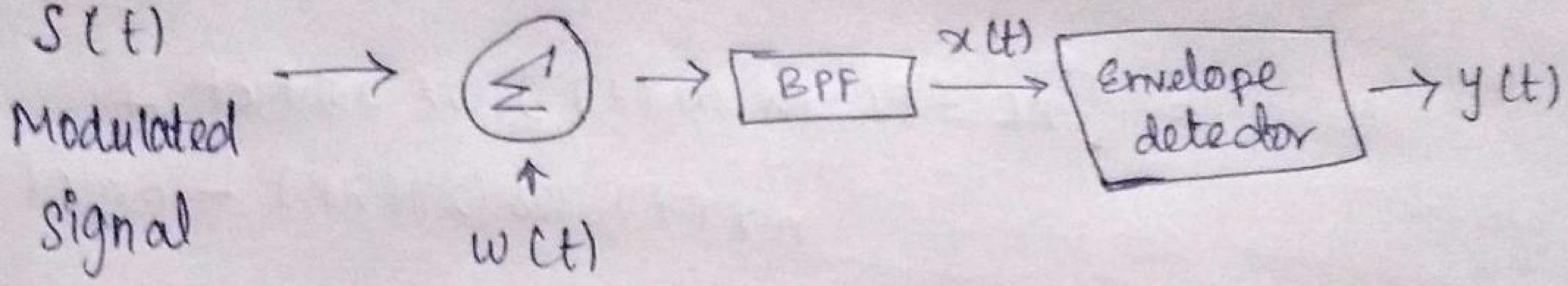
Noise in AM Reciever:



$$s(t) = A_c [1 + k_a m(t)] \cos(2\pi f_c t) \rightarrow ①$$

$A_c \cos 2\pi f_c t \rightarrow$ carrier signal

Average power of signal $\Big\} = \left(\frac{A_c}{\sqrt{2}}\right)^2 + \left(\frac{A_c k_a m(t)}{\sqrt{2}}\right)^2$

$$= \cancel{A} \frac{A_c^2 + A_c^2 k_a^2 m(t)}{2}$$

$$= \frac{A_c^2 (1 + k_a^2 P)}{2}$$

Average power of noise in message bandwidth $\Big\} = N_0 W$

$$(SNR)_{channel} = \frac{A_c^2 (1 + k_a^2 P)}{2 W N_0} \quad - ②$$

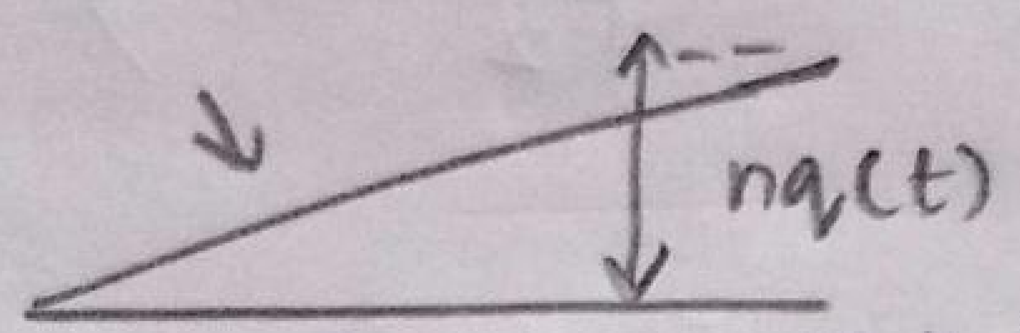
O/P SNR :

$$x(t) = s(t) + n(t)$$

$$= [A_c + A_c k_a m(t)] \cos 2\pi f_c t + n_x(t) \cos(2\pi f_c t) - n_q(t) \sin 2\pi f_c t$$

$$\text{O/P SNR} = [A_c + A_c k_a m(t) - n_I(t)] \cos 2\pi f_c t - n_q(t) \sin 2\pi f_c t \rightarrow (3)$$

Resultant y(t):



$$y(t) = \text{Envelope of } x(t)$$

$$= \sqrt{[A_c + A_c k_a m(t) + n_I(t)]^2 + n_q^2(t)}$$

if $[A_c + A_c k_a m(t) + n_I(t)]^2 >> n_q^2(t)$

$$y(t) = [A_c + A_c m(t) k_a + n_I(t)] = (4)$$

$$y(t) = A_c k_a m(t) + n_I(t) \rightarrow (5)$$

$$\text{Average O/P signal power} = \frac{A_c^2 k_a^2 P}{2} - (6)$$

Average O/P Noise power = $N_0 W$

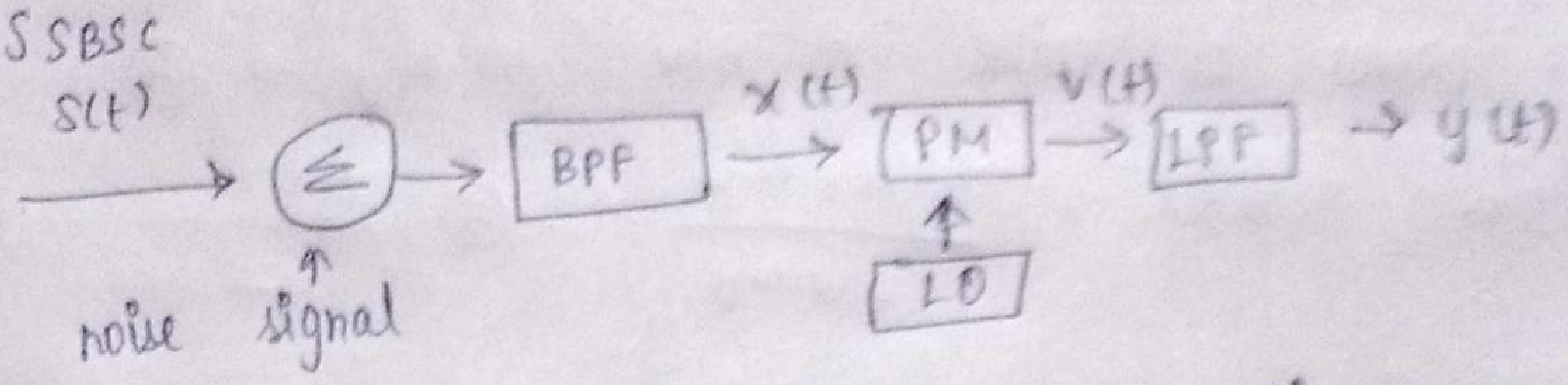
$$(SNR)_{output} = \frac{A_c^2 k_a^2 P}{2 N_0 W}$$

$$FOM = \frac{(SNR)_{output}}{(SNR)_{channel}} = \frac{A_c^2 k_a^2 P}{2 N_0 W} \times \frac{2 W n_b}{A_c^2 (1 + k_a^2 P)}$$

FOM = figure of merit

$$FOM = \frac{k_a^2 P}{1 + k_a^2 P} < 1$$

Noise in Linear Reciever



DSB - SC → coherent detection - Rx is linear

$A_C = 1$

DSB - SC component of filtered signal $x(t)$ is

$s(t) = (A_C \cos 2\pi f_C t \; m(t))$ — ①

$$(SNR)_I = \frac{\text{Avg. power of modulated signal } s(t)}{\text{Avg power of filtered noise } n(t)}$$

$$(SNR)_C = \frac{\text{Avg power of modulated signal}}{\text{Avg power of channel noise in message BW}}$$

$$(SNR)_0 = \frac{\text{Avg power of demodulated message signal}}{\text{Avg. power of Noise}}$$

$$FOM = \frac{(SNR)_0}{(SNR)_C} \quad \text{— ②}$$

Average power of DSB-SC modulated signal component } $= \frac{c^2 A_c^2 P}{2}$ — ③

Avg power of noise in BW $= W N_0$ → ④

$(SNR)_C$ DSBSC $= \frac{c^2 A_c^2 P}{2 W N_0}$ — ⑤

Total signal at coherent detector i/p is

$x(t) = s(t) + n(t)$

$= A_c \cos(2\pi f_c t)\, m(t) + n_I(t) \cos 2\pi f_c t - n_Q(t) \sin 2\pi f_c t$ → ⑥

O/P of PM ~~component~~ component of coherent detector is $v(t) = x(t) \cos 2\pi f_c t$

$v(t) = A_c \cos^2(2\pi f_c t)\, m(t) + n_I(t) \cos^2 2\pi f_c t - n_Q(t) \sin 2\pi f_c t \cos 2\pi f_c t$

$= A_c\, m(t) \left[\frac{1 + \cos(4\pi f_c t)}{2}\right] + n_I(t) \left[\frac{1 + \cos 4\pi f_c t}{2}\right]$

$= \frac{1}{2} n_Q(t) \left[\sin(2\pi f_c t + 2\pi f_c t) + \sin(2\pi f_c t - 2\pi f_c t)\right]$

$= \frac{1}{2} (A_c\, m(t) + \frac{1}{2} n_I(t) - \frac{1}{2} n_Q(t) \sin 4\pi f_c t + \frac{1}{2} [(A_c\, m(t)\, n_I(t)] \cos 4\pi f_c t$ → ⑦

Rx o/p y(t),

$$y(t) = \frac{1}{2}(A_C\, m(t) + \frac{1}{2} n_I(t) \quad -(8)$$

Message signal comp at Rx o/p = $\frac{(A_c m(t)}{2}$ -(9)

Avg. power of msg signal component } = $\frac{C^2 A_C^2 P}{4}$ -(10)

P → Avg power of msg signal

Noise component at Rx o/p is $\frac{n_I(t)}{2}$ -(11)

Avg. power of noise at Rx o/p = $\frac{W N_0}{2}$ -(12)

$$\text{O/P SNR } (SNR)_0, \text{DSBSC} = \frac{C^2 A_C^2 P/4}{W N_0/2}$$

$$= \frac{C^2 A_C^2 P}{2 W N_0} \quad -(13)$$

$$\text{FOM} = \frac{\frac{C^2 A_C^2 P}{2 W_0 N}}{\frac{C^2 A_C^2 P}{2 W_0 N}} \Rightarrow 1$$

FOM = 1