

# Amplitude Modulation

① Step 1: in communication:

move out the message signal  $m(t)$  to a much higher freq;  $f_c$ .

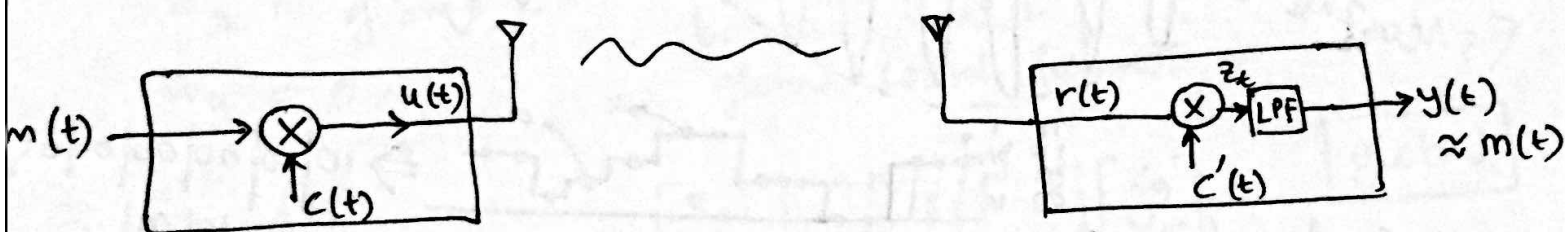
Step 2: send

Step 3: At receiver move back the received signal  $r_t$  to baseband.

② Many ways to send information:

- Modulate the amplitude of carrier
- Modulate phase
- Modulate freq.
- Modulate all those together.

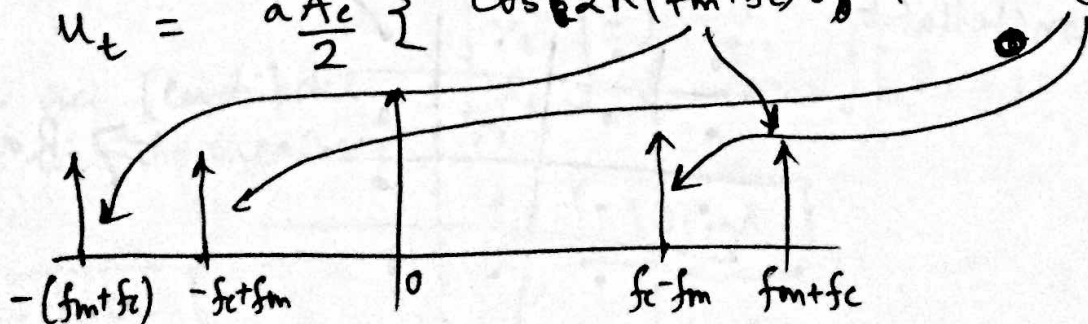
③ Basic sketch of amp. modulation



$$u_t = m_t \cdot A_c \cos(2\pi f_c t)$$

say  $m_t = a \cos 2\pi f_m t$

$$\therefore u_t = \frac{a A_c}{2} \left\{ \cos(2\pi(f_m + f_c)t) + \cos(2\pi(f_c - f_m)t) \right\}$$



Demod:  $r_t = A_c \cdot m_t \cos 2\pi f_c t$

$$z_t = r_t \cdot A_c \cos 2\pi f_c t = (A_c m_t \cos 2\pi f_c t) (A_c \cos 2\pi f_c t)$$

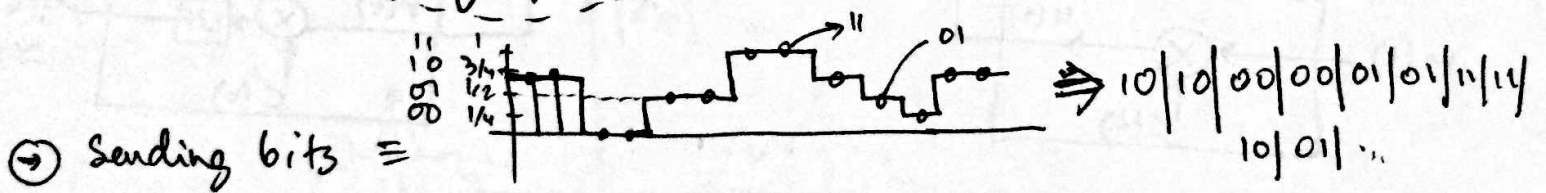
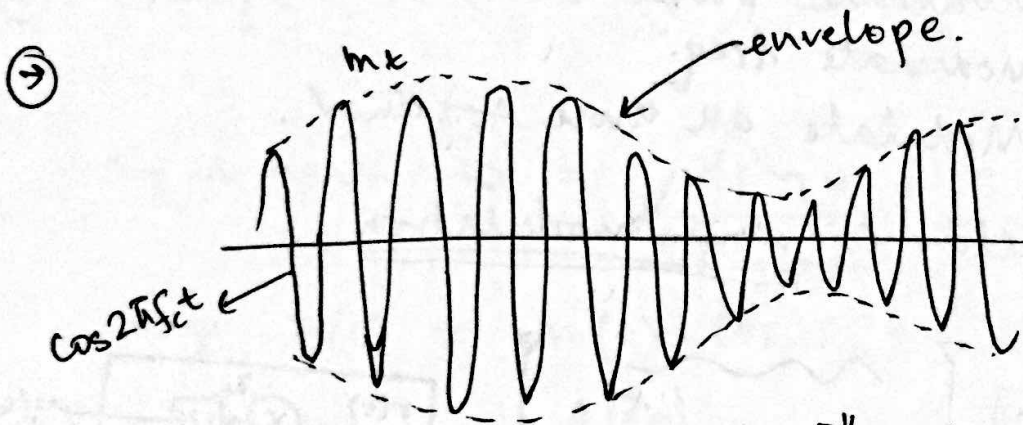
$$= A_c^2 m_t \cos(2\pi f_c t) \cdot \cos(2\pi f_c t)$$

$$z_t = A_c \cdot \frac{1}{2} m_t \left\{ \cos(2\pi 2f_c t) + \cos 0 \right\}$$

LPF ( $z_t$ ) only leaves  $\frac{A_c \cdot m_t}{2}$   
Constant:

∴ We recover  $m_t$ .

③ Of freq  $f_c$  has to match exactly at  $R_x$ .  
And sometimes phase has to match too. (PLL)



⑥ Freq. / Phase modulation is manipulating  $f_c$  and  $\phi_c$

⑦ QAM  $\Rightarrow$  modulating both

⑧ Constellation

