Chapter 3: Amplitude Modulation

MULTIPLE CHOICE

1. AM stands for:
   a. Audio Modulation  
   b. Amplitude Modulation  
   c. Angle Modulation  
   d. Antenna Modulation
   ANS: B

2. The "envelope" of an AM signal is due to:
   a. the baseband signal  
   b. the carrier signal  
   c. the amplitude signal  
   d. none of the above
   ANS: A

3. If the audio \( V_a \sin(\omega_a t) \) modulates the carrier \( V_c \sin(\omega_c t) \), then the modulation index, \( m \), is:
   a. \( m = \frac{\omega_a}{\omega_c} \)  
   b. \( m = \frac{V_a}{V_c} \)  
   c. \( m = \left( \frac{V_a}{V_c} \right)^2 \)  
   d. \( m = \frac{V_a}{\omega_a} \)
   ANS: B

4. The equation for full-carrier AM is:
   a. \( v(t) = (E_c + E_m) \sin(\omega_c t) \)  
   b. \( v(t) = (E_c + E_m) \sin(\omega_m t) \)  
   c. \( v(t) = (E_c \times E_m) \sin(\omega_m t) \times \sin(\omega_c t) \)  
   d. \( v(t) = (E_c + E_m \sin(\omega_m t)) \sin(\omega_c t) \)
   ANS: D

5. Overmodulation causes:
   a. distortion  
   b. splatter  
   c. both a and b  
   d. none of the above
   ANS: C

6. The peak voltage of an AM signal goes from \( E_{\text{max}} \) to \( E_{\text{min}} \). The modulation index, \( m \), is:
   a. \( m = \frac{E_{\text{min}}}{E_{\text{max}}} \)  
   b. \( m = \frac{E_{\text{max}}}{E_{\text{min}}} \)  
   c. \( m = \frac{(E_{\text{max}} - E_{\text{min}})}{(E_{\text{max}} + E_{\text{min}})} \)  
   d. \( m = \frac{(E_{\text{max}} + E_{\text{min}})}{(E_{\text{max}} - E_{\text{min}})} \)
   ANS: C

7. If \( V_a \sin(\omega_a t) \) amplitude modulates the carrier \( V_c \sin(\omega_c t) \), it will produce the frequencies:
   a. \( \omega_c + \omega_a \) and \( \omega_c - \omega_a \)  
   b. \( (\omega_c + \omega_a)/2 \) and \( (\omega_c - \omega_a)/2 \)  
   c. \( \omega_c + \omega_a \) and \( 2\omega_c + 2\omega_a \)  
   d. none of the above
   ANS: A

8. At 100% modulation, the total sideband power is:
   a. equal to the carrier power  
   b. twice the carrier power  
   c. half the carrier power  
   d. 1.414 \times \text{carrier power}
   ANS: C
ANS: C

9. If a 5-kHz signal modulates a 1-MHz carrier, the bandwidth of the AM signal will be:
   a. 5 kHz
   b. 10 kHz
   c. 1.005 MHz
   d. none of the above

ANS: B

10. If an AM radio station increases its modulation index, you would expect:
    a. the audio to get louder at the receiver
    b. the received RF signal to increase
    c. the signal-to-noise ratio to increase
    d. all of the above

ANS: D

11. The modulation index can be derived from:
    a. the time-domain signal
    b. the frequency-domain signal
    c. both a and b
    d. none of the above

ANS: C

12. The main problem in using quadrature AM would be:
    a. requires too much bandwidth
    b. requires too much power
    c. incompatibility with ordinary AM radios
    d. all of the above

ANS: C

13. As compared to plain AM, SSB AM:
    a. is more efficient
    b. requires a more complex demodulator circuit
    c. requires less bandwidth
    d. all of the above

ANS: D

14. The SC in SSB SC stands for:
    a. single-carrier
    b. suppressed-carrier
    c. sideband-carrier
    d. none of the above

ANS: B

15. PEP stands for:
    a. Peak Envelope Power
    b. Peak Efficiency Power
    c. Peak Envelope Product
    d. none of the above

ANS: A

16. If an SSB transmitter radiates 1000 watts at peak modulation, what will it radiate with no modulation?
    a. 1000 watts
    b. 500 watts
    c. 250 watts
    d. 0 watts

ANS: D

17. Music on AM radio stations is "low-fidelity" because:
    a. AM is susceptible to noise
b. commercial AM stations use low power
c. commercial AM stations have a narrow bandwidth
d. all of the above

ANS: C

18. The type of information that can be sent using AM is:
   a. audio
c. digital data
   b. video
d. all of the above

ANS: D

19. Two tones modulate an AM carrier. One tone causes a modulation index of \( m_1 \) and the other tone causes a modulation index of \( m_2 \). The total modulation index is:
   a. \( m_1 + m_2 \)
c. \( \sqrt{m_1 \times m_2 + m_2 \times m_1} \)
   b. \( (m_1 + m_2) / 2 \)
d. \( \sqrt{m_1 \times m_1 + m_2 \times m_2} \)

ANS: D

20. To demodulate a USB SSB signal, the receiver must:
   a. be set to USB mode
c. both a and b
   b. reinsert the carrier
d. none of the above

ANS: C

COMPLETION

1. An advantage of AM is that the receiver can be very _________________.

   ANS: simple

2. A disadvantage of AM is its ________________ use of power.

   ANS: inefficient

3. The ________________ of an AM signal resembles the shape of the baseband signal.

   ANS: envelope

4. In AM, modulating with a single audio tone produces ________________ sidebands.

   ANS: two

5. Compared to the USB, the information in the LSB is ________________.

   ANS: the same

6. Compared to the USB, the power in the LSB is ________________.

   ANS: the same
7. In AM, total sideband power is always __________________ than the carrier power.
   ANS: less

8. In AM, as the modulation index increases, the carrier power ____________________.
   ANS: remains constant

9. The power in an AM signal is maximum when the modulation index is ________________.
   ANS: one

10. In AM, a voice-band signal of 300 Hz to 3000 Hz will require a bandwidth of ________________.
    ANS: 6000 Hz

11. With a 1-MHz carrier, if the LSB extends down to 990 kHz, then the USB will extend up to ___________.
    ANS: 1010 kHz

12. If an AM transmitter puts out 100 watts with no modulation, it will put out _______________ watts
    with 100% modulation.
    ANS: 150

SHORT ANSWER

1. An AM transmitter generates 100 watts with 0% modulation. How much power will it generate with 20%
   modulation?
   ANS: 102 watts

2. If the carrier power is 1000 watts, what is the power in the USB at 70.7% modulation?
   ANS: 125 watts

3. A carrier is modulated by three audio tones. If the modulation indexes for the tones are 0.3, 0.4, and 0.5,
   then what is the total modulation index?
   ANS: 0.707

4. You look at an AM signal with an oscilloscope and see that the maximum $V_{pp}$ is 100 volts and the
   minimum $V_{pp}$ is 25 volts. What is the modulation index?
   ANS: 0.6
5. A SSB transmitter is connected to a 50-ohm antenna. If the peak output voltage of the transmitter is 20 volts, what is the PEP?

ANS:
4 watts