

Problem 1

$$D_{eq} = \sqrt[3]{(2.5)(2.5)(50)} = 31.5 \text{ ft}$$

$$D_{SL} = \sqrt[3]{(0.0588)(1)(1)} = 0.389 \text{ ft}$$

$$R_1 = \left(\frac{0.505 \Omega}{3 \frac{\text{mi}}{\text{mi}}} \right) 200 \text{ mi} = 3.37 \Omega$$

$$R_b = \sqrt[3]{\left(\frac{1.762}{24} \right) (1)(1)} = 0.419 \text{ ft}$$

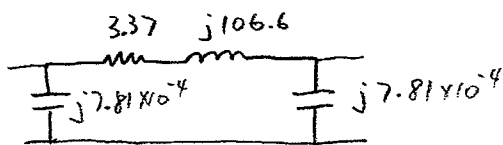
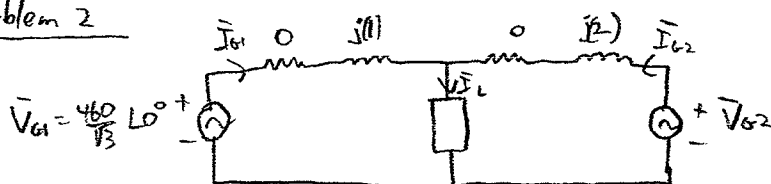
$$L = 2 \times 10^{-7} \ln \left(\frac{31.5}{0.389} \right) = 8.79 \times 10^{-7} \frac{\text{H}}{\text{m}}$$

$$C = \frac{2\pi\epsilon}{\ln \left(\frac{31.5}{0.419} \right)} = 1.2878 \times 10^{-11} \frac{\text{F}}{\text{m}}$$

$$X = j(2\pi fL)(609)(200) = j106.6 \Omega$$

$$Y = j\frac{\omega C}{2} = 2.427 \times 10^{-9} \frac{\text{S}}{\text{m}}$$

$$Y = j(2.427 \times 10^{-9})(1609)(200) = j7.81 \times 10^{-4}$$

Problem 2

$$\bar{S}_{3\phi @ G_1} (\delta - \beta) = 3 \bar{V}_{LN} \bar{I}_{G_1}^*$$

$$(\delta - \beta) = \cos^{-1}(1) = 0$$

$$\bar{I}_{G_1} = \frac{15 \text{ kW } L 0^\circ}{3 \left(\frac{460}{\sqrt{3}} L 0^\circ \right) (1)} = 18.83 L 0^\circ \text{ A}$$

$$\bar{V}_{Load} = \bar{V}_{G_1} - \bar{Z}_{Line1} \bar{I}_{G_1} = \frac{460}{\sqrt{3}} L 0^\circ - (j1)(18.83 L 0^\circ) = 266.25 L -4.06^\circ$$

$$c) \bar{V}_{Load}(L-L) = (\sqrt{3})(266.25) L -4.06^\circ + 30^\circ = 461.16 L 25.94^\circ \text{ V}$$

$$\bar{S}_{3\phi @ Load} L(\delta - \beta) = 3(\bar{V}_L)_{LN} \bar{I}_L^*$$

$$\bar{I}_L = \frac{30 \text{ kW } L 0^\circ}{3(266.25 L -4.06^\circ)} = 37.56 L -4.06^\circ$$

$$\bar{I}_{G_2} = \bar{I}_L - \bar{I}_{G_1} = (37.56 L -4.06^\circ) - (18.83 L 0^\circ) = 18.82 L -8.12^\circ$$

$$\bar{V}_{G_2} = \bar{V}_L + \bar{Z}_{Line2} \bar{I}_{G_2} = (266.25 L -4.06^\circ) + (j2)(18.82 L -8.12^\circ)$$

$$\bar{V}_{G_2} = 271.53 L 3.89^\circ$$

$$\bar{S}_{G_2} = 3 \bar{V}_{G_2} \bar{I}_{G_2}^* = 3(271.53 L 3.89^\circ)(18.82 L +8.12^\circ) = (14997.1 + j3191.92) \text{ kVA}$$

$$a) \text{ Real Power @ } G_2: \underline{14.997 \text{ kW}}$$

$$\bar{S}_{G_2} = 15000 \text{ kVA}$$

Problem 3

$$Y_{12} = Y_{21} = \frac{-1}{0.3 + j0.4} = -1.2 + j1.6$$

$$Y_{23} = Y_{32} = \frac{-1}{j0.2} = j5$$

$$Y_{13} = Y_{31} = \frac{-1}{j0.5} = j2$$

$$Y_{14} = Y_{41} = \frac{-1}{j0.25} = j4$$

$$Y_{11} = -(Y_{12} + Y_{13} + Y_{14}) = 1.2 - j7.6$$

$$Y_{44} = -(Y_{41}) = -j4$$

$$Y_{22} = -(Y_{21} + Y_{23}) = 1.2 - j6.6$$

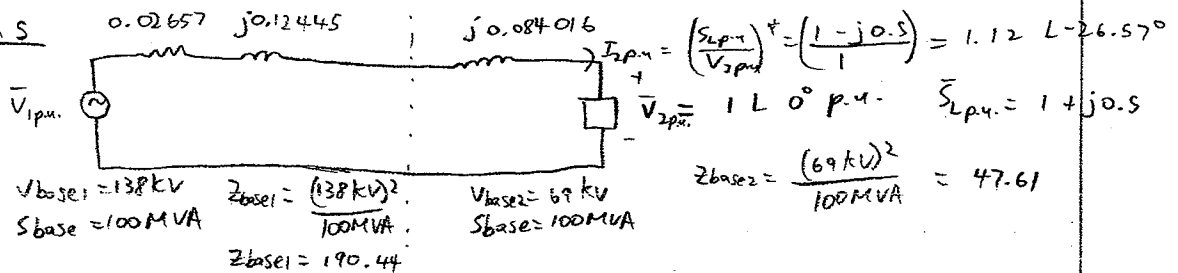
$$Y_{33} = -(Y_{32} + Y_{31}) = -j7$$

$$\bar{Y} = \begin{bmatrix} 1.2 - j7.6 & -1.2 + j1.6 & j2 & j4 \\ -1.2 + j1.6 & 1.2 - j6.6 & j5 & 0 \\ j2 & j5 & -j7 & 0 \\ j4 & 0 & 0 & -j4 \end{bmatrix}$$

Problem 4

1. F 2. F 3. F 4. T 5. F

Problem 5



$$V_{1pu} = (1 \angle 0^\circ) + (0.02657 + j0.12445 + j0.084016)(1.12 \angle -26.57^\circ) = 1.148 \angle 9.79^\circ$$

$$P_{spu} + jQ_{spu} = \bar{V}_{1pu} (\bar{I}_{2pu})^* = (1.148 \angle 9.79^\circ)(1.12 \angle 26.57^\circ) = 1.283 \angle 36.36^\circ$$

$$P_{spu} + jQ_{spu} = 1.033 + j0.7606$$

$$P_s = 1.033 (100 \text{ MVA}) = 103.32 \text{ MW}$$

$$Q_s = 0.7606 (100 \text{ MVA}) = 76.06 \text{ MVAR}$$

$$S_s = (103.32 + j76.06) \text{ MVA}$$

$$128 \angle 37.5^\circ$$