{3}} = \frac{N_1\sqrt{3}}{N_2}$$

$$\Rightarrow 16.6667 = \frac{100\sqrt{3}}{N_2} \Rightarrow N_2 = 10.4 \text{ turns}$$

2.2 If the ratings of G2 are 13.8 kV, 100 MVA are used as base values for the system, find the pu reactance of TL12 if it has 0.5 Ω/km and Length 80 km, knowing that T2 has the same rating above. [6]

$S_b = 100 MVA$

$V_{bL} = 13.8 kV$

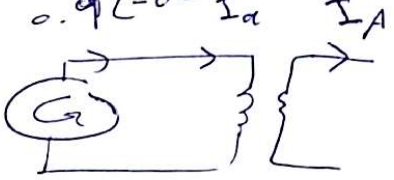
$X_{TL12} = 80(0.5) = 40\ \Omega$

$V_{bH} = 230 kV$

$$Z_b = \frac{V_b^2}{S_b} = \frac{230^2}{100} = 529$$

$$X(Pu) = \frac{X}{X_b} = \frac{40}{529} = 0.0756 Pu$$

2.3 If the current supplied by G2 is $0.9\angle -60^0$ pu, then find the current Entering bus 2 in Ampere by using negative sequence & base values Of (2.2) and the above ratings of T2. [8]



$$I_A = I_a \angle -30$$

$$I_{G2} = I_a = 0.9\angle -60^0 \text{ Pu}$$

$$I_A = 0.9\angle -90 \text{ Pu}$$

$$I_b = \frac{100M}{\sqrt{3}\,230k} = 251 A$$

$$I = I_b I_{pu} = 251(0.9)\angle -90$$

$$= 225.9\angle -90^0 A$$

[redacted]

2.4 If G1 is rated at 100 MVA, 25 kV and the values of its various reactance are 0.8 Ω, 0.4 Ω and 0.1 Ω. Evaluate the expression for the magnitude of its symmetrical current when a balanced 3-ph fault is applied at its open circuit terminals. [10]

$$i(t) = \frac{E}{X} + E\left(\frac{1}{x'} - \frac{1}{x}\right)e^{\frac{-t}{T'}} + E\left(\frac{1}{x''} - \frac{1}{x'}\right)e^{\frac{-t}{T''}}$$

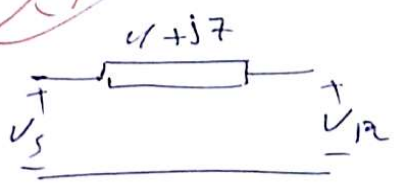
$$E = \frac{25}{\sqrt{3}}\ kV \;;\; i(t) = 18042 + 14433\left(\frac{1}{0.4} - \frac{1}{0.8}\right)e^{\frac{-t}{T'}}$$

$$+ 14433\left(\frac{1}{0.1} - \frac{1}{0.4}\right)e^{\frac{-t}{T''}}$$

$$= 18042 + 18041\, e^{\frac{-t}{T'}} + 108247.5\, e^{\frac{-t}{T''}}$$

Q3) A transmission line has the following constants: A=D=1, B=4+j7 and C=0. When the line supplies a given load, the voltage regulation is 20%. Find the PF of the load if the angle of the sending voltage is 5^0 With respect to the Zero angle the receiving voltage. [15]

short line



$$|V_S| \angle 5^\circ \qquad |V_R| \angle 0^\circ$$

$$V_S = V_R + I_R Z \quad \cdots (1)$$

$$I_S = 0 + I_R \quad \cdots (2)$$

$$I_R = \frac{V_S - V_R}{Z} = \frac{1.2|V_{RFL}| \angle \theta - |V_R| \angle 0}{4 + j7} = \frac{0.2|V_{RFL}| \angle 0}{4 + j7}$$

$$\Rightarrow \theta_{I_R} = -60 \Rightarrow \theta_Z = \theta_V - \theta_I = \boxed{60^\circ}$$

pf ?!

$$V_R\% = \frac{|V_S| - |V_{RFL}|}{|V_{RFL}|} = 0.2$$

$$|V_S| - |V_{RFL}| = 0.2|V_{RFL}|$$

$$|V_S| = 1.2|V_{RFL}|$$

$$\theta_Z = \theta_V - \theta_I$$