CHAPTER 7: MICROELECTRONICS

1. The integrated circuit was invented at Texas instrument in 1958 by
   A. Jonathan Kurtz
   B. James Faug
   C. Jack Kilby
   D. Harold Lanche

2. Which component cannot be fabricated into ICs?
   A. Diode
   B. Resistor
   C. Inductor
   D. Transistor

3. What is the purpose of a comparator in op-amps?
   A. To detect the occurrence of a changing input voltage
   B. To maintain a constant output when the dc input voltage changes
   C. To produce change in output when an input voltage equals a reference voltage
   D. To amplify an input voltage

4. The op-amp comparator circuit uses
   A. Negative feedback
   B. A resistor
   C. Positive feedback
   D. No feedback

5. What is a complete electronic circuit, containing transistors, diodes, resistors and capacitors processed on and contained entirely within a single chip of silicon?
   A. Integrated circuit (IC)
   B. Monolithic IC
   C. Linear IC
   D. Digital IC

6. What process is used to produce IC semiconductor elements?
   A. Alloy junction
   B. Mesa diffusion
   C. Grown diffusion
   D. Planar diffusion

7. Which integrated circuit is having more than 1000 gates?
   A. Small-scale integration (SSI)
   B. Medium-scale integration (MSI)
   C. Large-scale integration (LSI)
   D. Very large-scale integration (VLSI)

8. What characteristic does not apply to an op-amp?
   A. Low power
   B. High gain
   C. High input impedance
   D. Low output impedance

9. An integrator op-amp uses what element in the feedback path?
   A. Capacitor
   B. Resistor
   C. Inductor
   D. Transistor

10. Which integrated circuit is having more that 100 gates?
   A. Small-scale integration (SSI)
   B. Medium-scale integration (MSI)
   C. Large-scale integration (LSI)
   D. Very large-scale integration (VLSI)

11. Which of the choices below are sources of output offset voltage?
   A. The difference in V_{BE} values
   B. The difference in V_{CE} values
   C. The difference in transistor voltage
   D. All of the choices

12. The voltage gain of differential amplifier
   A. Equals the AC collector resistance divided by two times the AC resistance of the emitter diode
   B. Is the sum of two emitter currents
   C. Equals the difference between two base currents
   D. Is half of either collector current

13. Which integrated circuit is having 10 to 100 gates?
    A. Small-scale integration (SSI)
    B. Medium-scale integration (MSI)
    C. Large-scale integration (LSI)
    D. Very large-scale integration (VLSI)

14. Integrated circuits having up to 9 gates is called
    A. Small-scale integration (SSI)
    B. Medium-scale integration (MSI)
    C. Large-scale integration (LSI)
    D. Very large-scale integration (VLSI)

15. What is VCO
    A. Exhibits a frequency that can be varied with a dc control voltage
    B. A single pole low pass filter
    C. Is the terminal of the op-amp where input resistors are placed
    D. All of the choices

16. The reason why integrated circuits are divided into digital linear categories is because
    A. They either process analog or digital signals
    B. They are either used as input of output components
    C. Up to the present these are the only two known categories
    D. They are simply circuits that happen to be constructed integrally and like all circuits are either switching type or amplifying type

17. How is the output of a differentiator related to the input in an op-amp?
    A. The output of a differentiator is proportional to the rate of change of the input
    B. The output of a differentiator is inversely proportional to the rate of change of the input
    C. The two parameters are not related
    D. The two parameters are always equal to each other

18. ICs have advantages over discrete device circuits which is
    A. Lower cost
    B. High reliability
    C. Smaller size
    D. All of the above

19. Dual-in-line pick up (DIP) is the most popular IC package because
    A. It is low in cost
    B. It is one of the tiniest package known
    C. It ruggedly resist vibration due to its solid construction
    D. All of the above

20. What is the typical input resistance of the op-amp amplifier when measured under open loop?
    A. 2 MΩ
    B. 3 MΩ
    C. 1.5 MΩ
    D. 2.5 MΩ

21. After assembly, the ICs are tested and classified as either
    A. Military
    B. Industrial
    C. Military or industrial
    D. Military and industrial

22. For a constant input voltage to an integrator, why is the voltage across the capacitor linear?
    A. Capacitor diode does not dissipate heat
    B. Capacitor current is constantly changing
    C. Capacitor current is linear
    D. Capacitor current is constant

23. Upon what principle does a relaxation oscillator operate?
    A. Resistor in cascade
    B. The charging and discharging of capacitor
    C. The rectification process of a diode
    D. Switching transistors

24. ICs for military and space applications are tested in the temperature range of
    A. 0ºC to +70 ºC
    B. -55 ºC to +125 ºC
    C. -173 ºC to + 100 ºC
    D. -10 ºC to + 25 ºC

25. For most commercial and industrial operations, ICs are tested in the temperature range of

A. 0ºC to +70 ºC
B. -55 ºC to +125 ºC
C. -173 ºC to + 100 ºC
D. -10 ºC to + 25 ºC

26. An IC op-amp that combines FETs and bipolar transistors.

A. BIFET
B. MOSFET
C. CMOS
D. IGFET

27. A mass of metal attached to the case of a transistor to allow the heat to escape more easily.

A. Flag
B. Heat sink
C. Op-amp
D. Photodiode

28. Which of the following IC processes digital signals?

A. Digital IC
B. Discrete IC
C. Linear IC
D. Monolithic IC

29. Which of the following IC processes analog signals?

A. Digital IC
B. Discrete IC
C. Linear IC
D. Monolithic IC

30. A signal that is applied with equal strength to both inputs of a differential amplifier or an op-amp.

A. Common-emitter circuit
B. Common-ration signal
C. CMRR
D. Common mode signal

31. A base circuit that a designer can modify to get more advanced circuits
    A. Experimental
    B. Prototype
    C. Peak detector
    D. Loading

32. What is the most commonly used type of linear IC?
    A. 741
    B. 555 timer
    C. Operational amplifier
    D. LM 340

33. What has been considered as the industry standard of linear ICs?
    A. 555 timer
    B. 741 op amp
    C. LM 340
    D. LM 317

34. What type of response characterizes the single pole low pass filter?
    A. Flat from dc to the critical frequency
    B. Current downward up to the maximum frequency
    C. Curved upward to the maximum frequency
    D. No response characteristics

35. Which of the item below is an advantage of a shunt regulator over a series type?
    A. Has an inherent current limiting
    B. Efficient than series regulator because of its component used
    C. A non regulating device
    D. None of the choices

36. What is the most popular IC used in timing circuits?
    A. 555 timer
    B. 741
    C. LM 317
    D. LM 340

37. What is the typical total power dissipated by the operational amplifier?
    A. 5 mW
    B. 0.5 mW
    C. 50 mW
    D. 500 mW

38. In the standard letter-number identification code of operational amplifiers, the letter prefix which normally consists of two or three letters identifies the
    A. Manufacturer
    B. Type of packaging
    C. Type of op-amp
    D. Temperature range of operation

39. An op-amp circuit that has its output tied directly to the inverting input terminal is called a _____
    A. Current follower
    B. Inverting amplifier
    C. Non-inverting amplifier
    D. Voltage follower

40. Most op-amps circuit use
    A. Positive feedback
    B. Negative feedback
    C. Open-loop operation
    D. Closed-loop operation

41. The three most common package suffix codes are the following except one
    A. A
    B. D
    C. J
    D. N

42. What is the package suffix code for a plastic dual-in-line for surface mounting on PC board?
    A. D
    B. J
    C. N
    D. P

43. What is the approximate short circuit current output of 741 op amp?
    A. 15 mA
    B. 25 mA
    C. 30 mA
    D. 35 mA

44. A circuit whose components are soldered or otherwise connected mechanically
    A. Discrete circuit
    B. Non discrete circuit
    C. Biasing circuit
    D. Integrated circuit

45. MPP value in an op-amp is synonymous with
    A. Output voltage swing
    B. Equal to the difference of the two supply voltages
    C. The maximum unclipped peak-to-peak output of an amplifier
    D. All of the choices

46. What is the highest undistorted frequency out of an op-amp for a given slew rate and peak voltage?
    A. Power bandwidth
    B. Cut-off frequency
    C. Critical frequency
    D. 3-dB bandwidth

47. What is the summing point in op-amps?
    A. Simulates mathematical integration
    B. Acts as a scaling differentiator
    C. Determines the rate of change of the integrator output voltage
    D. A terminal of the op-amp where the input resistors are commonly connected

48. In terms of circuit components, what does the term pole refer to?
    A. A single RL circuit
    B. A single RC circuit
    C. A cascaded amplifier
    D. A summing amplifier

49. What is the slew rate of a 741 operational amplifier?
    - **A. 0.5 V/µs**
    - B. 1 V/µs
    - C. 0.5 V/ms
    - D. 1 V/ms

50. What specification of an operational amplifier which tells how fast the output voltage can change?
    - A. Frequency response
    - B. Common mode rejection ration
    - **C. Slew rate**
    - D. Open-loop voltage gain

51. What is the typical input bias current of a 741 operational amplifier?
    - A. 70 nA
    - **B. 80 nA**
    - C. 90 nA
    - D. 100 nA

52. The _____ of an op amp is its voltage gain when there is no negative feedback
    - A. CMRR
    - B. Unity gain
    - C. Close-loop
    - **D. Open-loop**

53. The term monolithic is derived tom a combination of the Greek words monos and lithos which means
    - A. Single-element
    - B. Single-water
    - **C. Single-stone**
    - D. Single-chip

54. A technique used to eliminate the need for inductive elements in monolithic integrated circuits.
    - A. Projection printing
    - B. Photolithographic
    - C. LC synthesis
    - **D. RC synthesis**

55. Most linear ICs are low-power devices with power dissipation ratings of

A. 5 W
B. 1 μW
C. Less than 1 W
D. More than 1 W but less than 2 W

56. An integrated circuit for both astable and monostable applications

A. 741 op-amp
B. Discrete ICs
C. Monolithic ICs
D. 555 timer

57. Astable multivibrator is

A. A square wave clock
B. Equivalent to a flip-flop
C. A one-shot multivibrator
D. Monostable in nature

58. In a 5 V level detector circuit

A. The noninverting input is connected to +5V
B. The input signal is connected to +5V
C. The inverting input is connected to +5V
D. The input signal must be riding on a +5V dc level

59. To convert a summing amplifier of an averaging amplifier

A. All inputs must be of the same value
B. The ratio of Rf/R must equal to the reciprocal of the number of inputs
C. All input resistors must be of different value
D. The ratio of Rf/R must equal to the number of inputs

60. An oscillator is described by

A. Regenerative feedback
B. No feedback
C. An integrator or differentiator
D. Unity gain and zero phase shift around the feedback loop

61. To use a comparator for zero-level detection, the inverting input is connected to

A. Ground
B. A positive reference voltage
C. The dc supply voltage
D. A negative reference voltage

62. In most modern IC op-amps, the 741 requires _____ power supplies

A. 1
B. 2
C. 3
D. 4

63. In an op-amp integrator, the feedback path consist of

A. A capacitor
B. An inductor
C. A resistor and a capacitor in series
D. A resistor and a capacitor in parallel

64. Microwave ICs cover the frequency range from

A. 0.5 to 15 GHz
B. 15 to 30 GHz
C. 30 to 45 GHz
D. 45 to 100 GHz

65. Considered as the fundamental form of IC

A. Hybrid
B. MSI
C. VLSI
D. Monolithic

66. Plastic dual-in-line for insertion into sockets has a package suffix code of

A. N
B. P
C. Both a and b
D. J

67. What is the specific application of µA741C op-amp
    - **A. For commercial**
    - B. For industrial
    - C. For military
    - D. For experimental

68. What is the most common method used for growth of single crystals for IC fabrication?
    - A. Epitaxial growth
    - **B. Czochralsky pulling technique**
    - C. Film deposition
    - D. Photolithography

69. The charge-coupled device (CCD) is a unique and versatile semiconductor structure invented in 1969 by
    - **A. W.S Boyle and G.E Smith**
    - B. W.F Davis and R.C Huntington
    - C. D. Cave and W. Blood Jr.
    - D. H.H Strellrecht and C.S. Meyer

70. The value of the input voltage that switches the output of a comparator or Schmitt trigger
    - **A. Trip point**
    - B. Firing voltage
    - C. Threshold voltage
    - D. All of the choices

71. A type of ground that appears at the inverting input of an op-amp that uses negative feedback.
    - A. Earth ground
    - B. Equipment ground
    - C. True ground
    - **D. Virtual ground**

72. The intel i486 32-bit microprocessor incorporates _____ transistors on a single chip.
    - **A. 1 million**
    - B. 100 thousand
    - C. 2 million
    - D. 200 thousand

73. In IC op-amps, the input bias current is defined as the

A. Average of the two base currents
B. Total of the base currents
C. Inverse of the base currents
D. Difference of the base currents

74. CMRR means

A. Common-mode rejection ratio
B. The ratio of the differential voltage gain to common-mode voltage gain
C. Both a and b
D. The difference between the two base voltages

75. The typical dimension of a MOSFET in a single IC ship is

A. 4 mils x 6.5 mils
B. 2 mils x 12 mils
C. 3 mils x 4.5 mils
D. 1.5 mils x 3 mils

76. The maximum rate that an output voltage of an op-amp can change

A. Slew rate
B. CMRR
C. Input offset voltage
D. Tail current

77. The unwanted capacitance between connecting wires and ground.

A. Summer capacitor
B. Stray wiring capacitance
C. Biasing capacitance
D. Feedback capacitance

78. The typical dimension of a BJT in a single IC chip is

A. 4 mils x 6.5 mils
B. 2 mils x 12 mils
C. 3 mils x 4.5 mils
D. 1.5 mils x 3 mils

79. The typical dimension of a diode in a single IC chip is
    A. 4 mils x 6.5 mils
    B. 2 mils x 12 mils
    C. 3 mils x 4.5 mils
    D. 1.5 mils x 3 mils

80. Which of the items below is equivalent to a relaxation oscillator?
    A. Astable multivibrator
    B. Flip-flop
    C. Monostable multivibrator
    D. Bistable multivibrator

81. The unity gain frequency of an op-amp
    A. Is the frequency where the voltage gain of an op-amp is 1
    B. Indicates the highest usable frequency
    C. It equals the gain bandwidth product
    D. All of the above

82. If the base 10 is called decimal number system, then the base 12 is called
    A. Bidecimal number system
    B. Dodecimal number system
    C. Duodecimal number system
    D. All of the above

83. What is the principal method used in the fabrication of semiconductor devices for hybrid and monolithic ICs?
    A. Epitaxial growth
    B. Photolithographic process
    C. Isolation diffusion
    D. Planar technology

84. The gain reduction in operational amplifier is known as
    A. Roll-off
    B. Back-off
    C. Gain-off
    D. Attenuation

85. The rate of gain reduction in operational amplifers

A. 5 db per decade (-5db/decade)
B. 6 db per decade (-6db/decade)
C. 10 db per decade (-10db/decade)
D. 20 db per decade (-20db/decade)

86. A capacitor inside an op-amp that prevents oscillations

A. Compensating capacitor
B. Limiting capacitor
C. Biasing capacitor
D. Coupling capacitor

87. A device that contains its own transistors, resistors and diodes

A. Integrated circuit
B. CMOS
C. Logic gates
D. All of the above

88. What provides a parameter specifying the maximum rate of change of the output when driven by a large step-input signal?

A. Step rate
B. Slew rate
C. Step rate
D. Dynamic rate

89. The absolute maximum rating for op-amps interval power dissipation is

A. 500 mW
B. 300 mW
C. 200 mW
D. 100 mW

90. What is the absolute maximum rating for an op-amps differential input voltage?

A. ±10 V
B. ±20 V
C. ±30 V
D. ±50 V

91. The amplifier CMRR of µA 741 op-amplifier is

A. 60 dB
B. 70 dB
C. 80 dB
D. 90 dB

92. The letter prefix LM identifies which of the following manufacturers?

A. National semiconductor corporation
B. Texas instrument
C. Motorola
D. Signetics

93. What is the letter prefix used by the Fairchild Semiconductor on their op-amp product?

A. µA
B. FS
C. SG
D. NE

94. Which of the following is not part of the three temperature range codes of op amps for commercial, industrial and military applications?

A. -30 to 200ºC
B. 0 to 70 ºC
C. -25 to 85 ºC
D. -55 to 125 ºC

95. What identifies the package style that houses the op amp chip?

A. Letter suffix
B. Letter prefix
C. Circuit designator
D. Military specification code

96. The package suffix code for ceramic dual-in-line is

A. J
B. D
C. N
D. P

97. The summing amplifier has two or more inputs, and its output voltage is proportional to the _____ of the algebraic sum of its input voltages.
    A. Positive
    B. Negative
    C. Reciprocal
    D. Inverse

98. When higher power ICs are needed, we can use
    A. Monolithic ICs
    B. Thin film ICs
    C. Thick film ICs
    D. Both b and c

99. In IC op-amps, one of the most important input characteristics is the _____ which is defined as the difference between the base currents.
    A. Input bias current
    B. Input offset current
    C. Total base current
    D. All of the choices

100. Monolithic ICs are
    A. Forms of discrete circuits
    B. Combination of thin-film and thick-film circuits
    C. Also called hybrid ICs
    D. Used for high power application