EE 341 - Quiz #2

Name (please print): Solution The last four digits of your SSN: _____

1. Consider a three-phase feeder shown below:

![Diagram of a three-phase feeder](image)

The load bus voltage $V_R$ is maintained at 1.386 kV (line-to-line). Compute the complex power supplied by the source and the power factor of the source.

Solution:

a) Load #1: $S_{1,\phi} = \frac{300}{3} \left(0.9 + j \sqrt{1 - 0.9^2}\right) = 90 + j43.59 \text{kVA}$

Load #2: $S_{2,\phi} = \frac{240}{3} + j \frac{240 \sqrt{1 - 0.8^2}}{0.8} = 80 + j60 \text{kVA}$

Load #3: $S_{1,\phi} = -j \frac{180}{3} = -j60 \text{kVA}$

Total load at load bus is $S_{\text{total,}\phi} = S_{2,\phi} + S_{3,\phi} = 80 \text{kW}$

b) Phase voltage at load bus: $V_{R,\phi} = \frac{1386}{\sqrt{3}} = 800\angle0^\circ V$

c) Current in transmission line is

$$I = \left(\frac{S_{\text{total,}\phi}}{V_{R,\phi}}\right)^* = \left(\frac{80,000}{800\angle0^\circ}\right)^* = 100\angle0^\circ A$$

d) Phase voltage at source bus:

$$V_{S,\phi} = V_{R,\phi} + I(j1) = 800 + j100 = 806.23\angle7.125^\circ V$$

e) Power supplied by source is

$$S_{S,3\phi} = 3V_{S,\phi}I^* + 3S_{1,\phi} = 3\times806.23\angle7.125^\circ\times100\angle-0^\circ + 3\times(90 + j43.59)\times10^3$$

$$= 510 + j160.7 \text{kVA}$$

or $S_{S,3\phi} = 3(S_{1,\phi} + S_{2,\phi} + S_{3,\phi}) + 3|I|^2 (j1) = 510 + j160.7 \text{kVA}$
\[ PF = \frac{510}{|S_{5.3\phi}|} = 0.954 \text{ lagging.} \]