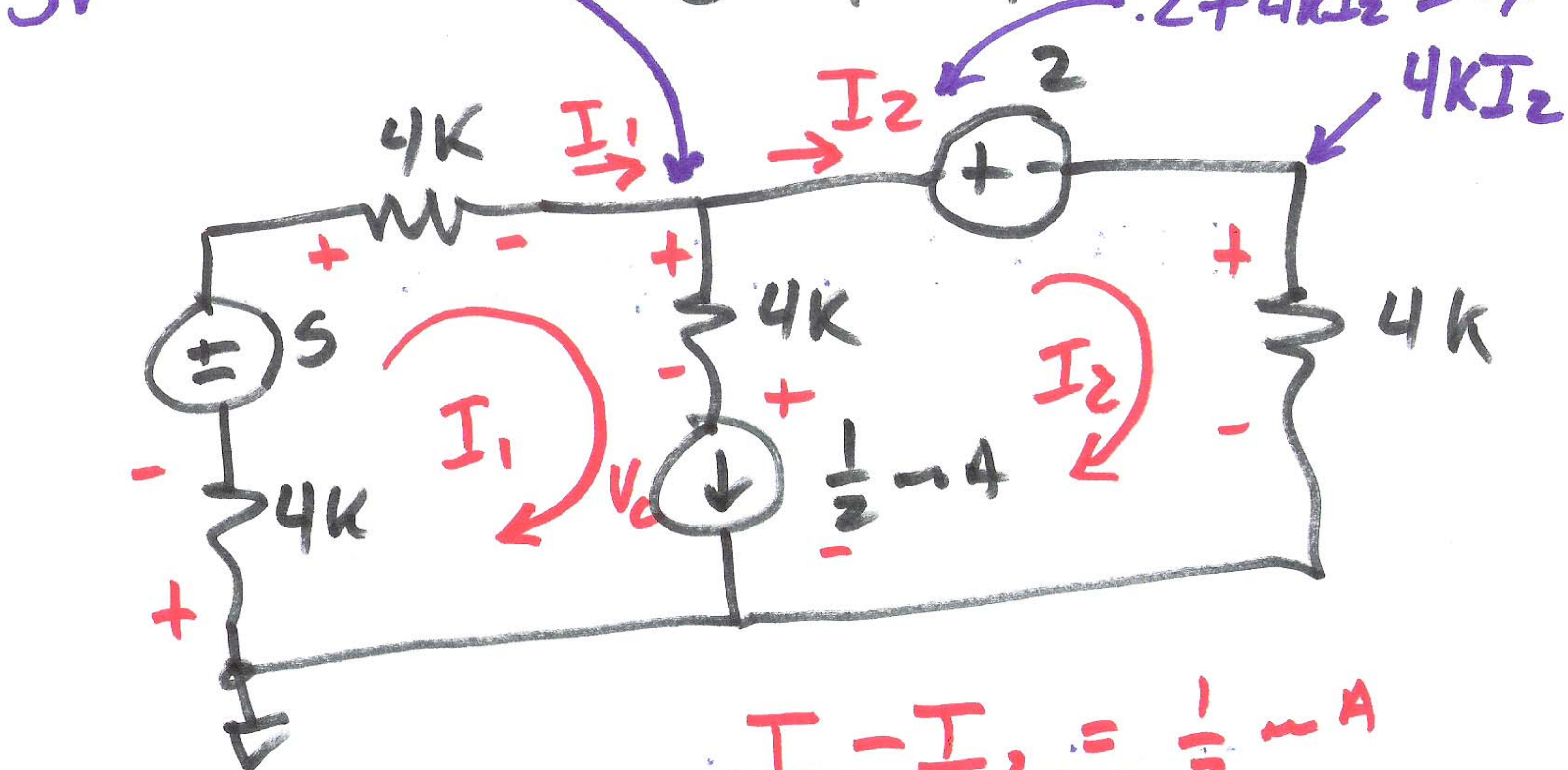
EE 220

Lecture 21

July 9, 2014



$$I_1 - I_2 = \frac{1}{2}\,mA$$

$$-V_c + 5 - 4kI_1 - 4k(I_1 - I_2) - 4kI_1 = 0$$

$$V_c + 4k(I_1 - I_2) - 2 - 4kI_2 = 0$$

$$5 - 8k I_1 = 2 + 4k I_2$$

$$I_1 = \frac{1}{2} mA + I_2$$

$$\underbrace{5 - 4V}_{1} - 8k I_2 = 2 + 4k I_2$$

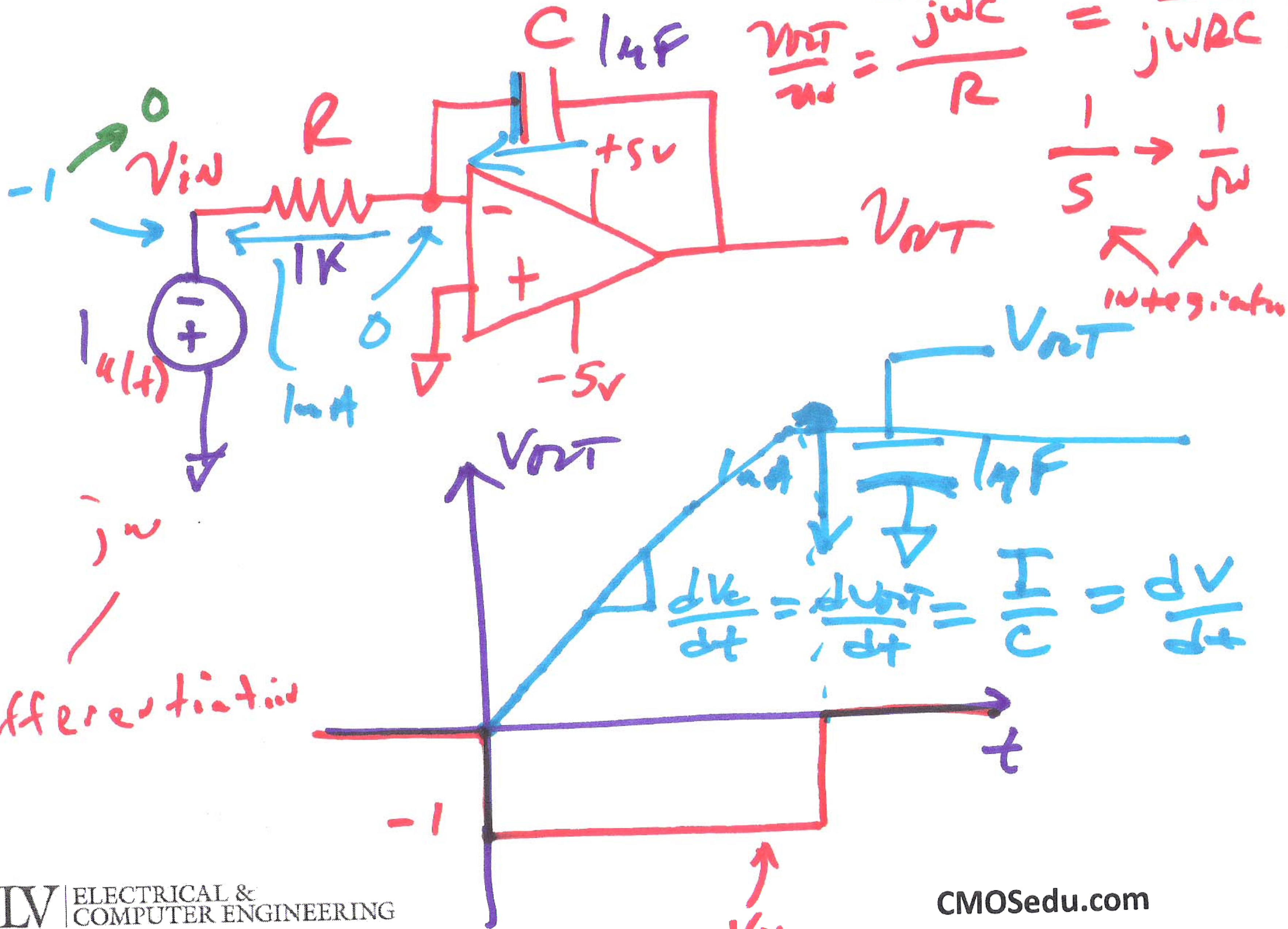
$$-1 = 12k I_2$$

$$I_2 = \frac{-1}{12k} = -83.3 \mu A$$

$$I_1 = .4167 mA$$

$$V_X = 2 + 4k \cdot (-83.3 \mu A) = \underline{\underline{1.67V}}$$

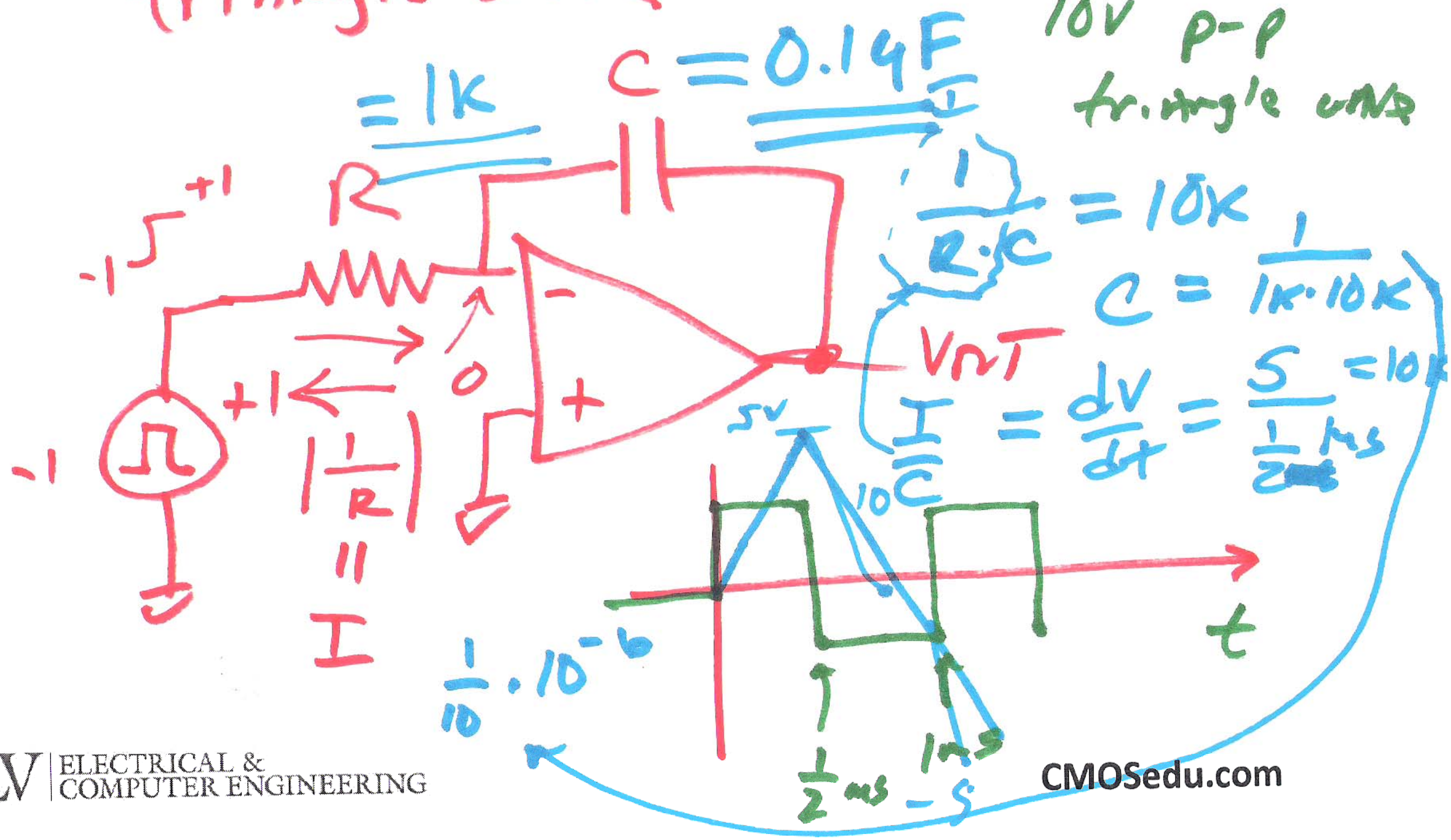
Op-Amp integrator

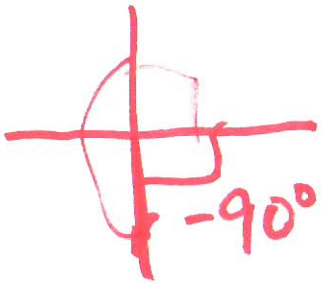


$$\frac{V_{OUT}}{V_{IN}} = \frac{-\frac{1}{j\omega C}}{R} = -\frac{1}{j\omega RC}$$

$$\frac{dV_C}{dt} = \frac{dV_{OUT}}{dt} = \frac{I}{C} = \frac{dV}{dt}$$

Design a circuit that can convert a +1 to -1V squarewave @ 1kHz into a +5 to -5V triangle wave

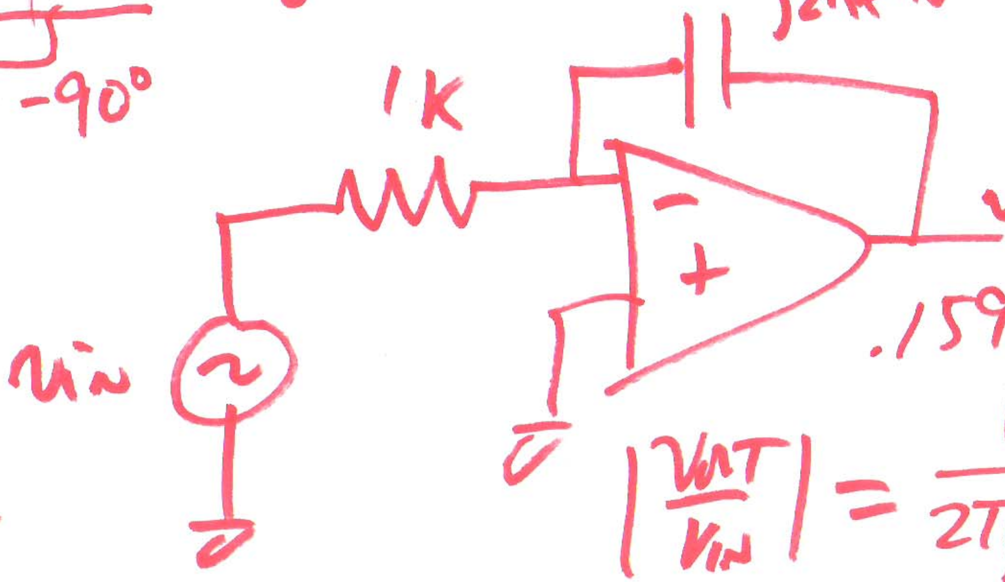




$\frac{1}{j} = -j$

0.14

$\frac{1}{j2\pi f \cdot 10^{-6}}$



$20 \log 10^3$

$60 \log 1$

1.59

60 dB

$.159 = \frac{1}{2\pi}$

$\frac{1}{2\pi RC}$

$\left|\frac{v_{out}}{v_{in}}\right| = \frac{1}{2\pi \, 10^3 \cdot 10^3 \, 10^{-6}}$

$2 \rightarrow 6\ dB$

$\sqrt{2} \rightarrow 3\ dB$

$\frac{1}{2} \rightarrow -6\ dB$

$\frac{1}{\sqrt{2}} \rightarrow -3\ dB$

$\left|\frac{1}{2\pi f \cdot RC}\right| = 1$ ← f_{unity}

$\frac{v_{out}}{v_{in}} = -\frac{\frac{1}{j\omega C}}{R} = -\frac{1}{j\omega RC}$

90° $\angle \frac{v_{out}}{v_{in}} = 180 - 90 = +90°$

$2{,}000 \rightarrow 66\ dB$

$66\ dB = 20 \log 10^3 + 20 \log 2 = 20 \log 1000 \times 2$

5)