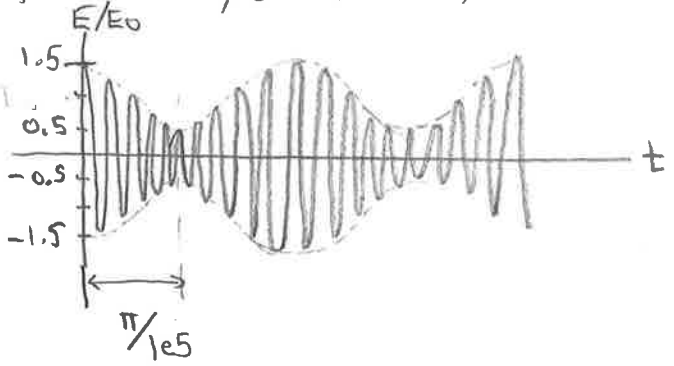
Ex 1.12

$\omega_c = 10^6$ rad/s carrier frequency

$\omega_m = 10^5$ rad/sec modulation frequency

$$E(t) = E_0 \underbrace{\left[1 + \alpha\cos(\omega_m t)\right]}_{\text{amplitude modulation}} \cos(\omega_c t)$$

a) If $\alpha = 0.5$, sketch $E(t)$

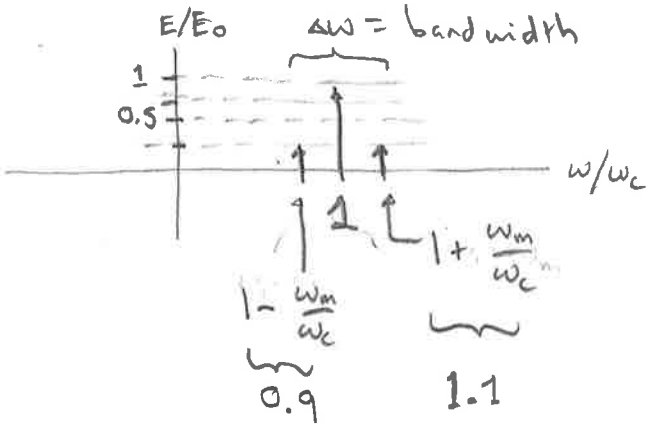


b) $E(t)$ also $= E_0\left[\cos(\omega_c t) + \alpha\cos(\omega_m t)\cos(\omega_c t)\right]$

$$E(t) = E_0\cos(\omega_c t) + \frac{\alpha E_0}{2}\cos(\omega_m + \omega_c)t + \frac{\alpha E_0}{2}\cos(\omega_c - \omega_m)t$$

(A sum of 3 signals of different frequencies of constant amp.)

c) Spectrum



d) For the audio spectrum, we need $\Delta\omega = 2\omega_m = (2)(20{,}000\text{Hz})(2\pi)$

$\Delta\omega = 251{,}327\ \frac{\pi}{s}$ or $\Delta f = 40$ kHz centered on the carrier frequency