SEMICONDUCTOR DEVICES

PREVIOUS YEAR BOARD EXAM QUESTIONS (2007-2016)

3 MARK QUESTIONS

1. Draw the circuit diagram of a half wave rectifier, and explain its working. Show the input and output waveforms also.

2. How does an LED operate? Explain working with a schematic diagram. Give two important advantages of LED's over conventional incandescent lamps.

3. For a CE-transistor amplifier, the audio signal voltage across the collector resistance of 2000 ohm is 2 V. Suppose the current amplification factor is 100, find input signal voltage, and base current, if base resistance is 1000 ohm.

4. Explain the formation of energy bands in solids. Draw energy band diagrams for a conductor and an intrinsic semiconductor.

5. Draw the circuit diagram of a common emitter transistor amplifier, in npn configuration. State 2 reasons for why CE amplifier is preferred more than a

CB transistor. Give the phase difference between input and output signals.

6. Explain the following:

(a). LED's are made out of compound semiconductors, and not of elemental semiconductors.

(b). Output characteristics are controlled by input characteristics in a CE transistor amplifier.

(c). In active state of transistor, emitter-base junction acts as a low resistance, while base-collector region acts as a high resistance.

7. (a). Explain, clearly how the active region in transfer characteristic curve of CE transistor, is used as an amplifier.

(b). In a transistor, doping level is increased slightly. How will it affect the collector current and base current?

8. (a). Identify the semiconductor device that is operated in reverse bias- Photodiode, LED, Solar cell. Give reason for why it is used in reverse bias.

(b). Zener diodes have higher dopant densities than an ordinary p-n junction diode. How does

this affect the junction field and width of depletion layer?

9. (a). Give the segment in transistor that is heavily doped and that is lightly doped. Give reason.

(b). If a forward bias is applied to a p-n junction diode, what happens to it?

10. (a). Give the functions of three segments of a transistor.

(b). Draw the circuit diagram of a p-n-p transistor in CE configuration. Using this circuit, explain how input and output characteristics are obtained.

11. Describe the working of a solar cell. Mention three basic processes involved in generation of emf. Give reason for why Si and GaAs are the preferred materials for fabricating solar cells.

12. Describe the working of a photodiode by drawing suitable circuit diagram. Draw the characteristics of photodiode for different illumination intensities. Give reason for why a photodiode is operated in reverse bias, even when forward bias produces a much greater value of current than in reverse bias.

13. (a). Name the two important process that occur during the formation of p-n junction.

(b). Draw the circuit diagram of a full wave rectifier, along with input and output waveforms and explain how the output obtained is made unidirectional.

14. (a). Describe briefly with help of a 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.

(b). Define the terms conduction band and valence band.

15. Draw the circuit diagram for n-p-n transistor in CE configuration. Hence, define the following terms:

(a). Input resistance

(b). Current amplification factor

(c). Output resistance

16. Show that the voltage gain of a CE transistor as an amplifier is given as $-\beta_{ac}R_L/R_i$, where β_{ac} is the current gain, r_L is load resistance and r_i is input resistance of transistor. Give the significance of negative sign in the expression.

17. (a). In a rectifier circuit, what is the role of a capacitor?

(b). Explain how the reverse current suddenly increases at breakdown voltage in a Zener diode.

(c). Give two characteristic features that distinguish between n-type and p-type semiconductors.

18. (a). "A Zener diode is heavily doped on both p and n regions"- Justify.

(b). Explain with diagram of how a depletion layer and barrier potential is formed in a p-n junction diode.

19. Draw the circuit diagram of n-p-n transistor in CE configuration. Deduce the relationship between emitter current, collector current and base current in circuit. Describe briefly of how the motion of charge carriers in transistors constitute all the currents.

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

(b). "A collector is much larger in size compared to emitter and base"- Give reason.

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

21. Give any two distinguishing features between conductors, insulators and semiconductors on basis of energy band diagrams.

22. (a). How are the V-I characteristics of a p-n junction diode used for rectification?

(b). Under what condition, does a transistor act as an amplifier?

(c). In an unbiased p-n junction diode, why does the holes from p-region diffuse to n-region?

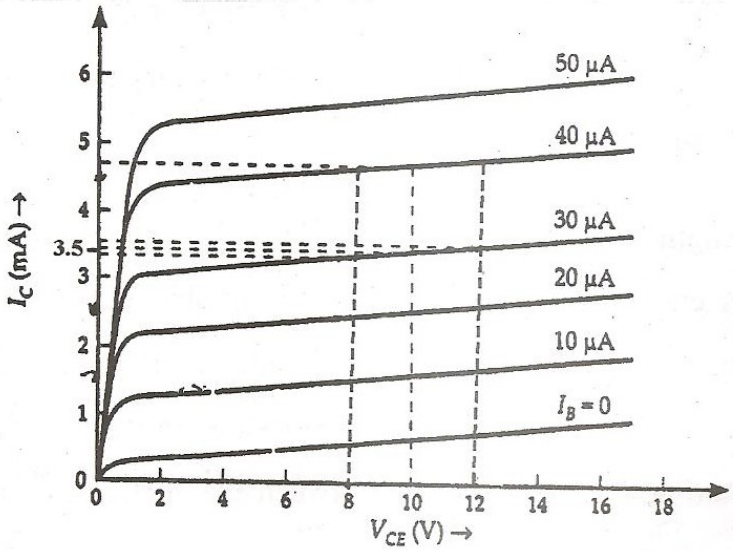
23.

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

(i) dynamic output resistance

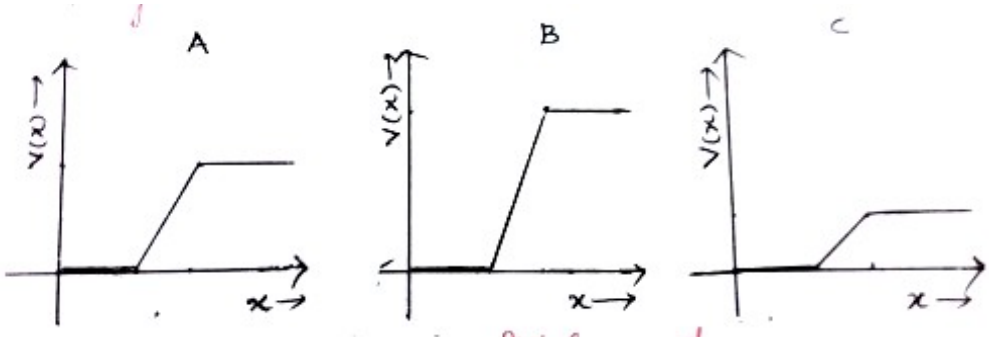
(ii) dc current gain and

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



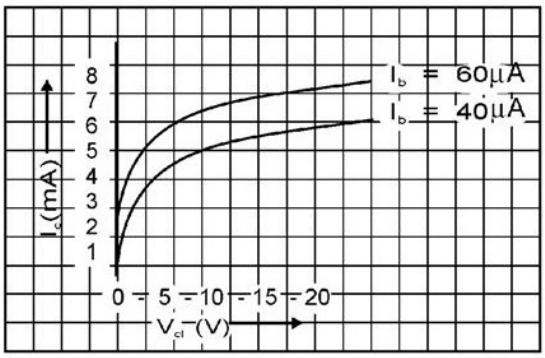
24. Name and explain the three different regions found in output characteristics of a CE transistor-amplifier.

25. The graph of a potential barrier versus length of depletion region is given for a diode as A. In comparison to A, graphs B & C are obtained after biasing diodes. Identify the types of biasing in both B & C from graph given:



26.

A certain n - p - n transistor has the common emitter output characteristics as shown



(a) find the emitter current at V_{cc} = 10V and I_b = 60 μA.

(b) find β at this point.

5 MARK QUESTIONS

1. (a). In a zener diode, what causes the setting up of high electric field even for a small reverse bias voltage across diode?

(b). Give two important considerations used while fabricating a Zener diode.

(c). How is a bandgap of a photodiode related to maximum wavelength of incident light?

(d). How is a sample of n-type semiconductor electrically neutral though it has an excess of negative charge carriers?

2. (a). Describe briefly using a circuit diagram, the three basic processes which take place to generate emf in solar cell when light falls on it.

(b). Define the terms minority carrier injection and breakdown voltage.

3. State the principle of working of a diode as a rectifier. Explain, with circuit diagram, the use of diode as a full wave rectifier. Draw the input and output waveforms.

4. (a). For choosing the semiconductor material for LED, what criterion is to be kept in mind?

(b). Give reason- “Base region of a transistor is thin and lightly doped”.

(c). Show the biasing of a p-n-p transistor in CE configuration, with a proper circuit diagram. Explain the movement of charge carriers through

different part of transistor and show that $I_E = I_B + I_C$.

5. Give a brief explanation for how,

(a). a barrier potential is formed in a p-n junction diode.

(b). a zener diode works to obtain a constant dc voltage from unregulated dc output of a rectifier.

(c). width of a depletion region is affected when it is forward biased and when it is reverse biased.

6. Draw the symbolic representation of a Zener diode and of a p-n junction diode. Draw the V-I characteristics and with the help of a circuit diagram, explain the action of Zener diode as a voltage stabilizer.

7. (a). Draw the circuit diagram of base biased transistor amplifier in CE configuration.

(b). Compare the conductivities of n-type and p-type semiconductors at room temperature and at absolute zero temperature.

(c). "In case of n-type semiconductors, the donor energy level is slightly below the bottom of conduction band whereas in p-type

semiconductor, the acceptor energy level is slightly above than valence band"- Explain what role do these energy levels play in conduction valence bands.

8. (a). Distinguish between conductor and a semiconductor on basis of energy band diagram. Explain.

(b). Draw a circuit diagram of CE amplifier using n-p-n transistor. Derive an expression for current gain β_{ac}.

(c). "A p-type semiconductor crystal is electrically neutral, although it has more no of holes than electrons in them" –Justify.

9. (a). How can an intrinsic semiconductor be converted into a p-type semiconductor?

(b). How a photodiode is used to detect optical signals?

(c). In a fullwave rectifier, how can you obtain steady dc output from pulsating voltage?

(d). To emit light in visible range, what should be the order of band gap of an LED?

10. (a). Draw the energy band diagram for an insulator.

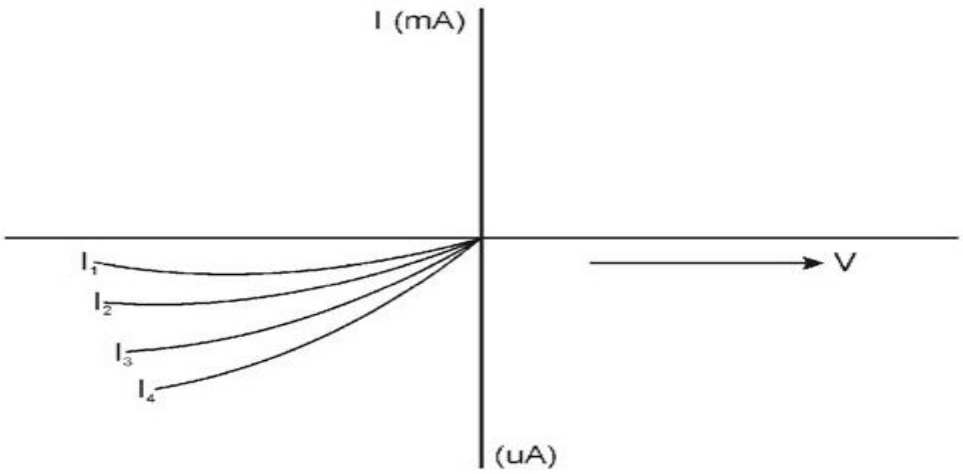
(b). Name the device that is used as a voltage stabilizer. Describe its biasing.

(c). Draw the circuit diagrams of a p-n junction diode in forward and reverse bias. Draw its typical V-I characteristics in both biasing. How are these circuits used to study V-I characteristics of a Silicon diode?

11. (a). How is a photodiode fabricated? Draw its V-I characteristics for two different intensities of illuminations.

(b). Draw the energy band diagrams of an n-type and p-type semiconductor at temperature T > 0 K. Mark the donor and acceptor energy levels with their energies.

12. (a). The given figure gives reverse bias current under different illumination intensities for a given photodiode. Arrange the intensities in decreasing order of magnitude.



(b).

An a.c. signal is fed into two circuits X and Y and the corresponding output in the two cases have the waveforms shown below. Name the circuits X and Y. Also draw their detailed circuit diagrams.