SAMPLE EXAM PROBLEM – CIRCUIT ANALYSIS (9 OF 80 PROBLEMS)

THREE PHASE CIRCUITS

SLIDE 1

In this video, we will cover a sample exam problem for the Power PE Exam. This exam problem falls under the topic of Circuit Analysis, which accounts for 9 of 80 problems on the PE exam. The question reads,

A 480V∠0°, ideal, wye connected generator supplies power to an ideal, delta connected load. The transmission line between the generator and load has an impedance of 1+j2 per phase. The load has an impedance of 15+j10 per phase. What is the line current?

(A) 8 A
(B) 14 A
(C) 20 A
(D) 35 A

SLIDE 2

On the exam, I recommend using figures to help you to visualize the problem, in the event that the PE exam does not provide a figure. If you check the website, you can download the technical study guide for the power pe exam for these types of figures. In this figure, the line voltage of 480 volts is shown for the wye generator. The per phase transmission line impedances of 1+j2 are also shown. Finally the delta load with per phase impedances of 15+j10 is shown.
SLIDE 3

In order to complete this problem you must first convert the delta load to an equivalent wye load. This will help to make a simpler circuit for solving for the line current, since the line current is equal to the phase current. The conversion for delta to wye impedances is to divide the delta impedance by 3.

\[ Z_{\text{wye}} = \frac{Z_{\text{delta}}}{3} = \frac{15 + j10}{3} = 5 + j3.33 \]

SLIDE 4

The next step is to convert the line voltage to phase voltage, to get a simpler circuit for solving for the line current. The phase voltage will be the voltage from C-N. The conversion from line voltage to phase voltage is to divide the line voltage by root 3 and subtract the 30 degree angle. This result is 277° - 30°
Now the drop along a phase includes the line impedance and the load impedance. With this simple circuit you now have the impedance and voltage for a phase and can therefore solve for the phase current which is also equal to the line current.

\[
I_{\text{line}} = \frac{V}{Z_{\text{load}} + Z_{\text{line}}} = \frac{277V \angle -30^\circ}{5 + j3.33 + 1 + j2} = \frac{277V \angle -30^\circ}{6 + j5.33} = \]

\[
I_{\text{line}} = \frac{277V \angle -30^\circ}{6 + j5.33} = \frac{277V \angle -30^\circ}{8.03\angle41.6^\circ} = 34.5\angle-71.6^\circ
\]

The correct answer is most nearly, (D) 35 A