Chapter I

Electronic Materials and Devices

1. The forbidden charge in germanium at 0°K is
(a) 0.785 eV (b) 1.21 eV
(c) 1.00 eV (d) 0.01 eV

2. One electron volt equals to
(a) 01.60×10^{-19} (b) 09.11×10^{-31}
(c) 19.40×10^{-10} (d) 01.16×10^{-19}

3. Which device is a combination of P-N junction diode and two resistors?
(a) SCR (b) SCS
(c) UJT (d) FET

4. The α of the transistor is
(a) A measure of its sensitivity
(b) A measure of quality
(c) A measure of thermal stability
(d) A measure of its noise immunity

5. Which of the following is also known as reverse blocking triode thyristor?
(a) Triac (b) Diac
(c) SCR (d) UJT

6. In germanium the majority of electrons are
(a) 1.22 m^2/Vs (b) 1.44 m^2/Vs
(c) 1.66 m^2/Vs (d) 1.88 m^2/Vs

7. While plotting the V-I characteristics of semi-conductor diode, the voltage is plotted along horizontal axis and the current along the vertical axis because
(a) The voltage and currents are independent variables
(b) The voltage and currents are dependent variables
(c) The voltage is dependent and the current is independent variable
(d) The voltage and the current are dependent variables

8. In order to increase the recombination rate in silicon PN junction device _____ is diffused.
(a) Aluminum (b) Silver
(c) Indium (d) Gold

9. One electron volt equals to
(a) 1.620×10^{-19}
(b) 1.602×10^{-19}
(c) 1.620×10^{-18}
(d) 1.602×10^{-18}

10. During IC fabrication, the chemical reaction involved in epitaxial growth takes place at a temperature of about
(a) 500 °C (b) 1000 °C
(c) 1200 °C (d) 1500 °C

11. If the PN junction is abrupt, the capacitance varies as
(a) Square root of reverse bias
(b) Square of reverse bias
(c) Cube root of reverse bias
(d) Cube of reverse bias

12. Match list I and list II and select the correct one using the codes given below:

List I	*List II*
P. Resistance	1. Current noise
Q. Diode	2. Partition noise
R. Triode	3. Shot noise
S. PN junction	4. Johnson noise

(a) P- (4), Q - (1), R- (2), S- (3)
(b) P- (2), Q - (3), R- (1), S- (4)
(c) P- (1), Q - (2), R- (3), S- (4)
(d) P- (4), Q - (3), R- (2), S- (1)

13. In a semiconductor diode, the time constant equals to
(a) Value of majority carrier lifetime
(b) Value of minority carrier lifetime
(c) Diffusion capacitance time constant
(d) Zero

14. A Triac has
(a) 2 layers (b) 3 layers
(c) 4 layers (d) 5 layers

15. Thyristors can be used to perform
(a) Rectification (b) Inversion
(c) Regulation (d) All of the above

16. Normal biasing of transistor is
(a) Forward bias the Emitter-Base and reverse bias the Collector-Base
(b) Forward bias both the Emitter-Base and Collector-Base
(c) Reverse bias both the Emitter-Base and Collector-Base
(d) Reverse bias both Emitter-Base and forward bias the Collector-Base

17. With reference to the current amplification factor of transistor
(a) α is greater than β
(b) α is smaller than β
(c) α and β are equal
(d) None of the above

18. For small values of drain to source voltage, JFET behaves like a
(a) Diode (b) Capacitor
(c) Inverter (d) Resistor

19. A thyristor is fabricated using
(a) Silicon
(b) Germanium
(c) Gallium arsenide
(d) Indium oxide

20. An SCR is a semiconductor device, which consists of
(a) 4 PN junctions
(b) 3 PN junctions
(c) 2 PN junctions
(d) 1 PN junction

21. Input impedance of MOSFET is
(a) Less than BJT but more than FET
(b) More than BJT but less than FET
(c) More than BJT and FET
(d) Less than BJT and FET

22. When a transistor is connected in common collector mode, then
(a) Input is in between Base and Emitter
(b) Input is in between Base and Collector
(c) Input is in between Emitter and Collector
(d) Input is in between Collector short-circuited

23. In general, a shell contains a maximum of _____ electrons.
(a) 2n (b) $2n^2$
(c) 2n–1 (d) 2n+1

24. The holding current I_H of the SCR is
(a) Inversely proportional to the temperature
(b) Directly proportional to the temperature
(c) Remains unaffected by variation in temperature
(d) None of the above

25. Which one of the following possesses negative resistance characteristics?
(a) Schottky diode
(b) Tunnel diode
(c) PN junction diode
(d) Hot-carrier diode

26. As the temperature increases in a semiconductor, the densities of the electrons and holes
(a) Increase (b) Decrease
(c) Become equal (d) Can't be defined

27. A glass is a/an
(a) Good conductor
(b) Semiconductor
(c) Insulator
(d) Resistive material

28. An ideal diode can be considered as an
(a) Amplifier (b) Bi-stable switch
(c) Oscillator (d) Fuse

29. Emission of a beta particle from an atom
(a) Increases the number of protons in an atom
(b) Increases the number of neutrons in an atom
(c) Decreases the number of protons in an atom
(d) Decreases the number of neutrons in an atom

30. A voltage regulator is based on the principle of
(a) Rectification
(b) Amplification
(c) Zener breakdown
(d) Avalanche breakdown

31. Which of the following doesn't have forbidden energy gap between valence band and conductor band?
(a) Conductor
(b) Insulator
(c) Semiconductor
(d) None of the above

32. An SCR is
(a) 3 layer, tri-junction device
(b) 3 layer, four-junction device
(c) 4 layer, tri-junction device
(d) 4 layer, four-junction device

33. An LED is made up of
(a) Phosphorescent material
(b) Germanium
(c) Silicon
(d) Gallium arsenide

34. The conductivity of the intrinsic semiconductor at absolute temperature is
(a) 1.1 eV (b) 0.63 eV
(c) Zero (d) Infinity

35. The region between the peak and valley points of the tunnel diode is called as
(a) Pinch-off region
(b) Saturation region
(c) Cut-off region
(d) Negative conduction region

36. Avalanche breakdown occurs when
(a) The forward current is excessive
(b) The forward bias exceeds a certain value
(c) The reverse bias exceeds a certain value
(d) The potential barrier is reduced to zero

37. Doping is a process of
(a) Purifying semiconductor material
(b) Increasing impurity percentage
(c) Removal of foreign atoms
(d) Increasing the bias potential

38. With reference to transistor which of the following is correct?
(a) $I_C = I_E + I_B$
(b) $I_B = I_C + I_E$
(c) $I_E = I_B + I_C$
(d) $I_E = I_B$

39. A Silicon-controlled switch is
(a) A unilateral device without a gate
(b) A unilateral device with 2 gates
(c) A bilateral device without a gate
(d) A bilateral device with 2 gates

40. The intrinsic stand-off ratio of UJT is
(a) Always equal to zero
(b) Always equal to unity
(c) Always greater than unity
(d) Always less than unity

41. Zener diode exhibits
(a) Avalanche breakdown
(b) Zener breakdown
(c) Both (a) & (b)
(d) Neither (a) nor (b)

42. In a transistor, if the base current is 1 mA and collector current is 2 mA, then
(a) $I_E = 1$ mA
(b) $I_E = 2$ mA
(c) $I_E = 3$ mA
(d) $I_E = 4$ mA

43. A BJT has
(a) One PN junction
(b) Two PN junctions
(c) Three PN junctions
(d) Four PN junctions

44. The switching time of LED is in the order of
(a) 1 second
(b) 1 microsecond
(c) 1 millisecond
(d) 1 nanosecond

45. For a doped semiconductor material, the dynamic resistance is
(a) Small and can be neglected
(b) Large and can be neglected
(c) Small but cannot be neglected
(d) Large but cannot be neglected

46. _____ is an example of acceptor material.
(a) Gallium (b) Arsenide
(d) Bismuth (d) Antimony

47. The β value of a transistor can be determined from the curve plotted between
(a) V_{BE} and I_E for constant V_{CE}
(b) V_{BE} and I_C for constant V_{CE}
(c) V_{CE} and I_E for constant I_B
(d) V_{CE} and I_C for constant I_B

48. When a semiconductor is heavily doped in a range of 10^{17} to 10^{18} impurity atoms/cm^3, then it behaves as
(a) Intrinsic semiconductor
(b) Extrinsic semiconductor
(c) Simply as semiconductor
(d) Degenerative semiconductor

49. The DC current gain of a transistor is
(a) Always positive and greater than unity
(b) Always positive and less than unity
(c) Always positive and equal to unity
(d) Always positive and equal to infinity

50. The Collector to Base with Emitter open current, a transistor is extremely temperature dependent because
(a) It is made up of free electrons and holes
(b) It is made up of thermally generated majority carrier
(c) It is made up of thermally generated minority carrier
(d) It is made up of free electrons alone

51. Diac can be analyzed by imaging it as
(a) Two diodes connected in series
(b) Two diodes connected in parallel
(c) Two diodes connected in anti-parallel connection
(d) One transistor and a diode connected parallelly

52. Graphite is a
(a) Conductor
(b) Insulator
(c) Semiconductor
(d) None of these

53. Tunnel diode, with its negative resistance characteristics can be employed for
(a) Current amplification
(b) Voltage amplification
(c) Power amplification
(d) All of the above

54. Thermistor is a device whose resistance
(a) Decreases proportionally with increase in temperature
(b) Decreases exponentially with increase in temperature
(c) Increases proportionally with increase in temperature
(d) Increases exponentially with increase in temperature

55. Capacitive effects are exhibited by PN junctions when they are
(a) Forward biased
(b) Reverse biased
(c) Either forward or reverse biased
(d) Neither forward nor reverse biased

56. Which of the following elements is the poorest conductor of heat?
(a) Sodium (b) Lead
(c) Zinc (d) Mercury

57. What is the type of capacitance effect exhibited by the PN junction, when it is reverse biased?
(a) Transition capacitance
(b) Diffusion capacitance
(c) Space charge capacitance
(d) Drift capacitance

58. Localized hot spots and device destruction can take place in power transistors due to
(a) Avalanche breakdown
(b) Primary breakdown
(c) Second breakdown
(d) Quasi-saturation breakdown

59. Recombination of electrons and holes takes place when
(a) An electron falls into a hole
(b) A positive ion and a negative ion bond together
(c) Avalanche electron becomes a conduction electron
(d) An atom is formed

60. The power consumption of an LCD as compared to an LED is
(a) Same (b) More
(c) Less (d) Can't be defined

61. When a photodiode is reverse biased, and kept in a dark room, the current flowing through the device corresponds to
(a) Zero current
(b) Maximum current the device can hold
(c) Normal current that flows through the device
(d) Reverse saturation current

62. If an atom has an atomic number of 6, then it has
(a) 3 electrons & 3 protons
(b) 4 electrons & 2 protons
(c) 2 electrons & 4 protons
(d) 6 electrons & 6 protons

63. Semiconductors are
(I) Ohmic as they obey Ohm's law
(II) Bipolar
(a) Only I is true
(b) Only II is true
(c) Both I & II are true
(d) Both I & II are false

64. An SCR can be constructed using
(a) One PNP and one NPN transistor
(b) Two PNP transistors
(c) Two NPN transistors
(d) All of the above

65. The current amplification factor of α of a transistor is always
(a) Less than 1 (b) Greater than 1
(c) Equal to 1 (d) None of these

66. Match the following

P.	SCR	(I)	Low current SCR without gate
Q.	Triac	(II)	Low current SCR with gate
R.	Schottky diode	(III)	Uni-directional
S.	SCS	(IV)	Bi-directional

(a) P-IV, Q-III, R-I, S-II
(b) P-I, Q-II, R-III, S-IV
(c) P-III, Q-IV, R-I, S-II
(d) P-I, Q-IV, R-II, S-III

67. Silicon is appreciably employed as a base material compared to germanium while manufacturing Zener diode since
(a) Silicon is abundantly available
(b) It is costlier
(c) It has low current capability
(d) It has high temperature capability

68. The input impedance of FET
(a) Is less than 10 kΩ
(b) Is greater than 10 MΩ
(c) Falls within a range between 10 kΩ and 10 MΩ
(d) Is less than 1 kΩ

69. An excited electron in an atom returns to the ground state
(a) Always in one jump
(b) In one or more jumps
(c) Always in two jumps
(d) Always in three jumps

70. Which one of the following pair is correctly matched?

(a)	Mass spectroscopy	-	Chadwick
(b)	Atomic number	-	Moseley
(c)	Neutron	-	Millikan
(d)	Measurement of charge of an electron	-	Aston

71. Impact ionization is a process of liberation of free electrons by breaking
(a) Metallic bond
(b) Ionic bond
(c) Covalent bond
(d) van der Waals bond

72. A forward biased diode
(a) Acts as an open switch
(b) Offers high resistance
(c) Has a large voltage drop
(d) Conducts current easily

73. UJT can be used as
(a) Oscillator
(b) Amplifier
(c) Oscillator and amplifier
(d) Either as oscillator or amplifier

74. In a Zener diode
(a) P & N regions are lightly doped
(b) The depletion region is wide
(c) P & N regions are heavily doped
(d) The junction field current is small

75. Which of the following statements are correct?
1. In semiconductor, the mobility of electrons is more than that of holes
2. In semiconductor, when temperature increases, the resistivity also increases
3. Metal has positive TCR
4. In metals, thermal conductivity is inversely proportional to electrical conductivity at constant temperature

(a) 1, 2, 3 (b) 1, 2, 4
(c) 2, 3, 4 (d) 1, 3, 4

76. The atomic number of silicon is
(a) 14 (b) 16
(c) 18 (d) 12

77. The common method of making PN junction is known as
(a) Diffusing
(b) Alloying
(c) Doping
(d) Biasing

78. As compared to PNP transistor, NPN transistors are preferred due to
(a) Economical
(b) Simple operating mechanism
(c) Consumes less bias voltage
(d) Better high frequency response

79. In tunnel diode, the impurity concentration is in the order of
(a) 1 part in 10^{10} parts
(b) 1 part in 10^{6} parts
(c) 1 part in 10^{9} parts
(d) 1 part in 10^{3} parts

80. The transport factor of common emitter circuit is given as
(a) $\Delta I_C / \Delta I_E$
(b) $\Delta I_C / \Delta I_B$
(c) $\Delta I_E / \Delta I_B$
(d) $\Delta I_C = \Delta I_E + \Delta I_B$

81. The dynamic resistance of diode is
(a) Constant and independent of operating voltage
(b) Constant and dependent on operating voltage
(c) Not a constant and independent of operating voltage
(d) Not a constant and dependent on operating voltage

82. The carrier mobility in a semiconductor is found to be 0.4 m^2/V_s. Its diffusion constant at 300 K will be
(a) 0.43 m^2/s (b) 0.16 m^2/s
(c) 0.04 m^2/s (d) 0.01 m^2/s

83. Which diode is otherwise known as ESAKI diode?
(a) PIN diode
(b) Schottky barrier diode
(c) GUNN diode
(d) Tunnel diode

84. The Hall coefficient of an intrinsic semiconductor is
(a) Positive under all conditions
(b) Negative under all conditions
(c) Zero under all conditions
(d) Zero at 0°K

85. Two elements that are frequently used for making transistors are
(a) Iridium and Tungsten
(b) Lead and Tin
(c) Iron and Carbon
(d) Silicon and Germanium

86. IGBT combines the
(a) Switching characteristics of JFET with power handling capacity of BJT
(b) Switching characteristics of MOSFET with power handling capacity of BJT
(c) Switching characteristics of BJT with power handling capacity of JFET
(d) Switching characteristics of BJT with power handling capacity of MOSFET

87. The best conductor of heat among the liquids is
(a) Water (b) Mercury
(c) Ether (d) Alcohol

88. Consider the following statements regarding a semiconductor
1. Acceptor level lies close to valence band
2. Donor level lies close to valence band
3. N-type semiconductor behaves as a conductor at 0°K
4. P-type semiconductor behaves as an insulator at 0°K
(a) 1 & 2 are correct (b) 1 & 3 are correct
(c) 1 & 4 are correct (d) 2 & 3 are correct

89. The current in a PMOS transistor is
(a) Less than thrice that in an NMOS device
(b) Greater than thrice that in a PMOS device
(c) Less than half of that in an NMOS device
(d) Greater than half of that in a WMOS device

90. In a semiconductor, the total current is equal to
(a) Sum of electron and hole currents flow in same direction
(b) Sum of electron and hole currents flow in opposite directions
(c) Electron current only
(d) Hole current only

91. Semiconductor materials are made up of
(a) Metallic bond
(b) Ionic bond
(c) Un-shared bond
(d) Covalent bond

92. The barrier potential of Schottky diode is
(a) 0.25 V (b) 0.35 V
(c) 0.45 V (d) 0.56 V

93. Consider the statements with respect to semiconductor breakdown.

***Statement 1*:** The Zener breakdown occurs in junctions which are lightly doped.

***Statement 2*:** The avalanche breakdown occurs in junctions, which are heavily doped.

(a) Statements 1 & 2 are correct
(b) Only statement 1 is correct
(c) Only statement 2 is correct
(d) Statements 1 & 2 are wrong

94. In a PN junction, the density of carriers is _____ near the junction and decays _____ with distance.

(a) Low, linearly
(b) High, linearly
(c) Low, exponentially
(d) High, exponentially

95. Which type of the following structures contains two atoms per cell?

(a) Body centered cubic
(b) Face centered cubic
(c) Single cubic cell
(d) None of the above

96. The turn-on time of a typical transistor is equal to

(a) Delay time
(b) Rise time
(c) Storage time
(d) Sum of delay time & rise time

97. Consider the following statements:

1. The bulk resistance is observed when diode is reverse biased
2. The junction resistance of a diode is variable resistance

(a) 1 is correct
(b) 1 & 2 are correct
(c) 2 is correct
(d) 1 is wrong but 2 is correct

98. A particle of zero initial velocity placed inside a uniform magnetic field will

(a) Move in zigzag directions along the line of flux
(b) Move with varying speed
(c) Move with constant speed along the line of force
(d) Move with constant speed opposite to the line of force

99. Across a varactor diode, an increase in its reverse bias potential causes

(a) Width of depletion layer to increase thus increasing the capacitance
(b) Width of depletion layer to decrease thus increasing the capacitance
(c) Width of depletion layer to increase thus decreasing the capacitance
(d) Width of depletion layer to decrease thus decreasing the capacitance

100. The germanium diode at room temperature for a forward current of 26 mA has dynamic resistance of about

(a) 100 Ω (b) 10 Ω
(c) 1 Ω (d) 0.1 Ω

101. Silicon can appreciably be employed as base material as compared to germanium while manufacturing Zener diode because

(a) Silicon is abundantly available
(b) It is not costlier
(c) Low current capability
(d) High temperature capacity

102. The maximum number of electron that an M-shell of an atom can contain is

(a) 4 (b) 12
(c) 18 (d) 34

103. As the temperature is increased, the voltage across the diode carrying constant current

(a) Increases
(b) Decreases
(c) Remains constant
(d) Fluctuates between low and high threshold values

104. Current flow in the semiconductor slap is due to

(a) Drift phenomenon
(b) Diffusion phenomenon
(c) Recombination phenomenon
(d) All of the above

105. If C_T = space change capacitance and C_D= storage capacitance of PN junction diode, then

(a) $C_T = C_D$ (b) $C_T > C_D$
(c) $C_T < C_D$ (d) $C_T = C_D = \infty$

106. At low temperature, the resistivity of metals is proportional to the

(a) 5^{th} power of absolute temperature
(b) 6^{th} power of absolute temperature
(c) 7^{th} power of absolute temperature
(d) 9^{th} power of absolute temperature

107. Which one is the valid statement with respect to PN junction diode?
(a) Under forward bias, the electrons from P region & holes from N region drift towards the junction
(b) A junction diode cannot be used as a switch in electrical circuits
(c) Depletion capacitance is voltage independent
(d) Diffusion current of minority carriers is proportional to the concentration gradient

108. In intrinsic semiconductor
(a) The electron density is twice the hole density
(b) The electron density is thrice the hole density
(c) The electron density is square root of the hole density
(d) The electron density is same as the hole density

110. The Fermi-Dirac probability function specifying all states at energy E (electron volts) occupied under the thermal equilibrium is given by
(a) $f(E) = KT - \ln e^{E-Ef}$
(b) $f(E) = 1 + e^{E-Ef}$
(c) $f(E) = 1(1 + e^{(E-Ef) / kT})$
(d) $f(E) = ((E)/E_f)e^{-KT}$

111. Which among the following diodes has zero breakdown voltage?
(a) Zener diode
(b) Schottky diode
(c) Backward diode
(d) Tunnel diode

112. Match list 1 with list 2 with respect to transistor biasing

	Biasing	*Region of operation*
(A)	When EB & CB junctions are forward biased	(1) Inverted
(B)	When EB & CB junctions are reverse biased	(2) Cut-off
(C)	When EB is forward biased & CB is reverse biased	(3) Active
(D)	When EB is reverse & CB is forward biased	(4) Saturation

(a) A-1, B-2, C-3, D-4
(b) A-4, B-2, C-3, D-1
(c) A-4, B-3, C-2, D-1
(d) A-4, B-1, C-3, D-2

113. A Zener diode may be thought as open for
(a) $0V < V < V_Z$ (b) $0V > V > V_Z$
(c) $0V > V < V_Z$ (d) $0V < V > V_Z$

114. In silicon material, the mobility of free electron is
(a) 2.5 m^2/Vs (b) 2.7 m^2/Vs
(c) 1.66 m^2/Vs (d) 2.33 m^2/Vs

115. The dynamic resistance r of a diode varies as
(a) $1/I$ (b) $1/I^2$
(c) I (d) I^2

116. The reverse saturation current in germanium diode is of the order of
(a) 1 nano amps
(b) 1 micro amps
(c) 1 milli amps
(d) 1 kilo amps

117. The covalent crystals are characterized by
(a) Good electrical conductivity and low hardness
(b) Good electrical conductivity and high hardness
(c) Poor electrical conductivity and high hardness
(d) Poor electrical conductivity and low hardness

118. The diode capacitance has _____ temperature coefficient and the figure of merit has _____ temperature coefficient.
(a) Positive, Positive
(b) Negative, Negative
(c) Positive, Negative
(d) Negative, Positive

119. A Schottky diode has
(a) Insulator - Semiconductor junction
(b) Semiconductor - Semiconductor junction
(c) Metal - Semiconductor junction
(d) Metal - Metal junction

120. Which is the largest transistor current?
(a) Emitter current
(b) Base current
(c) Collector current
(d) Both Emitter & Collector currents

121. A laser diode
(a) Produces always light of single wavelength
(b) Produces always light of multiple wavelength
(c) Can be made to produce light of single and multiple wavelengths
(d) Produces visible light spectrum

122. Which type contains two atoms per cell?
(a) Body centered cubic
(b) Face centered cubic
(c) Single cubic cell
(d) None of the above

123. With reference to JFET configuration, match the following

(P)	Common Source Configuration	(1)	No phase shift between input & output
(Q)	Common Drain Configuration	(2)	High input impedance & low output impedance
(R)	Common Gate Configuration	(3)	Source follower

(a) P-1, Q-2, R-3
(b) P-2, Q-3, R-1
(c) P-2, Q-1, R-3
(d) P-3, Q-1, R-2

124. A Nixie cold cathode glow discharge tube has
(a) 20 cathodes (b) 15 cathodes
(c) 14 cathodes (d) 10 cathodes

125. Consider the following statements
1. LED is also known as direct gap diode
2. LCD generates light

Of these statements
(a) 1 is correct but 2 is wrong
(b) 2 is correct but 1 is wrong
(c) Both 1 & 2 are correct
(d) Both 1 & 2 are wrong

126. The isolation capacitance of an opto coupler is in the order of
(a) 0.3 – 2.5 μF
(b) 0.3 – 2.5 F
(c) 0.3 – 2.5 pF
(d) 0.3 – 2.5 nF

127. The light activated SCRs are sensitive to
(a) Light
(b) Temperature
(c) Rate of change of applied voltage
(d) All of the above

128. The light emitting diode
(a) Usually made from metal oxide
(b) Is Used in reverse biased condition
(c) Gives light when temperature increases
(d) Gives light due to electron hole recombination

129. The numeric aperture is the fiber optic cable's ability
(a) To collect the light
(b) To diffract the light
(c) To reflect the light
(d) To refract the light

130. The color emitted by an LED depends mainly on
(a) Type of material used
(b) Type of biasing applied
(c) Recombination rate of charge carriers
(d) Environmental conditions

131. The minority holes are about _____ that of electron.
(a) Half (b) Same
(c) Twice (d) Thrice

132. Compared to visible red light emitting diode, an infrared LED
(a) Produces light with longer wavelength
(b) Produces light with shorter wavelength
(c) Produces light with medium wavelength
(d) Produces light of all wavelengths

133. At absolute zero temperature, an intrinsic semiconductor behaves like a
(a) Conductor
(b) Insulator
(c) Semiconductor
(d) Other metals

134. Germanium and silicon are
(a) Trivalent (b) Tetravalent
(c) Pentavalent (d) Covalent

135. In comparison to LED, LASER has
1. High emission frequency
2. No tuning arrangement
3. Narrow spectral bandwidth
4. Provision for confinement

Of these statements
(a) 1, 3, & 4 are correct
(b) 1, 2, & 3 are correct
(c) 1 & 3 are correct
(d) 2, 3, & 4 are correct

136. The volume charge density of mobile carriers is expressed in
(a) Coulombs / cubic meters
(b) Coulombs / meters
(c) Coulombs / seconds
(d) Coulombs / volts

137. An LCD requires a power of about
(a) 20 W (b) 20 mW
(c) 20 μW (d) 20 nW

138. Barrier potential of PN junction decreases as temperature
(a) Increases
(b) Decreases
(c) Remains constant
(d) Increases & then decreases

139. Valence electrons are
(a) In the closest orbit of the nucleus
(b) In the most distant orbit from the nucleus
(c) In the various orbits around the nucleus
(d) Not associated with a particular atom

140. In a PIN diode, the intrinsic layer sandwiched between the heavily doped P & N layers is
(a) Heavily doped
(b) Lightly doped
(c) Very lightly doped
(d) Moderately doped

141. If an atom has an atomic number of 6, then it has
(a) 3 electrons & 3 protons
(b) 4 electrons & 2 protons
(c) 2 electrons & 4 protons
(d) 6 electrons & 6 protons

142. Transistor is said to be in a quiescent state when
(a) It is unbiased
(b) No current flows through it
(c) No signal is applied to its input
(d) Emitter junction is reverse biased

143. In a Silicon crystal, the number of covalent bonds a single atom can form is
(a) 2 (b) 4
(c) 6 (d) 8

144. Peak inverse voltage of the diode is found to be
(a) Greater or equal to V_M
(b) Small or equal to V_M
(c) Equal to V_M
(d) Not equal to V_M

145. What is the type of capacitance effect exhibited by the PN junction when it is forward biased?
(a) Diffusion capacitance
(b) Storage capacitance
(c) Drift capacitance
(d) Transition capacitance

146. Which of the following elements is most abundant in the earth's crust?
(a) Oxygen (b) Sulphur
(c) Silicon (d) Carbon

147. A semiconductor has a resistivity which
(a) Is smaller than 10^{-2} Ω-cm
(b) Is larger than 10^{-2} Ω-cm
(c) Varies between 10^{-2} Ω-cm and 10^{-9} Ω-cm
(d) None of the above

148. In Bohr's theory of atom, all the orbits of the electrons are considered circular in shape. The de Broglie wavelength λn corresponding to the electron in the n^{th} orbit is
(a) Proportional to n
(b) Proportional to n^2
(c) Inversely proportional to n
(d) Inversely proportional to n^2

149. The variable capacitance property possessed by the reverse biased PN junction is used to construct a device known as
(a) Zener diode (b) Volta caps
(c) Gunn diode (d) Tunnel diode

150. Consider the following statements regarding Bohr atomic model.

(Pick the right one)
1. It introduces the idea of stationary orbit
2. It assumes that angular momentum of electron is equal to ½(h/2π)
3. It uses planetary model of atom revolving in circular orbit

(a) 1 & 2 (b) 2 & 3
(c) 1 & 3 (d) 1, 2 & 3

151. When an electron moves from a higher orbit to a lower orbit
(a) Emission of energy takes place
(b) Absorption of energy takes place
(c) Size of the atom increases
(d) Either absorption or emission of energy takes place

152. Emission of light in an LED results due to
(a) Emission of electrons
(b) Photovoltaic effect
(c) Generation of electromagnetic radiation
(d) Conversion of heat to electrical energy

153. Match the items in Group I with items in Group II most suitably

Group I	*Group II*
(P) LED	(1) Heavily doped
(Q) Avalanche photo diode	(2) Coherent radiation
(R) Tunnel diode	(3) Spontaneous emission
(S) LASER	(4) Current gain

(a) P-2, Q-1, R-3, S-4
(b) P-4, Q-3, R-2, S-1
(c) P-3, Q-4, R-1, S-2
(d) P-3, Q-2, R-1, S-4

154. Which of the following statements is/are correct?
(a) Two discrete diodes connected back-to-back can work as a transistor
(b) Heat sink is a sheet of insulator used to dissipate the heat developed at the collector junction of a power transistor
(c) The collector leakage current is strongly independent of temperature
(d) The collector junction of transistor is heavily doped

155. Consider the following statements

Rutherford's alpha particle scattering experiment proved that the nucleus
1. Contains massive particles
2. Is a +ve charge center
3. Is quite stable

Which of the statements are correct?
(a) 1, 2, 3 (b) 1, 2
(c) 2, 3 (d) 1, 3

156. The Common-emitter amplifier is preferred to Common-base amplifier due to
(a) Higher amplification factor
(b) Easy biasing network
(c) Good stability
(d) Economicity

157. When an electron moves from lower orbit to a higher orbit
(a) Emission of energy takes place
(b) Absorption of energy takes place
(c) Size of atom increases
(d) Either absorption or emission of energy takes place

158. Consider the statements
1. Ideal diode conducts with zero resistance when forward biased
2. Ideal diode appears as an infinite resistance when reverse biased

(a) Only 1 is correct
(b) Only 2 is correct
(c) Both 1 & 2 are correct
(d) Either 1 or 2 is correct

159. The forbidden energy gap E_G in a semiconductor is a function of
(a) Current (b) Voltage
(c) Potential (d) Temperature

160. Based on Quantum mechanical theory, the mass of holes are _____ than the electrons.
(a) Larger (b) Smaller
(c) Equal (d) None of the above

161. The atomic number of germanium is
(a) 24 (b) 26
(c) 28 (d) 32

162. Dislocations are
(a) Line defects
(b) Planar defects
(c) Point defects
(d) Chemical defects

163. Intrinsic concentration of charge carriers in a semiconductor varies as
(a) T (b) T^2
(c) T^3 (d) 1/T

164. On increasing the impurity concentration in the metal, the residual part of the resistivity
(a) Decreases
(b) Increases
(c) Remains constant
(d) May increase or decrease

165. At room temperature in intrinsic germanium, there is about
(a) One free electron for every 10^9 atoms
(b) One free electron for every 10^{10} atoms
(c) One free electron for every 10^{12} atoms
(d) One free electron for every 10^{15} atoms

166. The UJT is a
(a) Voltage controlled device
(b) Current controlled device
(c) Relaxation oscillator
(d) None of these

167. The electrical conductivity is directly proportional to

(I) Electron density

(II) Relaxation time of electrons

(a) Both I & II (b) Only II
(c) Only I (d) Neither I nor II

168. A compensated semiconductor is doped with
(a) Only donor impurities
(b) Only acceptor impurities
(c) Both donor and acceptor impurities
(d) Neither donor nor acceptor impurity

169. Hall effect multiplier gives an output proportional to the product of _____ signal.
(a) Two (b) Three
(c) Four (d) Infinite

170. The dynamic impedance of Zener diode _____ with increase in the current flow through it.
(a) Increases
(b) Decreases
(c) Remains unaffected
(d) Is independent

171. Donor impurity atoms in a semiconductor results in the formation of new
(a) Wide energy band
(b) Narrow energy band
(c) Discrete energy level just below conduction
(d) Discrete energy level just above conduction

172. The depletion region of a semiconductor has
(a) Only free electrons
(b) Only holes
(c) Both free electrons and holes
(d) Absence of free electrons and holes

174. The electron density in conduction band is proportional to
(a) Donor concentration
(b) Square of donor concentration
(c) Square root of donor concentration
(d) Cube root of donor concentration

175. Capacitance is
(a) Exponentially proportional to the time constant
(b) Linearly proportional to the time constant
(c) Differentially proportional to the time constant
(d) None of these

176. Diffusion capacitance is a capacitance of a
(a) Reverse biased semiconductor diode junction caused by unequal doping
(b) Reverse biased semiconductor diode junction caused by equal doping
(c) Forward biased semiconductor diode junction caused by unequal doping
(d) Forward biased semiconductor diode junction caused by equal doping

177. Constantan is a Copper-Nickel alloy consisting of
(a) 60 % Cu and 40 % Ni
(b) 70 % Cu and 30 % Ni
(c) 50 % Cu and 50 % Ni
(d) 80 % Cu and 20 % Ni

178. Current flow through the semiconductor is due to
(a) Drift current
(b) Diffusion current
(c) Recombination of charges
(d) All of the above

179. The depletion layer across the junction contains
(a) Mobile carriers
(b) No mobile carriers
(b) Immobile carriers
(d) No charge carriers

180. Conduction modulation is exhibited by
(a) Transistor
(b) Diode
(c) JFET
(d) Tunnel diode

181. For both Ge and Si, the barrier voltage decreases by about
(a) 1 mV/ °C
(b) 2 mV/ °C
(c) 3 mV/ °C
(d) 5 mV/ °C

182. The drift velocity of an electron depends on
(a) Electron and holes mobility
(b) Electron mobility
(c) Electron mobility and applied electric field
(d) Applied electric field

183. Junction gate type of FET can be operated
(a) Only in depletion mode
(b) Only in enhancement mode
(c) Both depletion & enhancement modes
(a) Either depletion or enhancement mode

184. To find whether the semiconductor is N-type or P-type, one of the following effects can be used
(a) Seebeck effect
(b) Peltier effect
(c) Hall effect
(d) Avalanche effect

185. The constant current area of FET lies between
(a) 0 & I_{DSS}
(b) Cut off & Pinch off regions
(c) Cut off & Saturation regions
(d) Pinch-off & break-down regions

186. Electrostatic discharge may kill
(a) BJT
(b) FET
(c) UJT
(d) MOSFET

187. The transistor was invented at Bell Laboratories in 1947 by
(a) John Bardeen
(b) Walter Brattain
(c) William Shockley
(d) All of the above

188. The reverse saturation current
(a) Remains same for every 10°C rise in temperature
(b) Doubles for every 10°C rise in temperature
(c) Reduces to half for every 10°C rise in temperature
(d) None of the above

189. Practically the hole mobility is _____ to the electron mobility in intrinsic semiconductor.
(a) Equal (b) Half
(c) Twice (d) Thrice

190. A BJT is _____ controlled and the FET is _____ controlled device.
(a) Current, Current
(b) Voltage, Voltage
(c) Voltage, Current
(d) Current, Voltage

191. Typical value of parameter h_{fe} is
(a) 25 (b) 50
(c) 75 (d) 100

192. The gate of FET is analogous to the _____ of BJT.
(a) Emitter (b) Collector
(c) Base (d) None of these

193. When a transistor is wrongly biased, then
(a) The emitter terminal gets heavily loaded
(b) Excess production of heat is observed at the collector terminal
(c) The output signal gets distorted
(d) The AC load line gets distorted

194. The equivalent circuit of FET contains
(a) A current source in series with resistance
(b) A resistance between drain and source terminals
(c) A current source between gate and source terminals
(d) A current source between drain and source terminals

195. Which of the following statements is/are correct?
1. The input capacitance of FET is low
2. The transfer characteristics of FET can be represented mathematically by the Shockley equation
(a) Statement 1
(b) Statement 2
(c) Both statements 1 & 2
(d) Either statement 1 or 2

196. Which of the following statements is/are correct?
I The DC load line is steeper than AC load line
II BJT is a voltage controlled device
(a) Statement I
(b) Statement II
(c) Both statements I & II
(d) Either statement I or II

197. Which of the following statements is/are correct?
(A) Hybrid parameter of transistors can be used only when input signal is large
(B) Out of the four h parameters of transistor, h_{fe} has the least numerical value
(a) Statement A
(b) Statement B
(c) Both statements A & B
(d) Either statement A or B

198. Which electron in an element is responsible for chemical & electrical properties?
(a) Valence electrons
(b) Revolving electrons
(c) Active electrons
(d) Passive electrons

199. Typical UJT structure has
(a) Lightly doped N-type silicon bar with ohmic contacts at its each end
(b) Heavily doped N-type silicon bar with ohmic contacts at its each end
(c) Lightly doped P-type silicon bar with ohmic contacts at its each end
(d) Heavily doped P-type silicon bar with ohmic contacts at its each end

200. Which of the following devices is also known as complementary SCR?
(a) Junction field effect transistor
(b) Unijunction transistor
(c) Programmable unijunction transistor
(d) Triac

201. In an ideal JFET, R_{GS} is infinite because
(a) $I_G < 0$ (b) $I_G > 0$
(c) $I_G = 0$ (d) $I_G = \infty$

202. For a transistor, the current amplification factor
(a) α is greater than β
(b) α is lesser than β
(c) α is equal to β
(d) α & β always equal to zero

203. In an N-type material, the free electrons concentration is approximately equal to
(a) The density of acceptor atoms
(b) The density of the donor atoms
(c) Sum of the density of acceptor and donor atoms
(d) None of these

204. The absolute zero temperature is equal to
(a) 0°C (b) 273°C
(c) –273°C (d) 27°C

205. The combined package of LED and a photodiode is known as
(a) Optocouplers
(b) Opto isolator
(c) Optically coupled isolator
(d) All of the above

206. The substrate for IC fabrication is
(a) P type with typical thickness 200 μm
(b) P type with typical thickness 50 μm
(c) N type with typical thickness 200 μm
(d) N type with typical thickness 50 μm

207. The advantages of opto isolators is/are
(a) Easy to interface with logic devices
(b) Capable of wideband signal transmission
(c) Problems such as noise transients, contact bounce is completely eliminated
(d) All of the above

208. In IC fabrication, metallization means
(a) Depositing SiO_2 layer
(b) Covering with metallic cap
(c) Forming interconnection conduction pattern
(d) All of the above

209. _____ number of electrons is responsible for its chemical and electrical properties.
(a) 32 (b) 14
(c) 16 (d) 9

210. A semiconductor is those material which has
(a) Almost filled valence and conduction bands
(b) Almost empty valence and conduction bands
(c) Almost filled valence and almost empty conduction bands
(d) Almost empty valence and almost filled conduction bands

211. In the case of insulators, as the temperature decreases, its resistivity
(a) Increases
(b) Decreases
(c) Becomes zero
(d) Remains unaltered

212. A silicon diode dissipates 3W for a forward DC current of 2A. The forward voltage drop across the diode will be
(a) 0.5 V (b) 1.0 V
(c) 1.5 V (d) 6.0 V

213. An electron in a completely filled band
(a) Contributes to the flow of electric current
(b) Does not contributes to the flow of electric current
(c) Can move but doesn't contribute to the flow of electric current
(d) None of these

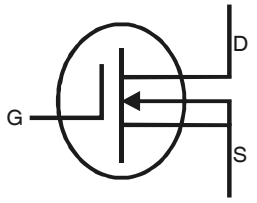
214. The junction resistance (r_j) of a germanium diode is found to be
(a) $25\ mV / I_F$ (b) $50\ mV / I_F$
(c) $76\ mV / I_F$ (d) $96\ mV / I_F$

215. The relation between the energy released and frequency of the emitted radiation of an atom is given by the expression
(a) $\Delta E = h/f$ (b) $\Delta E = h + f$
(c) $\Delta E = h\ f$ (d) $\Delta E = 1 + h/f$

216. The transistor must be operated in_____ when employed as amplifying device.
(a) Saturation region
(b) Cut-off region
(c) Active region
(d) Any of the three regions

217. The number of equations required to solve a network by mesh analysis is equal to the number of
(a) Independent nodes (b) Independent branchs
(c) Independent meshs (d) Independent loops

218. The symbol given below denotes



(a) n-channel depletion MOSFET
(b) p-channel depletion MOSFET
(c) n-channel enhancement MOSFET
(d) p-channel enhancement MOSFET

219. The frequency biased PN junction diode
(a) Acts like an open circuit
(b) Offers infinite resistance
(c) Provides very high voltage drop
(d) Conducts current easily

220. The active components of the IC's are formed in
(a) The substrate (b) SiO_2 layer
(c) Epitaxial layer (d) None of these

221. The material whose Hall effect is found to be zero is
(a) Conductor
(b) Insulator
(c) Extrinsic semiconductor
(d) Intrinsic semiconductor

222. In a single chip computer, CMOS circuits are used because of
(a) Low lower dissipation
(b) Large packing density
(c) High noise immunity
(d) economicity

224. In a transistor, if I_C=100mA and I_E=100mA then the value of β is given by
(a) 200 (b) 100
(c) 10 (d) 1

225. The junction resistance (r_j) of a Germanium diode is
(a) $25\,mV/I_F$ (b) $50\,mV/I_F$
(c) $76\,mV/I_F$ (d) $96\,mV/I_F$

226. I_{CBO} doubles for energy 10°C rise in temperature for
(a) Germanium
(b) Silicon
(c) Extrinsic Semiconductor
(d) Both (a) & (b)

227. The nucleus of atom is made of
(a) Protons & Electrons
(b) Protons & Neutrons
(c) Protons & Krypton
(d) Neutron & Electrons

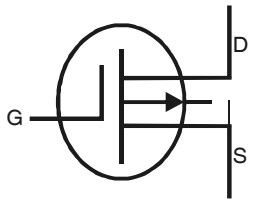
228. Widely used semiconductors such as silicon, germanium are placed in _____.
(a) First column
(b) Second column
(c) Third column
(d) Fourth column

229. Compare the Lists

List I	*List II*
(P) Pico	(1) 10^{-12}
(Q) Femto	(2) 10^{-15}
(R) Atto	(3) 10^{-18}
(S) Nano	(4) 10^{-9}

(a) P-(4), Q-(2), R-(3), S-(1)
(b) P-(1), Q-(2), R-(3), S-(4)
(c) P-(4), Q-(3), R-(2), S-(1)
(d) P-(1), Q-(3), R-(2), S-(4)

230. The symbol given below denotes



(a) n channel depletion MOSFET
(b) p channel depletion MOSFET
(c) n channel enhancement MOSFET
(d) p channel enhancement MOSFET

231. Which is valid with respect to JFET?
(a) Operated in depletion and enhancement modes
(b) Gate is not insulated from channel
(c) Channel doesn't permanently exist
(d) It possesses low input impedance

232. On introducing a dielectric medium in between the plates of a capacitor, one of the following quantities will not change
(a) Charge storing capacity
(b) Potential difference
(c) Electric field strength
(d) Electric flux density

233. A PN junction is a/an
(a) Oscillator (b) Amplifier
(c) Insulator (d) Rectifier

234. Ferrites are subgroup of
(a) Paramagnetic materials
(b) Diamagnetic materials
(c) Ferromagnetic materials
(d) Ferrimagnetic materials

235. Line imperfection in a crystal is called as
(a) Point dislocation
(b) Edge dislocation
(c) Schottky defect
(d) van der Waals defect

236. The elements in a periodic table are arranged, based on the increasing order of
(a) Atomic number
(b) Mass number
(c) Molecular weight
(d) Alphabetical order

237. For a silicon, the I_{CBO} doubles for every
(a) 5°C rise in temperature
(b) 6°C rise in temperature
(c) 10°C rise in temperature
(d) 12°C rise in temperature

238. The conductor of a 10 km long, single phase, two-wire line is separated by a distance 1.5 m. The diameter of each conductor is 1 cm. If the conductors are of copper, the inductance of the circuit is found to be
(a) 50.0 mH (b) 45.3 mH
(c) 23.8 mH (d) 19.6 mH

239. An n-channel JFET having a pinch off voltage of –5 V shows a transconductance of 1 mA/V when applied gate-to-source voltage of –3 V. Then its maximum transconductance is found to be
(a) 1.5 mA/V (b) 2.0 mA/V
(c) 2.5 mA/V (d) 3.0 mA/V

240. Strictly speaking, for an NPN transistor,
(a) I_C should be positive but I_E should be negative
(b) I_C should be negative but I_E should be positive
(c) Both I_C & I_E should be positive
(d) Both I_C & I_E should be negative

241. Air gap in the iron core of an inductor prevents
(a) Core saturation (b) Hysteresis loss
(c) Flux leakage (d) Transformer action

242. The solid which has no periodic structures at all is called as
(a) Crystalline solid
(b) Amorphous solid
(c) Polycrystalline solid
(d) Solids

243. The resistivity of pure silicon decreases
(a) With decrease in temperature
(b) With increase in temperature
(c) With constant temperature
(d) None of these

244. JFET channel is pinched-off only when
(a) V_{DD} is equal to V_P
(b) V_{DS} is greater than V_P
(c) V_{DS} is less than V_P
(d) V_{DS} is equal to V_P

245. Determine the invalid statement.
(a) For an n-channel JFET, both V_{GS} and V_P are negative
(b) For a p-channel JFET, both V_{GS} and V_P are positive
(c) For an n-channel JFET, I_{DSS} is positive
(d) For a p-channel JFET, I_{DSS} is positive

246. The function of SiO_2 layer in IC fabrication is
(a) Oxide masking
(b) Oxide passivation
(c) Oxide purification
(d) Both (a) & (b)

247. When gold and aluminum react, an intermetallic compound is formed known as
(a) Purple plaque (b) Yellow plaque
(c) Red plaque (d) White plaque

248. A plasma is a
(a) Collection of electrons, positive and negative ions only
(b) Collection of electrons and positive ions only
(c) Collection of neutral atoms and molecules only
(d) Collection of electrons, positive and negative ions, neutral atoms and molecules

249. Which is the final step in wafer processing sequence?
(a) Photolithography
(b) Chemical vapour
(c) Metallization
(d) Oxidation

250. Diffusion constant for electron is _____ to hole.
(a) Equal
(b) Greater than
(c) Lesser than
(d) Can't be determined

251. When a transistor is used as amplifier, then _____ breakdown is more destructive to the device.
(a) Zener (b) Diode
(c) Collector-Base (d) Base-Emitter

252. The variation of I_C with V_{CE} observed in a bipolar transistor output characteristic is called as
(a) Ohmic effect (b) Early effect
(c) Late effect (d) Natural effect

253. Small signals refers to
(a) Low amplitude signals
(b) Low frequency signals

(c) Small signals as compared to bias currents
(d) Small signals as compared to bias currents & voltages in a circuit

254. Kirk effect in a transistor occurs when
(a) The majority carrier's concentration in the collector becomes comparable to the donor-atom doping density
(b) The minority carrier's concentration in the collector becomes comparable to the acceptor atom doping density
(c) Emitter-base junction is reverse biased
(d) The base region of transistor stretches into the collector region of transistor

255. The parasitic resistance value can be reduced by
(a) Operating the transistor in saturation region
(b) Operating the transistor in cut-off region
(c) Changing the transistor structure
(d) Grounding the emitter terminal of the transistor

256. Consider the statements

***Statement I*:** N-channel MOS transistors are faster than p-channel MOS transistor.

Statement II: Surface field effect is the operational principle of MOSFETs.

Which of the above is/are a valid one?
(a) Statement I only
(b) Statement II only
(c) Both statements I and II
(d) Either statement I or II

257. Identify the ordered processing steps in fabrication of integrated circuits.
(a) Diffusion, Oxidation, Chemical vapor deposition, Photolithography, Metallization
(b) Oxidation, Diffusion, Chemical vapor deposition, Photolithography, Metallization
(c) Chemical vapor deposition, Oxidation, Diffusion, Photolithography, Metallization
(d) Diffusion, Oxidation, Photolithography, Chemical vapor deposition, Metallization

258. Parasitic resistance is produced by
(a) Viruses
(b) Infinite resistance of silicon
(c) Finite resistance of impurity
(d) Finite resistance of silicon between the top contacts on the transistor and active base region beneath the emitter

259. {111} planes oxidize faster than {100} because
(a) They have higher tensile strength
(b) They have fewer atoms per unit surface area
(c) They have more atoms per unit surface area
(d) They are good conductors

260. In IC fabrication, gettering is a process by which
(a) The silicon wafer is highly polished
(b) The silicon wafer is pre-heated to an optimum temperature for diffusion
(c) The harmful impurities or defects are removed from the region in a wafer where devices are to be fabricated
(d) Wafers are sliced into thin films

261. The law, which governs the diffusion process during the IC fabrication, is
(a) Flicker's law (b) Flick law
(c) Fick law (d) Fickler's law

262. In order to increase the speed of digital operations, _____ is used as diffusant which reduces the carrier life time.
(a) Boron (b) Arsenic
(c) Nickel (d) Gold

263. The most common diffusant used in interstitial diffusion in IC fabrication is
(a) Boron (b) Arsenic
(c) Nickel (d) Gold

264. The volt-ampere relation for PN junction can be expressed as
(a) $I = I_s[e^{V/n.Vt}] - 1$
(b) $I = 1/I_s[e^{V/n.Vt}] - 1$
(c) $I = I_s[e^{V/n.Vt} - 1]$
(d) $I = I_s[e^{V/n.Vt} + 1]$

265. The velocity of the electron in the n^{th} orbit is given by the equation
(a) $V_n = (h_n / \pi m r_n)$
(b) $V_n = (\pi h^2 / m r_n)$
(c) $V_n = (n(h/2\pi)/ m r_n)$
(d) $V_n = (nh/2\pi m r_n)$

266. What is the de Broglie wavelength of neutrons at room temperature?
(a) 0.145 nm (b) 0.82 nm
(c) 0.64 nm (d) 4.23 nm

267. Metallic crystal possesses
(a) High optical reflection and absorption co-efficient
(b) Good conducting property due to the presence of free electrons
(c) Opaque to all electromagnetic radiations from low frequency to the middle ultraviolet
(d) All of these

268. Germanium has a
(a) Diamond cube (dc) structure
(b) Simple cube (sc) structure
(c) Face centered cube (fcc) structure
(d) Body centered cube (bcc) structure

269. Superconductivity is otherwise known as
(a) Zero resistivity
(b) Zero conductivity
(c) Infinite resistivity
(d) Simply semiconductor

270. The tunnel effect was discovered in 1960 by
(a) H.K. Onnes (b) Deaver & Fairbank
(c) J. Bardeen (d) Giaever

271. The unit of electrical dipole moment is
(a) Debye
(b) Pascal
(c) Ohms
(d) Flux

272. Superconductivity can be destroyed by the application of
(a) An electrical field
(b) A magnetic field
(c) Both electrical & magnetic fields simultaneously
(d) Either electric or magnetic field

273. The electron mobility is greater in
(a) Germanium
(b) Silicon
(c) Gallium arsenide
(d) Bakelite

274. The relative distance of the electron from the nucleus is same as
(a) The relative distance between Earth and Moon
(b) The relative distance between Sun and Earth
(c) The relative distance between Earth and Pluto
(d) The relative distance between Sun and Pluto

275. If an excess carrier is injected into semiconductor,
(a) They diffuse away from the point of injection
(b) They concentrate at the point of injection
(c) They randomly move but centered at the point of injection
(d) They uniformly distribute themselves

276. One part of donor impurities to 10^8 parts of germanium
(a) Increases the conductivity of the crystal two-fold
(b) Increases the conductivity of the crystal four-fold
(c) Increases the conductivity of the crystal eight-fold
(d) Increases the conductivity of the crystal ten-fold

277. The following statement forms the basis of one of the following electronic devices. Identify it.

"If a particle is electronic on a potential barrier with energy certainly less than the height of the potential barrier, it will not necessarily be reflected by the barrier but there is always a probability that it may cross the barrier and continue its forward motion".

(a) Tunnel diode
(b) PIN diode
(c) Schottky diode
(d) Metal oxide semiconductor diode

278. The Bragg's diffraction equation is given by
(a) $\sin\theta = n\lambda / 2d$
(b) $\sin\theta = n/2d\lambda$
(c) $\sin\theta = 2dn\lambda$
(d) $\sin\theta = 2(n-\lambda d)$

279. Silicon & carbon have a
(a) Diamond cube (dc) structure
(b) Simple cube (sc) structure
(c) Face centered cube (fcc) structure
(d) Body centered cube (bcc) structure

280. Which one of the following factors doesn't correspond to a common collector amplifier?
(a) High input impedance
(b) Low output impedance
(c) High voltage gain
(d) High current gain

281. The gain of source follower is
(a) 1 (b) 5
(c) 10 (d) 100

282. Identify the false statement with respect to the Zener diode.
(a) Zener diode is needed for voltage regulation
(b) Zener diode is operated in reverse biased condition
(c) Zener diode has similar characteristics to that of an ideal current source
(d) None of the above

283. Consider the statements:

***Statement I*:** Fermi level is slightly lowered by adding the donor impurity

***Statement II*:** Fermi level is the maximum energy that any electron can have at room temperature.

Which of the following is correct?

(a) Statement I
(b) Statement II
(c) Both statements I & II
(d) Either statement I or II

284. GaAs LED's emit radiation in the

(a) Ultraviolet region
(b) Visible region
(c) Infrared region
(d) Invisible region

285. LED's are fabricated from

(a) Si (b) Ge
(c) Si or Ge (d) GaAs

286. Which material is generally used to build LED?

(a) Compounds of gallium
(b) Compounds of phosphorus
(c) Compounds of germanium
(d) Compounds of silicon

287. A UJT has

(a) Negative resistance characteristics
(b) Low firing current
(c) Bipolar device
(d) All of these

288. Breakdown in a silicon UJT was observed to occur at a voltage of 6V, for a V_{BB} = 10V its stand off ratio is found to be

(a) 1.66 (b) 0.60
(c) 0.54 (d) 0.51

289. Which switching device was used in the first generation computers?

(a) Vacuum tubes (b) Transistors
(c) IC's (d) Diodes

290. Which of the following is not a merit of transistors in place of vacuum tubes?

(a) Transistors are compact
(b) Consume less power
(c) Faster and economical
(d) None of these

291. Which diode is otherwise called as hot carrier diode?

(a) Schottky diode
(b) Tunnel diode
(c) PIN diode
(d) Varactor diode

292. Which one of the following devices is a unipolar one?

(a) PIN diode
(b) Zener diode
(c) PN diode
(d) Schottky diode

293. _____ is another type of VVC diode.

(a) PN junction diode
(b) Step recovery diode
(c) PIN diode
(d) Schottky diode

294. Tunneling phenomena was invented by

(a) Einstein (b) Henry Hill
(c) Dr. Fresnel (d) Dr. Leo Easaki

295. An FET acts as

(a) A variable resistor
(b) A variable capacitor
(c) A variable voltage source
(d) A variable current source

296. The donor impurity must have only _____ valence electrons.

(a) 2 (b) 3
(c) 4 (d) 5

297. A P-type germanium semiconductor is doped with

(a) Gallium (b) Gold
(c) Silver (d) Silicon

298. The Miller indices of the diagonal plane of a cube are

(a) 0 1 0 (b) 1 1 0
(c) 0 0 1 (d) 1 1 1

299. The junction capacitance varies

(a) Directly as square root of the voltage
(b) Inversely as square root of the voltage
(c) Directly as cube root of the voltage
(d) Inversely as cube root of the voltage

300. Silicon diode is less suited for low voltage rectifier operation because

(a) Its breakdown voltage is low
(b) It is costly
(c) It is temperature dependent
(d) Its breakdown voltage is high

301. A capacitor C charges to the applied voltage in
(a) Three time constants
(b) Five time constants
(c) Six time constants
(d) Ten time constants

302. A time constant is
(a) A relative measure of time
(b) An absolute measure of time
(c) Not an absolute measure of time
(d) Both (a) and (c)

303. It will take _____ time constants to discharge the capacitor almost completely.
(a) One (b) Two
(c) Four (d) Five

304. A 0.25 microfarads capacitor is charged through a 2.2 M Ohms resistor towards an applied voltage of 50 V. In one time constant, the capacitor would have charged to
(a) 11.6 V (b) 21.6 V
(c) 31.6 V (d) 41.6 V

305. The phenomenon "conductivity modulation" is exhibited by
(a) UJT (b) Diac
(c) SCR (d) Triac

306. The intrinsic stand-off ratio is dependent on
(a) Current carrying capacity of UJT
(b) Geometry of UJT
(c) Voltage handling capacity of UJT
(d) Noise ratio

307. Between the peak point Vp and the valley point Vv of the static emitter characteristics the emitter voltage _____ as emitter current increases.
(a) Increases
(b) Decreases
(c) Remains constant
(d) Is zero

308. Cermets are
(a) Inductive materials
(b) Capacitive material, resistive materials
(c) Resistive materials
(d) Magnetic materials

309. One angstrom is equal to
(a) 10^{-9} metre
(b) 10^{-11} metre
(c) 10^{-10} metre
(d) 10^{-12} metre

310. The storage time of a P – N junction diode
(a) Decreases with increased reverse bias voltage
(b) Decreases with increased forward bias voltage
(c) Increases with increased reverse bias voltage
(d) None of these

311. The switching speed of a Schottky diode is
(a) Lower than p-n junction diode
(b) Same as p-n junction diode
(c) Higher than p-n junction diode
(d) Can't define

312. The most commonly used configuration of an n-p-n transistor as a switch is
(a) Common collector
(b) Common emitter
(c) Common base
(d) Both common base and common collector

313. N-P-N transistors are preferred ones than P-N-P transistors for digital application because
(a) Electron mobility is more compared to holes mobility
(b) They are cheaper
(c) They are costlier
(d) Easy availability in the market

314. The Schottky diode is
(a) A vacuum device
(b) A metal – semiconductor device
(c) Purely semiconductor device
(d) MOS device

315. For a MOSFET the gate current
(a) Is decedent on drain current
(b) Increases with increase in drain voltage
(c) Decreases with decrease in drain voltage
(d) Is negligibly very small

316. The term "Baud Rate" is defined as
(a) Rate at which parallel data transmission takes place
(b) Rate at which microprocessor operates
(c) Rate at which parallel data are converted to serial data
(d) Rate at which serial data transmission takes place

317. The gate voltage required for the conduction of an n-channel enhanced mode MOSFET having a threshold voltage of 2V is
(a) 0 V (b) 1 V
(c) 2 V (d) More than 2 V

318. A Schottky transistor used as a switch operates between
(a) Cut-off and saturation regions
(b) Cut-off and active regions
(c) Active and saturation regions
(d) None of these

319. For a transistor operating in the saturation region
(a) $I_c \le h_{fe} . I_B$ (b) $I_c > h_{fe} . I_B$
(c) $I_c = h_{fe} . I_B$ (d) $I_c = 0$

320. Which one of the following is a unique characteristic of Schottky transistor?
(a) Lower propagation delay
(b) Higher propagation delay
(c) Lower power dissipation
(d) Higher power dissipation

321. Higher switching speed is possible in Schottky transistor than ordinary N-P-N transistor due to
(a) It operates in cut-off and saturation regions
(b) It operates in active and saturation regions
(c) It is prevented from going into saturation
(d) It is prevented from going into cut-off

322. Consider the statements

***Statement I*:** The temperature coefficient of resistance of a semiconductor is negative while that of a metal is positive.

***Statement II*:** A semiconductor behaves as an insulator at 0°K while it has some conductivity at room temperature.

Which of the following is/are correct?
(a) Statement I
(b) Statement II
(c) Both statements I & II
(d) Either statement I or II

323. When a transistor is turned from ON to OFF, the transistor comes to OFF state,
(a) Once the input signal is removed
(b) As soon as the input signal is reversed
(c) As soon as the power supply is switched off
(d) After the excess charge stored in the base region is removed.

324. The delay in the switching mode operation of a p-n junction diode is caused due to the
(a) Metallic contact
(b) Small size
(c) Different doping levels at two sides of junction
(d) Excess minority charge stored on the two sides of the junction when it is forward biased.

325. An open input terminal of ECL gate
(a) Will behave as if it is connected to logic high level
(b) Will behave as if it is connected to logic low level
(c) Will assume same voltage between logic high and low levels
(d) Will assume a very high voltage causing damage to the device.

326. With respect to semiconductor, identify the valid statement.
I Drift and diffusion occur simultaneously in a semiconductor device.
II Mobility of free electrons is same as that of holes.
III A crystal is not electrically neutral.
IV Semiconductors exhibit negative temperature coefficient.
(a) I (b) II
(c) III (d) IV

327. Which one is categorized as P-type impurity?
(a) Arsenic (b) Boron
(c) Bismuth (d) Antimony

328. Which one is categorized as N-type impurity?
(a) Bismuth (b) Indium
(c) Gallium (d) Boron

329. In which band(s) do the movements of electrons and holes take place?
(a) Valence band
(b) Conduction band
(c) Conduction and valence bands respectively
(d) Neither valence nor conduction band

330. The ratio of majority and minority carriers of an intrinsic semiconductor is
(a) Zero (b) Infinity
(c) Unity (d) Very large

331. The ratio of majority and minority carriers of an extrinsic semiconductor is
(a) Zero (b) Infinity
(c) Unity (d) Very large

332. Consider the statements given below

***Statement I*:** In FET the generator current is proportional to the input voltage.

***Statement II*:** In BJT, the generator current is proportional to the input current.

Which of the following is valid?
(a) Statement I
(b) Statement II
(c) Both statements I & II
(d) Either statement I or II

333. Transconductance of JFET is given by

(a) $\frac{\Delta V_{DS}}{\Delta I_D}$ (b)

(c) (d)

334. Ultraviolet radiation is used in IC fabrication for

(a) Diffusion
(b) Masking
(c) Isolation
(d) Metallization

335. FETs are used in an amplifier to obtain

(a) Low input impedance
(b) Low output impedance
(c) High input impedance
(d) High output impedance

336. Which of the following exhibits very high input impedance?

(a) Diode (b) P-N-P
(c) N-P-N (d) FET

337. Which one of the following materials does not have a covalent bond?

(a) Silver (b) Silicon
(c) Organic polymer (d) Diamond

338. The device having scalar characteristics with that of an ideal voltage source is

(a) FET
(b) P-N-P transistor
(c) Zener diode
(d) MOSFET

339. The device having closer characteristics with an ideal current source is

(a) Vacuum diode
(b) Zener diode
(c) UJT
(d) Transistor in common base mode

340. A piece of copper and another of silicon are cooled from room temperature to 80°K. The resistance of

(a) Each of them increases
(b) Each of them decreases
(c) Copper increases and silicon decreases
(d) Copper decreases and silicon increases

341. In a conductor, the valence band and the conduction band

(a) Are separated by a small gap
(b) Are separated by a large gap
(c) Are overlapping
(d) Don't exist at all

342. The forbidden in germanium at 0°K is

(a) 0.785 eV (b) 1.21 eV
(c) 1.00 eV (d) 0.01 eV

343. Einstein's relation is given by

(a)

(b)

(c)

(d)

344. Mobility of electron is highest in

(a) Silicon (b) Germanium
(c) Gallium arsenide (d) Carbon

345. The mean free path for electron drift increases with

(a) Purity concentration
(b) Strain hardening
(c) Elastic modulus
(d) Length

346. To make silicon P-type, one must add

(a) Ge (b) Si
(c) Sb (d) Ga

347. An N-type semiconductor as a whole is

(a) Positively charged
(b) Negatively charged
(c) Electrically neutral
(d) Can't be defined

348. The peak inverse voltage is the maximum voltage that can be applied to a diode without

(a) Burning (b) Destruction
(c) Overheating (d) Charging

349. As the temperature is increased the voltage across a diode carrying a constant current

(a) Increases
(b) Decreases
(c) Remains constant
(d) Alternately increases and decreases

350. The P-N junction diode is a

(a) Passive device (b) Vacuum device
(c) Unilateral device (d) Bilateral device

351. In an unbiased junction, the thickness of charge depletion region is of the order

(a) 0.005 μm (b) 0.5 μm
(c) 5 μm (d) 10^{-10} m

352. In the symbol of transistor the arrow mark shows
(a) Emitter (b) Collector
(c) Base (d) Gate

353. The input resistance of a common amplifier transistor is of the order
(a) 1 MΩ (b) 1 kΩ
(c) 0.01 Ω (d) 0.001 Ω

354. The output characteristics curve of a transistor is much more like those of
(a) A diode (b) A tetrode
(c) A triode (d) A pentode

355. The gain of a voltage follower is
(a) Greater than 1
(b) Lesser than 1
(c) Equal to 1
(d) Slightly less than 1

356. Lowest output resistance is obtained in
(a) CB (b) CE
(c) CC (d) None of these

357. Transistor is a
(a) Current controlled current device
(b) Current controlled voltage device
(c) Voltage controlled current device
(d) Voltage controlled voltage device

358. The temperature coefficient of a Zener diode changes from negative to positive
(a) Below 5 V
(b) Above 6 V
(c) Between 5 V and 6 V
(d) Exactly at 0 V

359. In an unbiased semiconductor junction, the junction current at equilibrium is
(a) Zero because equal and opposite charges are crossing the junction
(b) Zero because no charges are crossing the junction
(c) Due to diffusion of minority carriers
(d) Due to diffusion of majority carriers

360. Due to thermo-ionic emission, the weight of the metal piece
(a) Increases
(b) Decreases
(c) Remains the same
(d) Varies but can't define

361. Boltzmann diode equation relates
(a) Voltage and temperature characteristics of a junction
(b) Voltage and current characteristics of a junction
(c) Current and temperature characteristics of a junction
(d) Resistance and temperature characteristics of a junction

362. Which of the following is an active device?
(a) Electric bulb
(b) Loudspeaker
(c) Transformer
(d) None of the above

363. The main application of the enhancement mode MOSFET is
(a) Amplification
(b) Switching
(c) Tuning
d) Rectification

364. _____ indicates how effectively the input voltage controls the output current in a JFET.
(a) Slow rate
(b) Transconductance
(c) Transresistance
(d) Intrinsic stand-off ratio

365. Transconductance is measured in
(a) Mho (b) Volts
(c) Amperes (d) Ohms

366. _____ is preferred form of bias for a JFET amplifier.
(a) Self bias
(b) Voltage divider bias
(c) Two supply bias
(d) Emitter feedback bias

367. Transconductance is basically a/an
(a) AC quantity
(b) DC quantity
(c) Either AC or DC quantity
(d) None of these

368. An ordinary resistor connected across a circuit can be considered as
(a) An active load
(b) A passive load
(c) A switching device
(d) Three terminal device

369. The transconductance JFET at the Q-point is _____ the maximum transconductance which occurs when Vds = 0.
(a) Less than
(b) Greater than
(c) Equal to
(d) None of the above

370. The main advantage of cascade amplifier is
(a) Low input resistance
(b) Low input capacitance
(c) High output resistance
(d) High output capacitance

371. A current regulator diode is basically a
(a) Zener diode
(b) MOSFET
(c) JFET whose gate and source are tied up
(d) Transistor

372. _____ is an excellent device for interfacing digital IC's to high power loads.
(a) Depletion mode power MOSFET
(b) Enhancement mode power MOSFET
(c) JFET
(d) Bipolar transistor

373. VMOS transistor exhibits
(a) Negative thermal coefficient
(b) Positive thermal coefficient
(c) Zero thermal coefficient
(d) None of the above

374. VMOS transistor can shut off amperes of current in
(a) Few milli seconds
(b) Few seconds
(c) Few microseconds
(d) Tens of nanoseconds

375. The merits of VMOS transistors as compared to bipolar transistor is/are
(a) No extra changes are stored while in induction
(b) Cannot go into thermal run away
(c) Exhibits negative temperature coefficient
(d) All of the above

376. VMOS transistor is basically
(a) Power transistor
(b) Three diodes connected parallelly
(c) JFET
(d) Enhanced-mode MOSFET

377. A JFET has
(a) One built-in diode
(b) Two built-in diodes
(c) Three built-in diodes
(d) Four built-in diodes

378. The JFET acts as a _____ along the horizontal part of the drain curve.
(a) Resistor
(b) Current source
(c) Voltage source
(d) Current sink

379. The JFET acts as a _____ along vertical parts of the drain curve.
(a) Resistor (b) Current source
(c) Voltage source (d) Current sink

380. The transconductance curve of JFET which is also called as square law curve is
(a) Straight line (b) Parabolic
(c) Circular (d) Wavy

381. Which of the following is/are valid statement(s)?
I The gate of a JFET is forward biased hence acts as a voltage controlled device
II The gate of a JFET is reversed biased, hence acts as a voltage controlled device
III The gate of a JFET is reverse biased, hence acts as voltage controlled device
(a) I (b) II
(c) I and II (d) I, II and III

382. The point above the drain voltage, where there is no increase in drain current in a JFET is called as
(a) Breakdown point
(b) Pinch off point
(c) Knee point
(d) Critical point

383. The depletion region is one which has
(a) Immobile charges
(b) Mobile charges
(c) Atoms
(d) Molecules

384. Constantan is a/an
(a) Alloy (b) Metal
(c) Nonmetal (d) Isotope

385. The nature of atomic bond found in diamond is
(a) Tetravalent
(b) Covalent
(c) Metallic
(d) Ionic

386. The conductivity of a P-type semiconductor is
(a) $\sigma = q \mu_o P$ (b) $\sigma = q \mu_o$
(c) $\sigma = q \mu_o n$ (d) $\sigma = q p$

387. The gate cut-off and pinch-off voltages of JFET have
(a) Same magnitude and sign
(b) Different magnitudes but same sign
(c) Same magnitude but different signs
(d) Different magnitudes and signs

388. The pinch-off voltage of JFET has a same magnitude as that of
(a) Gate voltage
(b) Gate source voltage
(c) Drain–source voltage
(d) None of these

389. The current gain of a transistor is
(a) The ratio of collector current to emitter current
(b) The ratio of collector current to base current
(c) The ratio of base current to collector current
(d) The ratio of emitter current to collector current

390. The base current of a transistor is typically
(a) Less than emitter current
(b) Greater than emitter current
(c) Same as emitter current
(d) Equal to the sum of emitter and collector currents

391. The free electrons have ___ in the base region of a transistor.
(a) Short lifeterm (b) Long lifeterm
(c) No lifeterm at all (d) Infinite lifeterm

392. The free electrons recombine with a hole in the base region of a transistor to become
(a) Free electrons (b) Valence electrons
(c) Atom (d) Majority carrier

393. A transistor acts as a
(a) Diode and voltage source
(b) Diode and current source
(c) Diode and power supply
(d) Diode and resistance

394. The knee voltage of a PN junction diode is approximately equal to the
(a) Forward voltage
(b) Applied voltage
(c) Breakdown voltage
(d) Potential

395. The capacitance of a varactor diode increases, when the reverse voltage across it is
(a) Decreased
(b) Increased
(c) Kept constant
(d) None of the above

396. A Zener diode
(a) Is a battery under forward biased condition
(b) Acts like battery when it breakdowns
(c) Is a switch
(d) Is a device having barrier potential more than 5V

397. A back diode
(a) Is ordinary Zener diode
(b) Is used to rectify strong signals
(c) Conducts better in the forward than in the reverse directions
(d) Is used to rectify weak signals whose peak amplitudes are between 0.1 V and 0.7 V

398. Exposure of insulating material to moisture causes an increase in
(a) Dielectric loss
(b) Dielectric constant
(c) Dielectric strength
(d) Insulation resistance

399. Cu_2MnAl is a
(a) Semiconductor
(b) Ferrimagnetic material
(c) Paramagnetic material
D) Ferromagnetic material

400. Soft magnetic material is
(a) Tungsten steel (b) Alcomax
(c) Bismuth (d) Iron

401. Ferrimagnetic materials are generally used as
(a) Conductors
(b) Insulators
(c) Semiconductors
(d) Resistors

402. Identify N-type impurity from the following
(a) Fe (b) Ga
(c) Sb (d) B

403. Which one of the following is a superconductive material?
(a) Gold (b) Silver
(c) Mercury (d) Copper

404. Facing fraction of simple cube is
(a) 6.48 (b) 0.52
(c) 0.65 (d) 0.89

405. Air exhibits
(a) Ferromagnetism
(b) Ferrimagnetism
(c) Paramagnetism
(d) Antiferromagnetism

406. The main advantage of a point contact diode is that

(a) The ratio of forward current to reverse current is very high
(b) Low input impedance
(c) Its cut-in voltage is equal to zero
(d) Its reverse resistance is infinite

407. Match the lists.

List I (Band gap in eV)	*List II* (Material)
A. 0.67	1. GaAs
B. 1.1	2. Cadmium sulphate
C. 1.4	3. Silicon
D. 2.4	4. Germanium

(a) A-4, B-3, C-1, D-2
(b) A-3, B-2, C-1, D-4
(c) A-4, B-1, C-3, D-2
(d) A-2, B-3, C-1, D-4

408. Match the given lists.

List I (Name of the device)	*List II* (Application)
A. Diode	1. Rectification
B. Tunnel diode	2. Microwave switching
C. Zener diode	3. As oscillator
D. PIN diode	4. Voltage stabilization

(a) A-1, B-3, C-4, D-2
(b) A-1, B-4, C-3, D-2
(c) A-1, B-2, C-4, D-3
(d) A-2, B-4, C-3, D-1

409 The output characteristics of a JFET is similar to

(a) Triode (b) Pentode
(c) Thyratron (d) Tetrode

410. Internal heating in a capacitor is mainly due to

(a) Dielectric charge
(b) Leakage resistance
(c) Electron movement
(d) Plate dimension

411. The capacitance of a parallel plate capacitor is not affected by

(a) Area of plates
(b) Dielectric medium
(c) Distance between the plates
(d) Thickness of the plates

412. According to Coulomb's first law

(a) Like charges attract each other
(b) Like charges repel each other
(c) There is no force between the charges
(d) None of these

413. Varistors are

(a) Carbon resistors
(b) Rheostats
(c) Non linear resistors
(d) Potentiometers

414. Resistivity of a semiconductor depends upon

(i) Atomic structure of the semiconductor
(ii) Shape of the semiconductor
(iii) Length of the semiconductor

Of these statements

(a) (i) is correct
(b) (ii) is correct
(c) (iii) is correct
(d) (i) and (iii) are correct

415. The impurity atoms in semiconductors

(a) Inject more charge carriers
(b) Reduce the energy gap
(c) Increase the kinetic energy of valence electrons
(d) All of the above

416. The Hall angle of a metal sample is

(a) Independent of the magnetic flux density B
(b) Independent of the carrier mobility
(c) Independent of the density of free carriers
(d) Dependent on magnetic flux density

417. I_{CBO} in a transistor can be reduced by

(a) Reducing I_B
(b) Reducing V_{CC}
(c) Reducing I_E
(d) Reducing the temperature

418. Mass of a proton is

(a) 1.67×10^{-24} kg (b) 1.67×10^{-25} kg
(c) 1.67×10^{-26} kg (d) 1.67×10^{-27} kg

419. The kinetic energy of a bounded electron is _____ that of an unbounded electron.

(a) Less than (b) Twice than
(c) Greater than (d) Same as

420. Superconductivity is due to

(a) All electrons having Fermi energy at 0° K
(b) All electrons interacting in the super conducting state
(c) Crystal structure having no atomic vibration at 0° K
(d) Crystal structure having infinite atomic vibration at 0° K

421. A linear resistor is a
(a) Current controlled resistor
(b) Voltage controlled resistor
(c) Both (a) and (b)
(d) Neither (a) nor (b)

422. A capacitor with no initial charge at t=μ acts as a
(a) Short circuit (b) Open circuit
(c) Voltage source (d) Current source

423. Donor type impurities
i. Have five valence electrons
ii Create excess free electrons
iii Are used to make n-type semiconductors
iv Have three valence electrons
Of these statements
(a) i and iv are correct
(b) i, ii and iii are correct
(c) ii, iii and iv are correct
(d) iii and iv are correct

424. Ionic bond in solid depends on
(a) Transfer rate of electrons
(b) Sharing of electrons
(c) Electric dipole
(d) All of the above

425. A material is said to be superconductive when its resistance is
(a) Infinity (b) Zero
(c) Negative (d) Very small

426. The type of bonding observed in graphite is
(a) Metallic (b) Covalent
(c) van der Waals (d) Both (b) and (c)

427. The temperature at/beyond which ferroelectric materials lose their ferroelectric properties is called as
(a) Curie temperature
(b) Absolute temperature
(c) Inversion temperature
(d) Critical temperature

428. Ferro-electric materials are widely used as _____ transducers.
(a) Active
(b) Passive
(c) Electromechanical
(d) Crystal

429. Match the items given in list I with those in list II.

List I (*Materials*)	*List II* (*Forbidden energy gap*)
(A) Conductors	1. Large eV
(B) Insulators	2. Zero eV
(C) Germanium	3. 1.12 eV
(D) Silicon	4. 0.72 eV

(a) A-4, B-3, C-1, D-2
(b) A-2, B-1, C-3, D-4
(c) A-1, B-2, C-4, D-3
(d) A-2, B-1, C-4, D-3

430. Identify the wrong statements
i. Asbestos is least hygroscopic
ii. Asbestos is used as insulation in high voltage installations
iii. Asbestos are neither mechanically strong nor flexible
(a) i (b) ii
(c) iii (d) i and iii

431. Barium titanate is a
(a) Piezo-electric material
(b) Ferro-electric material
(c) Semiconductor material
(d) Both piezo-electric and ferro-electric material

432. Insulation used in commutator is
(a) Wood (b) PVC
(c) Mica (d) Glass

433. Dielectric materials are essentially
(a) Insulating materials
(b) Ferro-electric materials
(c) Ferri-electric materials
(d) Superconducting materials

434. The property of bakelite is/are
(a) Hardness
(b) Uncombustibility
(c) Highly inflammable
(d) Both (a) and (b)

435. Hysteresis loss is
(a) Proportional to f
(b) Proportional to 1/f
(c) Proportional to f^2
(d) Proportional to $1/f^2$

436. The magnetic material employed for VHF application is
(a) Silicon steel (b) Alnico
(c) Cobalt salt (d) Ferrite

437. Soft magnetic material is
(a) Tungsten steel (b) Iron
(c) Alcomax (d) Bismuth

438. Piezo-electricity is observed in
(a) Mica (b) Nickel
(c) Glass (d) Quartz

439. Rochelle salt, a peizo-electric crystal has
(a) One curie point
(b) Two curie points
(c) Three curie points
(d) No curie point

440. Basically iron is a
(a) Ferro-magnetic material
(b) Ferri-magnetic material
(c) Para-magnetic material
(d) Anti-ferromagnetic material

441. A 0°K, germanium acts as
(a) Insulator
(b) Superconductor
(c) Dielectric
(d) Semiconductor

442 With the fall in temperature, the receptivity of metals normally
(a) Increases
(b) Tends to be zero
(c) Remains unchanged
(d) Decreases first and then increases

443 The transport phenomenon in conductor is due to
(a) Electric field
(b) Magnetic field
(c) Electro-magnetic field
(d) None of the above

444. Power loss in an electrical circuit can take place in
(a) Inductance only
(b) Capacitance only
(c) Resistance only
(d) Inductance and resistance

445. The dynamic resistance of a parallel resonant circuit is given by
(a) LC/R_L (b) LCR_L
(c) C/LR_L (d) L/CR_L

446. A choke coil of inductance L and series resistance R is shunted by a capacitor C. The dynamic impedance of the resonant circuit would be
(a) R/LC (b) C/RL
(c) L/RC (d) 1/RLC

447. A series R-C circuit is suddenly connected to a dc voltage of V volts. The current in the series circuit just after the switch is closed is equal to
(a) Zero (b) V/RC
(c) VC/R (d) V/R

448. A series RL circuit with R = 100 ohms, L = 50 Hz is supplied to a dc source of 100V. The time taken for the current to rise 70% of its steady state value is
(a) 0.3 seconds (b) 0.6 seconds
(c) 0.9 seconds (d) 1.0 seconds

449. A capacitance C is charged through a resistance R, the time constant of the charging circuit is given by
(a) R/C (b) 1/RC
(c) RC (d) C/R

450. With the increase in temperature, the resistance of the carbon
(a) Increases (b) Decreases
(c) Remains same (d) Becomes zero

451. On placing a dielectric in an electric field, the field strength
(a) Increases (b) Decreases
(c) Remains constant (d) Reduces to zero

452. Coulomb's law for the force between electric charges most closely resembles with
(a) Newton's law of motion
(b) Law of conservation of energy
(c) Gauss theorem
(d) Newton's law of gravitation

453. Tunnel diode is
(a) Linear resistor
(b) Current dependent resistor
(c) Voltage dependent resistor
(d) Non-linear resistor

454. A UJT has
(a) Anode, cathode and gate
(b) Two anodes and one gate
(c) Emitter, base and collector
(d) One emitter and two bases

455. Vulcanized rubber
(a) Is produced from trans-polyisoprene
(b) Is also known as neoprene
(c) Contains 20% of sulphur
(d) Is produced from cis-polyisoprene

456. Thermoplastic and thermoset polymers differ in
(a) Electrical properties
(b) Glass transition temperature
(c) Mechanical properties
(d) Thermal properties

457. The acceptor atoms in a P-type semiconductor at normal temperature
(a) Carry a positive charge
(b) Carry a negative charge
(c) Are neutral
(d) Are ions

458. Electroid transformation in alloys is _____ reaction
(a) Solid to solid (b) Solid to liquid
(c) Liquid to solid (d) Liquid to liquid

459. Photoluminescence which persists for some period after excitation is known as
(a) Phosphorescence
b) Tri-luminescence
(c) Fluorescence
(d) Bioluminescence

460. Germanium photodiodes have dark currents in the order of
(a) 5 mA (b) 10 mA
(c) 25 mA (d) 10 A

461. Which one of the following is a Square law device?
(a) Zener diode (b) Crystal diode
(c) Tunnel diode (d) Varactor diode

462. A PIN diode is
(a) A metal semiconductor diode
(b) A microwave switch
(c) A microwave detector
(d) None of these

463. One of the following microwave diodes is suitable for very low power oscillators
(a) Tunnel diode
(b) Gunn diode
(c) PIN diode
(d) Zener diode

464. Charge on the capacitor is
(a) directly related to voltage and inversely related to capacitance
(b) directly related to capacitance and inversely related to voltage
(c) directly related to both voltage and capacitance
(d) Inversely proportional to both voltage and capacitance

465. Dielectric constant relates to
(a) Comparative charge stored for a given material versus air
(b) The fact that the dielectric doesn't have charge characteristics
(c) The insulating properties of the non-conducting mediums
(d) None of the above

466. Since dielectric materials are nonconductive
(a) Capacitors leakage resistance is finite
(b) Capacitors leakage resistance is infinite
(c) A capacitor cannot pass current through the circuit
(d) None of the above

467. In a series dc circuit containing both a resistor and a capacitor, as the capacitor charges
(a) The voltage across the resistor decreases
(b) The voltage across the resistor increases
(c) The voltage across the resistor remains unaffected
(d) None of the above

468. Active devices used in digital circuit generally operate as
(a) Amplifiers
(b) Switches
(c) Rectifiers
(d) Wave form generators

469. The devices commonly used for making digital circuits are
(a) Mechanical switches
(b) Relays
(c) Vacuum tubes
(d) Semiconductor devices

470. The time required to switch a P-N junction from ON to OFF is equal to
(a) Zero (b) Storage time
(c) Switching time (d) Transition time

471. The storage time of a p-n junction
(a) Decreases with increased reverse-bias
(b) Decreases with increased forward-bias
(c) Increases with increased reverse-bias
(d) Increases with increased forward-bias

472. The maximum operating frequency of a diode when used as a switch
(a) Depends on the diode characteristics and switching voltages
(b) Depends on switching voltages
(c) Depends on diode characteristics
(d) None of the above

473. Fast switching of P-N junction requires
(a) A large current in reverse direction
(b) Zero current in reverse direction
(c) Reverse saturation current in reverse direction
(d) None of the above

474. For fastest switching operation, it is preferable to use
(a) P-N junction diode
(b) Vacuum diode
(c) Zener diode
(d) Schottky diode

475. The most commonly used configuration of transistor as switch is
(a) CB (b) CC
(c) CE (d) CB or CC

476 When used as switch, a Schottky transistor switches between
(a) Cut-off and active regions
(b) Cut-off and saturation regions
(c) Active and saturation regions
(d) Different operation points in the active region

477. In switching application, CE configuration is preferred because
(a) It requires low voltage
(b) It requires only one power source
(c) Of easier construction
(d) Of negligible reverse saturation current

478. BJT with h_{fe} =200, I_b =10 mA and I_C= 4 mA is operating in
(a) Active region (b) Cut-off region
(c) Saturation region (d) None of these

479. Schottky transistors are preferred over normal transistors in digital applications because of their
(a) Higher propagation delay
(b) Higher power dissipation
(c) Lower propagation delay
(d) Lower power dissipation

480. For a MOSFET, the gate current
(a) Is dependent on drain current
(b) Is negligibly small
(c) Is independent of gate voltage
(d) Increases with increase in gate voltage

481. For an n-channel enhancement mode MOSFET, the drain current
(a) Decreases with increases in drain voltage
(b) Decreases with decrease in drain voltage
(c) Increases with increases in gate voltage
(d) Increases with decrease in gate voltage

482. The delay in the switching mode operation of a p-n junction diode is mainly due to
(a) Metallic contacts
(b) Different doping levels
(c) Minority charge storage in the junction during forward biased condition
(d) Majority carriers in forward biased condition

483. When separation between two charges is increased, the potential energy
(a) Increases
(b) Decreases
(c) Remains constant
(d) Either (a) or (b)

484. The saturation current in a diode depends upon
(a) Plate voltage
(b) Cathode temperature
(c) Cathode material
(d) Separation between cathode and plate

485. At zero kelvin, a piece of germanium becomes
(a) Semiconductor (b) Good conductor
(c) Bad conductor (d) None of these

486. When an N-P-N transistor is used as an amplifier then
(a) Electrons move from base to collector
(b) Electrons move from emitter to base
(c) Electrons move from collector to base
(d) Holes move from base to emitter

487. In a semiconductor crystal, if the current flows due to breakage of crystal bonds, then the semiconductor is called
(a) Acceptor
(b) Donor
(c) Intrinsic semiconductor
(d) Extrinsic semiconductor

488. If a transistor emitter current is 2mA, the collector current is
(a) Greater than 2 mA
(b) Less than 2 mA
(c) Equal to 2 mA
(d) Equal to 4 mA

489. A photodiode is used in reverse bias because
(a) Majority of electron-hole pairs swept are reversed across the junction
(b) Only one side is illuminated
(c) Reverse current is small compared to photo-current
(d) Reverse current is large compared to photocurrent

490. In a phototransistor, the base current is
(a) Set by a bias voltage
(b) Directly proportional to light
(c) Inversely proportional to light
(d) Square to light intensity

491. A laser diode can be fabricated using
(a) Germanium
(b) Silicon
(c) Gallium arsenide
(d) Gallium phosphide

492. The general condition for a phototransistor is
(a) Common base configuration
(b) Common collector configuration
(c) Common emitter configuration
(d) Darlington-pair configuration

493. When a phototransistor is reverse biased, is kept in dark condition, the current flowing through the device corresponds to
(a) Zero current
(b) Reverse saturation current
(c) Maximum flow of device current
(d) Minimum flow of device current

494. Which of the following devices is suitable for very low power oscillator circuit only?
(a) TRAPATT diode (b) IMPATT diode
(c) Gunn diode (d) Tunnel diode

495. The transferred-electron bulk effect occurs in
(a) Germanium
(b) Gallium arsenide
(c) Silicon
(d) Metal-semiconductor junction

496. The colour of an LED can be changed by
(a) Using different band gap semiconductors
(b) Varying the doping level of the semiconductor
(c) Increasing applied voltage
(d) None of the above

497. A Ge atom contains
(a) Four valence electrons
(b) Six valence electrons
(c) Four protons
(d) Six protons

498. At 25°C, a Zener diode rates at 2 watts, its power rating at 50°C will be
(a) Zero watts
(b) Less than 1 watt
(c) Greater than 2 watts
(d) Less than 2 watts

499. In any conductor, Hall voltage $V_{H,}$ is
(a) Directly proportional to B
(b) Directly proportional to 1/B
(c) Directly proportional to B^2
(d) Directly proportional to $1/B^2$

500. Drift current in germanium is caused by
(a) Concentration gradient of charge carriers
(b) Thermal agitation of crystal lattice
(c) Incidence of light energy
(d) Applied electric field

501. In a given semiconductor, Fermi level E is proportional to (n=total number of free electrons per unit volume).
(a) n (b) $n^{1/2}$
(c) $n^{2/3}$ (d) $n^{4/3}$

502. FET has offset voltage of about
(a) 0.2 volts (b) 0.6 volts
(c) 1.0 volts (d) 3.6 volts

503. At 300°K, the forbidden energy gap in germanium is
(a) 0.543 eV (b) 0.632 eV
(c) 0.72 eV (d) 0.89 eV

504. Semiconductors in pure form are poor conductors because
(a) They have no valence electrons
(b) All valence electrons are in electron pairs
(c) They have a large number of holes
(d) They have fewer electrons than protons

505. When a pure semiconductor is heated
(a) It becomes metal
(b) Its atomic structure collapses
(c) Its resistance increases
(d) Its resistance decreases

506. In a pure semiconductor, electric current is due to
(a) Holes
(b) Electrons
(c) Both holes and electrons
(d) Valence electrons

507. Merit of four-point probe method of determining resistivity is that
(a) It needs very small current
(b) It gives the average resistivity
(c) It gives the resistivity at a localized region of the sample
(d) It gives the exact resistivity of the bulk sample with respect to voltage variations

508. The n type impurity
(a) Can be added to Ge but not to Si
(b) Can be added to Si but not to Ge
(c) Creates excess holes
(d) Creates excess electrons

509. Resistivity of semiconductor depends on
(a) The length of the specimen
(b) Cross-sectional area of the specimen
(c) Volume of the specimen
(d) Atomic nature of the semiconductor

510. A hole is the vacancy created when
(a) Free electron moves on application of electric field
(b) An electron breaks its covalent bond
(c) An atom core moves
(d) An electron reverts from conduction band to valency band

511. When a free electron is recaptured by a hole, the process is called
(a) Diffusion (b) Restoration
(c) Recombination (d) Drift

512. P-type semiconductor is
(a) Positively charged
(b) Electrically neutral
(c) Negatively charged
(d) Both (a) and (b)

513. An n-type semiconductor is
(a) Positively charged
(b) Negatively charged
(c) Both (a) and (b)
(d) Electrically neutral

514. LEDs fabricated from gallium arsenide emit radiation in the
(a) Visible range
(b) Infrared region
(c) Ultraviolet region
(d) Ultrasonic region

515. At room temperature, resistivity of pure silicon is expressed as
(a) 230 Ohms-cm
(b) 2300 Ohms-cm
(c) 23000 Ohms-cm
(d) 230000 Ohms-cm

516. Valence electrons are found
(a) In the nucleus
(b) In the innermost shell
(c) In the outermost shell
(d) As free electrons in an atom

517. The diffusion constant for holes in germanium is found to be
(a) 13 cm^2/s (b) 28 cm^2/s
(c) 32 cm^2/s (d) 47 cm^2/s

518. The relative dielectric constant of silicon is
(a) 6 (b) 10
(c) 12 (d) 14

519. In semiconductor, the rate of diffusion of charge carriers depends on
(a) Concentration gradient
(b) Mobility
(c) Both (a) and (b)
(d) Either (a) or (b)

520. In p-type semiconductor
(a) n=p (b) p<n
(c) n<p (d) p>>n

521. When an atom loses one electron,
(a) It becomes positive ion
(b) It becomes negative ion
(c) It becomes neutral
(d) It also loses one proton

522. At 300°K, the forbidden energy gap in silicon is
(a) 0.78 eV (b) 1.21 eV
(c) 0.72 eV (d) 1.10 eV

523. An intrinsic semiconductor at absolute zero temperature
(a) Acts as a good conductor
(b) Acts as a good insulator
(c) Has only few holes and electrons
(d) Has only few holes but no electrons

524. Unijunction transistor
(a) Is a bulk semiconductor device
(b) Has two p-n junctions
(c) Is a unipolar device
(d) Has one p-n junction

525. In Schottky barrier diode, conduction is
(a) Entirely by electrons
(b) Entirely by holes
(c) Mainly by electrons and partially by holes
(d) Mainly by holes and partially by electrons

526. Identify from the following, the diode which doesn't exhibit negative resistance characteristics.
(a) Gunn diode
(b) Tunnel diode
(c) LSA diode
(d) IMPATT diode

527. The major application of tunnel diode is
(a) As voltage controllable device
(b) As switching device in digital circuits
(c) As oscillator
(d) As rectifier

528. Energy required to break a covalent bond in a semiconductor is
(a) Equal to 1.6 eV
(b) Greater in Ge than in Si
(c) Equal to the width of the forbidden energy gap
(d) None of the above

529. Temperature coefficient of resistance of a pure semiconductor specimen is
(a) Zero (b) Positive
(c) Negative (d) None of the above

530. Forbidden energy gap between the valence band and conduction band is least in the case of
(a) Impure silicon (b) Pure silicon
(c) Pure germanium (d) Mica

531. In germanium an electron in the conduction band
(a) Has same energy as an electron in valence band
(b) Has less energy as compared to an electron in valence band
(c) Has greater energy as compared to an electron in valence band
(d) Has zero charge

532. In UJT, the value of stand-off ratio is
(a) 0.2 (b) 0.4
(c) 0.7 (d) 0.9

533. Zener breakdown results due to
(a) Strong electric field across the junction
(b) Thermal decomposition
(c) Impact ionization
(d) Emission of free electrons

534. _____ utilizes the cumulative multiplication principle of carriers through field induced impact ionization.
(a) Zener diode
(b) Varactor diode
(c) PIN diode
(d) Avalanche diode

535. Tunnel diode is basically a junction diode with
(a) High doping in p region alone
(b) High doping in n region alone
(c) High doping in both p and n regions
(d) Low doping in both p and n regions

536. In a tunnel diode, depletion layer width is of the order
(a) 100 Angstroms (b) 0.1 Micron
(c) 1 Micron (d) 5 Microns

537. On increasing the current through the Zener diode by a factor of 2, the voltage across the diode
(a) Gets doubled
(b) Becomes 4 times
(c) Becomes half
(d) Remains the same

538. The dynamic resistance of a Zener diode
(a) Increases with increase in current
(b) Decreases with increase in current
(c) Decreases with decrease in current
(d) Is independent of variation in current

539. In n-type germanium with boron impurity, the ionization energy is about
(a) 0.002 eV (b) 0.010 eV
(c) 0.100 eV (d) 1.000 eV

540. In p-type semiconductor
(a) Holes form the majority carrier
(b) Free electrons form the minority carrier
(c) Hole density is equal to electron density
(d) It is formed by adding pentavalent impurity

541. In an intrinsic semiconductor, Fermi level represents the energy level with probability of its occupation of
(a) 0 per cent (b) 25 per cent
(c) 50 per cent (d) 75 per cent

542. In germanium, medium doping corresponds to impurity of the order
(a) 1 part in 10^5 (b) 1 part in 10^4
(c) 1 part in 10^3 (d) 1 part in 10^2

543. Forbidden energy gap between the valence and conduction bands is least in the case of
(a) Pure Si (b) Pure Ge
(c) Mica (d) Impure Si

544. Hole in a lattice is defined as
(a) Free proton
(b) Free neutron
(c) Acceptor ion
(d) Vacancy created by removal of electron from covalent bond.

545. In germanium, when atoms are held together by the sharing of valence electrons
(a) Each shared atom leaves a hole
(b) Valence electrons are free to move away from the nucleus
(c) They form reversible covalent bonds
(d) They form irreversible covalent bonds

546. Seed crystal used in crystal growth is
(a) A small crystal formed out of epitaxial growth
(b) A signal crystal with a specific orientation
(c) A signal crystal containing acceptor impurity
(d) A signal crystal containing donor impurity

547. Crystal structure possessing imperfection causes
(a) Increased mobility
(b) Decreased mobility
(c) Increased conductivity
(d) Decreased conductivity

548. Through repeated zone refining, the residual impurity in a semiconductor is of the order
(a) 1 part in 10^4 (b) 1 part in 10^7
(c) 1 part in 10^9 (d) 1 part in 10^{11}

549. Purification of silicon is difficult because of
(a) Its high surface tension
(b) Its crystalline nature
(c) Its high melting point
(d) Its high resistivity

550. The conduction band
(a) Has same energy as forbidden band
(b) Is a range of energies corresponding to the free electrons
(c) Is seen very close to forbidden band
(d) None of these

551. Which is the initial process to be followed in preparing devices from a semiconductor block?
(a) Crystal formation (b) Crystal pulling
(c) Purification (d) Wafering

552. Epitaxial growth is best suited for
(a) Growing polycrystalline pure silicon
(b) Growing crystal of several inch thickness
(c) Very thick single crystal on a substrate
(d) Very thin single crystal on a substrate

553. Excess majority carriers are the carriers which are
(a) Equal to the number of hole concentration
(b) In excess of the equilibrium number
(c) Minority carriers in P-type semiconductor
(d) Thermally generated

554. At room temperature intrinsic carrier concentration is higher in germanium than in silicon due to
(a) Larger atomic number
(b) Greater atomic weight
(c) High carrier mobility
(d) Smaller energy gap

❑❑❑

ANSWERS

1. (*a*)	2. (*a*)	3. (*c*)	4. (*b*)	5. (*c*)	6. (*c*)	7. (*d*)	8. (*d*)
9. (*b*)	10. (*c*)	11. (*a*)	12. (*d*)	13. (*b*)	14. (*d*)	15. (*d*)	16. (*a*)
17. (*b*)	18. (*d*)	19. (*a*)	20–(*b*)	21. (*c*)	22. (*b*)	23. (*b*)	24. (*a*)
25. (*b*)	26. (*a*)	27. (*c*)	28. (*b*)	29. (*a*)	30. (*c*)	31. (*a*)	32. (*c*)
33. (*d*)	34. (*c*)	35. (*d*)	36. (*c*)	37. (*b*)	38. (*c*)	39. (*b*)	40. (*d*)
41. (*c*)	42. (*c*)	43. (*b*)	44. (*d*)	45. (*a*)	46. (*a*)	47. (*d*)	48. (*d*)
49. (*b*)	50. (*c*)	51. (*a*)	52. (*c*)	53. (*a*)	54. (*b*)	55. (*c*)	56. (*a*)
57. (*b*)	58. (*c*)	59. (*a*)	60. (*c*)	61. (*d*)	62. (*d*)	63. (*c*)	64. (*a*)
65. (*a*)	66. (*c*)	67. (*d*)	68. (*b*)	69. (*b*)	70. (*b*)	71. (*c*)	72. (*d*)
73. (*a*)	74. (*c*)	75. (*d*)	76. (*a*)	77. (*b*)	78. (*d*)	79. (*d*)	80. (*b*)
81. (*d*)	82. (*d*)	83. (*d*)	84. (*b*)	85. (*d*)	86. (*b*)	87. (*b*)	88. (*c*)
89. (*c*)	90. (*b*)	91. (*d*)	92. (*a*)	93. (*d*)	94. (*d*)	95. (*a*)	96. (*d*)
97. (*d*)	98. (*c*)	99. (*c*)	100. (*c*)	101. (*d*)	102. (*c*)	103. (*b*)	104. (*d*)
105. (*c*)	106. (*a*)	107. (*d*)	108. (*d*)	109. (*c*)	110. (*c*)	111. (*d*)	112. (*b*)
113. (*a*)	114. (*a*)	115. (*a*)	116. (*b*)	117. (*c*)	118. (*c*)	119. (*c*)	120. (*a*)
121. (*a*)	122. (*a*)	123. (*b*)	124. (*d*)	125. (*a*)	126. (*c*)	127. (*d*)	128. (*d*)
129. (*a*)	130. (*a*)	131. (*a*)	132. (*a*)	133. (*b*)	134. (*b*)	135. (*c*)	136. (*a*)
137. (*d*)	138. (*a*)	139. (*b*)	140. (*c*)	141. (*d*)	142. (*c*)	143. (*b*)	144. (*a*)
145. (*d*)	146. (*c*)	147. (*c*)	148. (*a*)	149. (*b*)	150. (*c*)	151. (*a*)	152. (*a*)
153. (*c*)	154. (*b*)	155. (*a*)	156. (*a*)	157. (*b*)	158. (*c*)	159. (*d*)	160. (*a*)
161. (*d*)	162. (*a*)	163. (*c*)	164. (*b*)	165. (*a*)	166. (*b*)	167. (*a*)	168. (*c*)
169. (*d*)	170. (*b*)	171. (*c*)	172. (*d*)	173. (*d*)	174. (*c*)	175. (*b*)	176. (*c*)
177. (*a*)	178. (*d*)	179. (*c*)	180. (*c*)	181. (*d*)	182. (*c*)	183. (*a*)	184. (*c*)
185. (*d*)	186. (*d*)	187. (*d*)	188. (*b*)	189. (*b*)	190. (*d*)	191. (*b*)	192. (*c*)
193. (*c*)	194. (*d*)	195. (*c*)	196. (*d*)	197. (*d*)	198. (*a*)	199. (*a*)	200. (*c*)
201. (*c*)	202. (*b*)	203. (*b*)	204. (*c*)	205. (*d*)	206. (*a*)	207. (*d*)	208. (*b*)
209. (*b*)	210. (*c*)	111. (*a*)	212. (*c*)	213. (*b*)	214. (*a*)	215. (*c*)	216. (*c*)
217. (*d*)	218. (*a*)	219. (*d*)	220. (*c*)	221. (*d*)	222. (*b*)	224. (*a*)	225. (*a*)
226. (*a*)	227. (*b*)	228. (*d*)	229. (*b*)	230. (*d*)	231. (*b*)	232. (*d*)	233. (*d*)
234. (*d*)	235. (*b*)	236. (*a*)	237. (*b*)	238. (*c*)	239. (*c*)	240. (*a*)	241. (*a*)
242. (*b*)	243. (*b*)	244. (*d*)	245. (*d*)	246. (*d*)	247. (*a*)	248. (*d*)	249. (*c*)
250. (*b*)	251. (*d*)	252. (*b*)	253. (*d*)	254. (*d*)	255. (*c*)	256. (*c*)	257. (*d*)
258. (*d*)	259. (*c*)	260. (*c*)	261. (*c*)	262. (*d*)	263. (*d*)	264. (*a*)	265. (*c*)
266. (*a*)	267. (*d*)	268. (*a*)	269. (*a*)	270. (*d*)	271. (*a*)	272. (*b*)	273. (*c*)
274. (*c*)	275. (*a*)	276. (*c*)	277. (*a*)	278. (*a*)	280. (*c*)	281. (*a*)	282. (*c*)
283. (*d*)	284. (*c*)	285. (*d*)	286. (*a*)	287. (*a*)	288. (*b*)	289. (*a*)	290. (*d*)
291. (*a*)	292. (*d*)	293. (*b*)	294. (*d*)	295. (*d*)	296. (*d*)	297. (*a*)	298. (*b*)
299. (*b*)	300. (*d*)	301. (*b*)	302. (*d*)	303. (*d*)	304. (*c*)	305. (*a*)	306. (*b*)
307. (*b*)	308. (*c*)	309. (*c*)	310. (*a*)	311. (*c*)	312. (*c*)	313. (*a*)	314. (*b*)
315. (*d*)	316. (*d*)	317. (*d*)	318. (*b*)	319. (*a*)	320. (*a*)	321. (*c*)	322. (*c*)
323. (*d*)	324. (*d*)	325. (*c*)	326. (*a*)	327. (*b*)	328. (*a*)	329. (*c*)	330. (*c*)
331. (*d*)	332. (*c*)	333. (*c*)	334. (*a*)	335. (*c*)	336. (*d*)	337. (*a*)	338. (*c*)
339. (*d*)	340. (*d*)	341. (*c*)	342. (*a*)	343. (*a*)	344. (*b*)	345. (*a*)	346. (*d*)
347. (*c*)	348. (*c*)	349. (*b*)	350. (*c*)	351. (*b*)	352. (*a*)	353. (*b*)	354. (*c*)
355. (*d*)	356. (*c*)	357. (*a*)	358. (*c*)	359. (*a*)	360. (*c*)	361. (*a*)	362,(*d*)
363. (*b*)	364. (*b*)	365. (*a*)	366. (*a*)	367. (*a*)	368. (*b*)	369. (*a*)	370. (*b*)
371. (*c*)	372. (*a*)	373. (*a*)	374. (*d*)	375. (*d*)	376. (*d*)	377. (*b*)	378. (*b*)

379. (*a*)	380. (*b*)	381. (*b*)	382. (*b*)	383. (*b*)	384. (*a*)	385. (*b*)	386. (*a*)
387. (*c*)	388. (*a*)	389. (*b*)	390. (*a*)	391. (*a*)	392. (*b*)	393. (*b*)	394. (*d*)
395. (*a*)	396. (*b*)	397. (*d*)	398. (*a*)	399. (*c*)	400. (*d*)	401. (*c*)	402. (*c*)
403. (*c*)	404. (*b*)	405. (*c*)	406. (*a*)	407. (*a*)	408. (*a*)	409. (*b*)	410. (*b*)
411. (*d*)	412. (*b*)	413. (*c*)	414. (*a*)	415. (*b*)	416. (*c*)	417. (*d*)	418. (*d*)
419. (*a*)	420. (*c*)	421. (*c*)	422. (*b*)	423. (*b*)	424. (*a*)	425. (*b*)	426. (*d*)
427. (*a*)	428. (*c*)	429. (*d*)	430. (*d*)	431. (*d*)	432. (*c*)	433. (*a*)	434. (*d*)
435. (*a*)	436. (*d*)	437. (*b*)	438. (*d*)	439. (*b*)	440. (*a*)	441. (*a*)	442. (*b*)
443. (*a*)	444. (*d*)	445. (*d*)	446. (*c*)	447. (*d*)	448. (*b*)	449. (*b*)	450. (*b*)
451. (*b*)	452. (*d*)	453. (*c*)	454. (*d*)	455. (*d*)	456. (*d*)	457. (*c*)	458. (*a*)
459. (*a*)	460. (*b*)	461. (*d*)	462. (*b*)	463. (*a*)	464. (*c*)	465. (*a*)	466. (*d*)
467. (*a*)	468. (*c*)	469. (*d*)	470. (*c*)	471. (*a*)	472. (*a*)	473. (*a*)	474. (*d*)
475. (*c*)	476. (*a*)	477. (*a*)	478. (*c*)	479. (*c*)	480. (*b*)	481. (*c*)	482. (*b*)
483. (*d*)	484. (*c*)	485. (*c*)	486. (*a*)	487. (*c*)	488. (*a*)	489. (*a*)	490. (*b*)
491. (*c*)	492. (*c*)	493. (*b*)	494. (*d*)	495. (*b*)	496. (*b*)	497. (*a*)	498. (*c*)
499. (*a*)	500. (*d*)	501. (*c*)	502. (*b*)	503. (*c*)	504. (*b*)	505. (*d*)	506. (*c*)
507. (*c*)	508. (*d*)	509. (*d*)	510. (*b*)	511. (*c*)	512. (*b*)	513. (*d*)	514. (*b*)
515. (*c*)	516. (*c*)	517. (*d*)	518. (*c*)	519. (*c*)	520. (*d*)	521. (*a*)	522. (*d*)
523. (*b*)	524. (*d*)	525. (*a*)	526. (*d*)	527. (*b*)	528. (*c*)	529. (*c*)	530. (*a*)
531. (*c*)	532. (*c*)	533. (*a*)	534. (*d*)	535. (*c*)	536. (*a*)	537. (*d*)	538. (*b*)
539. (*b*)	540. (*a*)	541. (*c*)	542. (*a*)	543. (*d*)	544. (*d*)	545. (*c*)	546. (*b*)
547. (*b*)	548. (*b*)	549. (*c*)	550. (*b*)	551. (*c*)	552. (*d*)	553. (*b*)	554. (*d*)