

招生學年度	103	招生類別	碩士班
系所班別	電機光電碩士班聯合招生 (電機工程學系碩士班、電機工程學系 電子工程碩士班、光電工程學系碩士班)		
科目名稱	通訊原理		
注意事項	本考科可使用掌上型計算機		

1. (20%) Assume that a message signal is given by

$$m(t) = 2 \cos(2\pi f_m t) + \cos(4\pi f_m t)$$

Calculate an expression for

$$X_c(t) = \frac{1}{2} A_c m(t) \cos(2\pi f_c t) \pm \frac{1}{2} A_c \hat{m}(t) \sin(2\pi f_c t)$$

for $A_c = 4$. Show that the result is upper-sideband or lower-sideband SSB depending upon the choice of the algebraic sign.

2. An FM modulator has output

$$X_c(t) = 100 \cos \left[2\pi f_c t + 2\pi f_d \int m(\alpha) d\alpha \right]$$

where $f_d = 20 \text{ Hz/V}$. Assume that $m(t)$ is the rectangular pulse

$$m(t) = 4\Pi \left[\frac{(t-4)}{8} \right].$$

- (6%) Sketch the phase deviation in radians.
 - (6%) Sketch the frequency deviation in hertz.
 - (6%) Determine the peak frequency deviation in hertz.
 - (6%) Determine the peak phase deviation in radians.
 - (6%) Determine the power at the modulator output.
3. (20%) Let $X(t) = A \sin(Wt + Y)$, where A , W and Y are independent random variables. Assume A has mean 9 and variance 25, Y is uniform on $[-2\pi, 2\pi]$, and W is uniform on $[-20, 20]$. Find the mean and autocorrelation for the random process $X(t)$.
4. Suppose the impulse response of a linear system is given by $h(t) = 3, 2 < t < 5$.
- (10%) If the input $X(t)$ to this system is a white noise with spectral density $N_0/2 = 5$, find the autocorrelation function $R_Y(\tau)$, where $Y(t)$ is the output.
 - (10%) Now suppose the signal $s(t) = b_0 P(t) + b_1 P(t-3) + b_2 P(t-6)$, where $P(t) = 1, 0 < t < 3$, and $b_i = 1$ or -1 , is applied to the input of the system. For the case $b_0 = b_2 = -1$ and $b_1 = 1$, sketch the resulting output.
 - (10%) Now suppose the signal $s(t) + X(t)$ is applied to the input of the system. At what 3 instants should the output be sampled to detect b_0, b_1 and b_2 ? What is the variance of the output statistic at these sampling instants?