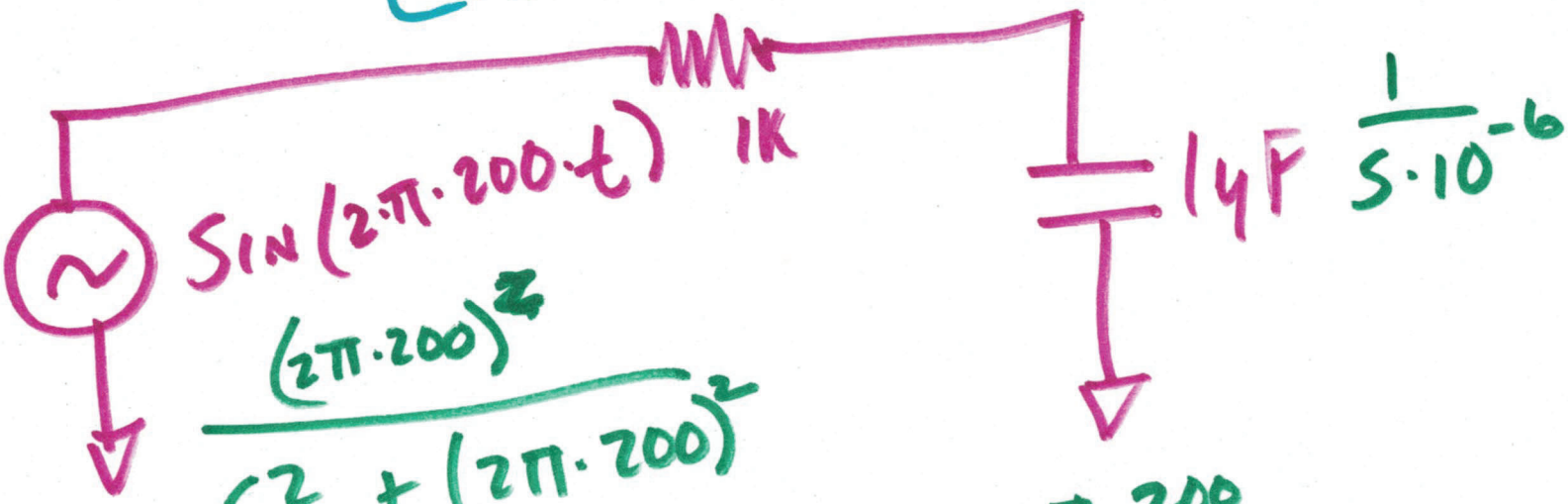
EE 221 Circuits II

April 19, 2021

Lecture 22



$$\frac{(2\pi\cdot 200)^2}{s^2+(2\pi\cdot 200)^2}$$

$$I(s)=\frac{\dfrac{2\pi\cdot 200}{s^2+(2\pi\cdot 200)^2}}{10^3+\dfrac{1}{s\cdot 10^{-6}}}$$

$$I(s) = \frac{2\pi \cdot 200 \cdot 5 \cdot 10^{-6}}{(s^2 + (2\pi \cdot 200)^2) \cdot (10^3 + \frac{1}{s \cdot 10^{-6}})} \cdot s \cdot 10^{-6}$$

$$I(s) = \frac{2\pi \cdot 200 \cdot 5 \cdot 10^{-6} \cdot 10^3}{(s - p_1)(s - p_2)(s \cdot 10^{-3} + 1)} \cdot 10^3$$

$$= \frac{2\pi \cdot 0.2 \cdot s}{(s - p_1)(s - p_2)(s + 10^3)}$$

$$p_1, p_2 = \frac{\pm \sqrt{-4 \cdot (2\pi \cdot 200)^2}}{2} = \pm j 2\pi \cdot 200$$

$$p_1 = j2\pi \cdot 200 = 2\pi \cdot 200 \angle 90 = 2\pi \cdot 200 e^{j90}$$

$$p_2 = -j2\pi \cdot 200 = 2\pi \cdot 200 \angle -90 = 2\pi \cdot 200 \cdot e^{-j90}$$

$$\frac{2\pi \cdot (0.2) \cdot s}{(s-p_1)(s-p_2)(s+10^3)} = \frac{A}{s-p_1} + \frac{B}{s-p_2} + \frac{C}{s+10^3}$$

$$A = \frac{2\pi \cdot 0.2 \cdot p_1}{(p_1-p_2)(p_1+10^3)} = \frac{0.4\pi \cdot 2\pi \cdot 200 e^{j90}}{(j4\pi \cdot 200)(j2\pi \cdot 200 + 10^3)}$$

$$B = \frac{2\pi \cdot 0.2 \cdot p_2}{(p_2-p_1)(p_2+10^3)} = \frac{0.4\pi \cdot 2\pi \cdot 200 e^{-j90}}{(-j4\pi \cdot 200)(-j2\pi \cdot 200 + 10^3)}$$

$$C = \frac{2\pi \cdot (0.2) \cdot (-10^3)}{(-10^3 - p_1)(-10^3 - p_2)}$$

$$-j2\pi\cdot 200 + 10^3 = 1605\angle 51.5^\circ = 1605e^{j51.5}$$

$$10^3 + j(-2\pi\cdot 200) = 1605\angle -51.5^\circ = 1605e^{-j51.5}$$

$$C = \frac{-0.4\pi\cdot 10^3}{(-10^3 - -j2\pi\cdot 200)(-10^3 - (-j2\pi\cdot 200))}$$

$$= \frac{400\pi}{\underbrace{(10^3 + j2\pi\cdot 200)}_{1605e^{j51.5}}\underbrace{(-10^3 + j2\pi\cdot 200)}_{1605\angle 128.5}}$$

$$A = \frac{0.8^{2}\pi \cdot 2\pi \cdot 200 e^{j90}}{4\pi \cdot 200 e^{j90} \cdot 1605 e^{j51.5}} = 391\,\mu A\, e^{-j51.5}$$

$$B = 391\,\mu A\, e^{j51.5}$$

$$C = \frac{400\pi}{1605 e^{j51.5} \cdot 1605 e^{j128.5}} = \frac{400\pi}{(1605)^{2} e^{j180}}$$

$$C = -487\,\mu A$$

$$I(s) = \frac{391\angle -51.5}{s - j2\pi \cdot 200} + \frac{391\angle 51.5}{s + j2\pi \cdot 200} + \frac{-4874}{s + 10^3}$$

$$i(t) = u(t) \cdot \left(391\angle \left(e^{-j51.5} \cdot e^{-j2\pi \cdot 200 \cdot t} + e^{j51.5} \cdot e^{-j2\pi \cdot 200 t} \right) + (-4874)\, e^{\frac{-t}{10^{-3}}} \right)$$

$$i(t) = u(t) \cdot \left(391.2 \cdot \left(\frac{e^{j(2\pi \cdot 200t - 51.5)} + e^{-j(2\pi \cdot 200t - 51.5)}}{2} \right) + (-487.4 e^{-t/10^{-3}}) \right)$$

$$i(t) = u(t) \cdot \left(782.4 \cos(2\pi \cdot 200t - 51.5^\circ) - 487.4 e^{-t/10^{-3}} \right)$$

$360 \cdot 200 \cdot 1m - 51.5$

20.5

$486 - 487 \approx 0$

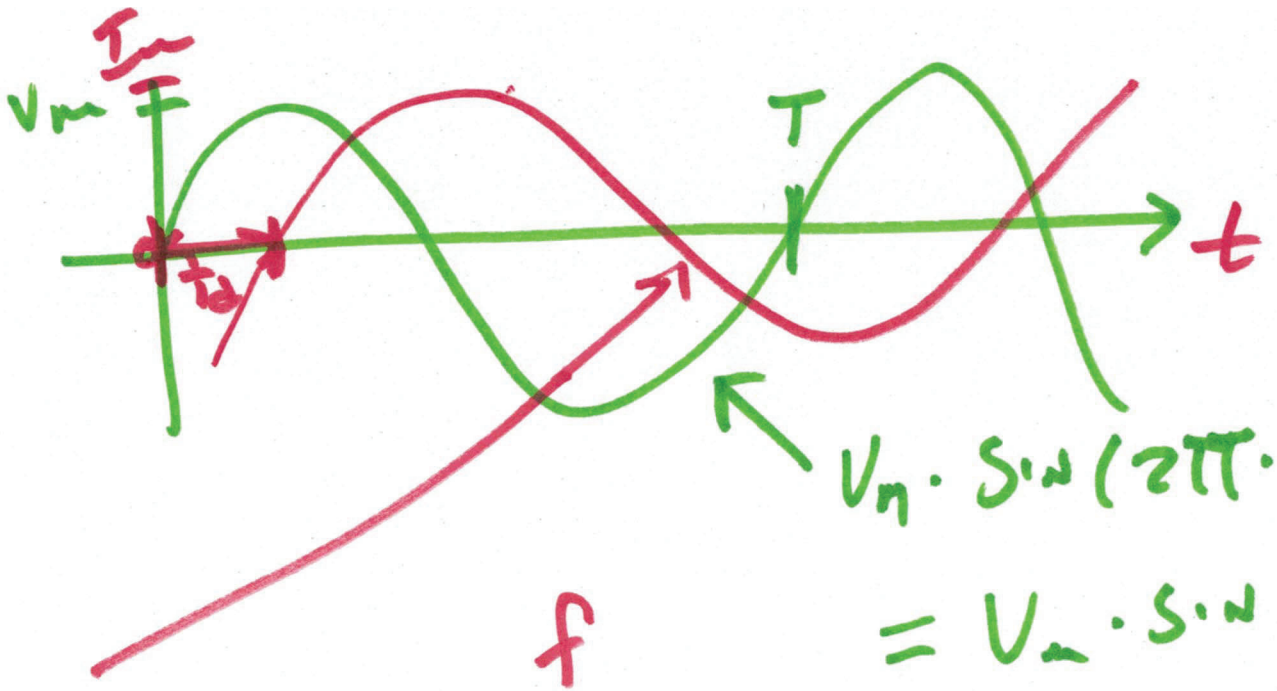
1

$.37$

e^{-1}

$732 \angle -180$

7)

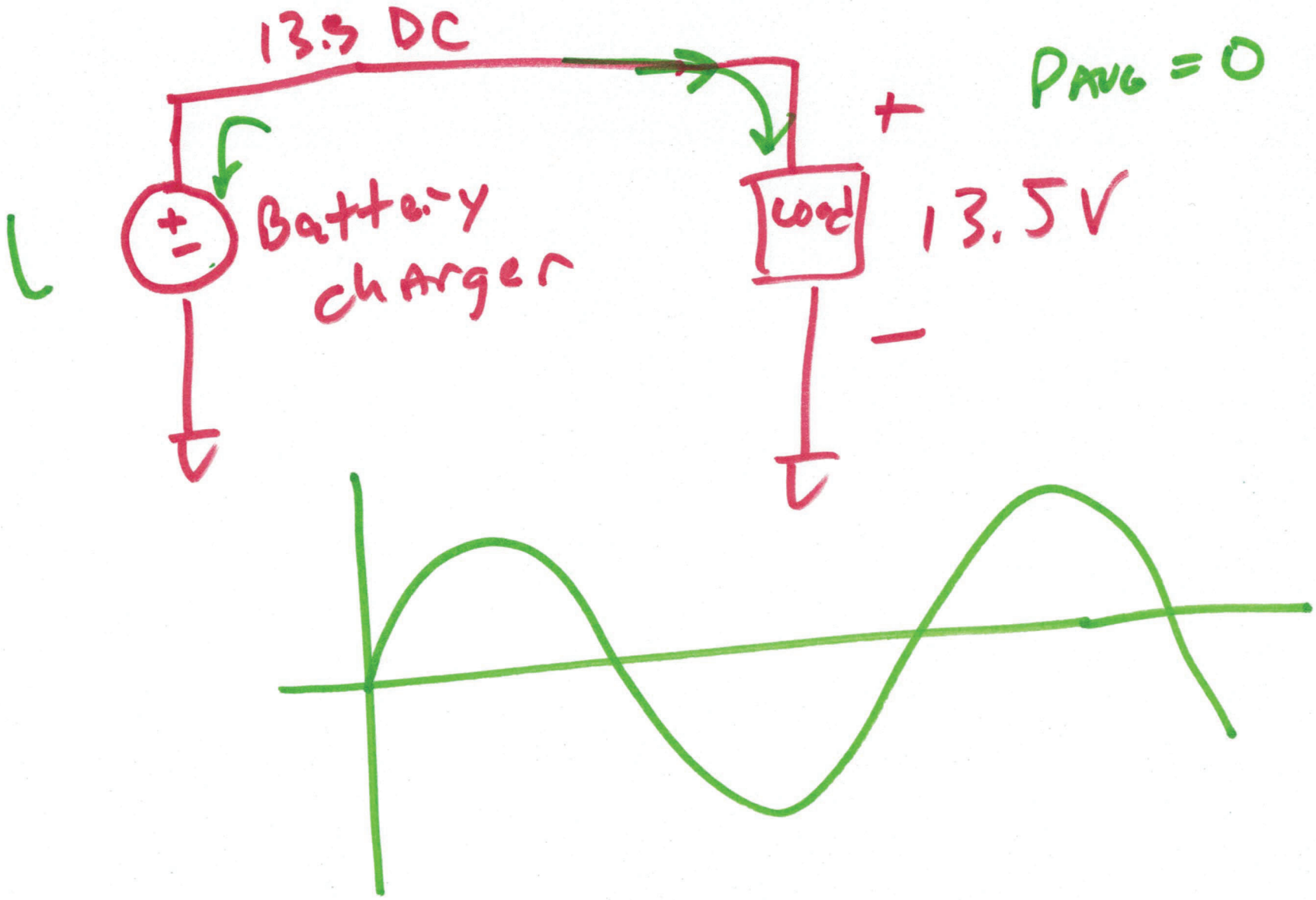


$$I_m \sin\left(2\pi \cdot \frac{f}{T} \cdot t - \theta\right)$$

$$f = \frac{1}{T}$$

$$\theta = \frac{t_d}{T} \cdot 360 = t_d \cdot f \cdot 360$$

$$f = \frac{1}{T}$$

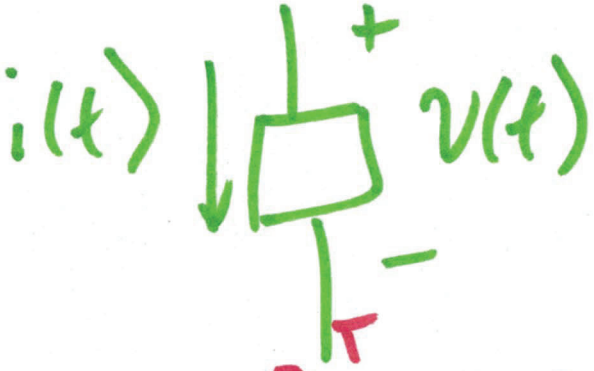

13.5 DC
$P_{AVG} = 0$
+
Battery charger
load
13.5 V
−

Sinusoids 170V 120V

Rms $\frac{V_m}{\sqrt{2}} = V_{rms}$

Power

instantaneous power $= p(t) = i(t) \cdot v(t)$



Average power

$$P_{AVG} = \frac{1}{T}\int_0^T p(t)\cdot dt$$

$$v(t) = V_m \cdot \cos(2\pi f \cdot t + \phi_v)$$

$$i(t) = I_m \cos(2\pi f \cdot t + \phi_i)$$

$$\cos a \cos b = \frac{1}{2}\cos(a+b) + \frac{1}{2}\cos(a-b)$$

$$P_{AVG} = f \int_0^{\frac{1}{f}} V_m I_m \cos(2\pi \cdot ft + \phi_v) \cdot \cos(2\pi ft + \phi_i) \cdot dt$$

$$\frac{1}{\frac{1}{f}} \quad \frac{1}{T} \int_0^T \left(\frac{V_m I_m}{2} \cdot \left(\cos(\phi_v - \phi_i) + \cos(4\pi \cdot ft + \phi_v + \phi_i) \right) \right) dt$$

$p(t)$

$$\frac{V_m}{\sqrt{2}} \cdot \frac{I_m}{\sqrt{2}} \cdot \cos(\phi_v - \phi_i)$$

$$V_{rms} \cdot I_{rms} \cdot \cos(\phi_v - \phi_i)$$

power factor Angle