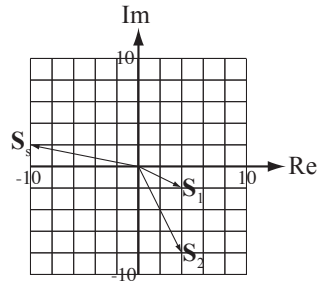
Solution of ECE 300 Test 12 S09

1. In a circuit there are a source absorbing complex power $\mathbf{S}_s$ and three impedances absorbing complex powers $\mathbf{S}_1$, $\mathbf{S}_2$ and $\mathbf{S}_3$. Referring to the diagram below, find the numerical magnitude and angle of $\mathbf{S}_3$.

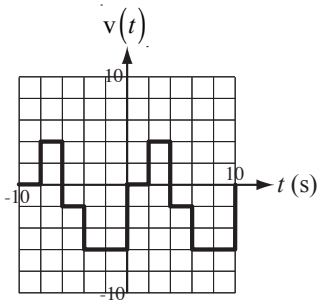
$$\mathbf{S}_s + \mathbf{S}_1 + \mathbf{S}_2 + \mathbf{S}_3 = 0$$

$$-10 + j2 + 4 - j2 + 4 - j8 + \mathbf{S}_3 = -2 - j8 + \mathbf{S}_3 = 0 \Rightarrow \mathbf{S}_3 = 2 + j8 = 8.246\angle 75.96°$$



2. Below is a periodic waveform $\mathrm{v}(t)$ of period 10 s. Find its numerical rms value.

$$V_{\text{rms}} = \sqrt{\frac{1}{10}\left(2\times 0^2 + 2\times 4^2 + 2\times(-2)^2 + 2\times(-4\text{6})^2 + 2\times(-6)^2\right)} = \sqrt{\frac{16+4+36+36}{5}} = 4.289 \text{ V}$$



3. An electrical load operating at 60 Hz consists of a 300Ω resistor, a 0.5H inductor and a 10μF capacitor all connected in parallel. What is the numerical power factor of this load and is it leading or lagging?

$$Z_L = \frac{1}{1/300 + 1/\left(j377 \times 0.5\right) + j377 \times 10^{-5}} = \frac{1}{0.00333 - j0.00531 + j0.00377} = \frac{1}{0.00333 - j0.00154}$$

$$Z_L = \frac{1}{0.00333 - j0.00154} = \frac{1}{0.00367 \angle -24.73^\circ} = 272.49 \angle 24.73^\circ$$

$\text{PF} = \cos\left(24.73^\circ\right) = 0.9083$ lagging

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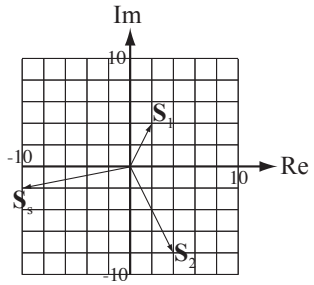
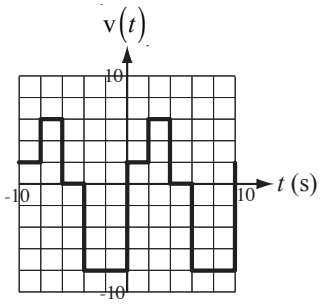
$$\mathbf{S}_s + \mathbf{S}_1 + \mathbf{S}_2 + \mathbf{S}_3 = 0$$

$$-10 - j2 + 2 + j4 + 4 - j8 + \mathbf{S}_3 = -4 - j6 + \mathbf{S}_3 = 0 \Rightarrow \mathbf{S}_3 = 4 + j6 = 7.211\angle 56.31°$$



2. Below is a periodic waveform $\mathrm{v}(t)$ of period 10 s. Find its numerical rms value.

$$V_{\text{rms}} = \sqrt{\frac{1}{10}\left(2\times 2^2 + 2\times 6^2 + 2\times 0^2 + 2\times(-8)^2 + 2\times(-8)^2\right)} = \sqrt{\frac{4+36+0+64+64}{5}} = 5.797 \text{ V}$$



3. An electrical load operating at 60 Hz consists of a 400Ω resistor, a 0.5H inductor and a 10μF capacitor all connected in parallel. What is the numerical power factor of this load and is it leading or lagging?

$$Z_L = \frac{1}{1/400 + 1/\left(j377 \times 0.5\right) + j377 \times 10^{-5}} = \frac{1}{0.00250 - j0.00531 + j0.00377} = \frac{1}{0.00250 - j0.00154}$$

$$Z_L = \frac{1}{0.00250 - j0.00154} = \frac{1}{0.00294 \angle -31.55^\circ} = 340.87 \angle 31.55^\circ$$

$$\text{PF} = \cos\left(31.55\right) = 0.8522 \text{ lagging}$$

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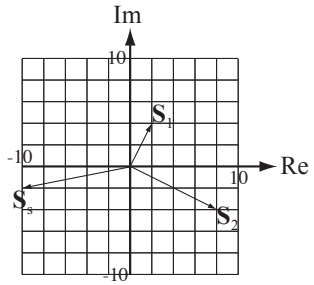
1. In a circuit there are a source absorbing complex power $\mathbf{S}_s$ and three impedances absorbing complex powers $\mathbf{S}_1$, $\mathbf{S}_2$ and $\mathbf{S}_3$. Referring to the diagram below, find the numerical magnitude and angle of $\mathbf{S}_3$.

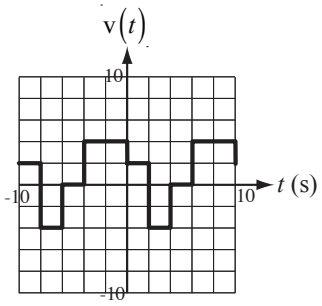
$$\mathbf{S}_s + \mathbf{S}_1 + \mathbf{S}_2 + \mathbf{S}_3 = 0$$

$$-10 - j2 + 2 + j4 + 8 - j4 + \mathbf{S}_3 = -j2 + \mathbf{S}_3 = 0 \Rightarrow \mathbf{S}_3 = j2 = 2\angle 90°$$



2. Below is a periodic waveform $\mathrm{v}(t)$ of period 10 s. Find its numerical rms value.

$$V_{\text{rms}} = \sqrt{\frac{1}{10}\left(2\times 2^2 + 2\times(-4)^2 + 2\times 0^2 + 2\times 4^2 + 2\times 4^2\right)} = \sqrt{\frac{4+16+16+16}{5}} = 3.225$$



3. An electrical load operating at 60 Hz consists of a 250Ω resistor, a 0.5H inductor and a 10μF capacitor all connected in parallel. What is the numerical power factor of this load and is it leading or lagging?

$$Z_L = \frac{1}{1/250 + 1/\left(j377 \times 0.5\right) + j377 \times 10^{-5}} = \frac{1}{0.004 - j0.00531 + j0.00377} = \frac{1}{0.004 - j0.00154}$$

$$Z_L = \frac{1}{0.004 - j0.00154} = \frac{1}{0.00428 \angle -21°} = 233.40 \angle 21°$$

$$\text{PF} = \cos\left(21°\right) = 0.9336 \text{ lagging}$$