CHAPTER-14

SEMICONDUCTOR ELECTRONICS

One mark questions

1. Which devices were used instead of transistors before its invention? (K)
2. On what principle cathode ray tube (CRT) works? (K)
3. What is a semi-conductor? (K)
4. Give an example of elemental semi-conductor. (U)
5. Give an example of organic semi-conductor. (U)
6. How 'energy bands' are formed in a solid? (U)
7. What is a 'valence band' in solids? (U)
8. Where do the 'conduction band' is situated in solids? (K)
9. Do the 'conduction band' is filled with electrons or empty in solids normally? (K)
10. What is the value of energy gap in conductors? (K)
11. What is the value of energy gap in semiconductors? (K)
12. What is the value of energy gap in insulators? (K)
13. What is forbidden energy gap? (K)
14. What is fermi energy? (K)
15. For which type of material conduction band overlaps with valence band? (K)
16. How does conductivity of semiconductor change with temperature? (U)
17. What is the unique property of the semiconductor which is used is electronics? (U)
18. What is a 'hole' in semi-conductor? (U)
19. What are intrinsic semi-conductors? (K)
20. What are extrinsic semi-conductors? (K)
21. With the help of a diagram show that an intrinsic semi-conductor behaves as insulator at 0K (S)
22. What is meant by 'doping' a semi-conductor? (K)
23. What is the advantage of doping a semiconductor? / OR (U)
24. What is the necessity of doping of a semi-conductor? (U)
25. Which type of extrinsic semi-conductor is obtained by doping with pentavalent impurity? (K)
26. Mention the name of the extrinsic semi-conductor which is doped with trivalent dopant. (K)
27. Doping silicon with indium (boron/aluminum) leads to which type of semiconductor? (K)
28. Doping in silicon with phosphorous (arsenic, antimony) leads to which type of semiconductor? (K)
29. What is diffusion current in a p-n junction diode? (U)
30. What is 'drift current' in a p-n junction diode? (U)
31. What is barrier potential in a semiconductor diode? (U)
32. What is depletion region in a semiconductor diode? (U)
33. Write the circuit symbol of p-n junction diode. (S)
34. When the diode is said to be forward biased? (K)
35. When the diode is said to be reverse biased? (K)
36. What happens to the width of the depletion region when the diode is forward biased? (K)

37. What happens to width of the depletion region when the diode is reverse biased? (K)
38. What is breakdown voltage of a semiconductor diode? (U)
39. What is cut-in voltage of a semiconductor diode? (U)
40. What is reverse saturation current? (U)
41. What is dynamic resistance in a semiconductor diode? (U)
42. What is a rectifier? (K)
43. What is a half-wave rectifier? (K)
44. What is a full-wave rectifier? (K)
45. How to get a steady d.c output from the pulsating d.c output of a full wave rectifier? (U)
46. What are filter circuits in rectifiers? (K)
47. What is internal field emission or field ionization in a Zener diode? (U)
48. Symbolically represent a Zener diode. (S)
49. In which region Zener diode is operated in voltage regulator? (K)
50. What is photo diode? (K)
51. What is LED? (K)
52. Mention any one use of LED? (K)
53. Give one application of photo diode. (K)
54. Why commonly used silicon diode will not emit light when it is forward biased? (U)
55. Which region of a transistor has maximum doping concentration? (K)
56. What is a BJT? (K)
57. Write the relation between emitter current, collector current and base current in a transistor. (K)
58. Define input resistance of a transistor in CE mode? (U)
59. Define output resistance of a CE transistor? (U)
60. Write the formula for a.c. current amplification factor of a common emitter transistor. (U)
61. Write the formula for d.c. current amplification factor of a common emitter transistor. (U)
62. Define current amplification factor of a common emitter transistor. (U)
63. What is voltage gain in an amplifier? (K)
64. Write the formula for voltage gain of the transistor amplifier in CE configuration. (U)
65. What is an amplifier in electronic circuits? (K)
66. What is a feedback amplifier? (K)
67. Why a transistor oscillator is also called tuned collector oscillator? (U).
68. Write the expression for the resonant frequency of oscillation of transistor oscillator. (U)
69. What are logic gates in electronics? (K)
70. What are digital signals in electronics? (K)
71. What are analogue signals in electronics? (K)
72. Write the circuit symbol of OR gate. (S)
73. Draw the circuit symbol of AND gate. (S)
74. Represent the circuit symbol of NOT gate. (S)
75. Write the circuit symbol of NAND gate. (S)
76. Draw the logic symbol of NOR gate. (S)
77. What is a 'truth table' in logic gates? (U)
78. What is the use of writing truth table for the logic gate? (U)

79. Which logic gate is called as an 'inverter'? (K)
80. Write the truth table of OR gate. (U)
81. Give the truth table of AND gate. (U)
82. Write the truth table of NOT gate. (U)
83. Represent the behavior of NAND gate using truth table. (U)
84. Give the truth table of NOR gate. (U)
85. The input of a NOT gate is '1'. What is its output? (A)
86. Which electronic components are used to construct logic gates? (K)
87. Why NAND & NOR gates are called universal gates? (U)
88. The inputs of a NOR gate is '1' & '0'. Write the output of this gate. (A)
89. What is an integrated circuit? (K)
90. Which technology is most widely used in the fabrication of IC? (K)
91. Represent a typical analogue signal with a diagram. (S)
92. Represent digital signal graphically. (S)
93. What is the function of digital IC? (U)
94. OPAMP belongs to which category of IC? (K)
95. Expand OPAMP. (K)
96. Give an example for 'passive component' of an integrated circuit. (K)
97. Mention a component which is called as 'active component' in integrated circuits. (K)

Two mark questions

1. Write two advantages of semi-conductor devices over vacuum tubes. (K)
2. Distinguish between intrinsic and extrinsic semiconductors. (U)
3. Distinguish between p-type and n-type semiconductors. (U)
4. How hole current is developed in intrinsic semi-conductors? Explain. (U)
5. What are extrinsic semiconductors? Mention the types of extrinsic semiconductor. (K)
6. Why majority charge carriers increase on doping a pure semiconductor? (U)
7. Draw the graphs showing the V-I characteristics of a p-n junction diode a) in forward bias b) in reverse bias. (S)
8. Carbon, silicon and germanium have same lattice structure. Why carbon is an insulator while germanium and silicon are semiconductors? (U)
9. Draw schematic block diagram of p-n junction of a semiconductor diode. (S)
10. Give any two applications of LED's/ light emitting diode. (K)
11. Draw a graph representing the output characteristics of a transistor in CE mode. (S)
12. Draw input and output waveforms of a full wave rectifier. (S)
13. Represent I-V characteristics of a Zener diode graphically. (S)
14. Define the terms 'threshold voltage' & reverse saturation current in a p-n junction diode. (U)
15. What is space-charge region in a semiconductor? (U)
16. Which property of diode is used in rectification of a.c? And how it is used? (U)
17. Draw I-V characteristics of a solar cell. (S)

18. What is a transistor? Mention the two different types of transistors. (K)
19. Name the universal gates in logic circuits. (K)
20. Two inputs are given to a NOR gate through two NOT gates. Write the truth table for the resulting logic gate and identify the resulting logic gate. (A) (U)
21. The output a NOR gate is passed through a NOT gates. Write the truth table for the resulting logic gate and identify the resulting logic gate. (U) (A)
22. Which are the two categories of integrated circuits? (K)
23. What is the function of linear IC? Give an example of it. (K)
24. Write the block diagram representing transistor amplifier with a feedback oscillator. (S)
25. How the junctions of a transistor are usually biased? (K)
26. Write the formula for voltage gain of a transistor in CE configuration and explain the terms. (U)
27. Obtain the expression for the power gain in a transistor in CE mode when it is used as an amplifier. (U)
28. A transistor is having a β equal to 80 has a change in base current of 250μA. Calculate the change in the collector current. (A)

Three mark questions

1. Distinguish between conductors, semi-conductors and insulators on the basis of property of conductivity.(U)
2. Classify on the basis of electrical resistivity metals, semi-conductors and insulators. (U)
3. Which are the three different types of compound semi-conductors, give an example for each. (K)
4. Distinguish between conductor, semiconductor and insulator based on band theory of solids. (K)
5. What is an intrinsic semiconductor? Explain the variation of conductivity with temperature in it. (U)
6. Explain how a p-n junction is formed in a semiconductor. (U)
7. With suitable circuit diagram, explain the V-I characteristics of a semiconductor diode under forward bias. (U) (S)
8. Explain the V-I characteristics of a semiconductor diode under reverse bias by drawing a suitable graph. (U) (S)
9. Explain why reverse current suddenly increases at the breakdown region in a Zener diode? (U)
10. With the help of a circuit explain how a capacitor filters ripples of pulsating d.c. in rectifier. (U)(S)
11. What is a Zener diode? How it is fabricated? (U)
12. Mention the three optoelectronic junction devices. (K)
13. Describe the construction and working of a photo diode. (U)
14. What are the advantages of LED's incandescent low power lamps? (K)
15. Describe the construction and working of a solar cell. (U)
16. What are the criteria for the selection of material for solar cell fabrication? (U)
17. Give any three applications of solar cell. (K)
18. Which are the three segments (regions) of a transistor? Describe them in brief. (U)
19. Describe the action of a transistor. (U)
20. When is the transistor said to be switched ON and switched OFF? Represent it by drawing transfer characteristics of a base biased transistor in CE configuration. (U) (S)

21. Obtain the expression for voltage gain of n-p-n transistor, when it is used as an amplifier in CE configuration. (U)
22. Define (i) input resistance (ii) output resistance and (iii) current amplification factor of a transistor in CE mode. (U)
23. Describe the three important ac parameters of common emitter transistor in CE configuration. (U)
24. Write the block diagram of feedback amplifier. What is positive feedback? Write the expression for frequency of LC coupled oscillator. (U) (S)
25. Why a feedback is essential for an oscillator? How it is achieved? (U)
26. Name any three feedback circuits. (K)
27. Mention any three applications of logic gates. (K)
28. Using only NOR gates, show with a circuit diagram, how to construct
    (i) NOT gate, **(ii)** OR gate and **(iii)** AND gate.
29. A logical circuit with three inputs and one output is constructed using one NOR gate and one AND gate. Two inputs A and B are given to NOR gate. A third input C and the output of NOR gate are given as inputs to AND gate. Determine the input state which provide the final output Y=1 from the AND gate.

Five mark questions

1. Describe the action of a semiconductor diode under forward and reverse bias with I-V diagrams. (U) (S)
2. What is a rectifier? Explain with necessary circuit diagram, the construction and working of a half wave rectifier. (U) (S)
3. What is a rectifier? Describe the construction and working of a full wave rectifier by drawing input and output waveforms. (U) (S)
4. Explain with necessary diagram how a Zener diode acts as a voltage regulator. (U) (S)
5. Draw circuit arrangement for studying input and output characteristics of n-p-n transistor in CE configuration and explain its action with the help of graphs. (U) (S)
6. Explain with necessary circuit diagram the working of n-p-n-transistor as an amplifier in CE mode. (U) (S)
7. Explain with necessary circuit diagram the working of n-p-n-transistor as a switch. (U) (S)
8. With a necessary circuit describe the working of a tuned collector oscillator. (U) (S)

Numerical problems

1. The input frequency of a rectifier is 100 Hz. Calculate the output frequency if the rectifier is (a) half wave rectifier (b) full wave rectifier. (A) **[50HZ, 100Hz]**
2. An amplifier of voltage gain 12 is connected in series with another amplifier of voltage gain 20. If the input signal is 20 mV, calculate the output voltage of ac signal. (A) **[4.8 V]**
3. An LED is constructed from a p-n junction, based on a certain Ga-As-P semi-conducting material whose energy gap is 1.9 eV. Calculate the wavelength of the light emitted by this LED, also identify the colour of the emitted light. (A) **[650 nm, Red in colour]**

4. A silicon transistor is connected in CE mode to use it as a switch, in which base voltage is varied from 0-6.0 V. the transistors dc current gain is 300, base resistance 150 KΩ, collector resistance 1.5 KΩ & collector voltage 6 V. Assume that the transistor is saturated and if VCE =0V, VBE=1V, calculate the minimum base current for which the transistor will reach saturation and hence determine input voltage when the transistor is switched on. (A)

[13.3 μA, 1.995 V]

5. The current amplification factor of CE transistor amplifier is 110. An audio signal voltage across 2.5 KΩ collector resistor is 2.5V, calculate base current. (A) **[9μA]**
6. One cubic meter of silicon is simultaneously doped with $3.05X10^{16}$ atoms of arsenic and $5X10^{14}$ atoms of indium. If intrinsic carrier concentration $n_i = 4X10^{16}$, calculate the number of electrons and holes. (A)
7. A p-n junction diode is connected in series with 5kΩ across a battery of emf 5.7V and negligible internal resistance in such a way that the diode is forward biased. If the barrier potential in diode is 0.7V, calculate the current through the diode. What is the resistance that should be combined with 5kΩ so that the current through the diode becomes 3mA? (A)
8. The electrical conductivity of a semiconductor increases when an electromagnetic radiation of wavelength shorter than 2480nm is incident on it. Calculate the energy band gap in eV for the semiconductor. (A).

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