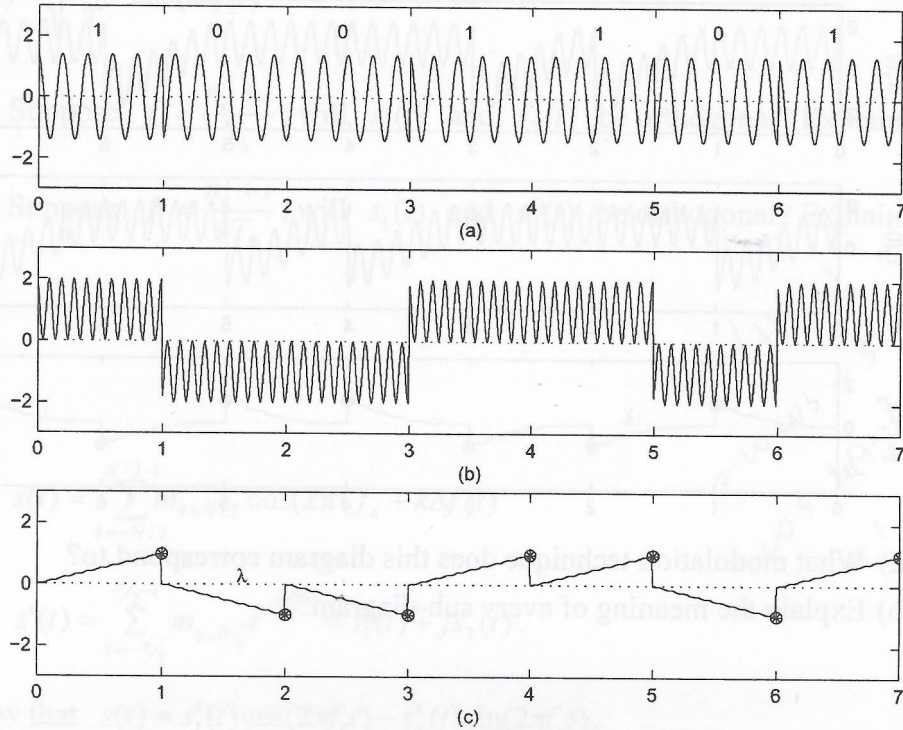


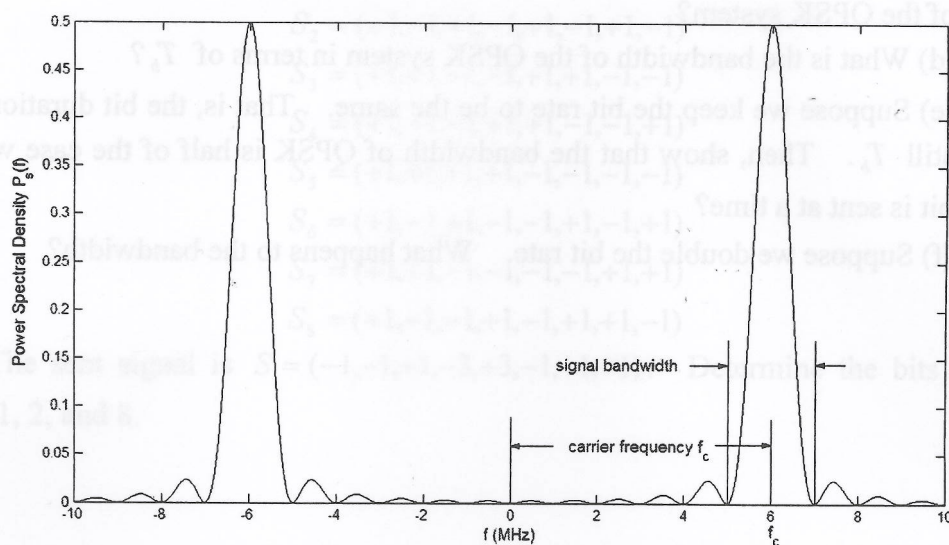
Communication Test (2011/01/14)

1. For the baseband pulse transmission, how can we differentiate users?
2. Consider the following diagram:

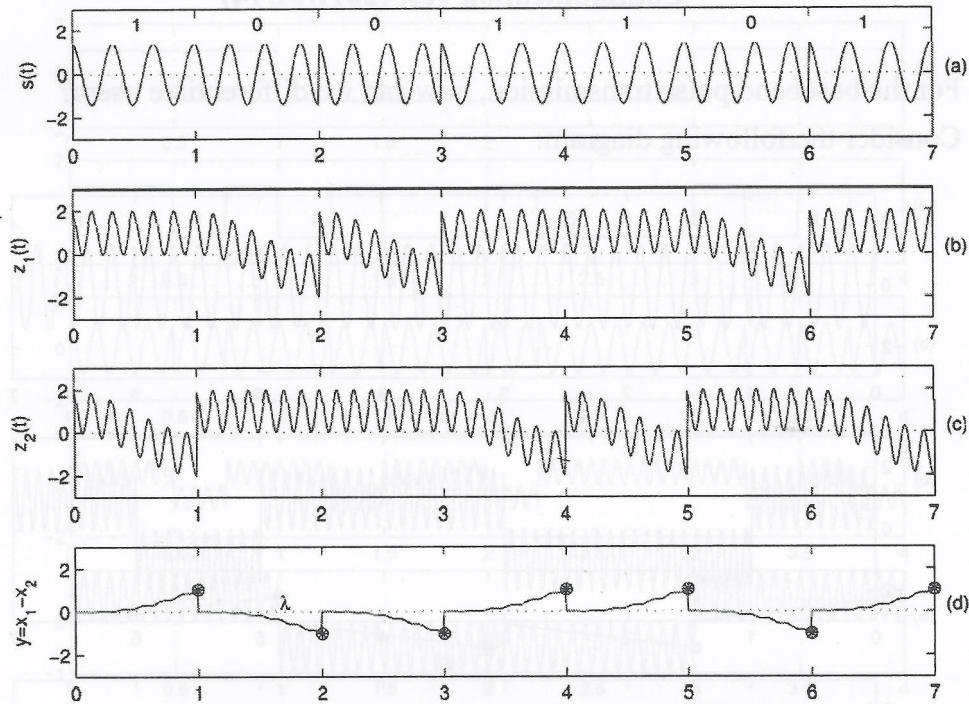


- (a) What modulation technique does this diagram correspond to?
- (b) Explain the meaning of every sub-diagram.

3. Explain the meaning of the following figure.



4. Consider the following diagram:



- (a) What modulation technique does this diagram correspond to?
- (b) Explain the meaning of every sub-diagram.

5. (a) For the QPSK system, two bits are bundled together to be sent out. Explain how the two bits are represented.
- (b) When the receiver receives a QPSK signal, how does it determine whether each bit is 1 or 0?
- (c) Suppose the bit duration time is T_b . What is the symbol duration time T of the QPSK system?
- (d) What is the bandwidth of the QPSK system in terms of T_b ?
- (e) Suppose we keep the bit rate to be the same. That is, the bit duration time is still T_b . Then, show that the bandwidth of QPSK is half of the case when one bit is sent at a time?
- (f) Suppose we double the bit rate. What happens to the bandwidth?

6. For the FSK system,

$$s_1(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_1 t) \quad \text{and} \quad f_i = \frac{n_c + i}{2T_b}$$

$$s_2(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_2 t)$$

(a) Suppose $f_i = \frac{n_c + i}{T_b}$, will $s_1(t)$ and $s_2(t)$ be orthogonal? Explain.

(b) Suppose $f_i = \frac{n_c + i}{4T_b}$, will $s_1(t)$ and $s_2(t)$ be orthogonal? Explain.

7. Let $s(t) = \sum_{k=-N/2}^{N/2-1} m_{k+N/2} \cos(2\pi(f_c + k\Delta f)t)$

and $s'(t) = \sum_{k=-N/2}^{N/2-1} m_{k+N/2} e^{j\frac{2\pi kt}{T}} = s'_1(t) + js'_2(t)$.

Show that $s(t) = s'_1(t) \cos(2\pi f_c t) - s'_2(t) \sin(2\pi f_c t)$.

8. Suppose there are eight users in a CDMA system whose vectors are as follows:

$$S_1 = (+1, +1, +1, +1, +1, +1, +1, +1)$$

$$S_2 = (+1, -1, +1, -1, +1, -1, +1, -1)$$

$$S_3 = (+1, +1, -1, -1, +1, +1, -1, -1)$$

$$S_4 = (+1, -1, -1, +1, +1, -1, -1, +1)$$

$$S_5 = (+1, +1, +1, +1, -1, -1, -1, -1)$$

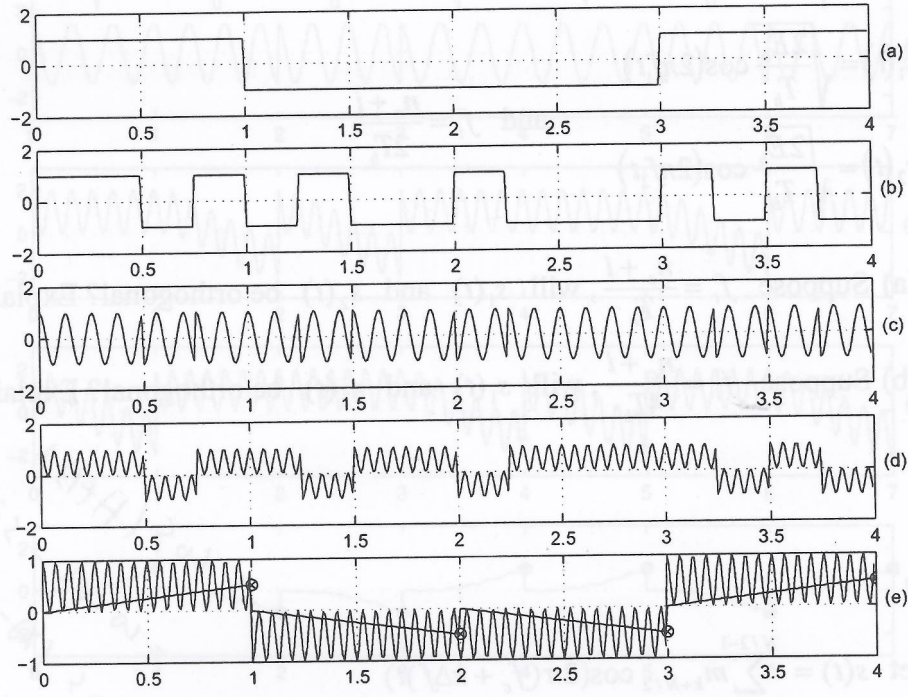
$$S_6 = (+1, -1, +1, -1, -1, +1, -1, +1)$$

$$S_7 = (+1, +1, -1, -1, -1, -1, +1, +1)$$

$$S_8 = (+1, -1, -1, +1, -1, +1, +1, -1)$$

The sent signal is $S = (-1, +1, +1, -3, +3, -1, +1, +1)$. Determine the bits sent of users 1, 2, and 8.

9.



- What modulation technique does this diagram correspond to?
- Explain the meaning of every sub-diagram.

10. Suppose you have two choices to transmit voice signal:

- by transmitting analog signal directly,
- and (2) by transmitting digital signal with high bit rate.

Which method will require a larger bandwidth? Explain.