PROBLEM 5-1 (continued)

Then:

$$V_a = \frac{11{,}000\angle 0^0}{\sqrt{3}} + (656)\angle \cos^{-1}\ 0.8\ (10)\angle +90^0$$

$$= 6{,}351 + (656)\,(0.8 - j0.6)\,(j10) = 6{,}351 + j5{,}248 + 3{,}936$$

$$= 10{,}287 + j5{,}248 = 11.548\angle 27.02^0 \text{ kV} \longleftarrow \textbf{Answer to (a)}$$

Determine the excitation voltage at a 1.0 power factor and 10 MW.

$$I_L = \frac{10^7}{\sqrt{3}\ (11)\left(10^3\right)} = 525 \text{ A}$$

Then:

$$V_a = 6{,}351 + 525(1)\,(j10) = 6{,}351 + j5{,}250 = 8.239\angle 39.6^0 \text{ kV} \longleftarrow \textbf{Answer to (b)}$$

Determine the excitation voltage at a 0.8 power factor leading and 10 MW.

$$I_p = 656 \text{ A}$$

Then:

$$V_a = 6{,}351 + 656(0.8 + j0.6)\,(j10\,) = 6{,}351 + j5{,}248 - 3{,}936$$

$$= 5.777\angle 65.3^0 \text{ kV} \longleftarrow \textbf{Answer to (c)}$$

Determine the maximum power under the same conditions.
Since:

$$P_{3\phi} = \frac{|V_g|\ |V_m|\ \sin\ \delta}{X}$$

where: $|V_g|$ and $|V_m|$ are line-to-line voltage; $P = 3\phi$ W; and δ is the angle between $|V_g|$ and $|V_m|$.