ELECTRONICS PRINCIPLES (6th Edition)

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Chapter 1 INTRODUCTION

1. An ideal voltage source has
a. Zero internal resistance
b. Infinite internal resistance
c. A load-dependent voltage
d. A load-dependent current

2. A real voltage source has
a. Zero internal resistance
b. Infinite internal resistance
c. A small internal resistance
d. A large internal resistance

3. If a load resistance is 1 kohm, a stiff voltage source has a resistance of
a. At least 10 ohm
b. Less than 10 ohm
c. More than 100 kohm
d. Less than 100 kohm

4. An ideal current source has
a. Zero internal resistance
b. Infinite internal resistance
c. A load-dependent voltage
d. A load-dependent current

5. A real current source has
a. Zero internal resistance
b. Infinite internal resistance
c. A small internal resistance
d. A large internal resistance

6. If a load resistance is 1 kohm, a stiff current source has a resistance of
a. At least 10 ohm
b. Less than 10 ohm
c. More than 100 kohm
d. Less than 100 kohm

7. The Thevenin voltage is the same as the
a. Shorted-load voltage
b. Open-load voltage
c. Ideal source voltage
d. Norton voltage

8. The Thevenin resistance is equal in value to the
a. Load resistance
b. Half the load resistance
c. Internal resistance of a Norton circuit
d. Open-load resistance

9. To get the Thevenin voltage, you have to
a. Short the load resistor
b. Open the load resistor
c. Short the voltage source
d. Open the voltage source

10. To get the Norton current, you have to
a. Short the load resistor
b. Open the load resistor
c. Short the voltage source
d. Open the current source

11. The Norton current is sometimes called the
a. Shorted-load current
b. Open-load current
c. Thevenin current
d. Thevenin voltage

12. A solder bridge
a. may produce a short
b. may cause an open
c. is useful in some circuits
d. always has high resistance

13. A cold-solder joint
a. shows good soldering technique
b. usually produces an open
c. is sometimes useful
d. always has low resistance

14. An open resistor has
a. Infinite current through it
b. Zero voltage across it
c. Infinite voltage across it
d. Zero current through it

15. A shorted resistor has
a. Infinite current through it
b. Zero voltage across it
c. Infinite voltage across it
d. Zero current through it

16. An ideal voltage source and an internal resistance is an example of the
a. Ideal approximation
b. Second approximation
c. Higher approximation
d. Exact model

17. Treating a connecting wire as a conductor with zero resistance is an example of the
a. Ideal approximation
b. Second approximation
c. Higher approximation
d. Exact model

18. The voltage out of an ideal voltage source
a. Is zero
b. Is constant
c. Depends on the value of load resistance
d. Depends on the internal resistance

19. The current out of an ideal current source
a. Is zero
b. Is constant
c. Depends on the value of load resistance
d. Depends on the internal resistance

20. Thevenin's theorem replaces a complicated circuit facing a load by an
a. Ideal voltage source and parallel resistor
b. Ideal current source and parallel resistor
c. Ideal voltage source and series resistor
d. Ideal current source and series resistor

21. Norton's theorem replaces a complicated circuit facing a load by an
a. Ideal voltage source and parallel resistor
b. Ideal current source and parallel resistor
c. Ideal voltage source and series resistor

d. Ideal current source and series resistor

22. One way to short a device is
a. With a cold-solder joint
b. With a solder bridge
c. By disconnecting it
d. By opening it

23. Derivations are
a. Discoveries
b. Inventions
c. Produced by mathematics
d. Always called theorems

24. Laws are proved by
a. Definition
b. Experiment
c. Mathematics
d. Formulas

25. Definitions are
a. Man made
b. Invented
c. Made up
d. All of the above

Chapter 2 SEMICONDUCTORS

1. The nucleus of a copper atom contains how many protons?
a. 1
b. 4
c. 18
d. 29

2. The net charge of a neutral copper atom is
a. 0
b. +1
c. -1
d. +4

3. Assume the valence electron is removed from a copper atom. The net charge of the atom becomes
a. 0
b. + 1
c. -1
d. +4

4. The valence electron of a copper atom experiences what kind of attraction toward the nucleus?
a. None
b. Weak
c. Strong
d. Impossible to say

5. How many valence electrons does a silicon atom have?
a. 0
b. 1
c. 2
d. 4

6. Which is the most widely used semiconductor?
a. Copper
b. Germanium
c. Silicon
d. None of the above

7. How many protons does the nucleus of a silicon atom contain?
a. 4
b. 14
c. 29
d. 32

8. Silicon atoms combine into an orderly pattern called a
a. Covalent bond
b. Crystal
c. Semiconductor
d. Valence orbit

9. An intrinsic semiconductor has some holes in it at room temperature. What causes these holes?
a. Doping
b. Free electrons
c. Thermal energy
d. Valence electrons

10. Each valence electron in an intrinsic semiconductor establishes a
a. Covalent bond
b. Free electron
c. Hole
d. Recombination

11. The merging of a free electron and a hole is called
a. Covalent bonding
b. Lifetime
c. Recommendation
d. Then-nal energy

12. At room temperature an intrinsic silicon crystal acts approximately like
a. A battery
b. A conductor
c. An insulator
d. A piece of copper wire

13. The amount of time between the creation of a hole and its disappearance is called
a. Doping
b. Lifetime
c. Recombination
d. Valence

14. The valence electron of a conductor is also called a
a. Bound electron
b. Free electron
c. Nucleus
d. Proton

15. A conductor has how many types of flow?
a. 1
b, 2
c. 3
d. 4

16. A semiconductor has how many types of flow?
a. 1
b. 2
c. 3
d. 4

17. When a voltage is applied to a semiconductor, holes will flow
a. Away from the negative potential
b. Toward the positive potential
c. In the external circuit
d. None of the above

18. A conductor has how many holes?
a. Many
b. None
c. Only those produced by thermal energy
d. The same number as free electrons

19. In an intrinsic semiconductor, the number of free electrons
a. Equals the number of holes
b. Is greater than the number of holes
c. Is less than the number of holes
d. None of the above

20. Absolute zero temperature equals
a. -273 degrees C
b. 0 degrees C
c. 25 degrees C
d. 50 degrees C

21. At absolute zero temperature an intrinsic semiconductor has
a. A few free electrons
b. Many holes
c. Many free electrons
d. No holes or free electrons

22. At room temperature an intrinsic semiconductor has
a. A few free electrons and holes
b. Many holes
c. Many free electrons
d. No holes

23. The number of free electrons and holes in an intrinsic semiconductor increases when the temperature
a. Decreases
b. Increases
c. Stays the same
d. None of the above

24. The flow of valence electrons to the left means that holes are flowing to the
a. Left
b. Right
c. Either way
d. None of the above

25. Holes act like
a. Atoms
b. Crystals
c. Negative charges
d. Positive charges

26. Trivatent atoms have how many valence electrons?
a. 1
b. 3
c. 4
d. 5

27. A donor atom has how many valence electrons?
a. 1
b. 3
c. 4
d. 5

28. If you wanted to produce a p-type semiconductor, which of these would you use?
a. Acceptor atoms
b. Donor atoms
c. Pentavalent impurity
d. Silicon

29. Holes are the minority carriers in which type of semiconductor?
a. Extrinsic
b. Intrinsic
c. n-type
d. p-type

30. How many free electrons does a p-type semiconductor contain?
a. Many
b. None
c. Only those produced by thermal energy
d. Same number as holes

31. Silver is the best conductor. How many valence electrons do you think it has?
a. 1
b. 4
c. 18
d. 29

32. Suppose an intrinsic semiconductor has 1 billion free electrons at room temperature. If the temperature changes to 75'C, how many holes are there?
a. Fewer than 1 billion
b. 1 billion
c. More than 1 billion
d. Impossible to say

33. An external voltage source is applied to a p-type semiconductor. If the left end of the crystal is positive, which way do the majority carriers flow?
a. Left
b. Right
c. Neither
d. Impossible to say

34. Which of the following doesn't fit in the group?
a. Conductor
b. Semiconductor
c. Four valence electrons
d. Crystal structure

35. Which of the following is approximately equal to room temperature?
a. 0 degrees C
b. 25 degrees C
c. 50 degrees C
d. 75degrees C

36. How many electrons are there in the valence orbit of a silicon atom within a crystal?
a. 1
b. 4
c. 8
d. 14

37. Positive ions are atoms that have
a. Gained a proton
b. Lost a proton
c. Gained an electron
d. Lost an electron

38. Which of the following describes an n-type semiconductor?
a. Neutral
b. Positively charged
c. Negatively charged
d. Has many holes

39. A p-type semiconductor contains holes and
a. Positive ions
b. Negative ions
c. Pentavalent atoms
d. Donor atoms

40. Which of the following describes a p-type semiconductor?
a. Neutral
b. Positively charged
c. Negatively charged
d. Has many free electrons

41. Which of the following cannot move?
a. Holes
b. Free electrons
c. Ions
d. Majority carriers

42. What causes the depletion layer?
a. Doping
b. Recombination
c. Barrier potential
d. Ions

43. What is the barrier potential of a silicon diode at room temperature?
a. 0.3 V
b. 0.7 V
c. 1 V
d. 2 mV per degree Celsius

44. To produce a large forward current in a silicon diode, the applied voltage must be greater than
a. 0
b. 0.3 V
c. 0.7 V
d. 1 V

45. In a silicon diode the reverse current is usually
a. Very small
b. Very large
c. Zero
d. In the breakdown region

46. Surface-leakage current is part of the
a. Forward current
b. Forward breakdown
c. Reverse current
d. Reverse breakdown

47. The voltage where avalanche occurs is called the
a. Barrier potential
b. Depletion layer
c. Knee voltage
d. Breakdown voltage

48. Diffusion of free electrons across the junction of an unbiased diode produces
a. Forward bias
b. Reverse bias
c. Breakdown
d. The depletion layer

49. When the reverse voltage increases from 5 to 10 V, the depletion layer
a. Becomes smaller
b. Becomes larger
c. Is unaffected
d. Breaks down

50. When a diode is forward-biased, the recombination of free electrons and holes may produce
a. Heat
b. Light
c. Radiation
d. All of the above

Chapter 3 DIODE THEORY

1 . When the graph of current versus voltage is a straight line, the device is referred to as
a. Active
b. Linear
c. Nonlinear
d. Passive

2. What kind of device is a resistor?
a. Unilateral
b. Linear
c. Nonlinear
d. Bipolar

3. What kind of a device is a diode?
a. Bilateral
b. Linear
c. Nonlinear
d. Unipolar

4. How is a nonconducting diode biased?
a. Forward
b. Inverse
c. Poorly
d. Reverse

5. When the diode current is large, the bias is
a. Forward
b. Inverse
c. Poor
d. Reverse

6. The knee voltage of a diode is approximately equal to the
a. Applied voltage
b. Barrier potential
c. Breakdown voltage
d. Forward voltage

7. The reverse current consists of minority-carrier current and

a. Avalanche current
b. Forward current
c. Surface-leakage current
d. Zener current

8. How much voltage is there across the second approximation of a silicon diode when it is forward biased?
a. 0
b. 0.3 V
c. 0.7 V
d. 1 V

9. How much current is there through the second approximation of a silicon diode when it is reverse biased?
a. 0
b. 1 mA
c. 300 mA
d. None of the above

10. How much forward diode voltage is there with the ideal-diode approximation?
a. 0
b. 0.7 V
c. More than 0.7 V
d. 1 V

11. The bulk resistance of a 1N4001 is
a. 0
b. 0.23 ohm
c. 10 ohm
d. 1 kohm

12. If the bulk resistance is zero, the graph above the knee becomes
a. Horizontal
b. Vertical
c. Tilted at 450
d. None of the above

13. The ideal diode is usually adequate when
a. Troubleshooting
b. Doing precise calculations
c. The source voltage is low
d. The load resistance is low

14. The second approximation works well when
a. Troubleshooting
b. Load resistance is high
c. Source voltage is high
d. All of the above

15. The only time you have to use the third approximation is when
a. Load resistance is low
b. Source voltage is high
c. Troubleshooting
d. None of the above

16. How much load current is there in Fig. 3-19 (see your textbook) with the ideal diode?
a. 0
b. 14.3 mA
c. 15 mA
d. 50 mA

17. How much load current is there in Fig. 3-19 (see your textbook) with the second approximation?
a. 0
b. 14.3 mA
c. 15 mA
d. 50 mA

18. How much load current is there in Fig. 3-19 with the third approximation?
a. 0
b. 14.3 mA
c. 15 mA
d. 50 mA

19. If the diode is open in Fig. 3-19, the load voltage is
a. 0
b. 14.3 V
c. 20 V
d. -15 V

20. If the resistor is ungrounded in Fig. 3-19, the voltage measured with a DMM between the top of the resistor and ground is closest to
a. 0
b. 15 V
c. 20 V
d. -15 V

21. The load voltage measures zero in Fig. 3-19. The trouble may be
a. A shorted diode
b. An open diode
c. An open load resistor
d. Too much supply voltage

Chapter 4 DIODE CIRCUITS

1. If N1/N2 = 2, and the primary voltage is 120 V, what is the secondary voltage?
a. 0 V
b. 36 V
c. 60 V
d. 240 V

2. In a step-down transformer, which is larger?
a. Primary voltage
b. Secondary voltage
c. Neither
d. No answer possible

3. A transformer has a turns ratio of 4: 1. What is the peak secondary voltage if 115 V rms is applied to the primary winding?
a. 40.7 V
b. 64.6 V
c. 163 V
d. 650 V

4. With a half-wave rectified voltage across the load resistor, load current flows for what part of a cycle?
a. 0 degrees
b. 90 degrees
c. 180 degrees
d. 360 degrees

5. Line voltage may be from 105 V rms to 125 rms in a half-wave rectifier. With a 5:1 step-down transformer, the maximum peak load voltage is closest to

a. 21 V
b. 25 V
c. 29.6 V
d. 35.4 V

6. The voltage out of a bridge rectifier is a
a. Half-wave signal
b. Full-wave signal
c. Bridge-rectified signal
d. Sine wave

7. If the line voltage is 115 V rms, a turns ratio of 5: 1 means the rms secondary voltage is closest to
a. 15 V
b. 23 V
c. 30 V
d. 35 V

8. What is the peak load voltage in a full-wave rectifier if the secondary voltage is 20 V rms?
a. 0 V
b. 0.7 V
c. 14.1 V
d. 28.3 V

9. We want a peak load voltage of 40 V out of a bridge rectifier. What is the approximate rms value of secondary voltage?
a. 0 V
b. 14.4 V
c. 28.3 V
d. 56.6 V

10. With a full-wave rectified voltage across the load resistor, load current flows for what part of a cycle?
a. 0 degrees
b. 90 degrees
c. 180 degrees
d. 360 degrees

11. What is the peak load voltage out of a bridge rectifier for a secondary voltage of 15 V rms? (Use second approximation.)
a. 9.2 V
b. 15 V
c. 19.8 V
d. 24.3 V

12. If line frequency is 60 Hz, the output frequency of a half-wave rectifier is
a. 30 Hz
b. 60 Hz
c. 120 Hz
d. 240 Hz

13. If line frequency is 60 Hz, the output frequency of a bridge rectifier is
a. 30 Hz
b. 60 Hz
c. 120 Hz
d. 240 Hz

14. With the same secondary voltage and filter, which has the most ripple?
a. Half-wave rectifier
b. Full-wave rectifier
c. Bridge rectifier
d. Impossible to say

15. With the same secondary voltage and filter, which produces the least load voltage?
a. Half-wave rectifier
b. Full-wave rectifier
c. Bridge rectifier
d. Impossible to say

16. If the filtered load current is 10 mA, which of the following has a diode current of 10 mA?
a. Half-wave rectifier
b. Full-wave rectifier
c. Bridge rectifier
d. Impossible to say

17. If the load current is 5 mA and the filter capacitance is 1000uF, what is the peak-to-peak ripple out of a bridge rectifier?
a. 21.3 pV
b. 56.3 nV
c. 21.3 mV
d. 41.7 mV

18. The diodes in a bridge rectifier each have a maximum dc current rating of 2 A. This means the dc load current can have a maximum value of
a. 1 A
b. 2 A
c. 4 A
d. 8 A

19. What is the PIV across each diode of a bridge rectifier with a secondary voltage of 20 V rms?
a. 14.1 V
b. 20 V
c. 28.3 V
d. 34 V

20. If the secondary voltage increases in a bridge rectifier with a capacitor-input filter, the load voltage will
a. Decrease
b. Stay the same
c. Increase
d. None of these

21. If the filter capacitance is increased, the ripple will
a. Decrease
b. Stay the same
c. Increase
d. None of these

Chapter 5 SPECIAL-PURPOSE DIODES

1. What is true about the breakdown voltage in a zener diode?
a. It decreases when current increases.
b. It destroys the diode.
c. It equals the current times the resistance.
d. It is approximately constant.

2. Which of these is the best description of a zener diode?
a. It is a rectifier diode.
b. It is a constant-voltage device.
c. It is a constant-cuffent device.
d. It works in the forward region.

3. A zener diode
a. Is a battery
b. Has a constant voltage in the breakdown region
c. Has a barrier potential of 1 V
d. Is forward-biased

4. The voltage across the zener resistance is usually
a. Small
b. Large
c. Measured in volts
d. Subtracted from the breakdown voltage

5. If the series resistance decreases in an unloaded zener regulator, the zener current
a. Decreases
b. Stays the same
c. Increases
d. Equals the voltage divided by the resistance

6. In the second approximation, the total voltage across the zener diode is the sum of-the breakdown voltage and the voltage across the
a. Source
b. Series resistor
c. Zener resistance
d. Zener diode

7. The load voltage is approximately constant when a zener diode is
a. Forward-biased
b. Reverse-biased
c. Operating in the breakdown region
d. Unbiased

8. In a loaded zener regulator, which is the largest current?
a. Series current
b. Zener current
c. Load current
d. None of these

9. If the load resistance decreases in a zener regulator, the zener current
a. Decreases
b. Stays the same
c. Increases
d. Equals the source voltage divided by the series resistance

10. If the load resistance decreases in a zener regulator, the series current
a. Decreases
b. Stays the same
c. Increases
d. Equals the source voltage divided by the series resistance

11. When the source voltage increases in a zener regulator, which of these currents remains approximately constant?
a. Series current
b. Zener current
c. Load current
d. Total current

12. If the zener diode in a zener regulator is connected with the wrong polarity, the load voltage will be closest to
a. 0.7 V
b. 10 V
c. 14 V
d. 18 V

13. At high frequencies, ordinary diodes don't work properly because of
a. Forward bias
b. Reverse bias
c. Breakdown
d. Charge storage

14. The capacitance of a varactor diode increases when the reverse voltage across it
a. Decreases
b. Increases
c. Breaks down
d. Stores charges

15. Breakdown does not destroy a zener diode provided the zener current is less than the
a. Breakdown voltage
b. Zener test current
c. Maximum zener current rating
d. Banier potential

16. To display the digit 8 in a seven-segment indicator,
a. C must be lighted
b. G must be off
c. F must be on
d. All segments must be on

17. A photodiode is normally
a. Forward-biased
b. Reverse-biased
c. Neither forward- nor reverse-biased
d. Emitting light

18. When the light increases, the reverse minority carrier current in a photodiode
a. Decreases
b. Increases
c. Is unaffected
d. Reverses direction

19. The device associated with voltage-controlled capacitance is a
a. Light-emitting diode
b. Photodiode
c. Varactor diode
d. Zener diode

20. If the depletion layer gets wider, the capacitance
a. Decreases
b. Stays the same
c. Increases
d. Is variable

21. When the reverse voltage increases, the capacitance
a. Decreases
b. Stays the same
c. Increases
d. Has more bandwidth

22. The varactor is usually
a. Forward-biased
b. Reverse-biased
c. Unbiased
d. Operated in the breakdown region

23. The device to use for rectifying a weak ac signal is a
a. Zener diode
b. Light-emitting diode
c. Varistor
d. Back diode

24. Which of the following has a negative-resistance region?
a. Tunnel diode
b. Step-recovery diode
c. Schottky diode
d. Optocoupler

25. A blown-fuse indicator uses a
a. Zener diode
b. Constant-cuffent diode
c. Light-emitting diode
d. Back diode

26. To isolate an output circuit from an input circuit, which is the device to use?
a. Back diode
b. Optocoupler
c. Seven-segment indicator
d. Tunnel diode

27. The diode with a forward voltage drop of approximately 0.25 V is the
a. Step-recovery diode
b. Schottky diode
c. Back diode
d. Constant-current diode

28. For typical operation, you need to use reverse bias with a
a. Zener diode
b. Photodiode
c. Varactor
d. All of the above

Chapter 6 BIPOLAR TRANSISTOR

1. A transistor has how many doped regions?
a. 1
b. 2
c. 3
d. 4

2. What is one important thing transistors do?
a. Amplify weak signals
b. Rectify line voltage
C. Regulate voltage
d. Emit light

3. Who invented the first junction transistor?
a. Bell
b. Faraday
c. Marconi
d. Schockley

4. In an npn transistor, the majority carriers in the base are
a. Free electrons
b. Holes
c. Neither
d. Both

5. The barrier potential across each silicon depletion layer is
a. 0
b. 0.3 V
c. 0.7 V
d. 1 V

6. The emitter diode is usually
a. Forward-biased
b. Reverse-biased
c. Nonconducting
d. Operating in the breakdown region

7. For normal operation of the transistor, the collector diode has to be
a. Forward-biased
b. Reverse-biased
c. Nonconducting
d. Operating in the breakdown region

8. The base of an npn transistor is thin and
a. Heavily doped
b. Lightly doped
c. Metallic
d. Doped by a pentavalent material

9. Most of the electrons in the base of an npn transistor flow
a. Out of the base lead
b. Into the collector
c. Into the emitter
d. Into the base supply

10. Most of the electrons in the base of an npn transistor do not recombine because they
a. Have a long lifetime
b. Have a negative charge
c. Must flow a long way through the base
d. Flow out of the base

11. Most of the electrons that flow through the base will
a. Flow into the collector
b. Flow out of the base lead
c. Recombine with base holes
d. Recombine with collector holes

12. The current gain of a transistor is the ratio of the
a. Collector current to emitter current
b. Collector current to base current
c. Base current to collector current
d. Emitter current to collector current

13. Increasing the collector supply voltage will increase
a. Base current
b. Collector current
c. Emitter current
d. None of the above

14. The fact that only a few holes are in the base region means the base is
a. Lightly doped
b. Heavily doped
c. Undoped
d. None of the above

15. In a normally biased npn transistor, the electrons in the emitter have enough energy to overcome the barrier potential of the
a. Base-emitter junction
b. Base-collector junction
c. Collector-base junction

d. Recombination path

16. When a free electron recombines with a hole in the base region, the free electron becomes
a. Another free electron
b. A valence electron
c. A conduction-band electron
d. A majority carrier

17. What is the most important fact about the collector current?
a. It is measured in milliamperes.
b. It equals the base current divided by the current gain.
c. It is small.
d. It approximately equals the emitter current.

18. If the current gain is 200 and the collector current is 100 mA, the base current is
a. 0.5 mA
b. 2 mA
c. 2 A
d. 20 A

19. The base-emitter voltage is usually
a. Less than the base supply voltage
b. Equal to the base supply voltage
c. More than the base supply voltage
d. Cannot answer

20. The collector-emitter voltage is usually
a. Less than the collector supply voltage
b. Equal to the collector supply voltage
c. More than the collector supply voltage
d. Cannot answer

21. The power dissipated by a transistor approximately equals the collector current times
a. Base-emitter voltage
b. Collector-emitter voltage
c. Base supply voltage
d. 0.7 V

22. A small collector current with zero base current is caused by the leakage current of the
a. Emitter diode
b. Collector diode
c. Base diode
d. Transistor

23. A transistor acts like a diode and a
a. Voltage source
b. Current source
c. Resistance
d. Power supply

24. If the base current is 100 mA and the current gain is 30, the collector current is
a. 300 mA
b. 3 A
c. 3.33 A
d. 10 A

25. The base-emitter voltage of an ideal transistor is
a. 0
b. 0.3 V
c. 0.7 V
d. 1 V

26. If you recalculate the collector-emitter voltage with the second approximation, the answer will usually be
a. Smaller than the ideal value
b.. The same as the ideal value
c. Larger than the ideal value
d. Inaccurate

27. In the active region, the collector current is not changed significantly by
a. Base supply voltage
b. Base current
c. Current gain
d. Collector resistance

28. The base-emitter voltage of the second approximation is
a. 0
b. 0.3 V
c. 0.7 V
d. 1 V

29. If the base resistor is open, what is the collector current?
a. 0
b. 1 mA
c. 2 mA
d. 10 mA

Chapter 7 TRANSISTOR FUNDAMENTALS

1. The current gain of a transistor is defined as the ratio of the collector current to the
a. Base current
b. Emitter current
c. Supply current
d. Collector current

2. The graph of current gain versus collector-current indicates that the current gain
a. Is constant
b. Varies slightly
c. Varies significantly
d. Equals the collector current divided by the base current

3. When the collector current increases, what does the current gain do?
a. Decreases
b. Stays the same
c. Increases
d. Any of the above

4. As the temperature increases, the current gain
a. Decreases
b. Remains the same
c. Increases
d. Can be any of the above

5. When the base resistor decreases, the collector voltage will probably
a. Decrease
b. Stay the same
c. Increase
d. Do all of the above

6. If the base resistor is very small, the transistor will operate in the
a. Cutoff region

b. Active region
c. Saturation region
d. Breakdown region

7. Ignoring the bulk resistance of the collector diode, the collector-emitter saturation voltage is
a. 0
b. A few tenths of a volt
C. 1 V
d. Supply voltage

8. Three different Q points are shown on a load line. The upper Q point represents the
a. Minimum current gain
b. Intermediate current gain
c. Maximum current gain
d. Cutoff point

9. If a transistor operates at the middle of the load line, an increase in the base resistance will move the Q point
a. Down
b. Up
c. Nowhere
d. Off the load line

10. If a transistor operates at the middle of the load line, an increase in the current gain will move the Q point
a. Down
b. Up
c, Nowhere
d. Off the load line

11. If the base supply voltage increases, the Q point moves
a. Down
b. Up
c. Nowhere
d. Off the load line

12. Suppose the base resistor is open. The Q point will be
a. In the middle of the load line
b. At the upper end of the load line
c. At the lower end of the load line
d. Off the load line

13. If the base supply voltage is disconnected, the collector-emitter voltage will equal
a. 0 V
b. 6 V
c. 10.5 V
d. Collector supply voltage

14. If the base resistor is shorted, the transistor will probably be
a. Saturated
b. In cutoff
c. Destroyed
d. None of the above

15. If the collector resistor decreases to zero in a base-biased circuit, the load line will become
a. Horizontal
b. Vertical
c. Useless
d. Flat

16. The collector current is 10 mA. If the current gain is 100, the base current is
a. 1 microamp
b. 10 microamp
c. 100 microamp
d. 1 mA

17. The base current is 50 microamp. If the current gain is 125, the collector current is closest in value to
a. 40 microamp
b. 500 microamp
c. 1 mA
d. 6 mA

18. When the Q point moves along the load line, the voltage increases when the collector current
a. Decreases
b. Stays the same
c. Increases
d. Does none of the above

19. When there is no base current in a transistor switch, the output voltage from the transistor is
a. Low
b. High
c. Unchanged
d. Unknown

20. A circuit with a fixed emitter current is called
a. Base bias
b. Emitter bias
c. Transistor bias
d. Two-supply bias

21. The first step in analyzing emitter-based circuits is to find the
a. Base current
b. Emitter voltage
c. Emitter current
d. Collector current

22. If the current gain is unknown in an emitter-biased circuit, you cannot calculate the
a. Emitter voltage
b. Emitter current
c. Collector current
d. Base current

23. If the emitter resistor is open, the collector voltage is
a. Low
b. High
c. Unchanged
d. Unkiiown

24. If the collector resistor is open, the collector voltage is
a. Low
b. High
c. Unchanged
d. Unknown

25. When the current gain increases from 50 to 300 in an emitter-biased circuit, the collector current
a. Remains almost the same
b. Decreases by a factor of 6
c. Increases by a factor of 6
d. Is zero

26. If the emitter resistance decreases, the collector voltage
a. Decreases

b. Stays the same
c. Increases
d. Breaks down the transistor

27. If the emitter resistance decreases, the
a. Q point moves up
b. Collector current decreases
c. Q point stays where it is
d. Current gain increases

Chapter 8 TRANSISTOR BIASING

1. For emitter bias, the voltage across the emitter resistor is the same as the voltage between the emitter and the
a. Base
b. Collector
c. Emitter
d. Ground

2. For emitter bias, the voltage at the emitter is 0.7 V less than the
a. Base voltage
b. Emitter voltage
c. Collector voltage
d. Ground voltage

3. With voltage-divider bias, the base voltage is
a. Less than the base supply voltage
b. Equal to the base supply voltage
c. Greater than the base supply voltage
d. Greater than the collector supply voltage

4. VDB is noted for its
a. Unstable collector voltage
b. Varying emitter current
c. Large base current
d. Stable Q point

5. With VDB, an increase in emitter resistance will
a. Decrease the emitter voltage
b. Decrease the collector voltage
c. Increase the emitter voltage
d. Decrease the emitter current

6. VDB has a stable Q point like
a. Base bias
b. Emitter bias
c. Collector-feedback bias
d. Emitter-feedback bias

7. VDB needs
a. Only three resistors
b. Only one supply
c. Precision resistors
d. More resistors to work better

8. VDB normally operates in the
a. Active region
b. Cutoff region
c. Saturation region
d. Breakdown region

9. The collector voltage of a VDB circuit is not sensitive to changes in the
a. Supply voltage
b. Emitter resistance
c. Current gain
d. Collector resistance

10. If the emitter resistance increases in a VDB circuit, the collector voltage
a. Decreases
b. Stays the same
c. Increases
d. Doubles

11. Base bias is associated with
a. Amplifiers
b. Switching circuits
c. Stable Q point
d. Fixed emitter current

12. If the emitter resistance doubles in a VDB circuit, the collector current will
a. Double
b. Drop in half
c. Remain the same
d. Increase

13. If the collector resistance increases in a VDB circuit, the collector voltage will
a. Decrease
b. Stay the same
c. Increase
d. Double

14. The Q point of a VDB circuit is
a. Hypersensitive to changes in current gain
b. Somewhat sensitive to changes in current gain
c. Almost totally insensitive to changes in current gain
d. Greatly affected by temperature changes

15. The base voltage of two-supply emitter bias (TSEB) is
a. 0.7 V
b. Very large
c. Near 0 V
d. 1.3 V

16. If the emitter resistance doubles with TSEB, the collector current will
a. Drop in half
b. Stay the same
c. Double
d. Increase

17. If a splash of solder shorts the collector resistor of TSEB, the collector voltage will
a. Drop to zero
b. Equal the collector supply voltage
C. Stay the same
d. Double

18. If the emitter resistance increases with TSEB, the collector voltage will
a. Decrease
b. Stay the same
c. Increase
d. Equal the collector supply voltage

19. If the emitter resistor opens with TSEB, the collector voltage will
a. Decrease
b. Stay the same
c. Increase slightly

d. Equal the collector supply voltage

20. In TSEB, the base current must be very
a. Small
b. Large
c. Unstable
d. Stable

21. The Q point of TSEB does not depend on the
a. Emitter resistance
b. Collector resistance
c. Current gain
d. Emitter voltage

22. The majority carriers in the emitter of a pnp transistor are
a. Holes
b. Free electrons
c. Trivalent atoms
d. Pentavalent atoms

23. The current gain of a pnp transistor is
a. The negative of the npn current gain
b. The collector current divided by the emitter current
c. Near zero
d. The ratio of collector current to base current

24. Which is the largest current in a pnp transistor?
a. Base current
b. Emitter current
c. Collector current
d. None of these

25. The currents of a pnp transistor are
a. Usually smaller than npn currents
b. Opposite npn currents
c. Usually larger than npn currents
d. Negative

26. With pnp voltage-divider bias, you must use
a. Negative power supplies
b. Positive power supplies
c. Resistors
d. Grounds

Chapter 9 AC MODELS

1. For dc, the current in a coupling circuit is
a. Zero
b. Maximum
c. Minimum
d. Average

2. The current in a coupling circuit for high frequencies is
a. Zero
b. Maximum
c. Minimum
d. Average

3. A coupling capacitor is
a. A dc short
b. An ac open
c. A dc open and an ac short
d. A dc short and an ac open

4. In a bypass circuit, the top of a capacitor is
a. An open
b. A short
c. An ac ground
d. A mechanical ground

5. The capacitor that produces an ac ground is called a
a. Bypass capacitor
b. Coupling capacitor
c. Dc open
d. Ac open

6. The capacitors of a CE amplifier appear
a. Open to ac
b. Shorted to dc
c. Open to supply voltage
d. Shorted to ac

7. Reducing all dc sources to zero is one of the steps in getting the
a. DC equivalent circuit
b. AC equivalent circuit
c. Complete amplifier circuit
d. Voltage-divider biased circuit

8. The ac equivalent circuit is derived from the original circuit by shorting all
a. Resistors
b. Capacitors
c. Inductors
d. Transistors

9. When the ac base voltage is too large, the ac emitter current is
a. Sinusoidal
b. Constant
c. Distorted
d. Alternating

10. In a CE amplifier with a large input signal, the positive half cycle of the ac emitter current is
a. Equal to the negative half cycle
b. Smaller than the negative half cycle
c. Larger than the negative half cycle
d. Equal to the negative half cycle

11. Ac emitter resistance equals 25 mV divided by the
a. Quiescent base current
b. DC emitter current
c. AC emitter current
d. Change in collector current

12. To reduce the distortion in a CE amplifier, reduce the
a. DC emitter current
b. Base-emitter voltage
c. Collector current
d. AC base voltage

13. If the ac voltage across the emitter diode is 1 mV and the ac emitter current is 0.1 mA, the ac resistance of the emitter diode is
a. 1 ohm
b. 10 ohm
c. 100 ohm
d. 1 kohm

14. A graph of ac emitter current versus ac base-emitter voltage applies to the

a. Transistor
b. Emitter diode
c. Collector diode
d. Power supply

15. The output voltage of a CE amplifier is
a. Amplified
b. Inverted
c. 180 degrees out of phase with the input
d. All of the above

16. The emitter of a CE amplifier has no ac voltage because of the
a. DC voltage on it
b. Bypass capacitor
c. Coupling capacitor
d. Load resistor

17. The voltage across the load resistor of a CE amplifier is
a. Dc and ac
b. DC only
c. AC only
d. Neither dc nor ac

18. The ac collector current is approximately equal to the
a. AC base current
b. AC emitter current
c. AC source current
d. AC bypass current

19. The ac emitter current times the ac emitter resistance equals the
a. Dc emitter voltage
b. AC base voltage
c. AC collector voltage
d. Supply voltage

20. The ac collector current equals the ac base current times the
a. AC collector resistance
b. DC current gain
c. AC current gain
d. Generator voltage

Chapter 10 VOLTAGE AMPLIFIERS

1. The emitter is at ac ground in a
a. CB stage
b. CC stage
c. CE stage
d. None of these

2. The output voltage of a CE stage is usually
a. Constant
b. Dependent on re'
c. Small
d. Less the one

3. The voltage gain equals the output voltage divided by the
a. Input voltage
b. AC emitter resistance
c. AC collector resistance
d. Generator voltage

4. The input impedance of the base increases when
a. Beta increases
b. Supply voltage increases
c. Beta decreases
d. AC collector resistance increases

5. Voltage gain is directly proportional to
a. Beta
b. Ac emitter resistance
c. DC collector voltage
d. AC collector resistance

6. Compared to the ac resistance of the emitter diode, the feedback resistance of a swamped amplifier should be
a. Small
b. Equal
c. Large
d. Zero

7. Compared to a CE stage, a swamped amplifier has an input impedance that is
a. Smaller
b. Equal
c. Larger
d. Zero

8. To reduce the distortion of an amplified signal, you can increase the
a. Collector resistance
b. Emitter feedback resistance
c. Generator resistance
d. Load resistance

9. The emitter of a swamped amplifier
a. Is grounded
b. Has no de voltage
c. Has an ac voltage
d. Has no ac voltage

10. A swamped amplifier uses
a. Base bias
b. Positive feedback
c. Negative feedback
d. A grounded emitter

11. In a swamped amplifier, the effects of the emitter diode become
a. Important to voltage gain
b. Critical to input impedance
c. Significant to the analysis
d. Unimportant

12. The feedback resistor
a. Increases voltage gain
b. Reduces distortion
c. Decreases collector resistance
d. Decreases input impedance

13. The feedback resistor
a. Stabilizes voltage gain
b. Increases distortion
c. Increases collector resistance
d. Decreases input impedance

14. The ac collector resistance of the first stage includes the
a. Load resistance
b. Input impedance of first stage
c. Emitter resistance of first stage
d. Input impedance of second stage

15. If the emitter bypass capacitor opens, the ac output voltage will
a. Decrease
b. Increase
c. Remain the same
d. Equal zero

16. If the collector resistor is shorted, the ac output voltage will
a. Decrease
b. Increase
c. Remain the same
d. Equal zero

17. If the load resistance is open, the ac output voltage will
a. Decrease
b. Increase
c. Remain the same
d. Equal zero

18. If any capacitor is open, the ac output voltage will
a. Decrease
b. Increase
c. Remain the same
d. Equal zero

19. If the input coupling capacitor is open, the ac input voltage will
a. Decrease
b. Increase
c. Remain the same
d. Equal zero

20. If the bypass capacitor is open, the ac input voltage will
a. Decrease
b. Increase
c. Remainthe same
d. Equal zero

21. If the output coupling capacitor is open, the ac input voltage will
a. Decrease
b. Increase
c. Remain the same
d. Equal zero

22. If the emitter resistor is open, the ac input voltage will
a. Decrease
b. Increase
c. Remain the same
d. Equal zero

23. If the collector resistor is open, the ac input voltage will
a. Decrease
b. Increase
c. Remain the same
d. Equal approximately zero

24. If the emitter bypass capacitor is shorted, the ac input voltage will
a. Decrease
b. Increase
c. Remain the same
d. Equal zero

Chapter 11 POWER AMPLIFIERS

1. For class B operation, the collector current flows
a. The whole cycle
b. Half the cycle
c. Less than half a cycle
d. Less than a quarter of a cycle

2. Transformer coupling is an example of
a. Direct coupling
b. AC coupling
c. DC coupling
d. Impedance coupling

3. An audio amplifier operates in the frequency range of
a. 0 to 20 Hz
b. 20 Hz to 20 kHz
c. 20 to 200 kHz
d. Above 20 kHz

4. A tuned RF amplifier is
a. Narrowband
b. Wideband
c. Direct coupled
d. Impedance coupled

5. The first stage of a preamp is
a. A tuned RF stage
b. Large signal
c. Small signal
d. A dc amplifier

6. For maximum peak-to-peak output voltage, the Q point should be
a. Near saturation
b. Near cutoff
c. At the center of the dc load line
d. At the center of the ac load line

7. An amplifier has two load lines because
a. It has ac and dc collector resistances
b. It has two equivalent circuits
c. DC acts one way and ac acts another
d. All of the above

8. When the Q point is at the center of the ac load line, the maximum peak-to-peak output voltage equals
a. VCEQ
b. 2VCEQ
c. ICQ
d. 2IcQ

9. Push-pull is almost always used with
a. Class A
b. Class B
c. Class C
d. All of the above

10. One advantage of a class B push-pull amplifier is
a. Very small quiescent current drain
b. Maximum efficiency of 78.5 percent
c. Greater efficiency than class A
d. All of the above

11. Class C amplifiers are almost always
a. Transformer-coupled between stages
b. Operated at audio frequencies

c. Tuned RF amplifiers
d. Wideband

12. The input signal of a class C amplifier
a. Is negatively clamped at the base
b. Is amplified and inverted
c. Produces brief pulses of collector current
d. All of the above

13. The collector current of a class C amplifier
a. Is an amplified version of the input voltage
b. Has harmonics
c. Is negatively clamped
d. Flows for half a cycle

14. The bandwidth of a class C amplifier decreases when the
a. Resonant frequency increases
b. Q increases
c. XL decreases
d. Load resistance decreases

15. The transistor dissipation in a class C amplifier decreases when the
a. Resonant frequency increases
b. coil Q increases
c. Load resistance decreases
d. Capacitance increases

16. The power rating of a transistor can be increased by
a. Raising the temperature
b. Using a heat sink
c. Using a derating curve
d. Operating with no input signal

17. The ac load line is the same as the dc load line when the ac collector resistance equals the
a. DC emitter resistance
b. AC emitter resistance
c. DC collector resistance
d. Supply voltage divided by collector current

18. If RC = 3.6 kohm and RL = 10 kohm, the ac load resistance equals
a. 10 kohm
b. 2.65 kohm
c. I kohm
d. 3.6 kohm

19. The quiescent collector current is the same as the
a. DC collector current
b. AC collector current
c. Total collector current
d. Voltage-divider current

20. The ac load line usually
a. Equals the dc load line
b. Has less slope than the dc load line
c. Is steeper than the dc load line
d. Is horizontal

21. For a Q point near the center of the dc load line, clipping is more likely to occur on the
a. Positive peak of input voltage
b. Negative peak of output voltage
c. Positive peak of output voltage
d. Negative peak of emitter voltage

22. In a class A amplifier, the collector current flows for
a. Less than half the cycle
b. Half the cycle
c. Less than the whole cycle
d. The entire cycle

23. With class A, the output signal should be
a. Unclipped
b. Clipped on positive voltage peak
c. Clipped on negative voltage peak
d. Clipped on negative current peak

24. The instantaneous operating point swings-along the
a. AC load line
b. DC load line
c. Both load lines
d. Neither load line

25. The current drain of an amplifier is the
a. Total ac current from the generator
b. Total dc current from the supply
c. Current gain from base to collector
d. Current gain from collector to base

26. The power gain of an amplifier
a. Is the same as the voltage gain
b. Is smaller than the voltage gain
c. Equals output power divided by input power
d. Equals load power

27. Heat sinks reduce the
a. Transistor power
b. Ambient temperature
c. Junction temperature
d. Collector current

28. When the ambient temperature increases, the maximum transistor power rating
a. Decreases
b. Increases
c. Remains the same
d. None of the above

29. If the load power is 3 mW and the dc power is 150 mW, the efficiency is
a. 0
b. 2 percent
c. 3 percent
d. 20 percent

Chapter 12 EMITTER FOLLOWERS

1. An emitter follower has a voltage gain that is
a. Much less than one
b. Approximately equal to one
c. Greater than one
d. Zero

2. The total ac emitter resistance of an emitter follower equals
a. re'
b. re
c. re + re'
d. RE

3. The input impedance of the base of an emitter follower is usually
a. Low
b. High
c. Shorted to ground
d. Open

4. The dc emitter current for class A emitter followers is
a. The same as the ac emitter current
b. VE divided by RE
c. Vc divided by Rc
d. The same as the load current

5. The ac base voltage of an emitter follower is across the
a. Emitter diode
b. DC emitter resistor
c. Load resistor
d. Emitter diode and external ac emitter resistance

6. The output voltage of an emitter follower is across the
a. Emitter diode
b. DC collector resistor
c. Load resistor
d. Emitter diode and external ac emitter resistance

7. If Beta = 200 and re = 150 ohm, the input impedance of the base is approximately
a. 30 kohm
b. 600 n
c. 3 kohm
d. 5 kohm

8. The input voltage to an emitter follower is usually
a. Less than the generator voltage
b. Equal to the generator voltage
c. Greater than the generator voltage
d. Equal to the supply voltage

9. The ac emitter current is closest to
a. VG divided by re
b. vin divided by re'
c. VG divided by re'
d. vin divided by re

10. The output voltage of an emitter follower is approximately
a. 0
b. VG
c. vin
d. Vcc

11. The ac load line of an emitter follower is usually
a. The same as the dc load line
b. More horizontal than the dc load line
c. Steeper than the dc load line
d. Vertical

12. If the input voltage to an emitter follower is too large, the output voltage will be
a. Smaller
b. Larger
c. Equal
d. Clipped

13. If the Q point is at the middle of the dc load line, clipping will first occur on the
a. Left voltage swing
b. Upward current swing
c. Positive half cycle of input
d. Negative half cycle of input

14. If an emitter follower has VCEQ = 5 V, ICQ = 1 mA, and re = 1 kohm, the maximum peak-to-peak unclipped output is
a. 1 V
b. 2 V
c. 5 V
d. 10 V

15. If the load resistance of an emitter follower is very large, the external ac emitter resistance equals
a. Generator resistance
b. Impedance of the base
c. DC emitter resistance
d. DC collector resistance

16. If an emitter follower has re' = 10 ohm and re = 90 ohm, the voltage gain is approximately
a. 0
b. 0.5
c. 0.9
d. 1

17. A square wave out of an emitter follower implies
a. No clipping
b. Clipping at saturation
c. Clipping at cutoff
d. Clipping on both peaks

18. A Darlington transistor has
a. A very low input impedance
b. Three transistors
c. A very high current gain
d. One VBE drop

19. The ac load line of the emitter follower is
a. The same as the dc load line
b. Different from the dc load line
c. Horizontal
d. Vertical

20. If the generator voltage is 5 mV in an emitter follower, the output voltage across the load is closest to
a. 5 mV
b. 150 mV
c. 0.25 V
d. 0.5 V

21. If the load resistor of Fig. 12-la in your textbook is shorted, which of the following are different from their normal values:
a. Only ac voltages
b. Only dc voltages
c. Both dc and ac voltages
d. Neither dc nor ac voltages

22. If R1 is open in an emitter follower, which of these is true?
a. DC base voltage is Vcc
b. DC collector voltage is zero
c. Output voltage is normal
d. DC base voltage is zero

23. Usually, the distortion in an emitter follower is

a. Very low
b. Very high
c. Large
d. Not acceptable

24. The distortion in an emitter follower is
a. Seldom low
b. Often high
c. Always low
d. High when clipping occurs

25. If a CE stage is direct coupled to an emitter follower, how many coupling capacitors are there between the two stages?
a. 0
b. 1
c. 2
d. 3

26. A Darlington transistor has a Beta of 8000. If RE = 1 kohm and RL = 100 ohm, the input impedance of the base is closest to
a. 8 kohm
b. 80 kohm
c. 800 kohm
d. 8 Mohm

27. The transistors of a class B push-pull emitter follower are biased at or near
a. Cutoff
b. The center of the dc load line
c. Saturation
d. The center of the ac load line

28. Thermal runaway is
a. Good for transistors
b. Always desirable
c. Useful at times
d. Usually destructive

29. The ac resistance of compensating diodes
a. Must be included
b. Is usually small enough to ignore
c. Compensates for temperature changes
d. Is very high

30. A small quiescent current is necessary with a class B push-pull amplifier to avoid
a. Thermal runaway
b. Destroying the compensating diodes
c. Crossover distortion
d. Excessive current drain

31. The zener current in a zener follower is
a. Equal to the output current
b. Smaller than the output current
c. Larger than the output current
d. Prone to thermal runaway

32. In the two-transistor voltage regulator, the output voltage
a. Is regulated
b. Has much smaller ripple than the input voltage
c. Is larger than the zener voltage
d. All of the above

33. For a class B push-pull emitter follower to work properly, the emitter diodes must
a. Be able to control the quiescent current
b. Have a power rating greater than the output power
c. Have a voltage gain of I
d. Match the compensating diodes

34. The maximum efficiency of a class B push-pull amplifier is
a. 25 percent
b. 50 percent
c. 78.5 percent
d. 100 percent

35. The ac emitter resistance of an emitter follower
a. Equals the dc emitter resistance
b. Is larger than the load resistance
c. Has no effect on MPP
d. Is usually less than the load resistance

Chapter 13 JFETs

1. A JFET
a. Is a voltage-controlled device
b. Is a current-controlled device
c. Has a low input resistance
d. Has a very large voltage gain

2. A unipolar transistor uses
a. Both free electrons and holes
b. Only free electrons
c. Only holes
d. Either one or the other, but not both

3. The input impedance of a JFET
a. Approaches zero
b. Approaches one
c. Approaches infinity
d. Is impossible to predict

4. The gate controls
a. The width of the channel
b. The drain current
c. The proportional pinchoff voltage
d. All the above

5. The gate-source diode of a JFET should be
a. Forward-biased
b. Reverse-biased
c. Either forward- or reverse-biased
d. None of the above

6. Compared to a bipolar transistor, the JFET has a much higher
a. Voltage gain
b. Input resistance
c. Supply voltage
d. Current

7. The pinchoff voltage has the same magnitude as the
a. Gate voltage
b. Drain-source voltage
c. Gate-source voltage
d. Gate-source cutoff voltage

8. When the drain saturation current is less than IDSS, a JFET acts like a
a. Bipolar transistor

b. Current source
c. Resistor
d. Battery

9. RDS equals pinchoff voltage divided by the
a. Drain current
b. Gate current
c. Ideal drain current
d. Drain current for zero gate voltage

10. The transconductance curve is
a. Linear
b. Similar to the graph of a resistor
c. Nonlinear
d. Like a single drain curve

11. The transconductance increases when the drain current approaches
a. 0
b. ID(sat)
c. IDSS
d. IS

12. A CS amplifier has a voltage gain of
a. gmrd
b. gmrs
c. gmrs/(l + gmrs)
d. gmrd/(l + gmrd)

13. A source follower has a voltage gain of
a. gmrd
b. gmrs
c. gmrs/(l + gmrs)
d. gmrd/(l + gmrd)

14. When the input signal is large, a source follower has
a. A voltage gain of less than one
b. A small distortion
c. A high input resistance
d. All of these

15. The input signal used with a JFET analog switch should be
a. Small
b. Large
c. A square wave
d. Chopped

16. A cascode amplifier has the advantage of
a. Large voltage gain
b. Low input capacitance
c. Low input impedance
d. Higher gm

17. VHF stands for frequencies from
a. 300 kHz to 3 MHz
b. 3 to 30 MHz
c. 30 to 300 MHz
d. 300 MHz to 3 GHz

18. When a JFET is cut off, the depletion layers are
a. Far apart
b. Close together
c. Touching
d. Conducting

19. When the gate voltage becomes more negative in an n-channel JFET, the channel between the depletion layers
a. Shrinks
b. Expand
c. Conduct
d. Stop conducting

20. If a JFET has IDSS = 10 mA and VP = 2 V, then RDS equals
a. 200 ohm
b. 400 ohm
c. 1 kohm
d. 5 kohm

21. The easiest way to bias a JFET in the ohmic region is with
a. Voltage-divider bias
b. Self-bias
c. Gate bias
d. Source bias

22. Self-bias produces
a. Positive feedback
b. Negative feedback
c. Forward feedback
d. Reverse feedback

23. To get a negative gate-source voltage in a self-biased JFET circuit, you must have a
a. Voltage divider
b. Source resistor
c. Ground
d. Negative gate supply voltage

24. Transconductance is measured in
a. Ohms
b. Amperes
c. Volts
d. Mhos or Siemens

25. Transconductance indicates how effectively the input voltage controls the
a. Voltage gain
b. Input resistance
c. Supply voltage
d. Output current

Chapter 14 MOSFETs

1. Which of the following devices revolutionized the computer industry?
a. JFET
b. D-MOSFET
c. E-MOSFET
d. Power FET

2. The voltage that turns on an EMOS device is the
a. Gate-source cutoff voltage
b. Pinchoff voltage
c. Threshold voltage
d. Knee voltage

3. Which of these may appear on the data sheet of an enhancement-mode MOSFET?
a. VGS(th)
b. ID(on)

c. VGS(on)
d. All of the above

4. The VGS(on) of an n-channel E-MOSFET is
a. Less than the threshold voltage
b. Equal to the gate-source cutoff voltage
c. Greater than VDS(on)
d. Greater than VGS(th)

5. An ordinary resistor is an example of
a. A three-terminal device
b. An active load
c. A passive load
d. A switching device

6. An E-MOSFET with its gate connected to its drain is an example of
a. A three-terminal device
b. An active load
c. A passive load
d. A switching device

7. An E-MOSFET that operates at cutoff or in the ohmic region is an example of
a. A current source
b. An active load
c. A passive load
d. A switching device

8. CMOS stands for
a. Common MOS
b. Active-load switching
c. p-channel and n-channel devices
d. Complementary MOS

9. VGS(on) is always
a. Less than VGS(th)
b. Equal to VDS(on)
c. Greater than VGS(th)
d. Negative

10. With active-load switching, the upper E-MOSFET is a
a. Two-terminal device
b. Three-terminal device
c. Switch
d. Small resistance

11. CMOS devices use
a. Bipolar transistors
b. Complementary E-MOSFETs
c. Class A operation
d. DMOS devices

12. The main advantage of CMOS is its
a. High power rating
b. Small-signal operation
c. Switching capability
d. Low power consumption

13. Power FETs are
a. Integrated circuits
b. Small-signal devices
c. Used mostly with analog signals
d. Used to switch large currents

14. When the internal temperature increases in a power FET, the
a. Threshold voltage increases
b. Gate current decreases
c. Drain current decreases
d. Saturation current increases

15. Most small-signal E-MOSFETs are found in
a. Heavy-current applications
b. Discrete circuits
c. Disk drives
d. Integrated circuits

16. Most power FETS are
a. Used in high-current applications
b. Digital computers
c. RF stages
d. Integrated circuits

17. An n-channel E-MOSFET conducts when it has
a. VGS > VP
b. An n-type inversion layer
c. VDS > 0
d. Depletion layers

18. With CMOS, the upper MOSFET is
a. A passive load
b. An active load
c. Nonconducting
d. Complementary

19. The high output of a CMOS inverter is
a. VDD/2
b. VGS
c. VDS
d. VDD

20. The RDS(on) of a power FET
a. Is always large
b. Has a negative temperature coefficient
c. Has a positive temperature coefficient
d. Is an active load

Chapter 15 THYRISTORS

1. A thyristor can be used as
a. A resistor
b. An amplifier
c. A switch
d. A power source

2. Positive feedback means the returning signal
a. Opposes the original change
b. Aids the original change
c. Is equivalent to negative feedback
d. Is amplified

3. A latch always uses
a. Transistors
b. Feedback
c. Current
d. Positive feedback

4. To turn on a four-layer diode, you need
a. A positive trigger
b. low-current drop out
c. Breakover
d. Reverse-bias triggering

5. The minimum input current that can turn on a thyristor is called the
a. Holding current
b. Trigger current
c. Breakover current
d. Low-current drop out

6. The only way to stop a four-layer diode that is conducting is by
a. A positive trigger
b. Low-current drop out
c. Breakover
d. Reverse-bias triggering

7. The minimum anode current that keeps a thyristor turned on is called the
a. Holding current
b. Trigger current
c. Breakover current
d. Low-current drop out

8. A silicon controlled rectifier has
a. Two external leads
b. Three external leads
c. Four external leads
d. Three doped regions

9. A SCR is usually turned on by
a. Breakover
b. A gate trigger
c. Breakdown
d. Holding current

10. SCRs are
a. Low-power devices
b. Four-layer diodes
c. High-current devices
d. Bidirectional

11. The usual way to protect a load from excessive supply voltage is with a
a. Crowbar
b. Zener diode
c. Four-layer diode
d. Thyristor

12. An RC snubber protects an SCR against
a. Supply overvoltages
b. False triggering
c. Breakover
d. Crowbarring

13. When a crowbar is used with a power supply, the supply needs to have a fuse or
a. Adequate trigger current
b. Holding current
c. Filtering
d. Current limiting

14. The photo-SCR responds to
a. Current
b. Voltage
c. Humidity
d. Light

15. The diac is a
a. Transistor
b. Unidirectional device
c. Three-layer device
d. Bidirectional device

16. The triac is equivalent to
a. A four-layer diode
b. Two diacs in parallel
c. A thyristor with a gate lead
d. Two SCRs in parallel

17. The unijunction transistor acts as a
a. Four-layer diode
b. Diac
c. Triac
d. Latch

18. Any thyristor can be turned on with
a. Breakover
b. Forward-bias triggering
c. Low-current dropout
d. Reverse-bias triggering

19. A Shockley diode is the same as a
a. four-layer diode
b. SCR
c. diac
d. triac

20. The trigger voltage of an SCR is closest to
a. 0
b. 0.7 V
c. 4 V
d. Breakover voltage

21. Any thyristor can be turned off with
a. Breakover
b. Forward-bias triggering
c. Low-current drop out
d. Reverse-bias triggering

22. Exceeding the critical rate of rise produces
a. Excessive power dissipation
b. False triggering
c. Low-current drop out
d. Reverse-bias triggering

23. A four-layer diode is sometimes called a
a. Unijunction transistor
b. Diac
c. pnpn diode
d. Switch

24. A latch is based on
a. Negative feedback
b. Positive feedback
c. The four-layer diode
d. SCR action

Chapter 16 FREQUENCY EFFECTS

1. Frequency response is a graph of voltage gain versus
a. Frequency
b. Power gain
c. Input voltage

d. Output voltage

2. At low frequencies, the coupling capacitors produce a decrease in
a. Input resistance
b. Voltage gain
c. Generator resistance
d. Generator voltage

3. The stray-wiring capacitance has an effect on the
a. Lower cutoff frequency
b. Midband voltage gain
c. Upper cutoff frequency
d. Input resistance

4. At the lower or upper cutoff frequency, the voltage gain is
a. 0.35Amid
b. 0.5Amid
c. 0.707Amid
d. 0.995Amid

5. If the power gain doubles, the decibel power gain increases by
a. A factor of 2
b. 3 dB
c. 6 dB
d. 10 dB

6. If the voltage gain doubles, the decibel voltage gain increases by
a. A factor of 2
b. 3 dB
c. 6 dB
d. 10 dB

7. If the voltage gain is 10, the decibel voltage gain is
a. 6 dB
b. 20 dB
c. 40 dB
d. 60 dB

8. If the voltage gain is 100, the decibel voltage gain is
a. 6 dB
b. 20 dB
c. 40 dB
d. 60 dB

9. If the voltage gain is 2000, the decibel voltage gain is
a. 40 dB
b. 46 dB
c. 66 dB
d. 86 dB

10. Two stages have decibel voltage gains of 20 and 40 dB. The total ordinary voltage gain is
a.1
b. 10
c. 100
d. 1000

11. Two stages have voltage gains of 100 and 200. The total decibel voltage gain is
a. 46 dB
b. 66 dB
c. 86 dB
d. 106 dB

12. One frequency is 8 times another frequency. How many octaves apart are the two frequencies?
a. 1
b. 2
c. 3
d. 4

13. If f = 1 MHz, and f2 = 10 Hz, the ratio f/f2 represents how many decades?
a. 2
b. 3
c. 4
d. 5

14. Semilogarithmic paper means
a. One axis is linear, and the other is logarithmic
b. One axis is linear, and the other is semilogarithmic
c. Both axes are semilogarithmic
d. Neither axis is linear

15. If you want to improve the high-frequency response of an amplifier, which of these would you try?
a. Decrease the coupling capacitances.
b. Increase the emitter bypass capacitance.
c. Shorten leads as much as possible.
d. Increase the generator resistance.

16. The voltage gain of an amplifier decreases 20 dB per decade above 20 kHz. If the midband voltage gain is 86 dB, what is the ordinary voltage gain at 20 MHz?
a. 20
b. 200
c. 2000
d. 20,000

Chapter 17 DIFFERENTIAL AMPLIFIERS

1. Monolithic ICs are
a. Forms of discrete circuits
b. On a single chip
c. Combinations of thin-film and thick-film circuits
d. Also called hybrid ICs

2. The op amp can amplify
a. AC signals only
b. DC signals only
c. Both ac and dc signals
d. Neither ac nor dc signals

3. Components are soldered together in
a. Discrete circuits
b. Integrated circuits
c. SSI
d. Monolithic ICs

4. The tail current of a diff amp is
a. Half of either collector current
b. Equal to either collector current
c. Two times either collector current
d. Equal to the difference in base currents

5. The node voltage at the top of the tail resistor is closest to
a. Collector supply voltage
b. Zero
c. Emitter supply voltage
d. Tail current times base resistance

6. The input offset current equals the
a. Difference between two base currents
b. Average of two base currents
c. Collector current divided by current gain
d. Difference between two base-emitter voltages

7. The tail current equals the
a. Difference between two emitter currents
b. Sum of two emitter currents
c. Collector current divided by current gain
d. Collector voltage divided by collector resistance

8.The voltage gain of a diff amp with a differential output is equal to RC divided by
a. re'
b. re'/2
c. 2re'
d. RE

9. The input impedance of a diff amp equals re' times
a. 0
b. RC
c. RE
d. 2 times Beta

10. A dc signal has a frequency of
a. 0
b. 60 Hz
c. 0 to over 1 MHz
d. 1 MHz

11. When the two input terminals of a diff amp are grounded,
a. The base currents are equal
b. The collector currents are equal
c. An output error voltage usually exists
d. The ac output voltage is zero

12. One source of output error voltage is
a. Input bias current
b. Difference in collector resistors
c. Tail current
d. Common-mode voltage gain

13. A common-mode signal is applied to
a. The noninverting input
b. The inverting input
c. Both inputs
d. Top of the tail resistor

14. The common-mode voltage gain is
a. Smaller than voltage gain
b. Equal to voltage gain
c. Greater than voltage gain
d. None of the above

15. The input stage of an op amp is usually a
a. Diff amp
b. Class B push-pull amplifier
c. CE amplifier
d. Swamped amplifier

16. The tail of a diff amp acts like a
a. Battery
b. Current source
c. Transistor
d. Diode

17. The common-mode voltage gain of a diff amp is equal to RC divided by
a. re'
b. re'/2
c. 2re'
d. 2RE

18. When the two bases are grounded in a diff amp, the voltage across each emitter diode is
a. Zero
b. 0.7 V
c. The same
d. High

19. The common-mode rejection ratio is
a. Very low
b. Often expressed in decibels
c. Equal to the voltage gain
d. Equal to the common-mode voltage gain

20. The typical input stage of an op amp has a
a. Single-ended input and single-ended output
b. Single-ended input and differential output
c. Differential input and single-ended output
d. Differential input and differential output

21. The input offset current is usually
a. Less than the input bias current
b. Equal to zero
c. Less than the input offset voltage
d. Unimportant when a base resistor is used

22. With both bases grounded, the only offset that produces an error is the
a. Input offset current
b. Input bias current
c. Input offset voltage
d. Beta

Chapter 18 OPERATIONAL AMPLIFIERS

1. What usually controls the open-loop cutoff frequency of an op amp?
a. Stray-wiring capacitance
b. Base-emitter capacitance
c. Collector-base capacitance
d. Compensating capacitance

2. A compensating capacitor prevents
a. Voltage gain
b. Oscillations
c. Input offset current
d. Power bandwidth

3. At the unity-gain frequency, the open-loop voltage gain is
a. 1
b. Amid
c. Zero
d. Very large

4. The cutoff frequency of an op amp equals the unity-gain frequency divided by
a. the cutoff frequency
b. Closed-loop voltage gain

c. Unity
d. Common-mode voltage gain

5. If the cutoff frequency is 15 Hz and the midband open-loop voltage gain is 1,000,000, the unity-gain frequency is
a. 25 Hz
b. 1 MHz
c. 1.5 MHz
d. 15 MHz

6. If the unity-gain frequency is 5 MHz and the midband open-loop voltage gain is 200,000, the cutoff frequency is
a. 25 Hz
b. 1 MHz
c. 1.5 MHz
d. 15 MHz

7. The initial slope of a sine wave is directly proportional to
a. Slew rate
b. Frequency
c. Voltage gain
d. Capacitance

8. When the initial slope of a sine wave is greater than the slew rate,
a. Distortion occurs
b. Linear operation occurs
c. Voltage gain is maximum
d. The op amp works best

9. The power bandwidth increases when
a. Frequency decreases
b. Peak value decreases
c. Initial slope decreases
d. Voltage gain increases

10. A 741C uses
a. Discrete resistors
b. Inductors
c. Active-load resistors
d. A large coupling capacitor

11. A 741C cannot work without
a. Discrete resistors
b. Passive loading
c. Dc return paths on the two bases
d. A small coupling capacitor

12. The input impedance of a BIFET op amp is
a. Low
b. Medium
c. High
d. Extremely high

13. An LF157A is a
a. Diff amp
b. Source follower
c. Bipolar op amp
d. BIFET op amp

14. If the two supply voltages are plus and minus 15 V, the MPP value of an op amp is closest to
a. 0
b. +15V
c. -15 V
d. 30 V

15. The open-loop cutoff frequency of a 741C is controlled by
a. A coupling capacitor
b. The output short circuit current
c. The power bandwidth
d. A compensating capacitor

16. The 741C has a unity-gain frequency of
a. 10 Hz
b. 20 kHz
c. 1 MHz
d. 15 MHz

17. The unity-gain frequency equals the product of closed-loop voltage gain and the
a. Compensating capacitance
b. Tail current
c. Closed-loop cutoff frequency
d. Load resistance

18. If funity is 10 MHz and midband open-loop voltage gain is 1,000,000, then the open-loop cutoff frequency of the op amp is
a. 10 Hz
b. 20 Hz
c. 50 Hz
d. 100 Hz

19. The initial slope of a sine wave increases when
a. Frequency decreases
b. Peak value increases
c. Cc increases
d. Slew rate decreases

20. If the frequency is greater than the power bandwidth,
a. Slew-rate distortion occurs
b. A normal output signal occurs
c. Output offset voltage increases
d. Distortion may occur

21. An op amp has an open base resistor. The output voltage will be
a. Zero
b. Slightly different from zero
c. Maximum positive or negative
d. An amplified sine wave

22. An op amp has a voltage gain of 500,000. If the output voltage is 1 V, the input voltage is
a. 2 microvolts
b. 5 mV
c. 10 mV
d. 1 V

23. A 741C has supply voltages of plus and minus 15 V. If the load resistance is large, the MPP value is
a. 0
b. +15 V
c. 27 V
d. 30 V

24. Above the cutoff frequency, the voltage gain of a 741C decreases approximately
a. 10 dB per decade
b. 20 dB per octave
c. 10 dB per octave
d. 20 dB per decade

25. The voltage gain of an op amp is unity at the
a. Cutoff frequency
b. Unity-gain frequency
c. Generator frequency
d. Power bandwidth

26. When slew-rate distortion of a sine wave occurs, the output
a. Is larger
b. Appears triangular
c. Is normal
d. Has no offset

27. A 741C has
a. A voltage gain of 100,000
b. An input impedance of 2 Mohm
c. An output impedance of 75 ohm
d. All of the above

28. The closed-loop voltage gain of an inverting amplifier equals
a. The ratio of the input resistance to the feedback resistance
b. The open-loop voltage gain
c. Feedback resistance divided by the input resistance
d. The input resistance

29. The noninverting amplifier has a
a. Large closed-loop voltage gain
b. Small open-loop voltage gain
c. Large closed-loop input impedance
d. Large closed-loop output impedance

30. The voltage follower has a
a. Closed-loop voltage gain of unity
b. Small open-loop voltage gain
c. Closed-loop bandwidth of zero
d. Large closed-loop output impedance

31. A summing amplifier can have
a. No more than two input signals
b. Two or more input signals
c. A closed-loop input impedance of infinity
d. A small open-loop voltage gain

Chapter 19 NEGATIVE FEEDBACK

1. With negative feedback, the returning signal
a. Aids the input signal
b. Opposes the input signal
c. Is proportional to output current
d. Is proportional to differential voltage gain

2. How many types of negative feedback are there?
a. One
b. Two
c. Three
d. Four

3. A VCVS amplifier approximates an ideal
a. Voltage amplifier
b. Current-to-voltage converter
c. Voltage-to-current converter
d. Current amplifier

4. The voltage between the input terminals of an ideal op amp is
a. Zero
b. Very small
c. Very large
d. Equal to the input voltage

5. When an op amp is not saturated, the voltages at the noninverting and inverting inputs are
a. Almost equal
b. Much different
c. Equal to the output voltage
d. Equal to +15 V

6. The feedback fraction B
a. Is always less than 1
b. Is usually greater than 1
c. May equal 1
d. May not equal 1

7. An ICVS amplifier has no output voltage. A possible trouble is
a. No negative supply voltage
b. Shorted feedback resistor
c. No feedback voltage
d. Open load resistor

8. In a VCVS amplifier, any decrease in open-loop voltage gain produces an increase in
a. Output voltage
b. Error voltage
c. Feedback voltage
d. Input voltage

9. The open-loop voltage gain equals the
a. Gain with negative feedback
b. Differential voltage gain of the op amp
c. Gain when B is 1
d. Gain at funity

10. The loop gain AOLB
a. Is usually much smaller than 1
b. Is usually much greater than 1
c. May not equal 1
d. Is between 0 and 1

11. The closed-loop input impedance with an ICVS amplifier is
a. Usually larger than the open-loop input impedance
b. Equal to the open-loop input impedance
c. Sometimes less than the open-loop impedance
d. Ideally zero

12. With an ICVS amplifier, the circuit approximates an ideal
a. Voltage amplifier
b. Current-to-voltage converter
c. Voltage-to-current converter
d. Current amplifier

13. Negative feedback reduces the
a. Feedback fraction
b. Distortion
c. Input offset voltage
d. Loop gain

14. A voltage follower has a voltage gain of

a. Much less than 1
b. 1
c. More than 1
d. A

15. The voltage between the input terminals of a real op amp is
a. Zero
b. Very small
c. Very large
d. Equal to the input voltage

16. The transresistance of an amplifier is the ratio of its
a. Output current to input voltage
b. Input voltage to output current
c. Output voltage to input voltage
d. Output voltage to input current

17. Current cannot flow to ground through
a. A mechanical ground
b. An ac ground
c. A virtual ground
d. An ordinary ground

18. In a current-to-voltage converter, the input current flows
a. Through the input impedance of the op amp
b. Through the feedback resistor
c. To ground
d. Through the load resistor

19. The input impedance of a current-to-voltage converter is
a. Small
b. Large
c. Ideally zero
d. Ideally infinite

20. The open-loop bandwidth equals
a. funity
b. f2(OL)
c. funity/ACL
d. fmax

21. The closed-loop bandwidth equals
a. funity
b. f2(OL)
c. funity/ACL
d. fmax

22. For a given op amp, which of these is constant?
a. f2(CL)
b. Feedback voltage
c. ACL
d. ACLf2(CL)

23. Negative feedback does not improve
a. Stability of voltage gain
b. Nonlinear distortion in later stages
c. Output offset voltage
d. Power bandwidth

24. An ICVS amplifier is saturated. A possible trouble is
a. No supply voltages
b. Open feedback resistor
c. No input voltage
d. Open load resistor

25. A VCVS amplifier has no output voltage. A possible trouble is
a. Shorted load resistor
b. Open feedback resistor
c. Excessive input voltage
d. Open load resistor

26. An ICIS amplifier is saturated. A possible trouble is
a. Shorted load resistor
b. R2 is open
c. No input voltage
d. Open load resistor

27. An ICVS amplifier has no output voltage. A possible trouble is
a. No positive supply voltage
b. Open feedback resistor
c. No feedback voltage
d. Shorted load resistor

28. The closed-loop input impedance in a VCVS amplifier is
a. Usually larger than the open-loop input impedance
b. Equal to the open-loop input impedance
c. Sometimes less than the open-loop input impedance
d. Ideally zero

Chapter 20 LINEAR OP-AMP CIRCUITS

1. In a linear op-amp circuit, the
a. Signals are always sine waves
b. Op amp does not go into saturation
c. Input impedance is ideally infinite
d. Gain-bandwidth product is constant

2. In an ac amplifier using an op amp with coupling and bypass capacitors, the output offset voltage is
a. Zero
b. Minimum
c. Maximum
d. Unchanged

3. To use an op amp, you need at least
a. One supply voltage
b. Two supply voltages
c. One coupling capacitor
d. One bypass capacitor

4. In a controlled current source with op amps, the circuit acts like a
a. Voltage amplifier
b. Current-to-voltage converter
c. Voltage-to-current converter
d. Current amplifier

5. An instrumentation amplifier has a high
a. Output impedance
b. Power gain
c. CMRR
d. Supply voltage

6. A current booster on the output of an op amp will increase the short-circuit current by
a. ACL
b. Beta dc
c. funity
d. Av

7. Given a voltage reference of +2.5 V, we can get a voltage reference of +15 V by using a
a. Inverting amplifier
b. Noninverting amplifier
c. Differential amplifier
d. Instrumentation amplifier

8. In a differential amplifier, the CMRR is limited mostly by
a. CMRR of the op amp
b. Gain-bandwidth product
c. Supply voltages
d. Tolerance of resistors

9. The input signal for an instrumentation amplifier usually comes from
a. An inverting amplifier
b. A transducer
c. A differential amplifier
d. A Wheatstone bridge

10. In the classic three op-amp instrumentation amplifier, the differential voltage gain is usually produced by the
a. First stage
b. Second stage
c. Mismatched resistors
d. Output op amp

11. Guard driving reduces the
a. CMRR of an instrumentation amplifier
b. Leakage current in the shielded cable
c. Voltage gain of the first stage
d. Common-mode input voltage

12. In an averaging circuit, the input resistances are
a. Equal to the feedback resistance
b. Less than the feedback resistance
c. Greater than the feedback resistance
d. Unequal to each other

13. A D/A converter is an application of the
a. Adjustable bandwidth circuit
b. Noninverting amplifier
c. Voltage-to-current converter
d. Summing amplifier

14. In a voltage-controlled current source,
a. A current booster is never used
b. The load is always floated
c. A stiff current source drives the load
d. The load current equals ISC

15. The Howland current source produces a
a. Unidirectional floating load current
b. Bidirectional single-ended load current
c. Unidirectional single-ended load current
d. Bidirectional floating load current

16. The purpose of AGC is to
a. Increase the voltage gain when the input signal increases
b. Convert voltage to current
c. Keep the output voltage almost constant
d. Reduce the CMRR of the circuit
c
17. 1 ppm is equivalent to
a. 0.1%
b. 0.01%
c. 0.001%
d. 0.0001%

18. An input transducer converts
a. Voltage to current
b. Current to voltage
c. An electrical quantity to a nonelectrical quantity
d. A nonelectrical quantity to an electrical quantity

19. A thermistor converts
a. Light to resistance
b. Temperature to resistance
c. Voltage to sound
d. Current to voltage

20. When we trim a resistor, we are
a. Making a fine adjustment
a. Reducing its value
b. Increasing its value
d. Making a coarse adjustment

21. A D/A converter with four inputs has
a. Two outputs
b. Four outputs
c. Eight outputs
d. Sixteen outputs

22. An op amp with a rail-to-rail output
a. Has a current-boosted output
b. Can swing all the way to either supply voltage
c. Has a high output impedance
d. Cannot be less than 0 V.

23. When a JFET is used in an AGC circuit, it acts like a
a. Switch
b. Voltage-controlled current source
c. Voltage-controlled resistance
d. Capacitance

24. If an op amp has only a positive supply voltage, its output cannot
a. Be negative
b. Be zero
c. Equal the supply voltage
d. Be ac coupled

Chapter 21 ACTIVE FILTERS

31
1. The region between the passband and the stopband is called the
a. Attenuation
b. Center
c. Transition
d. Ripple

2. The center frequency of a bandpass filter is always equal to
a. The bandwidth
b. Geometric average of the cutoff frequencies
c. Bandwidth divided by Q
d. 3-dB frequency

3. The Q of a narrowband filter is always
a. small
b. equal to BW divided by f0

c. less than 1
d. greater than 1

4. A bandstop filter is sometimes called a
a. Snubber
b. Phase shifter
c. Notch filter
d. Time-delay circuit

5. The all-pass filter has
a. No passband
b. One stopband
c. the same gain at all frequencies
d. a fast rolloff above cutoff

6. The approximation with a maximally-flat passband is
a. Chebyshev
b. Inverse Chebyshev
c. Elliptic
d. Bessel

7. The approximation with a rippled passband is
a. Butterworth
b. Inverse Chebyshev
c. Elliptic
d. Bessel

8. The approximation that distorts digital signals the least is the
a. Butterworth
b. Chebyshev
c. Elliptic
d. Bessel

9. If a filter has six second-order stages and one first-order stage, the order is
a. 2
b. 6
c. 7
d. 13

10. If a Butterworth filter has 9 second-order stages, its rolloff rate is
a. 20 dB per decade
b. 40 dB per decade
c. 180 dB per decade
d. 360 dB per decade

11. If n = 10, the approximation with the fastest rolloff in the transition region is
a. Butterworth
b. Chebyshev
c. Inverse Chebyshev
d. Elliptic

12. The elliptic approximation has a
a. Slow rolloff rate compared to the Cauer
b. Rippled stopband
c. Maximally-flat passband
d. Monotonic stopband

13. Linear phase shift is equivalent to
a. Q = 0.707
b. Maximally-flat stopband
c. Constant time delay
d. Rippled passband

14. The filter with the slowest rolloff rate is the
a. Butterworth
b. Chebyshev
c. Elliptic
d. Bessel

15. A first-order active-filter stage has
a. One capacitor
b. Two op amps
c. Three resistors
d. a high Q

16. A first-order stage cannot have a
a. Butterworth response
b. Chebyshev response
c. Maximally-flat passband
d. Rolloff rate of 20 dB per decade

17. Sallen-Key filters are also called
a. VCVS filters
b. MFB filters
c. Biquadratic filters
d. State-variable filters

18. To build a 10th-order filter, we should cascade
a. 10 first-stage stages
b. 5 second-order stages
c. 3 third-order stages
d. 2 fourth-order stages

19. To get a Butterworth response with an 8th-order filter, the stages need to have
a. Equal Q's
b. Unequal center frequencies
c. Inductors
d. Staggered Q's

20. To get a Chebyshev response with a 12th-order filter, the stages need to have
a. Equal Q's
b. Equal center frequencies
c. Staggered bandwidths
d. Staggered center frequencies and Q's

21. The Q of a Sallen-Key second-order stage depends on the
a. Voltage gain
b. Center frequency
c. Bandwidth
d. GBW of the op amp

22. With Sallen-Key high-pass filters, the pole frequency must be
a. Added to the K values
b. Subtracted from the K values
c. Multiplied by the K values
d. Divided by the K values

23. If BW increases, the
a. Center frequency decreases
b. Q decreases
c. Rolloff rate increases
d. Ripples appear in the stopband

24. When Q is greater than 1, a bandpass filter should be built with
a. Low-pass and high-pass stages

b. MFB stages
c. Notch stages
d. All-pass stages

25. The all-pass filter is used when
a. High rolloff rates are needed
b. Phase shift is important
c. A maximally-flat passband is needed
d. A rippled stopband is important

26. A second-order all-pass filter can vary the output phase from
a. 90 degrees to -90 degrees
b. 0 degrees to -180 degrees
c. 0 degrees to -360 degrees
d. 0 degrees to -720 degrees

27. The all-pass filter is sometimes called a
a. Tow-Thomas filter
b. Delay equalizer
c. KHN filter
d. State-variable filter

28. The biquadratic filter
a. Has low component sensitivity
b. Uses three or more op amps
c. Is also called Tow-Thomas filter
d. All of the above

29. The state-variable filter
a. Has a low-pass, high-pass, and bandpass output
b. Is difficult to tune
c. Has high component sensitivity
d. Uses less than three op amps

30. If GBW is limited, the Q of the stage will
a. Remain the same
b. Double
c. Decrease
d. Increase

31. To correct for limited GBW, a designer may use
a. A constant time delay
b. Predistortion
c. Linear phase shift
d. A rippled passband

Chapter 22 NONLINEAR OP-AMP CIRCUITS

1. In a nonlinear op-amp circuit, the
a. Op amp never saturates
b. Feedback loop is never opened
c. Output shape is the same as the input shape
d. Op amp may saturate

2. To detect when the input is greater than a particular value, use a
a. Comparator
b. Clamper
c. Limiter
d. Relaxation oscillator

3. The voltage out of a Schmitt trigger is
a. A low voltage
b. A high voltage
c. Either a low or a high voltage
d. A sine wave

4. Hysteresis prevents false triggering associated with
a. A sinusoidal input
b. Noise voltages
c. Stray capacitances
d. Trip points

5. If the input is a rectangular pulse, the output of an integrator is a
a. Sine wave
b. Square wave
c. Ramp
d. Rectangular pulse

6. When a large sine wave drives a Schmitt trigger, the output is a
a. Rectangular wave
b. Triangular wave
c. Rectified sine wave
d. Series of ramps

7. If pulse width decreases and the period stays the same, the duty cycle
a. Decreases
b. Stays the same
c. Increases
d. Is zero

8. The output of a relaxation oscillator is a
a. Sine wave
b. Square wave
c. Ramp
d. Spike

9. If AOL = 200,000, the closed-loop knee voltage of a silicon diode is
a. 1 uV
b. 3.5 uV
c. 7 uV
d. 14 uV

10. The input to a peak detector is a triangular wave with a peak-to-peak value of 8 V and an average value of 0. The output is
a. 0
b. 4 V
c. 8 V
d. 16 V

11. The input voltage to a positive limiter is a triangular wave of 8 V pp and an average value of 0. If the reference level is 2 V, the output is
a. 0
b. 2 Vpp
c. 6 Vpp
d. 8 Vpp

12. The discharging time constant of a peak detector is 10 ms. The lowest frequency you should use is
a.10 Hz
b.100 Hz
c. 1 kHz
d. 10 kHz

13. A comparator with a trip point of zero is sometimes called a

a. Threshold detector
b. Zero-crossing detector
c. Positive limit detector
d. Half-wave detector

14. To work properly, many IC comparators need an external
a. Compensating capacitor
b. Pullup resistor
c. Bypass circuit
d. Output stage

15. A Schmitt trigger uses
a. Positive feedback
b. Negative feedback
c. Compensating capacitors
d. Pullup resistors

16. A Schmitt trigger
a. Is a zero-crossing detector
b. Has two trip points
c. Produces triangular output waves
d. Is designed to trigger on noise voltage

17. A relaxation oscillator depends on the charging of a capacitor through a
a. Resistor
b. Inductor
c. Capacitor
d. Noninverting input

18. A ramp of voltage
a. Always increases
b. Is a rectangular pulse
c. Increases or decreases at a linear rate
d. Is produced by hysteresis

19. The op-amp integrator uses
a. Inductors
b. The Miller effect
c. Sinusoidal inputs
d. Hysteresis

20. The trip point of a comparator is the input voltage that causes
a. The circuit to oscillate
b. Peak detection of the input signal
c. The output to switch states
d. Clamping to occur

21. In an op-amp integrator, the current through the input resistor flows into the
a. Inverting input
b. Noninverting input
c. Bypass capacitor
d. Feedback capacitor

22. An active half-wave rectifier has a knee voltage of
a. VK
b. 0.7 V
c. More than 0.7 V
d. Much less than 0.7 V

23. In an active peak detector, the discharging time constant is
a. Much longer than the period
b. Much shorter than the period
c. Equal to the period
d. The same as the charging time constant

24. If the reference voltage is zero, the output of an active positive limiter is
a. Positive
b. Negative
c. Either positive or negative
d. A ramp

25. The output of an active positive clamper is
a. Positive
b. Negative
c. Either positive or negative
d. A ramp

26. The positive clamper adds
a. A positive dc voltage to the input
b. A negative dc voltage to the input
c. An ac signal to the output
d. A trip point to the input

27. A window comparator
a. Has only one usable threshold
b. Uses hysteresis to speed up response
c. Clamps the input positively
d. Detects an input voltage between two limits

Chapter 23 OSCILLATORS

1. An oscillator always needs an amplifier with
a. Positive feedback
b. Negative feedback
c. Both types of feedback
d. An LC tank circuit

2. The voltage that starts an oscillator is caused by
a. Ripple from the power supply
b. Noise voltage in resistors
c. The input signal from a generator
d. Positive feedback

3. The Wien-bridge oscillator is useful
a. At low frequencies
b. At high frequencies
c. With LC tank circuits
d. At small input signals

4. A lag circuit has a phase angle that is
a. Between 0 and +90 degrees
b. Greater than 90 degrees
c. Between 0 and -90 degrees
d. The same as the input voltage

5. A coupling circuit is a
a. Lag circuit
b. Lead circuit
c. Lead-lag circuit
d. Resonant circuit

6. A lead circuit has a phase angle that is
a. Between 0 and +90 degrees
b. Greater than 90 degrees
c. Between 0 and -90 degrees
d. The same as the input voltage

7. A Wien-bridge oscillator uses
a. Positive feedback
b. Negative feedback
c. Both types of feedback
d. An LC tank circuit

8. Initially, the loop gain of a Wien-bridge oscillator is
a. 0
b. 1
c. Low
d. High

9. A Wien bridge is sometimes called a
a. Notch filter
b. Twin-T oscillator
c. Phase shifter
d. Wheatstone bridge

10. To vary the frequency of a Wien bridge, you can vary
a. One resistor
b. Two resistors
c. Three resistors
d. One capacitor

11. The phase-shift oscillator usually has
a. Two lead or lag circuits
b. Three lead or lag circuits
c. A lead-lag circuit
d. A twin-T filter

12. For oscillations to start in a circuit, the loop gain must be greater than 1 when the phase shift around the loop is
a. 90 degrees
b. 180 degrees
c. 270 degrees
d. 360 degrees

13.The most widely used LC oscillator is the
a. Armstrong
b. Clapp
c. Colpitts
d. Hartley

14. Heavy feedback in an LC oscillator
a. Prevents the circuit from starting
b. Causes saturation and cutoff
c. Produces maximum output voltage
d. Means B is small

15. When Q decreases in a Colpitts oscillator, the frequency of oscillation
a. Decreases
b. Remains the same
c. Increases
d. Becomes erratic

16. Link coupling refers to
a. Capacitive coupling
b. Transformer coupling
c. Resistive coupling
d. Power coupling

17. The Hartley oscillator uses
a. Negative feedback
b. Two inductors
c. A tungsten lamp
d. A tickler coil

18. To vary the frequency of an LC oscillator, you can vary
a. One resistor
b. Two resistors
c. Three resistors
d. One capacitor

19. Of the following, the one with the most stable frequency is the
a. Armstrong
b. Clapp
c. Colpitts
d. Hartley

20. The material with the piezoelectric effect is
a. Quartz
b. Rochelle salts
c. Tourmaline
d. All the above

21. Crystals have a very
a. Low Q
b. High Q
c. Small inductance
d. Large resistance

22. The series and parallel resonant frequencies of a crystal are
a. Very close together
b. Very far apart
c. Equal
d. Low frequencies

23. The kind of oscillator found in an electronic wristwatch is the
a. Armstrong
b. Clapp
c. Colpitts
d. Quartz crystal

24. A monostable 555 timer has the following number of stable states:
a. 0
b. 1
c. 2
d. 3

25. An astable 555 timer has the following number of stable states:
a. 0
b. 1
c. 2
d. 3

26. The pulse width out of a one-shot multivibrator increases when the
a. Supply voltage increases
b. Timing resistor decreases
c. UTP decreases
d. Timing capacitance increases

27. The output waveform of a 555 timer is
a. sinusoidal
b. triangular
c. rectangular
d. elliptical

28. The quantity that remains constant in a pulse-width modulator is
a. Pulse width
b. Period
c. Duty cycle
d. Space

29. The quantity that remains constant in a pulse-position modulator is
a. Pulse width
b. Period
c. Duty cycle
d. Space

30. When a PLL is locked on the input frequency, the VCO frequency
a. Is less than f0
b. Is greater than f0
c. Equals f0
d. Equals fin

31. The bandwidth of the low-pass filter in a PLL determines the
a. Capture range
b. Lock range
c. Free-running frequency
d. Phase difference

Chapter 24 REGULATED POWER AMPLIFIERS

1. Voltage regulators normally use
a. Negative feedback
b. Positive feedback
c. No feedback
d. Phase limiting

2. During regulation, the power dissipation of the pass transistor equals the collector-emitter voltage times the
a. Base current
b. Load current
c. Zener current
d. Foldback current

3. Without current limiting, a shorted load will probably
a. Produce zero load current
b. Destroy diodes and transistors
c. Have a load voltage equal to the zener voltage
d. Have too little load current

4. A current-sensing resistor is usually
a. Zero
b. Small
c. Large
d. Open

5. Simple current limiting produces too much heat in the
a. Zener diode
b. Load resistor
c. Pass transistor
d. Ambient air

6. With foldback current limiting, the load voltage approaches zero, and the load current approaches
a. A small value
b. Infinity
c. The zener current
d. A destructive level

7. A capacitor may be needed in a discrete voltage regulator to prevent
a. Negative feedback
b. Excessive load current
c. Oscillations
d. Current sensing

8. If the output of a voltage regulator varies from 15 to 14.7 V between the minimum and maximum load current, the load regulation is
a. 0
b. 1%
c. 2%
d. 5%

9. If the output of a voltage regulator varies from 20 to 19.8 V when the line voltage varies over its specified range, the source regulation is
a. 0
b. 1%
c. 2%
d. 5%

10. The output impedance of a voltage regulator is
a. Very small
b. Very large
c. Equal to the load voltage divided by the load current
d. Equal to the input voltage divided by the output current

11. Compared to the ripple into a voltage regulator, the ripple out of a voltage regulator is
a. Equal in value
b. Much larger
c. Much smaller
d. Impossible to determine

12. A voltage regulator has a ripple rejection of -60 dB. If the input ripple is 1 V, the output ripple is
a. -60 mV
b. 1 mV
c. 10 mV
d. 1000 V

13. Thermal shutdown occurs in an IC regulator if
a. Power dissipation is too high
b. Internal temperature is too high
c. Current through the device is too high
d. All the above occur

14. If a linear three-terminal IC regulator is more than a few inches from the filter capacitor, you may get oscillations inside the IC unless you use
a. Current limiting
b. A bypass capacitor on the input pin
c. A coupling capacitor on the output pin
d. A regulated input voltage

15. The 78XX series of voltage regulators produces an output voltage that is
a. Positive
b. Negative
c. Either positive or negative
d. Unregulated

16. The 78XX-12 produces a regulated output voltage of

a. 3 V
b. 4 V
c. 12 V
d. 40 V

17. A current booster is a transistor in
a. Series with the IC regulator
b. Parallel with the IC regulator
c. Either series or parallel
d. Shunt with the load

18. To turn on a current booster, we can drive its base-emitter terminals with the voltage across
a. A load resistor
b. A zener impedance
c. Another transistor
d. A current-sensing resistor

19. A phase splitter produces two output voltages that are
a. Equal in phase
b. Unequal in amplitude
c. Opposite in phase
d. Very small

20. A series regulator is an example of a
a. Linear regulator
b. Switching regulator
c. Shunt regulator
d. Dc-to-dc converter

21. To get more output voltage from a buck switching regulator, you have to
a. Decrease the duty cycle
b. Decrease the input voltage
c. Increase the duty cycle
d. Increase the switching frequency

22. An increase of line voltage into a power supply usually produces
a. A decrease in load resistance
b. An increase in load voltage
c. A decrease in efficiency
d. Less power dissipation in the rectifier diodes

23. A power supply with low output impedance has low
a. Load regulation
b. Current limiting
c. Line regulation
d. Efficiency

24. A zener-diode regulator is a
a. Shunt regulator
b. Series regulator
c. Switching regulator
d. Zener follower

25. The input current to a shunt regulator is
a. Variable
b. Constant
c. Equal to load current
d. Used to store energy in a magnetic field

26. An advantage of shunt regulation is
a. Built-in short-circuit protection
b. Low power dissipation in the pass transistor
c. High efficiency
d. Little wasted power

27. The efficiency of a voltage regulator is high when
a. Input power is low
b. Output power is high
c. Little power is wasted
d. Input power is high

28. A shunt regulator is inefficient because
a. It wastes power
b. It uses a series resistor and a shunt transistor
c. The ratio of output to input power is low
d. All of the above

29. A switching regulator is considered
a. Quiet
b. Noisy
c. Inefficient
d. Linear

30. The zener follower is an example of a
a. Boost regulator
b. Shunt regulator
c. Buck regulator
d. Series regulator

31. A series regulator is more efficient than a shunt regulator because
a. It has a series resistor
b. It can boost the voltage
c. The pass transistor replaces the series resistor
d. It switches the pass transistor on and off

32. The efficiency of a linear regulator is high when the
a. Headroom voltage is low
b. Pass transistor has a high power dissipation
c. Zener voltage is low
d. Output voltage is low

33. If the load is shorted, the pass transistor has the least power dissipation when the regulator has
a. Foldback limiting
b. Low efficiency
c. Buck topology
d. A high zener voltage

34. The dropout voltage of standard monolithic linear regulators is closest to
a. 0.3 V
b. 0.7 V
c. 2 V
d. 3.1 V

35. In a buck regulator, the output voltage is filtered with a
a. Choke-input filter
b. Capacitor-input filter
c. Diode
d. Voltage divider

36. The regulator with the highest efficiency is the
a. Shunt regulator
b. Series regulator
c. Switching regulator
d. Dc-to-dc converter

37. In a boost regulator, the output voltage is filtered with a
a. Choke-input filter
b. Capacitor-input filter

c. Diode
d. Voltage divider

38. The buck-boost regulator is also
a. A step-down regulator
b. A step-up regulator
c. An inverting regulator
d. All of the above