Chapter 6: Receivers

MULTIPLE CHOICE

1. The two basic specifications for a receiver are:
   a. the sensitivity and the selectivity
   b. the number of converters and the number of IFs
   c. the spurious response and the tracking
   d. the signal and the noise
   
   ANS: A

2. The superheterodyne receiver was invented by:
   a. Foster
   b. Seeley
   c. Armstrong
   d. Hertz
   
   ANS: C

3. Trimmers and padders are:
   a. two types of adjusting tools
   b. small adjustable resistors
   c. small adjustable inductors
   d. small adjustable capacitors
   
   ANS: D

4. "Skin effect" refers to:
   a. the way radio signals travel across a flat surface
   b. the tissue-burning effect of a strong RF signal
   c. the increase of wire resistance with frequency
   d. none of the above
   
   ANS: C

5. The "front end" of a receiver can include:
   a. the tuner
   b. the RF amplifier
   c. the mixer
   d. all of the above
   
   ANS: D

6. "IF" stands for:
   a. intermediate frequency
   b. intermodulation frequency
   c. indeterminate frequency
   d. image frequency
   
   ANS: A

7. AGC stands for:
   a. Audio Gain Control
   b. Automatic Gain Control
   c. Active Gain Control
   d. Active Gain Conversion
   
   ANS: B

8. The frequency of the local oscillator:
   a. is above the RF frequency
b. is below the RF frequency
c. can be either above or below the RF frequency
d. is fixed, typically at 455 kHz.

ANS: C

9. The local oscillator and mixer are combined in one device because:
   a. it gives a greater reduction of spurious responses
   b. it increases sensitivity
   c. it increases selectivity
   d. it is cheaper

ANS: D

10. Basically, sensitivity measures:
    a. the weakest signal that can be usefully received
    b. the highest-frequency signal that can be usefully received
    c. the dynamic range of the audio amplifier
    d. none of the above

ANS: A

11. Basically, selectivity measures:
    a. the range of frequencies that the receiver can select
    b. with two signals close in frequency, the ability to receive one and reject the other
    c. how well adjacent frequencies are separated by the demodulator
    d. how well the adjacent frequencies are separated in the mixer

ANS: B

12. When comparing values for shape factor:
    a. a value of 1.414 dB is ideal
    b. a value of 0.707 is ideal
    c. a value of 1.0 is ideal
    d. there is no ideal value

ANS: C

13. When comparing values for shape factor:
    a. a value of 2 is better than a value of 4
    b. a value of 4 is better than a value of 2
    c. both values are basically equivalent
    d. none of the above

ANS: A

14. Distortion in a receiver can occur in:
    a. the mixer
    b. the detector
    c. the IF amplifiers
    d. all of the above

ANS: D

15. Phase distortion is important in:
    a. voice communications systems
    b. color video receivers
    c. monochrome video receivers
    d. all of the above

ANS: B
16. The response of a receiver to weak signals is usually limited by:
   a. the AGC  c. the dynamic range of the receiver
   b. noise generated in the receiver  d. the type of detector circuit being used

   ANS: B

17. Image frequencies occur when two signals:
   a. are transmitted on the same frequency
   b. enter the mixer, with one being a reflected signal equal to the IF frequency
   c. enter the mixer, one below and one above the local oscillator by a difference equal to the IF
   d. enter the mixer, and the difference between the two signals is equal to twice the IF

   ANS: C

18. An image must be rejected:
   a. prior to mixing
   b. prior to IF amplification
   c. prior to detection
   d. images cannot be rejected

   ANS: A

19. Image frequency problems would be reduced by:
   a. having an IF amplifier with the proper shape factor
   b. having a wideband RF amplifier after the mixer
   c. having a narrowband RF amplifier before the mixer
   d. none of the above

   ANS: C

20. A common AM detector is the:
   a. PLL
   b. envelope detector
   c. ratio detector
   d. all of the above

   ANS: B

21. An FM detector is the:
   a. PLL
   b. ratio detector
   c. quadrature detector
   d. all of the above

   ANS: D

22. Germanium diodes are used in AM detectors because:
   a. they are faster than silicon diodes
   b. they are cheaper than silicon diodes
   c. they minimize distortion from nonlinearity
   d. all of the above

   ANS: C

23. A common SSB detector is:
   a. a PLL
   b. a diode
   c. a BFO
   d. a product detector

   ANS: D
24. BFO stands for:
   a. Beat Frequency Oscillator  
   b. Barrier Frequency Oscillator  
   c. Bipolar Frequency Oscillator  
   d. Bistable Frequency Oscillator  
   ANS: A

25. To demodulate both SSB and DSBSC, you need to:
   a. use a Foster-Seeley discriminator  
   b. reinject the carrier  
   c. use double conversion  
   d. use one diode for SSB and two diodes for DSBSC  
   ANS: B

26. Which would be best for DSBSC:
   a. carrier detection  
   b. coherent detection  
   c. envelope detection  
   d. ratio detection  
   ANS: B

27. An FM detector that is not sensitive to amplitude variations is:
   a. Foster-Seeley detector  
   b. a quadrature detector  
   c. a PLL detector  
   d. all of the above  
   ANS: C

28. The function of a limiter is:
   a. to remove amplitude variations  
   b. to limit spurious responses  
   c. to limit dynamic range  
   d. to limit noise response  
   ANS: A

29. Suppressing the audio when no signal is present is called:
   a. AGC  
   b. squelch  
   c. AFC  
   d. limiting  
   ANS: B

30. LNA stands for:
   a. Limited-Noise Amplifier  
   b. Low-Noise Amplifier  
   c. Low-Noise Audio  
   d. Logarithmic Noise Amplification  
   ANS: B

31. AFC stands for:
   a. Audio Frequency Compensator  
   b. Autodyne Frequency Compensation  
   c. Automatic Frequency Control  
   d. Autonomous Frequency Control  
   ANS: C

32. The function of AFC is:
   a. maintain a constant IF frequency  
   b. match the local oscillator to the received signal
c. lock the discriminator to the IF frequency
d. none of the above

ANS: B

33. SAW stands for:
   a. Symmetrical Audio Wave
c. Silicon-Activated Wafer
   b. Surface Acoustic Wave
d. Software-Activated Wave

ANS: B

34. The important property of a SAW is:
   a. it stabilizes the audio in a receiver
c. it is a stable bandpass filter
   b. it allows software radios to be built
d. none of the above

ANS: C

35. The main function of the AGC is to:
   a. keep the gain of the receiver constant
   b. keep the gain of the IF amplifiers constant
c. keep the input to the detector at a constant amplitude
d. all of the above

ANS: C

36. DSP stands for:
   a. Dynamic Signal Properties
c. Distorted Signal Packet
   b. Direct Signal Phase
d. Digital Signal Processor

ANS: D

37. SINAD stands for:
   a. Sinusoidal Amplitude Distortion
   b. Signal and Noise Amplitude Distortion
c. Signal-plus-Noise-to-Noise Ratio
d. Signal-plus-Noise and Distortion-to-Noise and Distortion Ratio

ANS: D

38. TRF stands for:
   a. Tuned Radio Frequency
c. Transmitted Radio Frequency
   b. Tracking Radio Frequency
d. Tuned Receiver Function

ANS: A

COMPLETION

1. Almost all modern receivers use the _________________________ principle.

   ANS: superheterodyne

2. The first radio receiver of any kind was built in the year _________________.
3. When two tuned circuits ________________ each other, it means that when the frequency of one is adjusted, the other changes with it.

ANS: track

4. The ________________ effect causes the resistance of wire to increase with frequency.

ANS: skin

5. The superhet was invented in the year ________________.

ANS: 1918

6. In a receiver, the ________________ refers to the input filter and RF stage.

ANS: front end

7. In a superhet, the output of the ________________ goes to the IF amplifiers.

ANS: mixer

8. In a superhet, the ________________ frequency is the difference between the local oscillator frequency and the received signal frequency.

ANS: intermediate
IF

9. The ________________ circuit adjusts the gain of the IF amplifiers in response to signal strength.

ANS: AGC

10. An ________________ converter uses the same transistor for both the local oscillator and the mixer.

ANS: autodyne

11. In low-side injection, the local oscillator is ________________ than the received signal frequency.

ANS: lower

12. ________________ is the ability of a receiver to separate two signals that are close to each other in frequency.

ANS: Selectivity

13. ________________ is the ability of a receiver to receive and successfully demodulate a very weak signal.

ANS: Sensitivity
14. A receiver with two different IF frequencies is called a double-__________________ receiver.
   ANS: conversion
15. A multiple-conversion receiver will have better rejection of ____________________ frequencies.
   ANS: image
16. A demodulator is also called a ____________________.
   ANS: detector
17. An ____________________ detector uses a diode to half-wave rectify an AM signal.
   ANS: envelope
18. A ____________________ detector is used for SSB signals.
   ANS: product
19. A BFO produces a locally generated ____________________.
   ANS: carrier
20. A DSBSC signal requires a ____________________ detection circuit.
   ANS: coherent
21. FM detectors have a characteristic ____________________-shaped curve.
   ANS: S
22. While still commonly found, the Foster-Seeley and ratio detectors are ____________________.
   ANS: obsolescent
23. Unlike the PLL detector, the quadrature detector is sensitive to changes in ____________________ of the input signal.
   ANS: amplitude
24. A dual-__________________ MOSFET is useful for AGC.
   ANS: gate
25. Diode mixers are too ____________________ to be practical in most applications.
   ANS: noisy
26. The IF amplifiers in an AM receiver must be Class ____________________.
27. A double-tuned IF transformer is usually _______________ coupled for the response to have a flat top and steep sides.
   ANS: over

28. Multiple IF stages can be _______________-tuned to increase the bandwidth.
   ANS: stagger

29. Compared to tuned circuits, ceramic and crystal IF filters do not require _______________.
   ANS: adjustment

30. Up-conversion is when the output of the mixer is a _______________ frequency than the incoming signal.
   ANS: higher

31. In a block converter, the frequency of the first local oscillator is _______________.
   ANS: fixed

32. Typically, AGC reduces the gain of the _______________ amplifiers.
   ANS: IF

33. An _______________-meter is designed to indicate signal strength in many communications receivers.
   ANS: S

34. The effectiveness of FM _______________ is measured by a receiver’s quieting sensitivity.
   ANS: limiting

35. A _______________ refers to any kind of FM or PM detector.
   ANS: discriminator

SHORT ANSWER

1. Suppose the bandwidth of a tuned circuit is 10 kHz at 1 MHz. Approximately what bandwidth would you expect it to have at 4 MHz?
   ANS:
2. Using high-side injection for a 1-MHz IF, what is the frequency of the local oscillator when the receiver is tuned to 5 MHz?

ANS: 6 MHz

3. An IF filter has a –60 dB bandwidth of 25 kHz and a –6 dB bandwidth of 20 kHz. What is the shape factor value?

ANS: 1.25

4. Suppose a receiver uses a 5-MHz IF frequency. Assuming high-side injection, what would be the image frequency if the receiver was tuned to 50 MHz?

ANS: 60 MHz

5. Suppose a SSB receiver requires an injected frequency of 1.5 MHz. What would be the acceptable frequency range of the BFO if the maximum acceptable baseband shift is 100 hertz?

ANS: 1.5 MHz ± 100 hertz

6. The transformer of a double-tuned IF amplifier has a \( Q \) of 25 for both primary and secondary. What value of \( k \) do you need to achieve optimal coupling?

ANS: 0.06

7. What value of transformer coupling would a double-tuned 10-MHz IF amplifier with optimal coupling need to get a bandwidth of 100 kHz?

ANS: 0.01