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Class 12 Physics Chapterwise PYQs

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Chapter-wise previous year questions, sorted by marks and year

Chapter 14: Semiconductor Electronics

Table of Contents

1-Mark Questions (112 questions · Section A · MCQ)

Q1. In an unbiased p-n junction, at equilibrium, which of the following statements is true?

(A) Diffusion current is zero but drift current exists.

(B) Diffusion current exists but drift current is zero.

(C) Diffusion and drift currents are equal and opposite.

(D) Both the diffusion and drift currents exist but are unequal.

[2026 • Set 55-1-1]

Q2. Assertion (A): On forward biasing a p-n junction diode, the height of the barrier potential increases. Reason (R): In forward biasing of a p-n junction diode, the direction of the applied voltage is in the same direction as the built-in potential.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

[2026 • Set 55-2-1]

Q3. Case Study: A p-type or n-type semiconductor can be converted into a p-n junction by doping it with suitable impurity. The motion of majority charge carriers causes diffusion current across the junction while the barrier electric field causes motion of minority carriers for drift current. In case of unbiased diode, the diffusion and drift currents are equal. This equilibrium is disturbed by the biasing batteries. Diodes, therefore, allow currents in one direction. This property of diode is used in making rectifiers. Silicon is doped with which of the following to obtain p-type semiconductor?

(A) Phosphorus
(B) Arsenic
(C) Boron
(D) Antimony

[2026 • Set 55-2-1]

Q4. A semiconductor has an electron concentration of 5×10^{22} m^{-3}. The concentration of holes is (given $n_i = 1{\cdot}5 \times 10^{16}$ m^{-3}):

(A) 5×10^{22} m^{-3}
(B) $1{\cdot}5 \times 10^{16}$ m^{-3}
(C) 9×10^{8} m^{-3}
(D) $4{\cdot}5 \times 10^{9}$ m^{-3}

[2026 • Set 55-2-1]

Q5. During forward biasing of a p-n junction diode, the:

(A) current is mainly due to drifting of majority carriers.
(B) current is mainly due to drifting of minority carriers.
(C) diffusion and drift currents are equal.
(D) current is of the order of 1 A.

[2026 • Set 55-2-1]

Q6. The threshold voltage for silicon diode is about:

(A) $0{\cdot}2$ V
(B) $0{\cdot}5$ V
(C) $0{\cdot}7$ V
(D) $1{\cdot}5$ V

[2026 • Set 55-2-1]

Q7. When we dope Ge with a pentavalent element, four of its electrons bond with four germanium neighbours but fifth electron remains weakly bound. The ionisation energy for this electron is about:

(A) $0{\cdot}01$ eV
(B) $0{\cdot}05$ eV
(C) $0{\cdot}1$ eV

(D) $0{\cdot}15$ eV

[2026 • Set 55-2-1]

Q8. When the forward bias voltage in a semiconductor diode is changed from $0{\cdot}8$ V to $1{\cdot}0$ V, the forward current changes by $2{\cdot}0$ mA. The forward bias resistance of the diode will be:

(A) $200\ \Omega$

(B) $175\ \Omega$

(C) $100\ \Omega$

(D) $125\ \Omega$

[2026 • Set 55-3-1]

Q9. The process named 'minority carrier injection' in a p-n junction diode occurs during:

(A) forward biasing

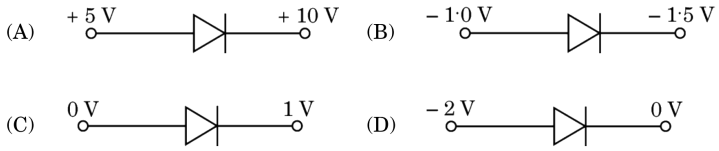
(B) reverse biasing

(C) no biasing at low temperature

(D) no biasing at high temperature

[2026 • Set 55-3-1]

Q10. Which of the following p-n junction diodes is forward biased?



(A) Option (A): p-side $+10$ V, n-side 0 V [see figure]

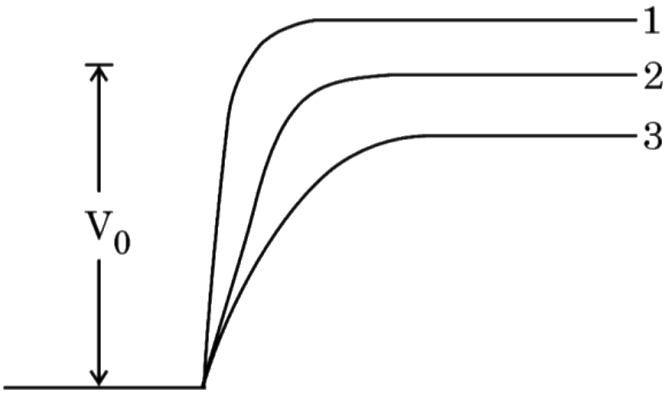
(B) Option (B): p-side $-1{\cdot}5$ V, n-side $-1{\cdot}5$ V [see figure]

(C) Option (C): see figure

(D) Option (D): see figure

[2026 • Set 55-3-2]

Q11. In the given figure, V_0 is the potential barrier across a p-n junction in an unbiased condition. Which of the following statements is correct?



(A) Curves 1 and 3 both correspond to forward biasing of p-n junction.
(B) Curve 3 corresponds to forward biasing and Curve 1 corresponds to reverse biasing.
(C) Curve 1 corresponds to forward biasing and Curve 3 corresponds to reverse biasing.
(D) Curves 1 and 3 both correspond to reverse biasing.

[2026 • Set 55-3-3]

Q12. In a reversed-biased p-n junction diode, the applied voltage mostly drops across:
(A) p-region only
(B) n-region only
(C) depletion region
(D) the diode

[2026 • Set 55-4-1]

Q13. Assertion (A): The conductivity of an n-type semiconductor is higher than that of a p-type semiconductor at a given temperature. Reason (R): The electrons being in the conduction band in n-type semiconductor are more mobile than the holes in the valence band in p-type semiconductor.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

[2026 • Set 55-4-1]

Q14. A good diode checked by a multimeter should indicate:
(A) high resistance in reverse bias and a low resistance in forward bias
(B) high resistance in both forward bias and reverse bias
(C) low resistance in both reverse bias and forward bias
(D) high resistance in forward bias and low resistance in reverse bias

[2026 • Set 55-5-1]

Q15. When a p-n junction diode is forward biased:
(A) the barrier height and the depletion layer width both increase.
(B) the barrier height increases and the depletion layer width decreases.
(C) the barrier height and the depletion layer width both decrease.
(D) the barrier height decreases and the depletion layer width increases.

[2025 • Set 55-1-1]

Q16. Assertion (A): We cannot form a p-n junction diode by taking a slab of a p-type semicon-

ductor and physically joining it to another slab of a n-type semiconductor. Reason (R): In a p-type semiconductor $n_h \gg n_e$, while in a n-type semiconductor $n_e \gg n_h$.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

[2025 • Set 55-1-1]

Q17. When the resistance measured between p and n ends of a p-n junction diode is high, it can act as a/an

(A) resistor

(B) inductor

(C) capacitor

(D) switch

[2025 • Set 55-2-1]

Q18. Assertion (A): In a semiconductor diode the thickness of depletion layer is not fixed. Reason (R): Thickness of depletion layer in a semiconductor device depends upon many factors such as biasing of the semiconductor.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(B) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true but Reason (R) is false.

(D) Both Assertion (A) and Reason (R) are false.

[2025 • Set 55-2-1]

Q19. Which of the following is an electrical conductor at room temperature ?

(A) Sn

(B) Mica

(C) Si

(D) C

[2025 • Set 55-4-1]

Q20. Assertion (A): n-type semiconductor is not negatively charged. Reason (R): Neutral pentavalent impurity atom doped in intrinsic semiconductor (neutral) donates its fifth unpaired electron to the crystal lattice and becomes a positive donor.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

[2025 • Set 55-4-1]

Q21. Assertion (A): The impurities in p-type Si are not pentavalent atoms. Reason (R): The hole density in valance band in p-type semiconductor is almost equal to the acceptor density.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

[2025 • Set 55-5-1]

Q22. Assertion (A): A hole is an apparent free particle with effective positive electronic charge. Reason (R): A hole is not necessarily a vacancy left behind by an electron in the valence band. Select the correct answer from the codes given below:
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

[2025 • Set 55-6-1]

Q23. Case Study (Extrinsic Semiconductors): Extrinsic semiconductors are made by doping pure or intrinsic semiconductors with suitable impurity. There are two type of dopants used in doping, Si or Ge, and using them p-type and n-type semiconductors can be obtained. A p-n junction is the basic building block of many semiconductor devices. Two important processes occur during the formation of a p-n junction: diffusion and drift. When such a junction is formed, a 'depletion layer' is created consisting of immobile ion-cores. This is responsible for a junction potential barrier. The width of a depletion layer and the height of potential barrier changes when a junction is forward-biased or reverse-biased. A semiconductor diode is basically a p-n junction with metallic contacts provided at the ends for application of an external voltage. Using diodes, alternating voltages can be rectified. (i) Which of the following is a donor impurity atom for Ge?
(A) Boron
(B) Antimony

(C) Aluminium
(D) Indium

[2025 • Set 55-6-1]

Q24. (ii) When a pentavalent atom occupies the position of an atom in the crystal lattice of Si, four of its electrons form covalent bonds with four silicon neighbours, while the fifth remains bound to the parent atom. The energy required to set this electron free is about:
(A) $0{\cdot}5$ eV
(B) $0{\cdot}1$ eV
(C) $0{\cdot}05$ eV
(D) $0{\cdot}01$ eV

[2025 • Set 55-6-1]

Q25. (iv) (a) In reverse-biased p-n junction: (A) the drift current is of the order of few mA. (B) the applied voltage mostly drops across the depletion region. (C) the depletion region width decreases. (D) the current increases with increase in applied voltage. OR (b) The output frequency of a full-wave rectifier with 50 Hz as input frequency is:
(A) (a) the drift current is of the order of few mA. | (b) 25 Hz
(B) (a) the applied voltage mostly drops across the depletion region. | (b) 50 Hz
(C) (a) the depletion region width decreases. | (b) 100 Hz
(D) (a) the current increases with increase in applied voltage. | (b) 200 Hz

[2025 • Set 55-6-1]

Q26. A p-n junction diode is forward biased. As a result,
(A) both the potential barrier height and the width of depletion layer decrease.
(B) both the potential barrier height and the width of depletion layer increase.
(C) the potential barrier height decreases and the width of depletion layer increases.
(D) the potential barrier height increases and the width of depletion layer decreases.

[2025 • Set 55-7-1]

Q27. Germanium crystal is doped at room temperature with a minute quantity of boron. The charge carriers in the doped semiconductors will be:
(A) electrons only
(B) holes only
(C) holes and few electrons
(D) electrons and few holes

[2025 • Set 55-7-1]

Q28. Ge is doped with As. Due to doping,
(A) the structure of Ge lattice is distorted.

(B) the number of conduction electrons increases.
(C) the number of holes increases.
(D) the number of conduction electrons decreases.

[2024 • Set 55-1-1]

Q29. The root mean square value of an alternating voltage applied to a full-wave rectifier is $\frac{V_0}{\sqrt{2}}$. Then the root mean square value of the rectified output voltage is:

(A) $\frac{V_0}{\sqrt{2}}$
(B) $\frac{V_0}{2}$
(C) $\frac{2V_0}{\sqrt{2}}$
(D) $\frac{V_0}{2\sqrt{2}}$

[2024 • Set 55-1-1]

Q30. In a full-wave rectifier, the current in each of the diodes flows for:

(A) Complete cycle of the input signal
(B) Half cycle of the input signal
(C) Less than half cycle of the input signal
(D) Only for the positive half cycle of the input signal

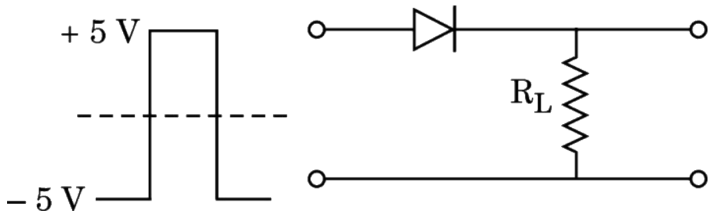
[2024 • Set 55-1-1]

Q31. An alternating voltage of frequency of 50 Hz is applied to a half-wave rectifier. Then the ripple frequency of the output will be:

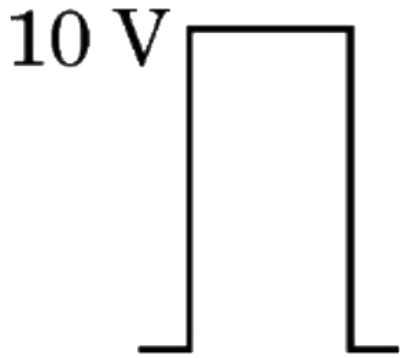
(A) 100 Hz
(B) 50 Hz
(C) 25 Hz
(D) 150 Hz

[2024 • Set 55-1-1]

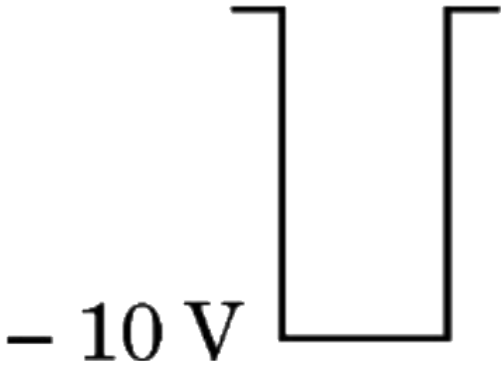
Q32. A signal, as shown in the figure, is applied to a p-n junction diode. Identify the output across resistance R_L:



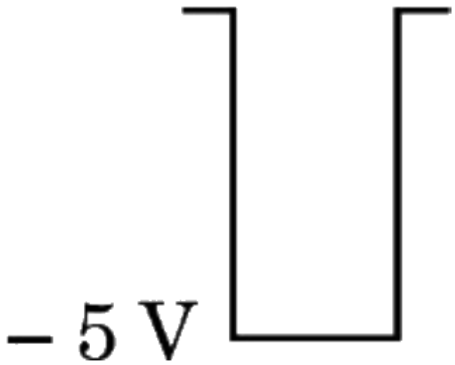
(A)



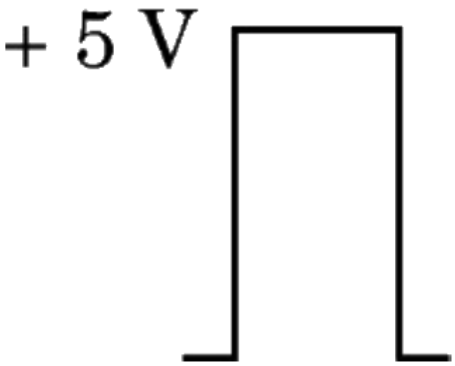
(B)



(C)



(D)



[2024 • Set 55-1-1]

Q33. An n-type semiconducting Si is obtained by doping intrinsic Si with:

(A) Al

(B) B
(C) P
(D) In

[2024 • Set 55-2-1]

Q34. When a p-n junction diode is subjected to reverse biasing:
(A) the barrier height decreases and the depletion region widens.
(B) the barrier height increases and the depletion region widens.
(C) the barrier height decreases and the depletion region shrinks.
(D) the barrier height increases and the depletion region shrinks.

[2024 • Set 55-2-1]

Q35. Si is doped with a pentavalent element. The energy required to set the additional electron free is about:
(A) 0.01 eV
(B) 0.05 eV
(C) 0.72 eV
(D) 1.1 eV

[2024 • Set 55-3-1]

Q36. Assertion (A): In a semiconductor, the electrons in the conduction band have lesser energy than those in the valence band. Reason (R): Donor energy level is just above the valence band in a semiconductor.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false and Reason (R) is also false.

[2024 • Set 55-3-1]

Q37. Assertion (A): The temperature coefficient of resistance is positive for metals and negative for p-type semiconductors. Reason (R): The charge carriers in metals are negatively charged, whereas the majority charge carriers in p-type semiconductors are positively charged.
(A) If both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).
(B) If both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).
(C) If Assertion (A) is true and Reason (R) is false.
(D) If both Assertion (A) and Reason (R) are false.

[2024 • Set 55-4-1]

Q38. When Ge is doped with pentavalent impurity, the energy required to free the weakly bound electron from the dopant is about

(A) 0.001 eV
(B) 0.01 eV
(C) 0.72 eV
(D) 1.1 eV

[2024 • Set 55-4-1]

Q39. At a given temperature, the number of intrinsic charge carriers in a semiconductor is 2.0×10^{19} cm^{-3}. It is doped with pentavalent impurity atoms. As a result, the number of holes in it becomes 8×10^{13} cm^{-3}. The number of electrons in the semiconductor is

(A) 2×10^{24} m^{-3}
(B) 4×10^{23} m^{-3}
(C) 1×10^{22} m^{-3}
(D) 5×10^{22} m^{-3}

[2024 • Set 55-4-1]

Q40. Initially during the formation of a p-n junction —

(A) diffusion current is large and drift current is small.
(B) diffusion current is small and drift current is large.
(C) both the diffusion and the drift currents are large.
(D) both the diffusion and the drift currents are small.

[2024 • Set 55-4-1]

Q41. An ac voltage $V = 0.5\sin(100\pi t)$ volt is applied, in turn, across a half-wave rectifier and a full-wave rectifier. The frequency of the output voltage across them respectively will be

(A) 25 Hz, 50 Hz
(B) 25 Hz, 100 Hz
(C) 50 Hz, 50 Hz
(D) 50 Hz, 100 Hz

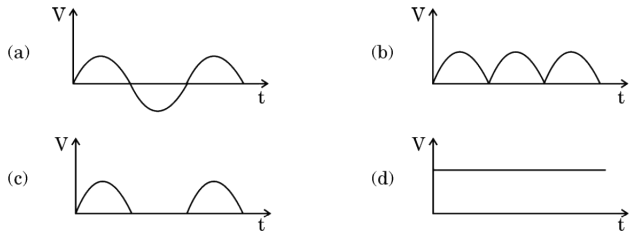
[2024 • Set 55-4-1]

Q42. A pure Si crystal having 5×10^{28} atoms m^{-3} is doped with 1 ppm concentration of antimony. If the concentration of holes in the doped crystal is found to be 4.5×10^{9} m^{-3}, the concentration (in m^{-3}) of intrinsic charge carriers in Si crystal is about:

(A) 1.2×10^{15}
(B) 1.5×10^{16}
(C) 3.0×10^{15}
(D) 2.0×10^{16}

[2024 • Set 55-5-1]

Q43. An ac source of voltage is connected in series with a p-n junction diode and a load resistor. The correct option for output voltage across load resistance will be:



(A) Graph (a)
(B) Graph (b)
(C) Graph (c)
(D) Graph (d)

[2023 • Set 55-1-1]

Q44. When an intrinsic semiconductor is doped with a small amount of trivalent impurity, then:

(A) its resistance increases.
(B) it becomes a p-type semiconductor.
(C) there will be more free electrons than holes in the semiconductor.
(D) dopant atoms become donor atoms.

[2023 • Set 55-1-1]

Q45. In the energy-band diagram of n-type Si, the gap between the bottom of the conduction band E_C and the donor energy level E_D is of the order of:

(A) 10 eV
(B) 1 eV
(C) 0.1 eV
(D) 0.01 eV

[2023 • Set 55-1-1]

Q46. In an extrinsic semiconductor, the number density of holes is 4×10^{20} m^{-3}. If the number density of intrinsic carriers is 1.2×10^{15} m^{-3}, the number density of electrons in it is

(A) 1.8×10^{9} m^{-3}
(B) 2.4×10^{10} m^{-3}
(C) 3.6×10^{9} m^{-3}
(D) 3.2×10^{10} m^{-3}

[2023 • Set 55-2-1]

Q47. Pieces of copper and of silicon are initially at room temperature. Both are heated to

temperature T. The conductivity of

(A) both increases.

(B) both decreases.

(C) copper increases and silicon decreases.

(D) copper decreases and silicon increases.

[2023 • Set 55-2-1]

Q48. The formation of depletion region in a p-n junction diode is due to

(A) movement of dopant atoms

(B) diffusion of both electrons and holes

(C) drift of electrons only

(D) drift of holes only

[2023 • Set 55-2-1]

Q49. Which one of the following elements will require the highest energy to take out an electron from them? Pb, Ge, C and Si

(A) Ge

(B) C

(C) Si

(D) Pb

[2023 • Set 55-2-2]

Q50. A semiconductor device is connected in series with a battery, an ammeter and a resistor. A current flows in the circuit. If the polarity of the battery is reversed, the current in the circuit almost becomes zero. The device is a/an

(A) intrinsic semiconductor

(B) p-type semiconductor

(C) n-type semiconductor

(D) p-n junction diode

[2023 • Set 55-2-3]

Q51. At a certain temperature in an intrinsic semiconductor, the electrons and holes concentration is $1.5 \times 10^{16}\,\text{m}^{-3}$. When it is doped with a trivalent dopant, hole concentration increases to $4.5 \times 10^{22}\,\text{m}^{-3}$. In the doped semiconductor, the concentration of electrons (n_e) will be:

(A) $3 \times 10^{9}\,\text{m}^{-3}$

(B) $5 \times 10^{7}\,\text{m}^{-3}$

(C) $5 \times 10^{9}\,\text{m}^{-3}$

(D) $6.75 \times 10^{38}\,\text{m}^{-3}$

[2023 • Set 55-3-1]

Q52. If a p-n junction diode is reverse biased:

(A) the potential barrier is lowered.
(B) the potential barrier remains unaffected.
(C) the potential barrier is raised.
(D) the current is mainly due to majority carriers.

[2023 • Set 55-3-1]

Q53. At $0\,K$, the resistivity of an intrinsic semiconductor is:

(A) same as that at $0°C$
(B) same as that at $300\,K$
(C) zero
(D) infinite

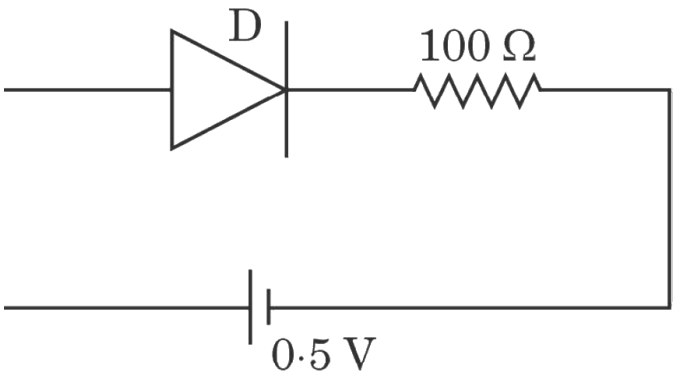
[2023 • Set 55-3-2]

Q54. For the forward biasing of a p-n junction diode, which of the following statements is not correct?

(A) The potential barrier decreases.
(B) Minority carrier injection occurs.
(C) Width of depletion layer increases.
(D) Forward current is due to the diffusion of both holes and electrons.

[2023 • Set 55-3-3]

Q55. The threshold voltage for a p-n junction diode used in the circuit is 0.7 V. The type of biasing and current in the circuit are:



(A) Forward biasing, 0 A
(B) Reverse biasing, 0 A
(C) Forward biasing, 5 mA
(D) Reverse biasing, 2 mA

[2023 • Set 55-4-1]

Q56. Assertion (A): In 'n' type semiconductor, number density of electrons is greater than the

number density of holes but the crystal maintains an overall charge neutrality. Reason (R): The charge of electrons donated by donor atoms is just equal and opposite to that of the ionised donor.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

[2023 • Set 55-4-1]

Q57. Assertion (A): The resistance of an intrinsic semiconductor decreases with increase in its temperature. Reason (R): The number of conduction electrons as well as hole increase in an intrinsic semiconductor with rise in its temperature.

(A) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true and (R) is NOT the correct explanation of (A).

(C) Assertion (A) is true and Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

[2023 • Set 55-5-1]

Q58. During the formation of a p-n junction:

(A) diffusion current keeps increasing.

(B) drift current remains constant.

(C) both the diffusion current and drift current remain constant.

(D) diffusion current remains almost constant but drift current increases till both currents become equal.

[2023 • Set 55-5-1]

Q59. Assertion (A): In insulators, the forbidden gap is very large. Reason (R): The valence electrons in an atom of an insulator are very tightly bound to the nucleus.

(A) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true and (R) is NOT the correct explanation of (A).

(C) Assertion (A) is true and Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

[2023 • Set 55-5-2]

Q60. The energy required by an electron to jump the forbidden band in silicon at room temperature is about

(A) 0.01 eV

(B) 0.05 eV
(C) 0.7 eV
(D) 1.1 eV

[2023 • Set 55-5-3]

Q61. In a p-n junction under equilibrium, there is no net current. Why?

[2021]

Q62. On what factor does the wavelength of the light emitted by an LED depend?

[2021]

Q63. How does the energy gap of an intrinsic semiconductor change when doped with a trivalent impurity?

[2021]

Q64. How does an increase in doping concentration affect the width of depletion layer of a p-n junction diode?

[2020 • Set 55-1-1]

Q65. Why cannot we use Si and Ge in fabrication of visible LEDs?

[2020 • Set 55-1-1]

Q66. At equilibrium, in a p-n junction diode the net current is
(A) due to diffusion of majority charge carriers.
(B) due to drift of minority charge carriers.
(C) zero as diffusion and drift currents are equal and opposite.
(D) zero as no charge carriers cross the junction.

[2020 • Set 55-2-1]

Q67. In an n-type semiconductor, the donor energy level lies
(A) at the centre of the energy gap.
(B) just below the conduction band.
(C) just above the valance band.
(D) in the conduction band.

[2020 • Set 55-2-1]

Q68. Can a slab of p-type semi-conductor be physically joined to another n-type semiconductor slab to form p-n junction? Justify your answer.

OR

In a p-n junction diode the forward bias resistance is low as compared to the reverse bias

resistance. Give reason.

[2020 • Set 55-4-1]

Q69. The _____ , a property of materials C, Si and Ge depends upon the energy gap between their conduction and valence bands.

[2020 • Set 55-5-1]

Q70. The ability of a junction diode to _____ an alternating voltage, is based on the fact that it allows current to pass only when it is forward biased.

[2020 • Set 55-5-1]

Q71. Photo diodes are used to detect

(A) radio waves
(B) gamma rays
(C) IR rays
(D) optical signals

[2020 • Set 55-5-1]

Q72. The wavelength and intensity of light emitted by a LED depend upon

(A) forward bias and energy gap of the semiconductor
(B) energy gap of the semiconductor and reverse bias
(C) energy gap only
(D) forward bias only

[2020 • Set 55-5-1]

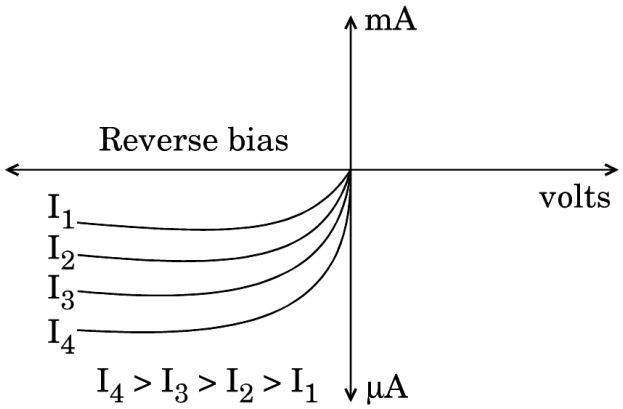
Q73. In sky wave mode of propagation, why is the frequency range of transmitting signals restricted to less than 30 MHz?

[2019 • Set 55-1-1]

Q74. On what factors does the range of coverage in ground wave propagation depend?

[2019 • Set 55-1-1]

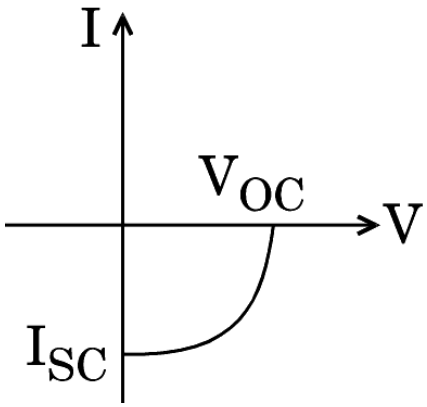
Q75. Identify the semiconductor diode whose V-I characteristics are as shown.



I3>I2>I1, current in microamperes on y-axis (negative side) and voltage in volts on x-axis'>

[2019 • Set 55-2-1]

Q76. Identify the semiconductor diode whose I-V characteristics are as shown.



[2019 • Set 55-2-2]

Q77. Draw the I-V characteristics of a Zener diode.

[2019 • Set 55-2-3]

Q78. Define amplitude modulation in communication system.

[2019 • Set 55-3-1]

Q79. Draw a plot of resistivity versus temperature for a typical semiconductor.

[2019 • Set 55-3-2]

Q80. Define the term 'attenuation' in communication system.

[2019 • Set 55-3-2]

Q81. Write the function of receiver in communication system.

[2019 • Set 55-3-3]

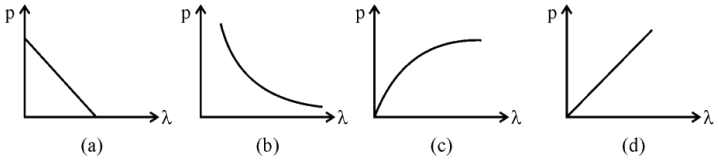
Q82. Why is ground wave transmission of signals restricted to a frequency of 1500 kHz?

[2019 • Set 55-4-1]

Q83. Why are the antennas in space wave mode of propagation generally mounted at heights of many wavelengths above the ground?

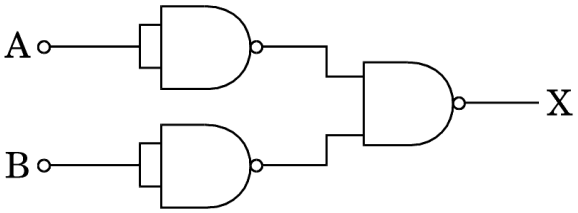
[2019 • Set 55-4-3]

Q84. Draw the output signal in a p-n junction diode when a square input signal of 10 V as shown in the figure is applied across it.



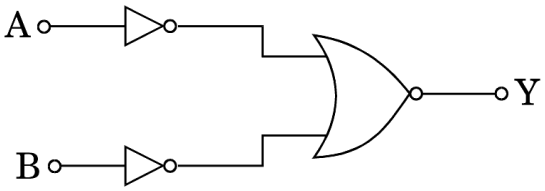
[2019 • Set 55-5-1]

Q85. Identify the equivalent gate for the circuit of a combination of gates shown in the figure. Write its symbol.



OR

Draw the logic symbol of the gate shown by the combination of gates and write its name.



[2019 • Set 55-5-1]

Q86. Can a transistor be used as a rectifier?

[2019 • Set 55-5-2]

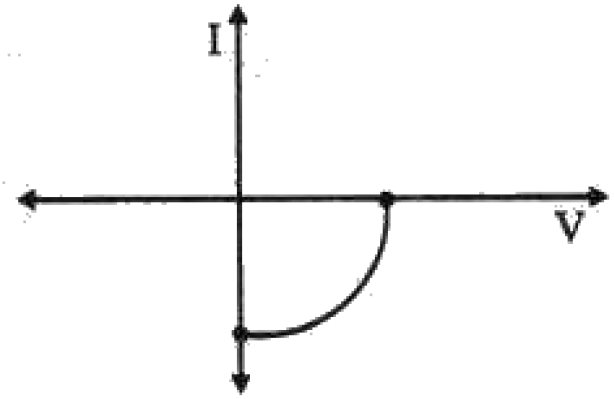
Q87. When a p-n junction diode is forward biased, how will its barrier potential be affected?

[2019 • Set 55-5-3]

Q88. Which mode of propagation is used by short wave broadcast services ?

[2018]

Q89. Name the junction diode whose I-V characteristics are drawn below:



[2017]

Q90. Draw logic symbol of an

OR

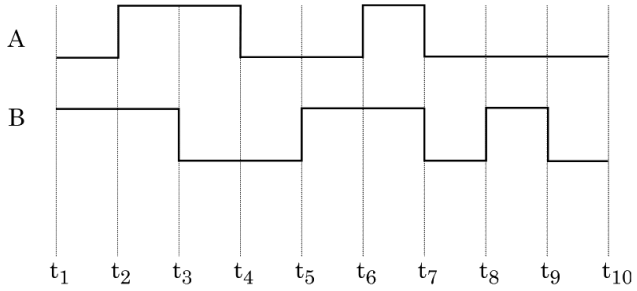
gate and write its truth table.

[2017]

Q91. Name the essential components of a communication system.

[2016]

Q92. Two signals A and B are used as inputs of a NOR gate. Draw the output wave form.

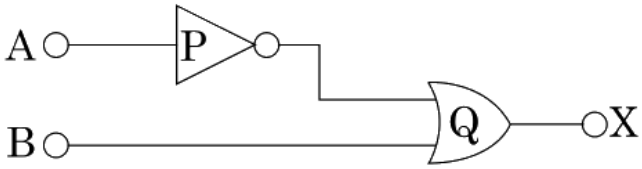


[2016]

Q93. A signal of 5 kHz frequency is amplitude modulated on a carrier wave of frequency 2 MHz. What are the frequencies of the side bands produced?

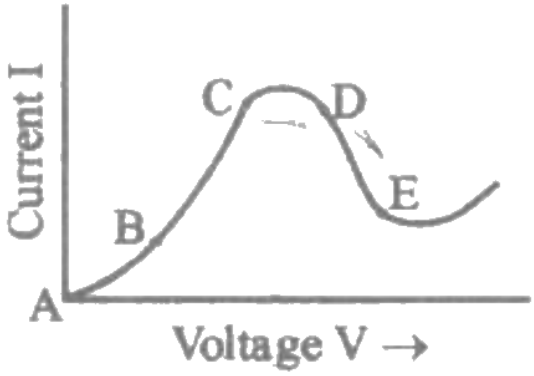
[2016]

Q94. Name the logic gates marked P and Q in the given logic circuit.



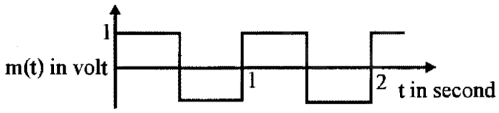
[2016]

Q95. Graph showing the variation of current versus voltage for a material GaAs is shown in the figure. Identify the region of (i) negative resistance (ii) where Ohm's law is obeyed.



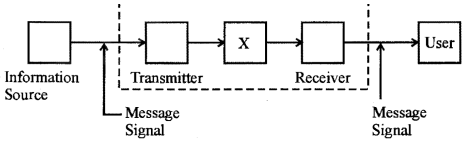
[2015]

Q96. The carrier wave is given by $C(t) = 2\sin(8\pi t)$ volt. The modulating signal is a square wave as shown. Find modulation index.



[2014]

Q97. The figure given below shows the block diagram of a generalized communication system. Identify the element labelled 'X' and write its function.



[2014]

Q98. Plot a graph showing variation of current versus voltage for the material GaAs.

[2014]

Q99. Name an appropriate communication channel needed to send a signal of band-width 100 kHz over a distance of 8 km.

[2013]

Q100. Show on a graph, the variation of resistivity with temperature for a typical semiconductor.

[2012]

Q101. What happens to the width of depletion layer of a p-n junction when it is (i) forward biased, (ii) reverse biased?

[2011]

Q102. In a transistor, doping level in base is increased slightly. How will it affect (i) collector current and (ii) base current?

[2011 • Set 55-1-1]

Q103. What is the function of a 'Repeater' in a communication system?

[2011 • Set 55-2-1]

Q104. Draw the logic circuit of a NAND gate and write its truth table.

[2011 • Set 55-2-1]

Q105. Give the logic symbol of NOR gate.

[2009]

Q106. State the reason, why a photodiode is usually operated at reverse bias?

[2008]

Q107. What will be the values of input A and B for the Boolean expression $(A+B)\cdot(A\cdot B)=1$?

[2007]

Q108. Why is frequency modulation preferred over amplitude modulation for transmission of music?

[2007]

Q109. Name the type of communication in which the signal is a discrete and binary coded version of the message or information.

[2006]

Q110. What should be the length of the dipole antenna for a carrier wave of frequency 3×10^8 Hz?

[2005]

Q111. Name the type of modulation scheme preferred for digital communication.

[2004]

Q112. Name the factor which decides the quality of reproduced document sent by Fax.

[2003]

2-Mark Questions (109 questions · Section B · VSA)

Q1. (b) How does the resistivity of a semiconductor depend on temperature? Show it on a plot.

[2026 • Set 55-2-3]

Q2. How are charge carriers created in an intrinsic semiconductor? Explain.

[2026 • Set 55-3-1]

Q3. Explain, with the help of suitable diagram, the two important processes that occur during the formation of a p-n junction.

[2026 • Set 55-3-2]

Q4. The hole concentration in an intrinsic semiconductor is 5×10^{16} m^{-3}. When it is doped with certain impurity, the electron concentration becomes 4×10^{12} m^{-3}. Find the new value of the hole concentration. Also identify the type of new semiconductor formed after doping.

[2026 • Set 55-4-1]

Q5. Suppose a pure Si crystal has 5×10^{28} atoms per m^3. It is doped with 5×10^{22} atoms per m^3 of Arsenic. Calculate the majority and minority carrier concentration in the doped silicon. (Given: $n_i = 1.5 \times 10^{16}\,\text{m}^{-3}$)

[2026 • Set 55-5-1]

Q6. A p-type Si semiconductor is made by doping an average of one dopant atom per 5×10^7 silicon atoms. If the number density of silicon atoms in the specimen is 5×10^{28} atoms/m^3, find the number of holes created per cubic centimetre in the specimen due to doping. Also give one example of such dopants.

[2025 • Set 55-1-1]

Q7. The threshold voltage of a silicon diode is 0.7 V. It is operated at this point by connecting the diode in series with a battery of V volt and a resistor of 1000 Ω. Find the value of V when the current drawn is 15 mA.

[2025 • Set 55-2-1]

Q8. In an intrinsic semiconductor, carrier's concentration is $5 \times 10^{16}\,\text{m}^{-3}$. On doping with impurity atoms, the hole concentration becomes $8 \times 10^{12}\,\text{m}^{-3}$.

(a) Identify (i) the type of dopant and (ii) the extrinsic semiconductor so formed.

(b) Calculate the electron concentration in the extrinsic semiconductor.

[2025 • Set 55-4-1]

Q9. In an n-type semiconductor electron-hole combination is a continuous process at room temperature. Yet the electron concentration is always greater than the hole concentration in it. Explain.

[2025 • Set 55-6-1]

Q10. Draw energy band diagrams of n-type and p-type semiconductors at temperature $T > 0$ K. Show the donor/acceptor energy levels with the order of difference of their energies from the bands.

[2025 • Set 55-7-1]

Q11. Plot a graph showing the variation of current with voltage for the material GaAs. On the graph, mark the region where:

(a) resistance is negative, and

(b) Ohm's law is obeyed.

[2024 • Set 55-1-1]

Q12. How does the conductivity of an intrinsic semiconductor vary with temperature? Explain. Show the variation in a plot.

[2024 • Set 55-1-2]

Q13. Differentiate between 'diffusion current' and 'drift current'. Explain their role in the formation of p-n junction.

[2024 • Set 55-1-3]

Q14. How does the energy gap of an intrinsic semiconductor effectively change when doped with a (a) trivalent impurity, and (b) pentavalent impurity? Justify your answer in each case.

[2024 • Set 55-2-1]

Q15. Suppose a pure Si crystal has 5×10^{28} atoms m^{-3}. It is doped by 1 ppm concentration of boron. Calculate the concentration of holes and electrons, given that $n_i = 1.5 \times 10^{16}$ m^{-3}. Is the doped crystal n-type or p-type?

[2024 • Set 55-3-1]

Q16. Draw the circuit diagram of a p-n junction diode in (i) forward biasing and (ii) reverse biasing. Also draw its I-V characteristics in the two cases.

[2024 • Set 55-4-1]

Q17. Differentiate between intrinsic and extrinsic semiconductors.

[2023 • Set 55-1-1]

Q18. Draw the circuit arrangement for studying the V-I characteristics of a p-n junction diode in forward bias and reverse bias. Show the plot of V-I characteristic of a silicon diode.

[2023 • Set 55-1-1]

Q19. Briefly explain how the diffusion and drift currents contribute to the formation of potential barrier in a p-n junction diode.

[2023 • Set 55-1-1]

Q20. Draw energy band diagram for an n-type and p-type semiconductor at $T > 0$ K.

[2023 • Set 55-2-1]

Q21. Answer the following giving reasons:

(i) A p-n junction diode is damaged by a strong current.

(ii) Impurities are added in intrinsic semiconductors.

[2023 • Set 55-2-1]

Q22. With the help of a circuit diagram, explain how a full wave rectifier gives output rectified voltage corresponding to both halves of the input ac voltage.

[2023 • Set 55-2-3]

Q23. Explain the roles of diffusion current and drift current in the formation of the depletion layer in a p-n junction diode.

[2023 • Set 55-3-1]

Q24. Explain the property of a p-n junction which makes it suitable for rectifying alternating voltages. Differentiate between a half-wave and a full-wave rectifier.

[2023 • Set 55-3-1]

Q25. How is the width of depletion layer of a p-n junction diode affected when it is (i) forward biased, and (ii) reverse biased? Justify your answers.

[2023 • Set 55-3-2]

Q26. Draw a circuit diagram of a p-n junction diode in (a) forward biasing, and (b) reverse biasing. Draw the V-I characteristics for each case.

[2023 • Set 55-3-3]

Q27. Draw energy band diagrams of n-type and p-type semiconductors at temperature $T > 0$ K, depicting the donor and acceptor energy levels. Mention the significance of these levels.

[2022 • Set 55-1-1]

Q28. Write the characteristics of a p-n junction which make it suitable for rectification.

[2022 • Set 55-1-1]

Q29. Explain the formation of depletion layer and barrier potential in a p-n junction diode.

[2022 • Set 55-1-2]

Q30. Distinguish between intrinsic and extrinsic semiconductors. Although in an extrinsic semiconductor $n_e \neq n_h$, yet it is electrically neutral. Why?

[2022 • Set 55-1-3]

Q31. Explain the formation of depletion region in a p-n junction.

[2022 • Set 55-2-1]

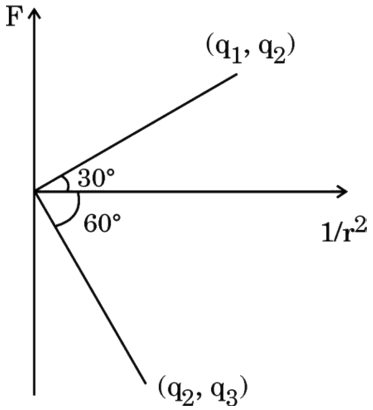
Q32. How is an emf generated by a solar cell due to the three basic processes involved? Explain.

[2022 • Set 55-2-1]

Q33. Briefly explain the working of a light emitting diode. Mention its two uses.

[2022 • Set 55-2-2]

Q34. The V - I characteristics of a solar cell is shown in the figure.



(a) What do the points P and Q represent?

(b) Give the circuit diagram for a solar cell.

[2022 • Set 55-2-3]

Q35. What is meant by doping of an intrinsic semiconductor? Name the two types of atoms used for doping of Ge/Si.

[2022 • Set 55-3-1]

Q36. (a) Draw the circuit diagram of an illuminated photodiode and its I-V characteristics.

(b) How can a photodiode be used to measure the light intensity?

[2022 • Set 55-3-2]

Q37. Name the extrinsic semiconductors formed when a pure germanium is doped with (i) a trivalent and (ii) pentavalent impurity. Draw the energy band diagrams of extrinsic semiconductors so formed.

[2022 • Set 55-3-3]

Q38. What is meant by energy band gap in a solid? Draw the energy band diagrams for a conductor, an insulator and a semiconductor.

[2022 • Set 55-4-1]

Q39. Name the device which converts electrical energy into light energy. Write three advantages of the device.

[2022 • Set 55-4-1]

Q40. Name the device which converts an ac input signal into a dc output signal. Write the principle of working of the device.

[2022 • Set 55-4-2]

Q41. Define barrier potential. Why does the thickness of the depletion layer in a p-n junction diode vary with increase in reverse bias?

[2022 • Set 55-4-3]

Q42. With the help of a circuit diagram, explain briefly how a p-n junction diode works as a half-wave rectifier.

[2022 • Set 55-5-1]

Q43. Why a photo-diode is operated in reverse bias whereas current in the forward bias is much larger than that in the reverse bias? Explain. Mention its two uses.

[2022 • Set 55-5-1]

Q44. Two crystals C_1 and C_2, made of pure silicon, are doped with arsenic and aluminium respectively.

(i) Identify the extrinsic semiconductors so formed.

(ii) Why is doping of intrinsic semiconductors necessary?

[2022 • Set 55-5-2]

Q45. Give two differences between a half wave rectifier and a full wave rectifier.

[2022 • Set 55-5-3]

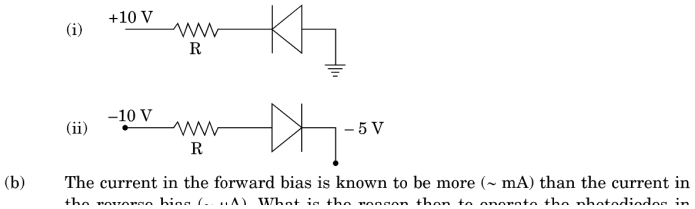
Q46. With the help of the circuit diagram, explain the working of a diode as a half-wave rectifier.

[2021]

Q47. With the help of the circuit diagram, explain briefly the working of a photodiode.

[2021]

Q48. (a) State whether the given ideal diodes are forward or reverse biased:



(b) The current in the forward bias is known to be more (~ mA) than the current in the reverse bias (~ μA). What is the reason then to operate the photodiodes in reverse bias?

(b) The current in the forward bias is known to be more ($\sim$ mA) than the current in the reverse bias ($\sim \mu$A). What is the reason then to operate the photodiodes in reverse bias?

[2021]

Q49. Explain the terms 'depletion layer' and 'potential barrier' in a p-n junction diode. How are the (a) width of depletion layer, and (b) value of potential barrier affected when the p-n junction is forward biased?

[2020 • Set 55-1-1]

Q50. Draw V-I characteristics of a p-n junction diode. Explain, why the current under reverse bias is almost independent of the applied voltage up to the critical voltage.

[2020 • Set 55-2-1]

Q51. Briefly explain how a potential barrier is set up across a p-n junction as a result of diffusion and drift of the charge carriers.

[2020 • Set 55-4-1]

Q52. (a) Why is a photo diode operated under reverse bias condition?

(b) Draw V-I characteristic curves of photo diode for incident light of intensities I_1 and I_2 $(I_2 > I_1)$.

OR

(a) State the level of doping and biasing condition used in light emitting diode (LED).

(b) Write any two advantages of LED over the conventional low power lamps.

[2020 • Set 55-4-1]

Q53. (a) Explain the formation of energy bands in crystalline solids.

(b) Draw the energy band diagrams of (i) a metal and (ii) a semiconductor.

[2020 • Set 55-4-1]

Q54. Why a signal transmitted from a TV tower cannot be received beyond a certain distance? Write the expression for the optimum separation between the receiving and the transmitting antenna.

[2019 • Set 55-1-1]

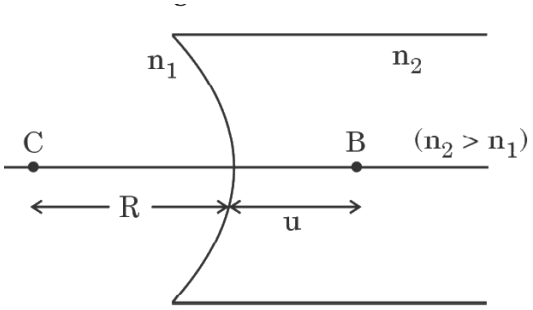
Q55. Write the relation between the height of a TV antenna and the maximum range up to which signals transmitted by the antenna can be received. How is this expression modified in the case of line of sight communication by space waves? In which range of frequencies, is this mode of communication used?

[2019 • Set 55-2-1]

Q56. A certain n-p-n transistor has the common emitter output characteristics as shown in the figure.

(a) Find the emitter current at $V_{CE} = 12.5\,\text{V}$ and $I_B = 60\,\mu\text{A}$, and

(b) Current gain 'β' at this point.



[2019 • Set 55-4-1]

Q57. The frequencies of two side bands in an amplitude modulated wave are 640 kHz and 660 kHz respectively. Find the frequencies of the carrier and the modulating signals. Also obtain the value of the bandwidth required in amplitude modulation.

OR

A sinusoidal carrier voltage is amplitude modulated by a sinusoidal voltage of 10 kHz with modulation index 0.3. If the carrier frequency is 10 MHz and its amplitude is 40 V, calculate the frequency and amplitude of the two sidebands.

[2019 • Set 55-5-1]

Q58. Draw a block diagram of a generalized communication system and write the functions of (i) a transmitter, and (ii) a receiver.

[2019 • Set 55-5-1]

Q59. A carrier wave of peak voltage 15 V is used to transmit a message signal. Find the peak voltage of the modulating signal in order to have a modulation index of 60%.

[2018]

Q60. Which basic mode of communication is used in satellite communication? What type of wave propagation is used in this mode? Write, giving reason, the frequency range used in this mode of propagation.

[2017]

Q61. Distinguish between a transducer and a repeater.

[2017]

Q62. **(i)** What is the line of sight communication?

(ii) Why is it not possible to use sky waves for transmission of TV signals? Upto what distance can a signal be transmitted using an antenna of height 'h'?

[2017]

Q63. Write two points of difference between intrinsic and extrinsic semiconductors.

[2017]

Q64. Distinguish between broadcast mode and point-to-point mode of communication and give one example for each.

[2017]

Q65. Describe, with the help of a circuit diagram, the working of a photodiode.

[2017]

Q66. Define modulation index. Why is it kept low? What is the role of a bandpass filter?

[2016]

Q67. State the concept of mobile telephony and explain its working.

[2016]

Q68. Why is base band signal not transmitted directly? Give any two reasons.

[2016]

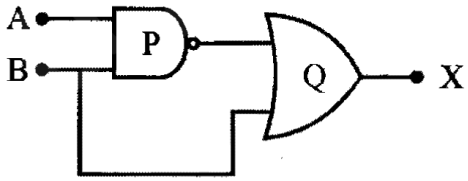
Q69. What is ground wave communication? Explain why this mode cannot be used for long distance communication using high frequencies.

[2015]

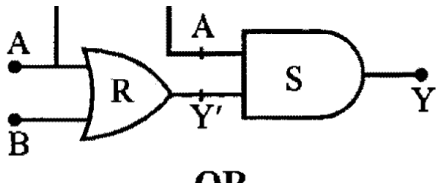
Q70. Distinguish between 'intrinsic' and 'extrinsic' semiconductors.

[2015]

Q71. Write the truth table for the combination of the gates shown. Name the gates used.



OR Identify the logic gates marked 'P' and 'Q' in the given circuit. Write the truth table for the combination.



[2014]

Q72. Explain, with the help of a circuit diagram, the working of a p-n junction diode as a half-wave rectifier.

[2014]

Q73. Draw a circuit diagram of n-p-n transistor amplifier in CE configuration. Under what condition does the transistor act as an amplifier ?

[2014]

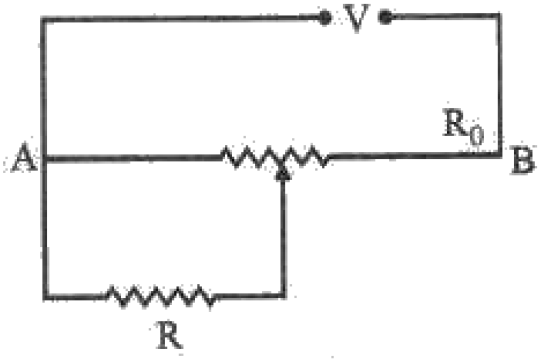
Q74. Write the functions of the following in communication systems :

(i) Receiver

(ii) Demodulator

[2014]

Q75. Block diagram of a receiver is shown in the figure:



(a) Identify 'X' and 'Y'.

(b) Write their functions.

[2013]

Q76. Explain, with the help of a circuit diagram, the working of a photo-diode. Write briefly how it is used to detect the optical signals.

OR

Mention the important considerations required while fabricating a p-n junction diode to be used as a Light Emitting Diode (LED). What should be the order of band gap of an LED if it is required to emit light in the visible range?

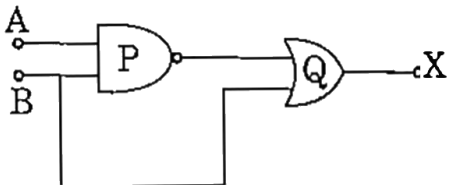
[2013]

Q77. Write two factors justifying the need of modulating a signal. A carrier wave of peak voltage $12\,\text{V}$ is used to transmit a message signal. What should be the peak voltage of the modulating signal in order to have a modulation index of 75%?

[2012]

Q78. **(i)** Identify the logic gates marked P and Q in the given logic circuit.

(ii) Write down the output at X for the inputs $A = 0$, $B = 0$ and $A = 1$, $B = 1$.

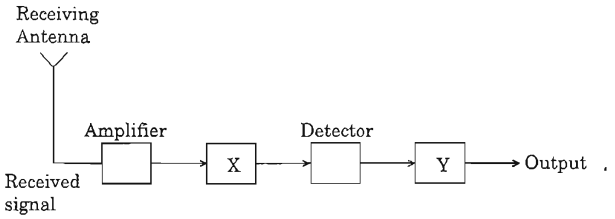


[2012]

Q79. Describe briefly with the help of a circuit diagram, how the flow of current carriers in a p-n-p transistor is regulated with emitter-base junction forward biased and base-collector junction reverse biased.

[2012]

Q80. In the given block diagram of a receiver, identify the boxes labelled as X and Y and write their functions.



X -> Amplifier -> Detector -> Y -> Output'>

[2012]

Q81. Distinguish between 'Analog and Digital signals'.

OR

Mention the function of any two of the following used in communication system:

(i) Transducer

(ii) Repeater

(iii) Transmitter

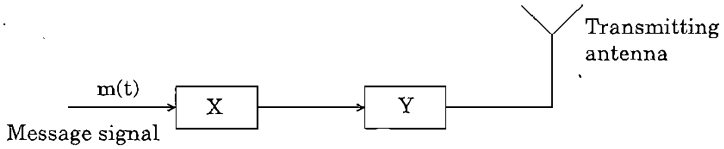
(iv) Bandpass Filter

[2012]

Q82. The current in the forward bias is known to be more ($\sim$ mA) than the current in the reverse bias ($\sim \mu$A). What is the reason, then, to operate the photodiode in reverse bias?

[2012]

Q83. Figure shows a block diagram of a transmitter. Identify the boxes 'X' and 'Y' and write their functions.



X -> Y -> Transmitting antenna'>

[2012]

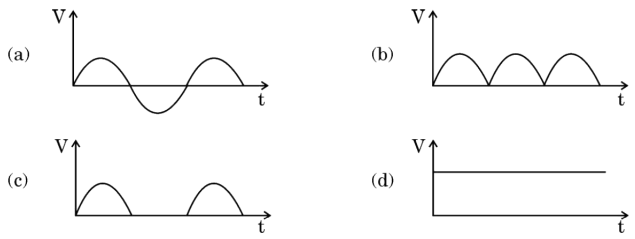
Q84. Write two characteristic features to distinguish between n-type and p-type semiconductors.

OR

How does a light emitting diode (LED) work? Give two advantages of LED's over the conventional incandescent lamps.

[2012]

Q85. Draw the output waveform at X, using the given inputs A and B for the logic circuit shown below. Also, identify the logic operation performed by this circuit.



[2011 • Set 55-1-1]

Q86. Name the semiconductor device that can be used to regulate an unregulated dc power supply. With the help of I-V characteristics of this device, explain its working principle.

[2011 • Set 55-1-1]

Q87. Draw the transfer characteristic curve of a base biased transistor in CE configuration. Explain clearly how the active region of the V_o versus V_i curve in a transistor is used as an amplifier.

[2011 • Set 55-1-1]

Q88. **(i)** Define modulation index.

(ii) Why is the amplitude of modulating signal kept less than the amplitude of carrier wave?

[2011 • Set 55-1-1]

Q89. Plot a graph showing temperature dependence of resistivity for a typical semiconductor. How is this behaviour explained?

[2011 • Set 55-2-1]

Q90. For an amplitude modulated wave, the maximum amplitude is found to be 10 V while the minimum amplitude is 2 V. Calculate the modulation index. Why is modulation index generally kept less than one?

[2011 • Set 55-2-1]

Q91. Draw a block diagram showing the important components in a communication system. What is the function of a transducer?

[2011 • Set 55-2-1]

Q92. Draw the circuit diagram of an illuminated photodiode in reverse bias. How is photodiode used to measure light intensity?

[2010]

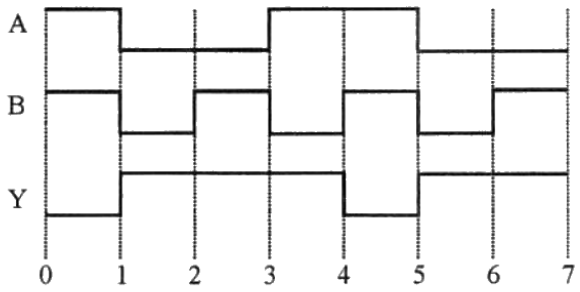
Q93. Explain the function of a repeater in a communication system.

[2010]

Q94. By what percentage will the transmission range of a TV tower be affected when the height of the tower is increased by 21%?

[2009]

Q95. The following figure shows the input waveforms (A, B) and the output waveform (Y) of a gate. Identify the gate, write its truth table and draw its logic symbol.



[2009]

Q96. Why are high frequency carrier waves used for transmission?

[2009]

Q97. What is meant by term 'modulation'? Draw a block diagram of a simple modulator for obtaining an AM signal.

[2009]

Q98. Write the function of (i) Transducer and (ii) Repeater in the context of communication system.

[2009]

Q99. Write two factors justifying the need of modulation for transmission of a signal.

[2009]

Q100. Distinguish between an intrinsic semiconductor and P-type semiconductor. Give reason, why a P-type semiconductor crystal is electrically neutral, although $n_h \gg n_e$.

[2008]

Q101. The given inputs A, B are fed to a 2-input NOR gate. Draw the output wave form of the gate.

[2008]

Q102. A transmitting antenna at the top of a tower has a height of $36\ m$ and the height of the receiving antenna is $49\ m$. What is the maximum distance between them, for satisfactory communication in the LOS mode? (Radius of earth $= 6400\ km$)

[2008]

Q103. Why do we need carrier waves of very high frequency in the modulation of signals? A carrier wave of peak voltage $20\ V$ is used to transmit a message signal. What should be the peak voltage of the modulating signal, in order to have a modulation index of 80%?

[2008]

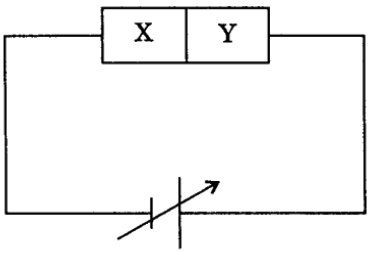
Q104. The output of an

OR

gate is connected to both the inputs of a NAND gate. Draw the logic circuit of this combination of gates and write its truth table.

[2007]

Q105. Two semiconductor materials X and Y shown in the given figure, are made by doping germanium crystal with indium and arsenic respectively. The two are joined end to end and connected to a battery as shown.

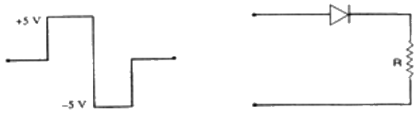


(i) Will the junction be forward biased or reverse biased?

(ii) Sketch a V-I graph for this arrangement.

[2007]

Q106. Draw and explain the output waveform across the load resistor R, if the input waveform is as shown in the given figure.



[2006]

Q107. Explain how the width of depletion layer in a p-n junction diode changes when the junction is (i) forward biased (ii) reverse biased.

[2006]

Q108. With the help of a diagram, show the biasing of a light emitting diode (LED). Give its two advantages over conventional incandescent lamps.

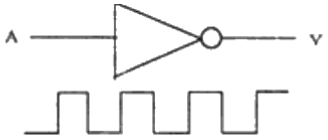
[2004]

Q109. In the figure below, circuit symbol of a logic gate and input wave form is shown.

(i) Name the logic gate,

(ii) write its truth table and

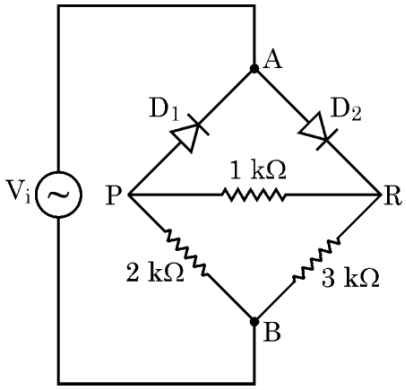
(iii) give the output wave form.



[2003]

3-Mark Questions (137 questions · Section C · SA)

Q1. An ac voltage $V_i = 12\sin(100\pi t)$ V is applied between points A and B in a network of two ideal diodes and three resistors as shown in figure.



During the positive half-cycle of the input voltage V_i supplied to the network:

(a) Identify which of the two diodes will conduct and why?

(b) Redraw an equivalent circuit diagram to show the flow of current.

(c) Calculate the output voltage drops V_o across the three resistors when the input voltage attains its peak value.

[2026 • Set 55-1-1]

Q2. Briefly explain the two important processes that occur during the formation of a p-n junction.

[2026 • Set 55-1-1]

Q3. A semiconductor has equal electron and hole concentration of 3×10^6 m^{-3}. On doping with a certain impurity, the hole concentration increases to 6×10^{10} m^{-3}.

(a) What type of semiconductor is obtained on doping?

(b) Calculate the new electron concentration of the semiconductor.

(c) How does the energy gap of semiconductor change with doping? Draw the energy band diagram for it.

[2026 • Set 55-1-2]

Q4. (a) Draw the V-I characteristics of silicon diode.

(b) Explain the following terms: (i) minority carrier injection in forward bias (ii) break-down voltage in reverse bias

[2026 • Set 55-1-3]

Q5. With the help of circuit diagrams, briefly explain the forward biasing and the reverse biasing of a p-n junction diode.

[2026 • Set 55-3-1]

Q6. With the help of a circuit diagram, explain the working of a full wave rectifier. Depict the input and output waveforms.

[2026 • Set 55-4-1]

Q7. (a) Draw circuit arrangement for studying V-I characteristics of a p-n junction diode.

(b) Show the shape of the characteristics of a diode.

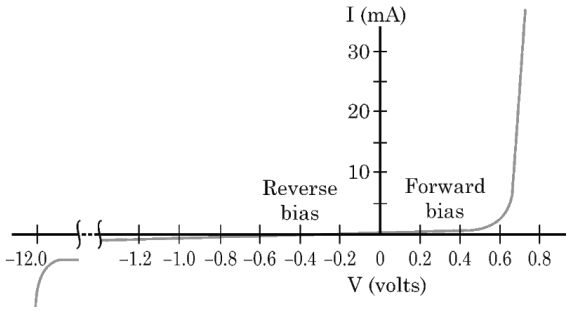
(c) Mention two information that you can get from these characteristics.

[2025 • Set 55-1-1]

Q8. (a) What are majority and minority charge carriers in an extrinsic semiconductor?

(b) A p-n junction is forward biased. Describe the movement of the charge carriers which produce current in it.

(c) The graph shows the variation of current with voltage for a p-n junction diode. Estimate the dynamic resistance of diode at V = -0.6 volt.



[2025 • Set 55-2-1]

Q9. (a) What are majority and minority charge carriers of p-type and n-type semiconductors ?

(b) Explain briefly the formation of diffusion current and drift current in a p-n junction diode.

[2025 • Set 55-4-1]

Q10. (a) Draw the energy-band diagrams for conductors, semiconductors and insulators at $T = 0$ K. How is an electron-hole pair formed in a semiconductor at room temperature?

(b) Carbon and silicon both, are members of IV group of periodic table and have the same lattice structure. Carbon is an insulator whereas silicon is a semiconductor. Explain.

[2025 • Set 55-5-1]

Q11. Differentiate between half-wave and full-wave rectification. With the help of a circuit diagram, explain the working of a full-wave rectifier.

[2025 • Set 55-5-1]

Q12. Explain the process of formation of 'depletion layer' and 'potential barrier' in a p-n junction region of a diode, with the help of a suitable diagram. Which feature of junction diode makes it suitable for its use as a rectifier?

[2025 • Set 55-7-2]

Q13. Draw the circuit diagrams for obtaining the $V - I$ characteristics of a p-n junction diode. Explain briefly the salient features of the $V - I$ characteristics in (i) forward biasing, and (ii) reverse biasing.

[2024 • Set 55-3-1]

Q14. On the basis of energy band diagrams, distinguish between (i) an insulator, (ii) a semiconductor, and (iii) a conductor.

[2024 • Set 55-3-1]

Q15. (a) Explain the characteristics of a p-n junction diode that makes it suitable for its use as a rectifier.

(b) With the help of a circuit diagram, explain the working of a full wave rectifier.

[2024 • Set 55-5-1]

Q16. Explain the following, giving reasons:

(a) A doped semiconductor is electrically neutral.

(b) In a p-n junction under equilibrium, there is no net current.

(c) In a diode, the reverse current is practically not dependent on the applied voltage.

[2024 • Set 55-5-1]

Q17. State the working principle of an LED. Write any two important advantages and two disadvantages of LED.

[2022 • Set 55-1-1]

Q18. With the help of a circuit diagram, explain the working of a p-n junction diode as a full-wave rectifier. Also draw its input and output waveforms.

[2022 • Set 55-2-1]

Q19. Briefly explain how emf is generated in a solar cell. Draw its I-V characteristics.

[2022 • Set 55-3-1]

Q20. Draw the energy band diagrams for conductors, semiconductors and insulators. Which band determines the electrical conductivity of a solid? How is the electrical conductivity of a semiconductor affected with rise in its temperature? Explain.

[2022 • Set 55-3-2]

Q21. Answer the following, giving reason:

(a) The resistance of a p-n junction is low when it is forward biased and is high when it is reverse biased.

(b) Doping of intrinsic semiconductors is a necessity for making electronic devices.

(c) Photodiodes are operated in reverse bias.

[2022 • Set 55-4-1]

Q22. **(i)** Draw V-I characteristics of a p-n junction diode.

(ii) Differentiate between the threshold voltage and the breakdown voltage for a diode.

(iii) Write the property of a junction diode which makes it suitable for rectification of ac voltages.

[2022 • Set 55-5-1]

Q23. Draw circuit diagram and explain the working of a zener diode as a dc voltage regulator with the help of its I-V characteristic.

[2020 • Set 55-1-1]

Q24. What is the purpose of heavy doping of p- and n-sides of a zener diode?

[2020 • Set 55-1-1]

Q25. With the help of a simple diagram, explain the working of a silicon solar cell, giving all three basic processes involved. Draw its I-V characteristic.

[2020 • Set 55-1-2]

Q26. Draw the circuit diagram of a full wave rectifier using two p-n junction diodes. Explain its working and show input and output voltage variations.

[2020 • Set 55-1-3]

Q27. What is the function of a solar cell? Briefly explain its working and draw its I-V characteristic curve.

[2020 • Set 55-2-1]

Q28. (a) Plot V-I characteristics for an illuminated photodiode under reverse bias for three different illumination intensities $I_1 > I_2 > I_3$.

(b) In a zener regulated power supply, a zener diode with $V_Z = 6$ V is used for regulation. The load current should be 4.0 mA and zener current is five times the load current for unregulated input of 10 V. Find the series resistor R_s used in the power supply.

[2020 • Set 55-2-2]

Q29. Name the diode which can act as a voltage regulator. Explain its working with the help of its labelled circuit diagram. Draw its V-I characteristic.

[2020 • Set 55-3-1]

Q30. (a) Why is an intrinsic semiconductor deliberately converted into an extrinsic semiconductor by adding impurity atoms?

(b) Explain briefly the two processes that occur in p-n junction region to create a potential barrier.

[2020 • Set 55-3-1]

Q31. With the help of a circuit diagram, explain how two p-n junction diodes along with a centre tapped transformer can be used as a full wave rectifier.

[2020 • Set 55-3-2]

Q32. (a) How are energy bands formed in a crystalline solid?

(b) Draw the energy band diagrams for p-type and n-type semiconductors. Depict the donor/acceptor energy levels in these diagrams and write their significance.

[2020 • Set 55-3-3]

Q33. What is a solar cell ? Draw its V-I characteristics. Explain the three processes involved in its working.

OR

Draw the circuit diagram of a full wave rectifier. Explain its working showing its input and output waveforms.

[2020 • Set 55-5-1]

Q34. Explain the formation of potential barrier and depletion region in a p-n junction diode. What is effect of applying forward bias on the width of depletion region ?

OR

What is photo diode ? Briefly explain its working and draw its V-I characteristics.

[2020 • Set 55-5-3]

Q35. Three photo diodes D_1, D_2 and D_3 are made of semiconductors having band gaps of $2.5\,\text{eV}$, $2\,\text{eV}$ and $3\,\text{eV}$ respectively. Which of them will not be able to detect light of wavelength $600\,\text{nm}$?

[2019 • Set 55-1-1]

Q36. Why photodiodes are required to operate in reverse bias? Explain.

[2019 • Set 55-1-1]

Q37. Describe briefly the functions of the three segments of n-p-n transistor.

[2019 • Set 55-1-1]

Q38. Draw the circuit arrangement for studying the output characteristics of n-p-n transistor in CE configuration. Explain how the output characteristics is obtained.

[2019 • Set 55-1-1]

Q39. Draw the circuit diagram of a full wave rectifier and explain its working. Also, give the input and output waveforms.

[2019 • Set 55-1-1]

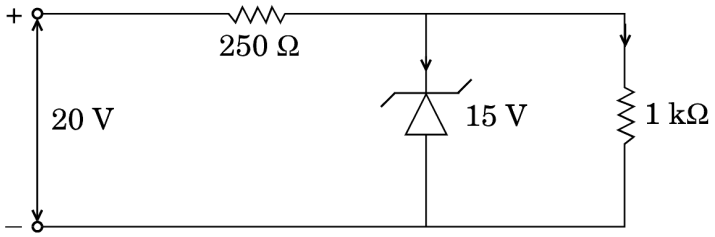
Q40. If A and B represent the maximum and minimum amplitudes of an amplitude modulated wave, write the expression for the modulation index in terms of A & B.

[2019 • Set 55-1-1]

Q41. A message signal of frequency $20\,\text{kHz}$ and peak voltage $10\,\text{V}$ is used to modulate a carrier of frequency $2\,\text{MHz}$ and peak voltage of $15\,\text{V}$. Calculate the modulation index. Why the modulation index is generally kept less than one?

[2019 • Set 55-1-1]

Q42. Give reason to explain why n and p regions of a Zener diode are heavily doped. Find the current through the Zener diode in the circuit given below: (Zener breakdown voltage is $15\,\text{V}$)



[2019 • Set 55-2-1]

Q43. A signal of low frequency f_m is to be transmitted using a carrier wave of frequency f_c. Derive the expression for the amplitude modulated wave and deduce expressions for the

lower and upper sidebands produced. Hence, obtain the expression for modulation index.

[2019 • Set 55-2-1]

Q44. Prove that in a common-emitter amplifier, the output and input differ in phase by $180°$. In a transistor, the change of base current by $30\,\mu$A produces change of $0.02\,$V in the base-emitter voltage and a change of $4\,$mA in the collector current. Calculate the current amplification factor and the load resistance used, if the voltage gain of the amplifier is 400.

[2019 • Set 55-2-1]

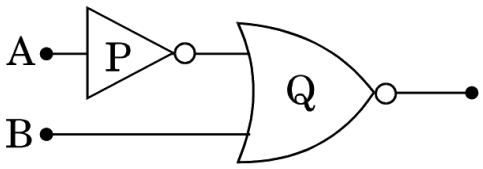
Q45. What is the reason to operate photodiodes in reverse bias? A p-n photodiode is fabricated from a semiconductor with a band gap of range of 2.5 to $2.8\,$eV. Calculate the range of wavelengths of the radiation which can be detected by the photodiode.

[2019 • Set 55-2-2]

Q46. Draw the circuit diagram of a full wave rectifier. Explain its working principle. Show the input waveforms given to the diodes D_1 and D_2 and the corresponding output waveforms obtained at the load connected to the circuit.

[2019 • Set 55-2-3]

Q47. (a) (i) Write the truth tables of the logic gates marked P and Q in the given circuit. (ii) Write the truth table for the circuit.



(b) Why are NOR gates considered as universal gates?

OR

(a) Explain how a potential barrier is developed in a p-n junction diode.

(b) Draw the circuit arrangement for studying the V-I characteristics of a p-n junction diode in reverse bias. Plot the V-I characteristics in this case.

[2019 • Set 55-3-1]

Q48. (a) What do you mean by bandwidth of a signal? Give its importance.

(b) Differentiate between Analog and Digital communication.

(c) Write the functions of transducer and repeaters.

[2019 • Set 55-3-1]

Q49. Draw the energy band diagram of (i) n-type, and (ii) p-type semiconductors at temperature $T > 0$ K. In the case of n-type Si-semiconductor, the donor energy level is slightly below the bottom of conduction band whereas in p-type semiconductor, the acceptor energy level is slightly above the top of valence band. Explain, giving examples, what role do these energy levels play in conduction and valence bands.

[2019 • Set 55-4-1]

Q50. With what considerations in view is a photodiode fabricated? Explain its working with the help of a suitable diagram. With the help of V-I characteristics, state how photodiode is used to detect optical signals.

[2019 • Set 55-4-1]

Q51. (a) What is amplitude modulation? Draw a diagram showing an amplitude modulated wave obtained by modulation of a carrier sinusoidal wave on a modulating signal.

(b) Define the terms (i) modulation index, and (ii) side bands. Mention the significance of side bands.

[2019 • Set 55-4-1]

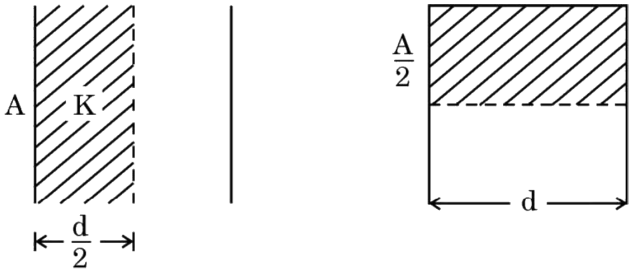
Q52. How is a light emitting diode fabricated? Briefly explain the basic processes involved in the emission of spontaneous radiation from it. Write two advantages of LED lamps over the incandescent low power lamps.

[2019 • Set 55-4-2]

Q53. How is Zener diode fabricated? Draw its I-V characteristic and use this to explain the working of a Zener diode as a voltage regulator.

[2019 • Set 55-4-3]

Q54. The figure shows the V-I characteristic of a semiconductor diode designed to operate under reverse bias.



(a) (b)

(a) Identify the semiconductor diode used.

(b) Draw the circuit diagram to obtain the given characteristics of this device.

(c) Briefly explain one use of this device.

[2019 • Set 55-5-1]

Q55. (a) Differentiate between three segments of an n-p-n transistor on the basis of their size and level of doping.

(b) Draw a plot of transfer characteristic and show which portion of the characteristic is used in amplification and why.

[2019 • Set 55-5-1]

Q56. (a) A student wants to use two p-n junction diodes to convert alternating current into direct current. Draw the labelled circuit diagram she would use and explain how it works.

(b) Give the truth table and circuit symbol for NAND gate.

[2018]

Q57. Draw the typical input and output characteristics of an n-p-n transistor in CE configuration. Show how these characteristics can be used to determine (a) the input resistance (r_i), and (b) current amplification factor (β).

[2018]

Q58. (a) Give three reasons why modulation of a message signal is necessary for long distance transmission.

(b) Show graphically an audio signal, a carrier wave and an amplitude modulated wave.

[2018]

Q59. Write the two processes that take place in the formation of a p-n junction. Explain with the help of a diagram, the formation of depletion region and barrier potential in a p-n junction.

[2017]

Q60. Define the term 'amplitude modulation'. Explain any two factors which justify the need for modulating a low frequency base-band signal.

[2017]

Q61. For a CE-transistor amplifier, the audio signal voltage across the collector resistance of $2\ \text{k}\Omega$ is $2\ \text{V}$. Given the current amplification factor of the transistor is 100, find the input signal voltage and base current, if the base resistance is $1\ \text{k}\Omega$.

[2017]

Q62. A zener diode is fabricated by heavily doping both p- and n- sides of the junction. Explain, why? Briefly explain the use of zener diode as a dc voltage regulator with the help of a

circuit diagram.

[2017]

Q63. Explain briefly with the help of necessary diagrams, the forward and the reverse biasing of a p-n junction diode. Also draw their characteristic curves in the two cases.

[2017]

Q64. (a) Define the term 'modulation index,' used in communication system. Why is its value kept less than or equal to one?

(b) A message signal of frequency 10 kHz and peak voltage of 10 V is used to modulate a carrier frequency 1 MHz and peak voltage 10 V. Determine the (i) modulation index, and (ii) side bands produced.

[2017]

Q65. What is sky wave propagation? Which frequency range is suitable for sky wave propagation and why? Over which range of frequencies can communication through free space using radio waves take place?

[2017]

Q66. What is space wave propagation? Which systems of communication use space waves? What is 'radio horizon' of a transmitting antenna of height h? Why is space wave propagation suitable for frequencies above 40 MHz?

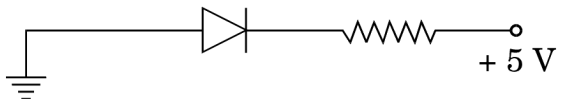
[2017]

Q67. (a) How is amplitude modulation achieved?

(b) The frequencies of two side bands in an AM wave are 640 kHz and 660 kHz respectively. Find the frequencies of carrier and modulating signal. What is the bandwidth required for amplitude modulation?

[2017]

Q68. (a) In the following diagram, is the junction diode forward biased or reverse biased?



(b) Draw the circuit diagram of a full wave rectifier and state how it works.

[2017]

Q69. Draw a block diagram of a generalized communication system. Write the functions of each of the following:

(a) Transmitter

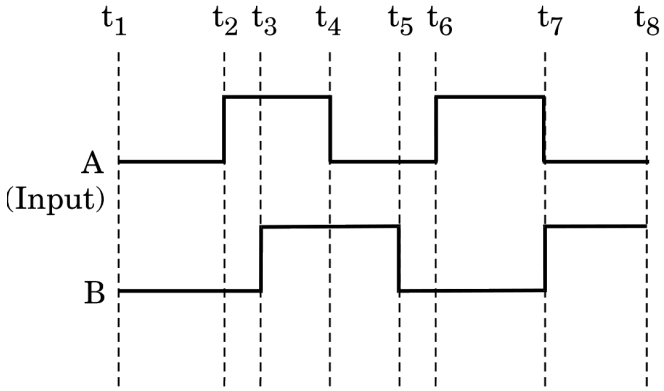
(b) Channel

(c) Receiver

[2017]

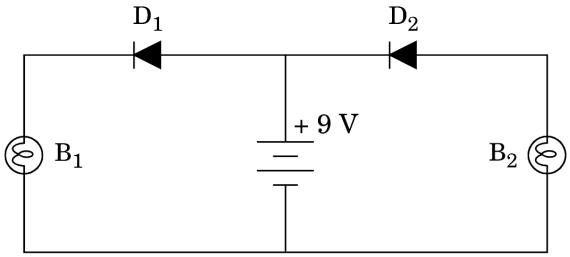
Q70. (a) Write the functions of the three segments of a transistor.

(b) The figure shows the input waveforms A and B for 'AND' gate. Draw the output waveform and write the truth table for this logic gate.



[2017]

Q71. (a) In the following diagram, which bulb out of B_1 and B_2 will glow and why?



(b) Draw a diagram of an illuminated p-n junction solar cell.

(c) Explain briefly the three processes due to which generation of emf takes place in a solar cell.

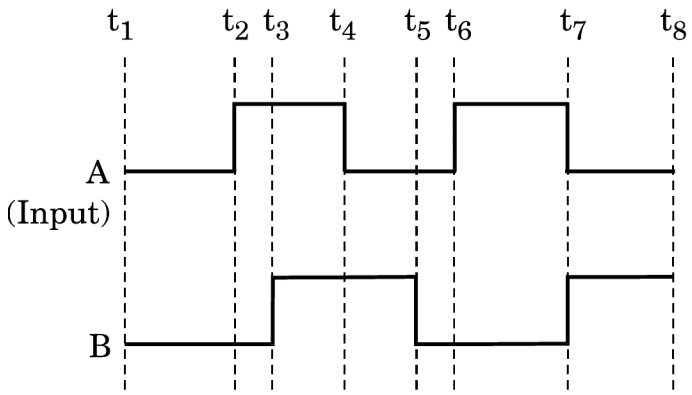
[2017]

Q72. (a) Draw the circuit diagram for studying the characteristics of a transistor in common emitter configuration. Explain briefly and show how input and output characteristics are drawn.

(b) The figure shows input waveforms A and B to a logic gate. Draw the output waveform for an

OR

gate. Write the truth table for this logic gate and draw its logic symbol.



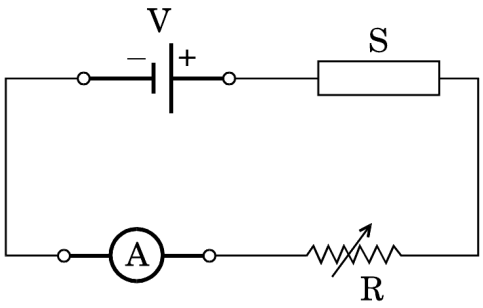
[2017]

Q73. (a) Draw the circuit diagram of an n-p-n transistor amplifier in common emitter configuration.

(b) Derive an expression for voltage gain of the amplifier and hence show that the output voltage is in opposite phase with the input voltage.

[2017]

Q74. (a) In the following diagram 'S' is a semiconductor. Would you increase or decrease the value of R to keep the reading of the ammeter A constant when S is heated? Give reason for your answer.



(b) Draw the circuit diagram of a photodiode and explain its working. Draw its $I - V$ characteristics.

[2017]

Q75. (i) Explain with the help of a diagram the formation of depletion region and barrier potential in a pn junction.

(ii) Draw the circuit diagram of a half wave rectifier and explain its working.

[2016]

Q76. (i) Which mode of propagation is used by shortwave broadcast services having frequency range from a few MHz upto 30 MHz? Explain diagrammatically how long distance

communication can be achieved by this mode.

(ii) Why is there an upper limit to frequency of waves used in this mode?

[2016]

Q77. For a CE-transistor amplifier, the audio signal voltage across the collector resistance of $2\ \text{k}\Omega$ is $2\ \text{V}$. Suppose the current amplification factor of the transistor is 100, find the input signal voltage and base current, if the base resistance is $1\ \text{k}\Omega$.

[2016]

Q78. What is Global Positioning System? Explain its working principle in brief.

[2016]

Q79. Explain briefly, with the help of a circuit diagram, the transistor action of npn transistor in CE configuration. Draw the typical shapes of input and output characteristics.

[2016]

Q80. **(i)** Describe the working of photodiode by drawing the circuit diagram.

(ii) Draw the characteristics of a photodiode for different illumination intensities.

(iii) Why is photodiode operated in reverse bias even though the reverse bias current is much weaker than the current in forward bias?

[2016]

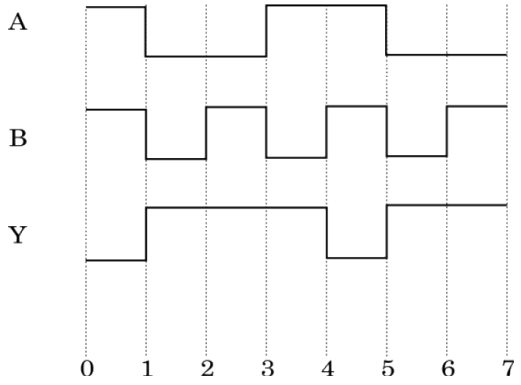
Q81. **(i)** Name two important processes that occur during the formation of a pn junction.

(ii) Draw the circuit diagram of a full wave rectifier along with the input and output waveforms. Briefly explain how the output voltage/current is unidirectional.

[2016]

Q82. **(i)** Distinguish between a conductor and a semi conductor on the basis of energy band diagram.

(ii) The following figure shows the input waveforms (A, B) and the output waveform (Y) of a gate. Identify the gate, write its truth table and draw its logic symbol.



[2016]

Q83. What is space wave propagation? State the factors which limit its range of propagation. Derive an expression for the maximum line of sight distance between two antennas for space wave propagation.

[2016]

Q84. **(i)** Explain briefly the process of emission of light by a Light Emitting Diode (LED).

(ii) Which semiconductors are preferred to make LEDs and why?

(iii) Give two advantages of using LEDs over conventional incandescent lamps.

[2016]

Q85. Draw a circuit diagram of a common emitter amplifier using n-p-n transistor. Derive an expression for the current gain β_{ac}.

[2016]

Q86. Mention any three applications of the internet. Explain one of these in detail.

[2016]

Q87. Write two important considerations used while fabricating a Zener diode. Explain, with the help of a circuit diagram, the principle and working of a Zener diode as voltage regulator.

[2015]

Q88. Draw the necessary energy band diagrams to distinguish between conductors, semiconductors and insulators. How does the change in temperature affect the behaviour of these materials? Explain briefly.

[2015]

Q89. **(a)** What are the three basic units in communication systems? Write briefly the function of each of these.

(b) Write any three applications of the internet used in communication systems.

[2015]

Q90. Draw a block diagram of a detector for AM signal and show, using necessary processes and the waveforms, how the original message signal is detected from the input AM wave.

[2015]

Q91. With what considerations in view, a photodiode is fabricated? State its working with the help of a suitable diagram. Eventhough the current in the forward bias is known to be more than in the reverse bias, yet the photodiode works in reverse bias. What is the

reason?

[2015]

Q92. Draw a circuit diagram of a transistor amplifier in CE configuration. Define the terms: (i) Input resistance and (ii) Current amplification factor. How are these determined using typical input and output characteristics?

[2015]

Q93. When Sunita, a class XII student, came to know that her parents are planning to rent out the top floor of their house to a mobile company she protested. She tried hard to convince her parents that this move would be a health hazard. Ultimately her parents agreed : (1) In what way can the setting up of transmission tower by a mobile company in a residential colony prove to be injurious to health ? (2) By objecting to this move of her parents, what value did Sunita display ? (3) Estimate the range of e.m. waves which can be transmitted by an antenna of height 20 m. (Given radius of the earth = 6400 km)

[2014]

Q94. Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams.

[2014]

Q95. Write two basic modes of communication. Explain the process of amplitude modulation. Draw a schematic sketch showing how amplitude modulated signal is obtained by superposing a modulating signal over a sinusoidal carrier wave.

[2014]

Q96. Write three important factors which justify the need of modulating a message signal. Show diagrammatically how an amplitude modulated wave is obtained when a modulating signal is superimposed on a carrier wave.

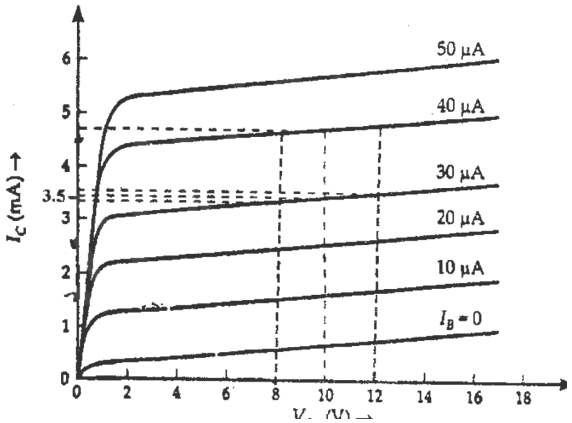
[2013]

Q97. Output characteristics of an n-p-n transistor in CE configuration is shown in the figure. Determine:

(i) dynamic output resistance

(ii) dc current gain and

(iii) ac current gain at an operating point $V_{CE} = 10$ V, when $I_B = 30\,\mu$A.



[2013]

Q98. Which mode of propagation is used by short wave broadcast services having frequency range from a few MHz upto 30 MHz? Explain diagrammatically how long distance communication can be achieved by this mode. Why is there an upper limit to frequency of waves used in this mode?

[2012]

Q99. Mention three different modes of propagation used in communication system. Explain with the help of a diagram how long distance communication can be achieved by ionospheric reflection of radio waves.

[2012]

Q100. Write any two factors which justify the need for modulating a signal. Draw a diagram showing an amplitude modulated wave by superposing a modulating signal over a sinusoidal carrier wave.

[2012]

Q101. Define modulation index. Give its physical significance. For an amplitude modulated wave, the maximum amplitude is found to be 10 V while the minimum amplitude is 2 V. Determine the modulation index μ.

[2012]

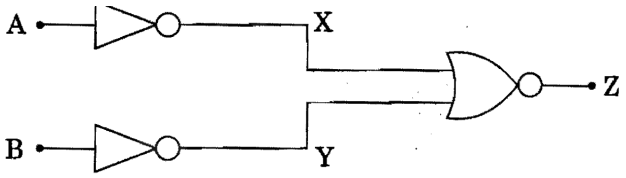
Q102. Name the three different modes of propagation of electromagnetic waves. Explain, using a proper diagram the mode of propagation used in the frequency range above 40 MHz.

[2012]

Q103. Draw a labelled diagram of a full wave rectifier circuit. State its working principle. Show the input-output waveforms.

[2011]

Q104. You are given a circuit below. Write its truth table. Hence, identify the logic operation carried out by this circuit. Draw the logic symbol of the gate it corresponds to.



[2011]

Q105. Name the important processes that occur during the formation of a p-n junction. Explain briefly, with the help of a suitable diagram, how a p-n junction is formed. Define the term 'barrier potential'.

[2011 • Set 55-2-1]

Q106. Draw transfer characteristics of a common emitter n-p-n transistor. Point out the region in which the transistor operates as an amplifier. Define the following terms used in transistor amplifiers:

(i) Input resistance

(ii) Output resistance

(iii) Current amplification factor

[2011 • Set 55-2-1]

Q107. What is space wave propagation? Give two examples of communication systems which use space wave mode. A TV tower is 80 m tall. Calculate the maximum distance upto which the signal transmitted from the tower can be received.

[2010]

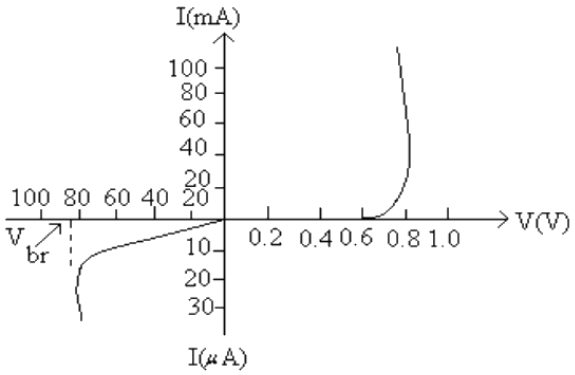
Q108. Distinguish between sky wave and space wave propagation. Give a brief description with the help of suitable diagrams indicating how these waves are propagated.

[2009]

Q109. With the help of a suitable diagram, explain the formation of depletion region in a p-n junction. How does its width change when the junction is (i) forward biased, and (ii) reverse biased?

[2009]

Q110. The figure below shows the V-I characteristic of a semiconductor diode.



(i) Identify the semiconductor diode used.

(ii) Draw the circuit diagram to obtain the given characteristic of this device.

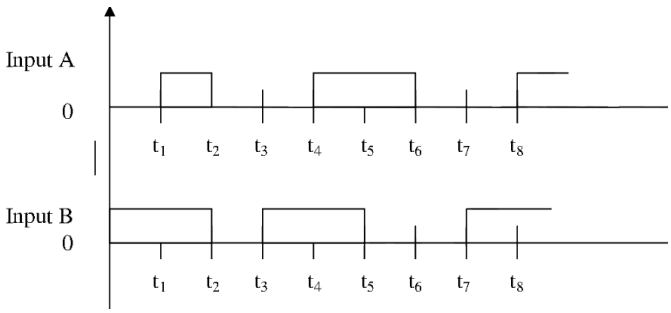
(iii) Briefly explain how this diode can be used as a voltage regulator.

[2008]

Q111. Draw a plot of the amplitude versus ω for an amplitude modulated wave. Define modulation index. State its importance for effective amplitude modulation.

[2008]

Q112. Two signals A, B as given below, are applied as input to (i) AND (ii) NOR (iii) NAND gates. Draw the output wave-form in each case.



[2008]

Q113. What does the term 'LOS communication' mean? Name the types of waves that are used for this communication. Give typical examples, with the help of a suitable figure, of communication systems that use space mode propagation.

[2008]

Q114. Draw a labeled circuit diagram of a full wave rectifier and briefly explain its working principle.

[2008]

Q115. Draw a labeled circuit diagram of a transistor amplifier in the common-emitter configura-

tion. Briefly explain, how the input/output signals differ in phase by $180°$.

[2008]

Q116. What is a digital signal? Explain the function of modem in data communication. Write two advantages of digital communication.

[2007]

Q117. Explain, with the help of a schematic diagram, the principle and working of a Light Emitting Diode. What criterion is kept in mind while choosing the semi-conductor material for such a device? Write two advantages of Light Emitting Diode over conventional incandescent lamps.

[2007]

Q118. Draw the circuit diagram of a common emitter amplifier using n-p-n transistor. What is the phase difference between the input signal and output voltage? State two reasons why a common emitter amplifier is preferred over a common base amplifier.

[2007]

Q119. Explain the formation of energy bands in solids. Draw energy band diagram for (i) a conductor, (ii) an intrinsic semiconductor.

[2007]

Q120. What is modulation? Explain the need of modulating a low frequency information signal. With the help of diagrams, differentiate between PAM and PDM.

[2007]

Q121. Write the acronym LASER in expanded form. State any four reasons for preferring diode lasers as light sources for optical communication links.

[2007]

Q122. What is an intrinsic semiconductor? How can this material be converted into (i) P-type (ii) N-type extrinsic semiconductor? Explain with the help of energy band diagrams.

[2006]

Q123. Define the term modulation. Name three different types of modulation used for a message signal using a sinusoidal continuous carrier wave. Explain the meaning of any one of these.

[2006]

Q124. Draw a circuit diagram for use of NPN transistor as an amplifier in common emitter configuration. The input resistance of a transistor is $1000\ \Omega$. On changing its base current by $10\ \mu A$, the collector current increases by $2\ mA$. If a load resistance of $5\ k\Omega$ is used in the circuit, calculate:

(i) the current gain

(ii) voltage gain of the amplifier

[2006]

Q125. Define the term 'critical frequency' in relation to sky wave propagation of electromagnetic waves. On a particular day, the maximum frequency reflected from the ionosphere is 10 MHz. On another day, it was found to decrease to 8 MHz. Calculate the ratio of the maximum electron densities of the ionosphere on the two days.

[2006]

Q126. Give reasons for the following:

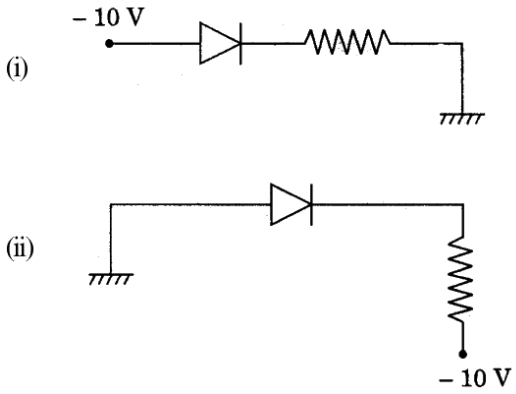
(i) Long distance radio broadcasts use short-wave bands.

(ii) The small ozone layer on top of the stratosphere is crucial to human survival.

(iii) Satellites are used for long distance TV transmission.

[2005]

Q127. Explain, with the help of a circuit diagram, how the thickness of depletion layer in a p-n junction diode changes when it is forward biased. In the following circuit which one of the two diodes is forward biased and which is reverse biased?



[2005]

Q128. Distinguish between analog and digital communication. Write any two modulation techniques employed for the digital data. Describe briefly one of the techniques used.

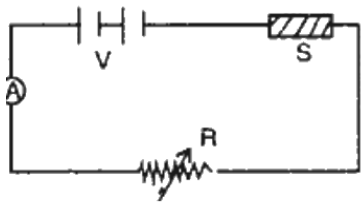
[2005]

Q129. Draw a schematic diagram of a single optical fibre structure. Explain briefly how an optical fibre is fabricated. Describe in brief, the mechanism of propagation of light signal through an optical fibre.

[2005]

Q130. The diagram shows a piece of pure semiconductor, S in series with a variable resistor R,

and a source of constant voltage V. Would you increase or decrease the value of R to keep the reading of ammeter (A) constant, when semiconductor S is heated? Give reason.



[2004]

Q131. Draw the circuit diagram of a common-emitter amplifier using an n-p-n transistor. Draw the input and output waveforms of the signal. Write the expression for its voltage gain.

[2004]

Q132. Write the symbol and truth table of an AND gate. Explain how this gate is realised in practice by using two diodes.

[2004]

Q133. With the help of a block diagram, explain the principle of an optical communication system. Give its two advantages over cable communication system. Or With the help of relevant diagrams, explain the following terms:

(i) Pulse-position modulation (PPM)

(ii) Pulse-duration modulation (PDM)

[2004]

Q134. Name the device used for data transmission from one computer to another. Justify the name. Using this device draw the block diagram for data communication and explain it briefly.

[2004]

Q135. Define Antenna. Write a short note on Antenna. Name two types of antenna.

[2003]

Q136. What is meant by the term 'modulation'? Explain with the help of a block diagram, how the process of modulation is carried out in radio broadcasts.

[2003]

Q137. Write three special characteristics of the light source used in optical communication. Name any one optical detector. Explain the meaning of the term 'sensitivity' and 'responsivity' of a detector.

[2003]

4-Mark Questions (1 questions · Section D · Case Study)

Q1. Sunil and his parents were travelling to their village in their car. On the way his mother noticed some grey coloured panels installed on the roof of a low building. She enquired from Sunil what those panels were and Sunil told his mother that those were solar panels.

(a) What were the values displayed by Sunil and his mother? State one value for each.

(b) In what way would the use of solar panels prove to be very useful?

(c) Name the semiconductor device used in solar panels. Briefly explain with the help of a diagram, how this device works.

[2017]

5-Mark Questions (22 questions · Section E · Long Answer)

Q1. (a) (i) A germanium crystal is doped with antimony. With the help of energy-band diagram, explain how the conductivity of the doped crystal is affected. (ii) Briefly explain the two processes involved in the formation of a p-n junction. (iii) What will the effect of (1) forward biasing, and (2) reverse biasing be on the width of depletion layer in a p-n junction diode?

OR

(b) (i) With the help of a circuit diagram, briefly explain the working of a full-wave rectifier using p-n junction diodes. (ii) Draw V-I characteristics of a p-n junction diode. Explain how these characteristics make a diode suitable for rectification. (iii) Carbon and silicon have the same lattice structure. Then why is carbon an insulator but silicon a semiconductor?

[2023 • Set 55-4-1]

Q2. (a) Draw the circuit arrangement for studying V-I characteristics of a p-n junction diode in (i) forward biasing and (ii) reverse biasing. Draw the typical V-I characteristics of a silicon diode. Describe briefly the following terms: (i) minority carrier injection in forward biasing and (ii) breakdown voltage in reverse biasing.

OR

(b) Name two important processes involved in the formation of a p-n junction diode. With the help of a circuit diagram, explain the working of junction diode as a full wave rectifier. Draw its input and output waveforms. State the characteristic property of a junction diode that makes it suitable for rectification.

[2023 • Set 55-5-1]

Q3. (a) Draw a circuit diagram of an n-p-n transistor with its emitter-base junction forward

biased and base-collector junction reverse biased. Briefly describe its working.

(b) Explain how a transistor in its active state exhibits a low resistance at its emitter-base junction and high resistance at its base-collector junction.

(c) Derive the expression for the voltage gain of a transistor amplifier in CE configuration in terms of the load resistance R_L, current gain β, and input resistance. Explain why input and output voltages are in opposite phase.

OR

(a) Write the important considerations which are to be taken into account while fabricating a p-n junction diode to be used as a Light Emitting Diode (LED). What should be the order of band gap of an LED, if it is required to emit light in the visible range? Draw a circuit diagram and explain its action.

(b) Draw the V-I characteristics of an LED. State two advantages of LED lamps over conventional incandescent lamps.

[2019 • Set 55-3-1]

Q4. (a) State briefly the processes involved in the formation of p-n junction explaining clearly how the depletion region is formed.

(b) Using the necessary circuit diagrams, show how the V-I characteristics of a p-n junction are obtained in (i) Forward biasing (ii) Reverse biasing How are these characteristics made use of in rectification ?

OR

(a) Differentiate between three segments of a transistor on the basis of their size and level of doping.

(b) How is a transistor biased to be in active state ?

(c) With the help of necessary circuit diagram, describe briefly how n-p-n transistor in CE configuration amplifies a small sinusoidal input voltage. Write the expression for the ac current gain.

[2014]

Q5. (a) Draw the circuit diagrams of a p-n junction diode in (i) forward bias, (ii) reverse bias. How are these circuits used to study the V–I characteristics of a silicon diode? Draw the typical V–I characteristics.

(b) What is a light emitting diode (LED)? Mention two important advantages of LEDs over conventional lamps.

OR

(a) Draw the circuit arrangement for studying the input and output characteristics of an n-p-n transistor in CE configuration. With the help of these characteristics define (i) input resistance, (ii) current amplification factor.

(b) Describe briefly with the help of a circuit diagram how an n-p-n transistor is used to produce self-sustained oscillations.

[2012]

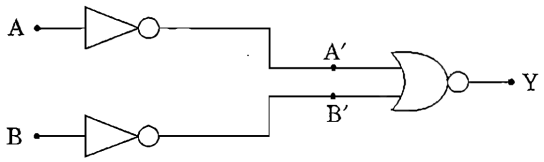
Q6. (a) Describe briefly, with the help of a diagram, the role of the two important processes involved in the formation of a p-n junction.

(b) Name the device which is used as a voltage regulator. Draw the necessary circuit diagram and explain its working.

OR

(a) Explain briefly the principle on which a transistor-amplifier works as an oscillator. Draw the necessary circuit diagram and explain its working.

(b) Identify the equivalent gate for the following circuit and write its truth table.



[2012]

Q7. (a) Draw a circuit for studying the input and output characteristics of an n-p-n transistor in CE configuration. Show how, from the output characteristics, the information about the current amplification factor (β_{ac}) can be obtained.

(b) Draw a plot of the transfer characteristic (V_o versus V_i) for a base-biased transistor in CE configuration. Show for which regions in the plot, the transistor can operate as a switch.

OR

Why is a zener diode considered as a special purpose semiconductor diode? Draw the I–V characteristics of a zener diode and explain briefly how reverse current suddenly increases at the breakdown voltage. Describe briefly with the help of a circuit diagram how a zener diode works to obtain a constant dc voltage from the unregulated dc output of a rectifier.

[2012]

Q8. Draw a simple circuit of a CE transistor amplifier. Explain its working. Show that the voltage gain, A_V, of the amplifier is given by $A_V = -\frac{\beta_{ac} R_L}{r_i}$, where β_{ac} is the current

gain, R_L is the load resistance and r_i is the input resistance of the transistor. What is the significance of the negative sign in the expression for the voltage gain?

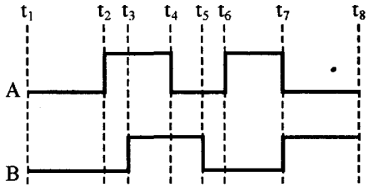
OR

(a) Draw the circuit diagram of a full wave rectifier using p-n junction diode. Explain its working and show the output, input waveforms.

(b) Show the output waveforms (Y) for the following inputs A and B of (i)

OR

gate (ii) NAND gate

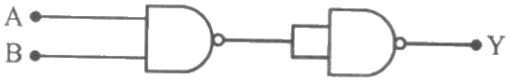


[2012]

Q9. (a) Explain the formation of depletion layer and potential barrier in a p-n junction.

(b) In the figure given below the input waveform is converted into the output waveform by a device 'X'. Name the device and draw its circuit diagram.

(c) Identify the logic gate represented by the circuit as shown and write its truth table.



[2010]

Q10. (a) With the help of the circuit diagram explain the working principle of a transistor amplifier as an oscillator.

(b) Distinguish between a conductor, a semiconductor and an insulator on the basis of energy band diagrams.

[2010]

Q11. Draw the electronic configuration in the atomic structures of 'Ge' and 'Si' atoms. How can these be made 'P-type' and 'N-type' semiconductors?

[2010]

Q12. With the help of a circuit diagram, explain the working of a P-N-P transistor.

[2010]

Q13. What are intrinsic and extrinsic semiconductors? How does the rise in temperature affect the conductivity of semiconductors?

[2010]

Q14. What is a P-N junction? How does it behave under forward and reverse bias? Explain with the help of circuit diagrams.

[2010]

Q15. Explain the working of a full wave rectifier using semiconductor diodes, with the help of a labeled circuit diagram.

[2010]

Q16. **(i)** Draw a circuit diagram to study the input and output characteristics of an n-p-n transistor in its common emitter configuration. Draw the typical input and output characteristics.

(ii) Explain, with the help of a circuit diagram, the working of n-p-n transistor as a common emitter amplifier.

[2009]

Q17. How is a zener diode fabricated so as to make it a special purpose diode? Draw I-V characteristics of zener diode and explain the significance of breakdown voltage. Explain briefly, with the help of a circuit diagram, how a p-n junction diode works as a half wave rectifier.

[2009]

Q18. State the principle of working of p-n diode as a rectifier. Explain, with the help of a circuit diagram, the use of p-n diode as a full wave rectifier. Draw a sketch of the input and output waveforms.

[2007]

Q19. Draw the symbolic representation of a (i) p-n-p, (ii) n-p-n transistor. Why is the base region of a transistor thin and lightly doped? With a circuit diagram, show the biasing of a p-n-p transistor in common base configuration. Explain the movement of charge carriers through different parts of the transistor in such a configuration and show that $I_e = I_b + I_c$.

[2007]

Q20. **(a)** Distinguish between metals, insulators and semiconductors on the basis of their energy bands.

(b) Why are photodiodes used preferably in reverse bias condition? A photodiode is fabricated from a semiconductor with band gap of 2.8 eV. Can it detect a wavelength of 6000 nm? Justify.

[2005]

Q21. (a) Explain briefly, with the help of a circuit diagram, how V-I characteristics of a p-n junction diode are obtained in (i) forward bias, and (ii) reverse bias. Draw the shape of the curves obtained.

(b) A semiconductor has equal electron and hole concentration of $6 \times 10^8/\text{m}^3$. On doping with certain impurity, electron concentration increases to $9 \times 10^{17}/\text{m}^3$. (i) Identify the new semiconductor obtained after doping. (ii) Calculate the new hole concentration.

[2005]

Q22. Draw a circuit diagram of a common emitter amplifier using n-p-n transistor. Show input and output voltages graphically. The current gain for common emitter amplifier is 59. If the emitter current is 6.0 mA, find (i) base current and (ii) collector current.

[2003]