Solution of ECE 315 Test 13 F06

Identify the kind of modulation in each case by circling the correct answer.

1. The information signal is simply multiplied by a sinusoidal carrier to form the transmitted signal.
   [DSBSC]   DSBTC   SSBSC   PAM
2. The Fourier transform of the transmitted signal consists of multiple scaled replicas of the Fourier transform of the information signal at integer multiples of the carrier's fundamental frequency.
   DSBSC   DSBTC   SSBSC   [PAM]
3. A scaled replica of the spectrum of the transmitted signal appears centered at $\pm f_c$ along with impulses also at $\pm f_c$ where f_c is the frequency of the sinusoidal carrier.
   DSBSC   [DSBTC]   SSBSC   PAM
4. Of these four modulation types, the one with the minimum bandwidth for the same information signal.
   DSBSC   DSBTC   [SSBSC]   PA
5. The information signal can be recovered by an envelope detector.
   DSBSC   [DSBTC]   SSBSC   PAM

Fill in the blank.

6. The technique of transmitting multiple signals at the same time and separating them by having each one modulate a different carrier frequency is called <u>frequency multiplexing</u>.
7. In synchronous demodulation a sinusoidal signal is generated in the receiver at the same frequency as the carrier of the incoming signal. The part of the receiver that generates this signal is called the <u>local oscillator</u>.
8. In DSBTC modulation, if the modulation index is too large a distortion a distortion of the demodulated signal occurs due to <u>overmodulation</u>.
9. In synchronous demodulation if the sinusoid generated in the receiver is not exactly the same frequency as the carrier frequency of the received signal the demodulated signal has an extra annoying tone in it called the <u>beat frequency</u>.
10. A sinusoid $4\cos(2\pi f_0 t)$ is analog multiplied by a carrier $3\cos(2\pi f_c t)$ to form a transmitted signal ($f_0 \neq f_c$). What is the signal power of the transmitted signal? (Hint: The signal power of the sum of two sinusoids at different frequencies is the sum of their individual signal powers and the signal power of any sinusoid is half of the square of its amplitude.)   Power = <u>36</u>.

$$4\cos(2\pi f_0 t) \times 3\cos(2\pi f_c t) = 12\cos(2\pi f_0 t)\cos(2\pi f_c t)$$

Using $\cos(x)\cos(y) = (1/2)[\cos(x-y) + \cos(x+y)]$,

$$4\cos(2\pi f_0 t) \times 3\cos(2\pi f_c t) = 6\cos(2\pi(f_0 - f_c)t) + 6\cos(2\pi(f_0 + f_c)_c t)$$

$$\text{Signal Power} = 6^2/2 + 6^2/2 = 36$$

OR

10. A sinusoid $3\cos(2\pi f_0 t)$ is analog multiplied by a carrier $8\cos(2\pi f_c t)$ to form a transmitted signal ($f_0 \neq f_c$). What is the signal power of the transmitted signal? (Hint: The signal power of the sum of two sinusoids at different frequencies is the sum of their individual signal powers and the signal power of any sinusoid is half of the square of its amplitude.)   Power = <u>144</u>.

$$3\cos(2\pi f_0 t) \times 8\cos(2\pi f_c t) = 24\cos(2\pi f_0 t)\cos(2\pi f_c t)$$

Using $\cos(x)\cos(y) = (1/2)[\cos(x-y) + \cos(x+y)]$,

$$3\cos(2\pi f_0 t) \times 8\cos(2\pi f_c t) = 12\cos(2\pi(f_0 - f_c)t) + 12\cos(2\pi(f_0 + f_c)_c t)$$

$$\text{Signal Power} = 12^2/2 + 12^2/2 = 144$$