Announcements:

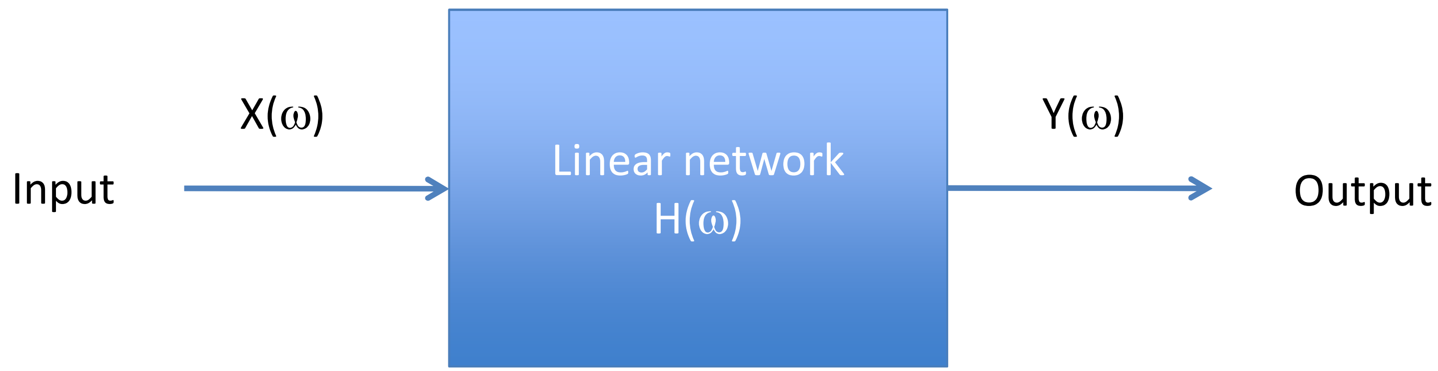
1. Announcement

EECS 70A: Network Analysis

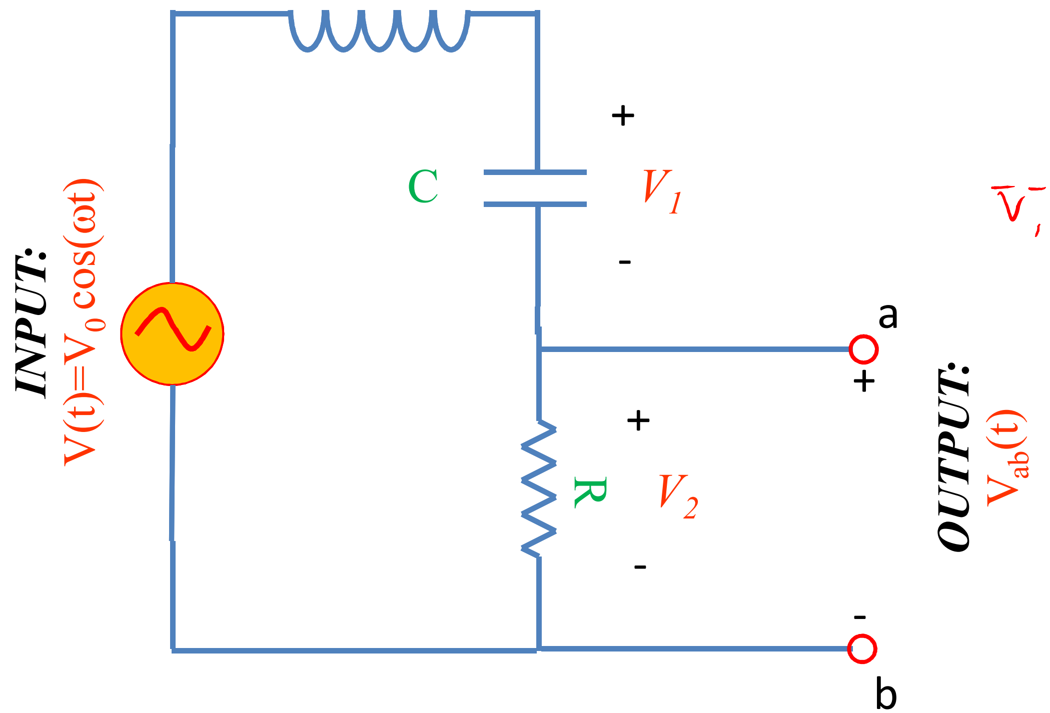
29 May 2014

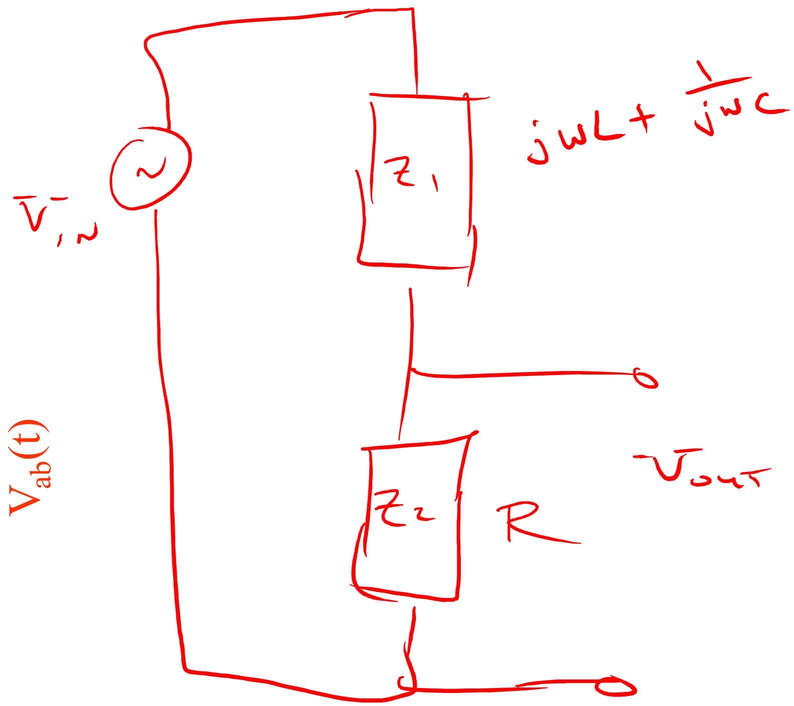

L
D
E
R
FASTEN
SEAT BELTS
becker Europa
treble
bass
tuning
M 6 9 12 15 AM
U 88 94 100 106 FM
AM
AM
FM
FM
FM
http://www.peachparts.com/shopforum/show
thread.php?t=256624

“Transfer function”



Band pass filter (RLC)



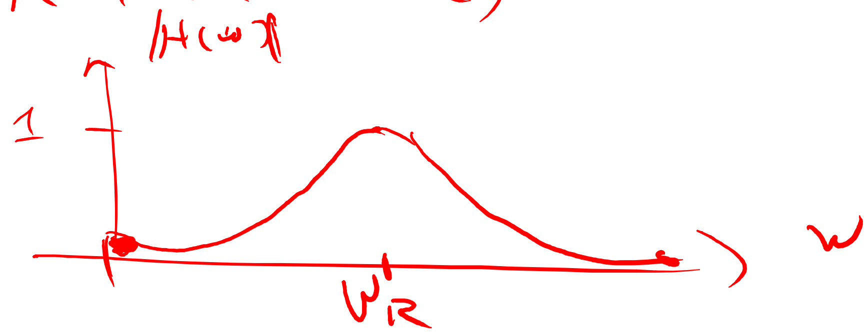


$$H(\omega) = \frac{Z_2}{Z_1 + Z_2} = \frac{R}{R + j\left(\omega L - \frac{1}{\omega C}\right)}$$

$$= \frac{R}{R + j\frac{1}{\omega}\left(\omega^2 L - \frac{1}{C}\right)}$$

$$\omega^2 L - \frac{1}{C} = 0$$

$$\omega_R = \sqrt{\frac{1}{LC}}$$



Bandwidth

"3 dB" BW

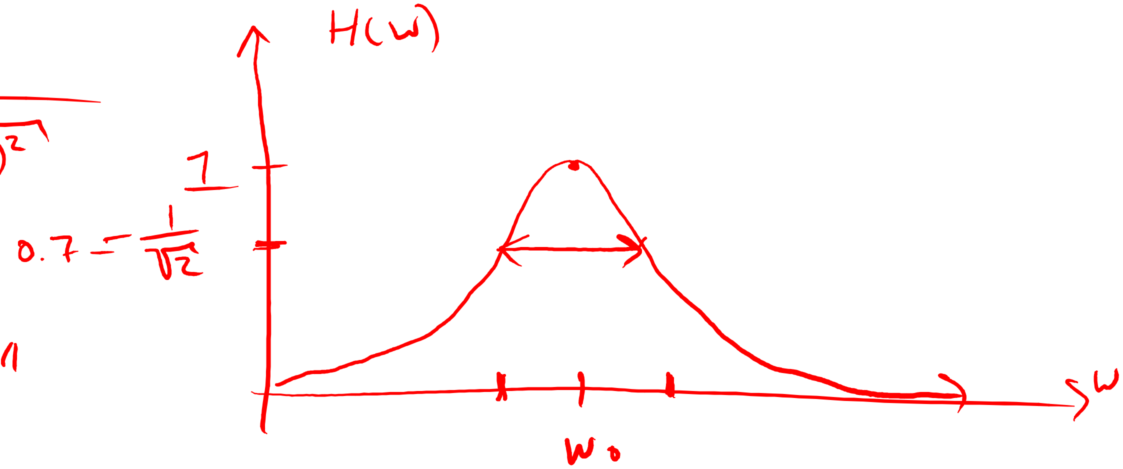
$$H(\omega) = \frac{R}{R + j\left(\omega L - \frac{1}{\omega C}\right)} \cdot \frac{R - j\left(\omega L - \frac{1}{\omega C}\right)}{R - j\left(\omega L - \frac{1}{\omega C}\right)}$$

$$= \frac{R}{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}\left[R - j\left(\omega L - \frac{1}{\omega C}\right)\right]$$

$$|H(\omega)| = \sqrt{\left(\mathrm{Re}[H(\omega)]\right)^2 + \left(\mathrm{Im}[H(\omega)]\right)^2} = \frac{R}{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$= \frac{R}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

$$\omega_0 \equiv \frac{1}{\sqrt{LC}}$$



$$\frac{\omega_0}{B} \equiv Q \text{ "quality factor"}$$

$$= \omega_0 \frac{L}{R} = \frac{1}{\omega_0 R C}$$

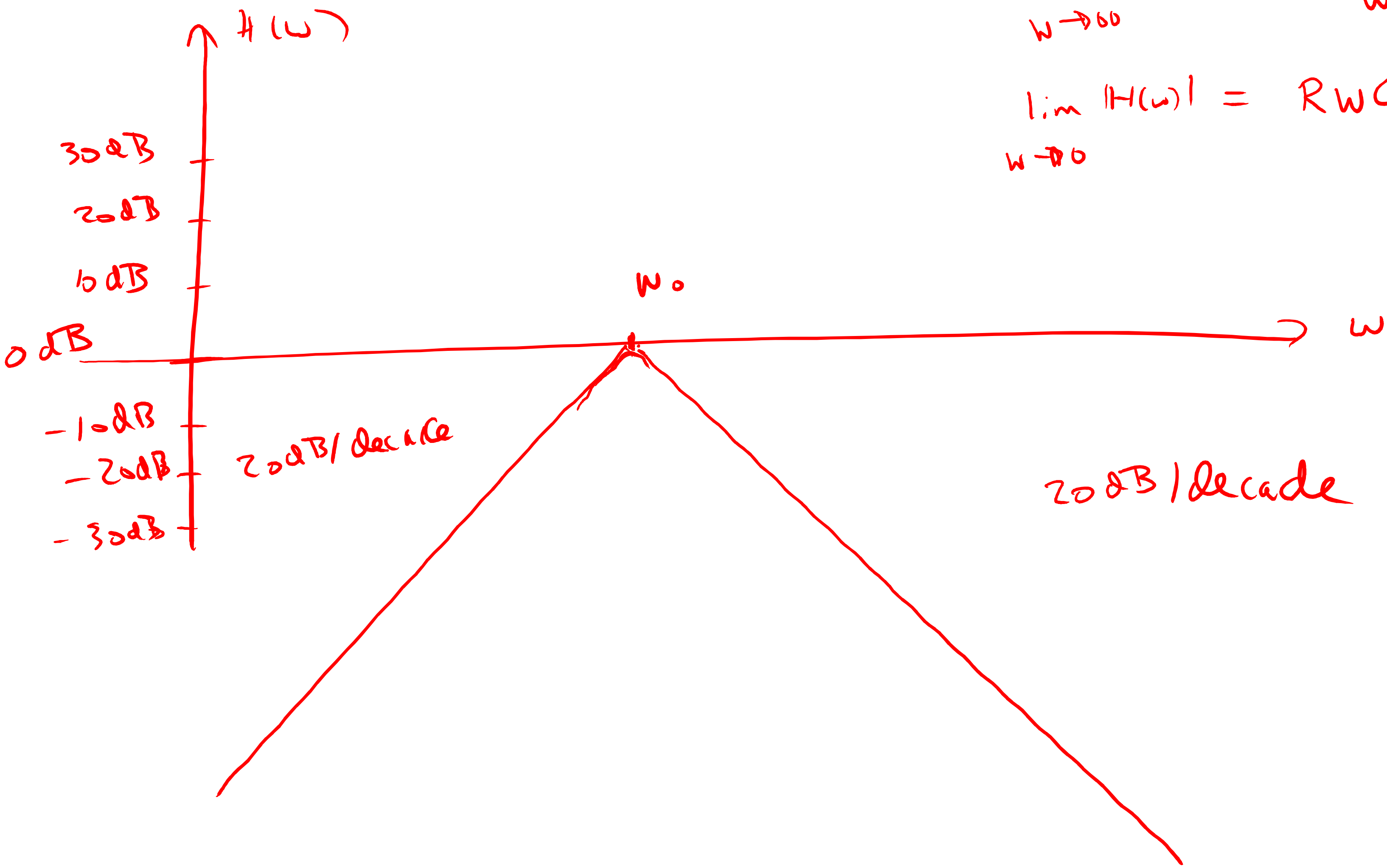
$$B = \frac{R}{L}$$

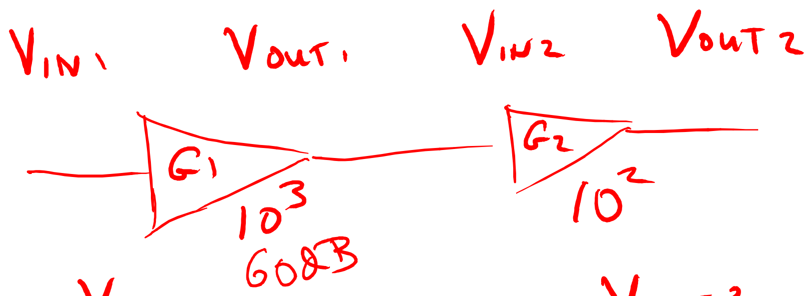
VERY IMPORTANT

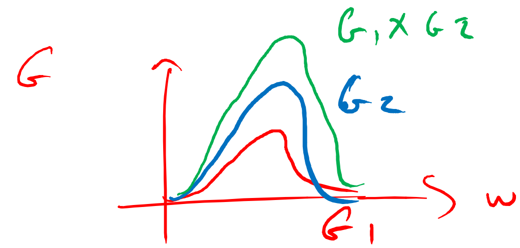
Bode of RLC

$$\lim_{w \to \infty} |H(w)| = \frac{R}{wL}$$

$$\lim_{w \to 0} |H(w)| = RwC$$







$\log xy = \log x + \log y$

$$\frac{V_{OUT1}}{V_{IN1}} = G_1 \qquad \frac{V_{OUT2}}{V_{IN2}} = G_2$$

$$\frac{V_{OUT2}}{V_{IN1}} = \frac{V_{IN2}\ G_2}{V_{IN1}} = \frac{V_{OUT1}\ G_2}{V_{IN1}} = G_1 G_2 = 10^2 10^5$$

$$= 10^5$$

$$G_1(dB) = 20 \log \frac{V_{OUT1}}{V_{IN1}} = 20 \log 10^3 = 20\ 3 \log 10$$

$$= 60\ dB$$

$$G_2(dB) = 40\ dB$$

$$G_{TOTAL}(dB) = 20 \log \frac{V_{OUT2}}{V_{IN1}} = 20 \log (G_1 G_2)$$

$$= 20 \log G_1 + 20 \log G_2 = G_1(dB) + G_2(dB)$$

$$= 60\ dB + 40\ dB = 100\ dB$$

Fourier

$$F(t) = \mathrm{Re}\left[\sum_n a_n e^{j\omega_n t}\right]$$

$$V_{in}(t) \longrightarrow \boxed{H(\omega)} \longrightarrow V_{out}(t)$$

$$V_{in}(t) = \mathrm{Re}\left[\sum_n a_n e^{j\omega_n t}\right]$$

$$V_{out} = \mathrm{Re}\left[\sum_n a_n H(\omega_n) e^{j\omega_n t}\right]$$

Ex. $V_{in}(t) = 1\,V \sin[(97.1\,MHz\ 2\pi)t] + 3\,V \sin[(100.3\,MHz\ 2\pi)t]$

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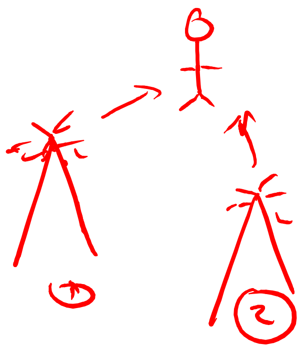
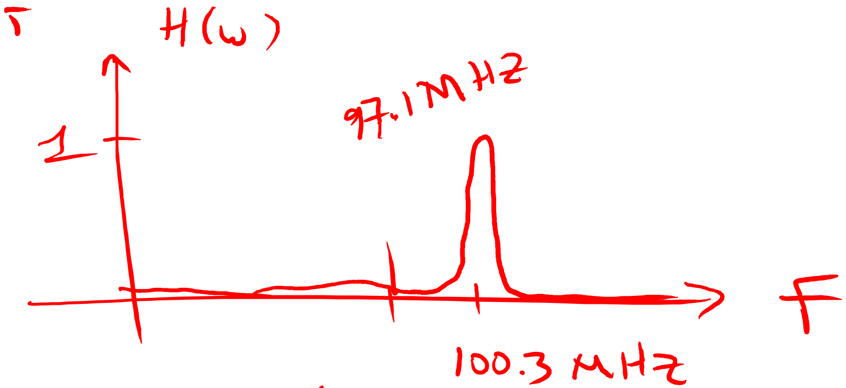


$$E\Big|_{\substack{x = EECS70 \\ STUDENT}} = E_{①} + E_{②}$$

$$2\pi F = \omega$$



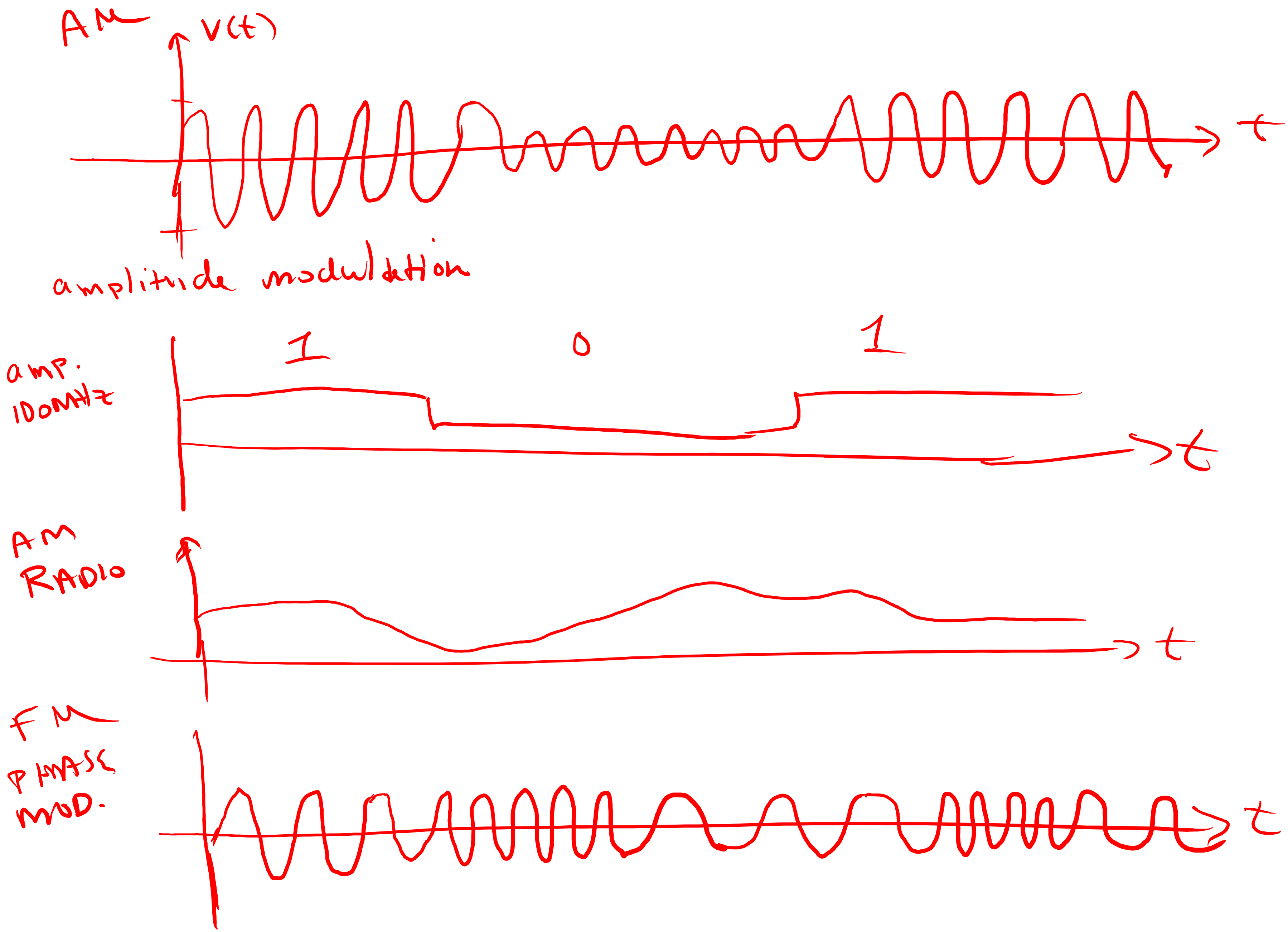
$$V_{out}(t) = 1V\, H(\omega)\Big|_{\omega = 97.1\,MHz \times 2\pi} \sin(97.1\,MHz\ 2\pi t)$$

0

$$+ 3V\, H(\omega)\Big|_{\omega = 100.3\,MHz} \sin(100.3\,MHz\ 2\pi t)$$

$$= 3V \sin(100.3\,MHz\ 2\pi t)$$

Modulation Schemes



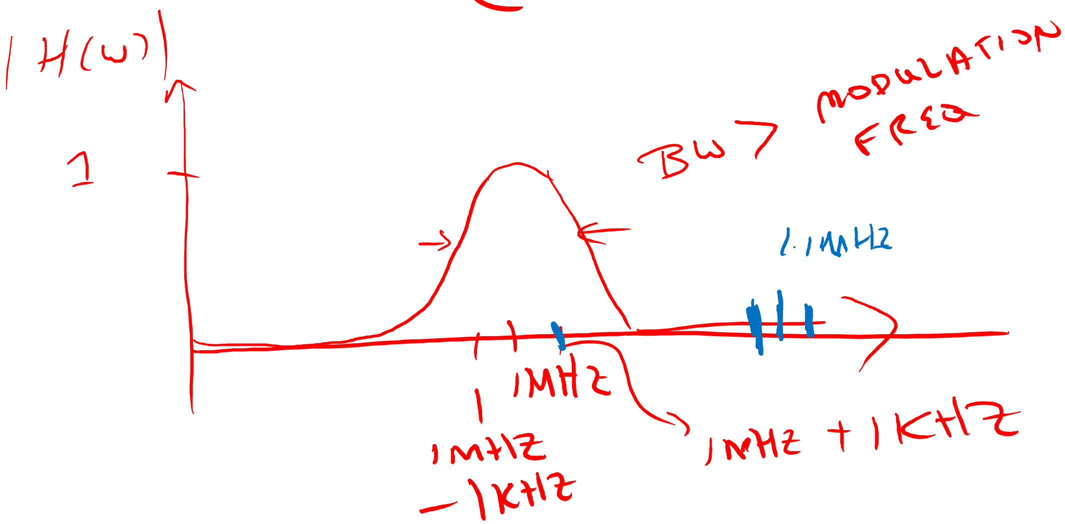
Sidebands

$$V(t) = \left(1V \sin(1kHz\, 2\pi t)\right) \sin(1MHz\, 2\pi t)$$

Fourier

$$= \mathrm{Re}\left[\sum a_n e^{j\omega_n t}\right]$$

$$= (1V)\, e^{j(1MHz + 1kHz)2\pi t} + (1V)\, e^{j(1MHz - 1kHz)2\pi t}$$



Demo