Assignment 1 -ANSWERS

(1 MARKS)

1.c 2.c 3.b 4.b 5. A 6. A 7. D 8. C 9. B 10. b

11. CASE BASED STUDY 1:

(I) Definition of extrinsic semiconductor (II) 1:1 (III) to increase conduction (IV) holes

12. CASE BASED STUDY 2:

(I) (c) (II) (b) (III) (a) (IV) (b)

(2 MARKS)

13.(i) Width of depletion layer's decreases in forward bias

(ii) Width depletion layer increases in reverse bias.

14. P-n Junction Diode as a Half-Wave Rectifier

AC voltage to be rectified is connected to the primary coil of a step-down transformer. Secondary coil is connected to the diode through resistor load resistance, across which output is obtained.

Working: During positive half cycle of the input AC, the p-n junction is forward biased. Thus,the resistance in p-n junction becomes low and current flows. Hence, we get output in the load. During negative half cycle of the input AC, the p-n junction is reverse biased. Thus, resistance of p-n junction is high and current does not flow. Hence, no output in the load. So, for complete cycle of AC, current flows through the load resistance in the same direction.

15. (i) **Metal** For metals, the valence band is completely filled and the conduction band can have two possibilities either it is partially filled with an extremely small energy gap between the valence and conduction bands or it is empty, with two bands overlapping each other.

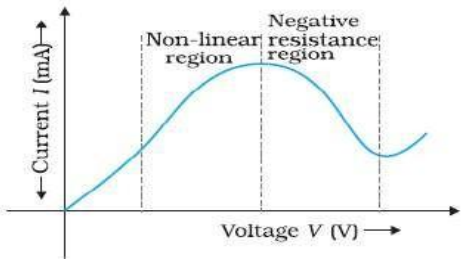
(ii) On applying a small even electric field, metals can conduct electricity.

16.With the formation of p-n junction, the holes from p-region diffuse into the n-region and electrons from n-region diffuse into p-region and electron-hole pair combine and get annihilated.This input produces potential barrier, V_B across in junction which opposes the further diffusion through the junction. Thus, small region forms in the vicinity of the junction which is depleted of free charge carrier and has only immotile ions is called the depletion region.

17. The four valence electrons of carbon are present in second orbit while that of silicon in third orbit. So, energy required to extricate an electron from silicon is much smaller than carbon.Therefore, the number of free electrons for conduction in silicon is significant on contraryofcarbon. This makes silicon conductivity much higher than carbon. This is the main distinguishableproperty.

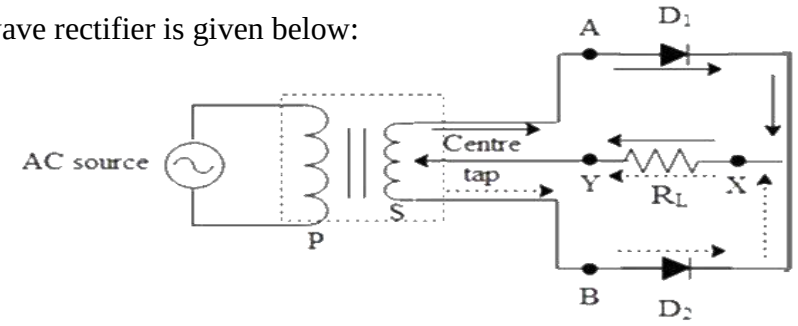
18. Between the region B and C, the semiconductor has a negative resistance.

19. A Graph showing variation of current versus voltage forGaAs



(3 MARKS)

20. The labelled diagram of a full wave rectifier is given below:



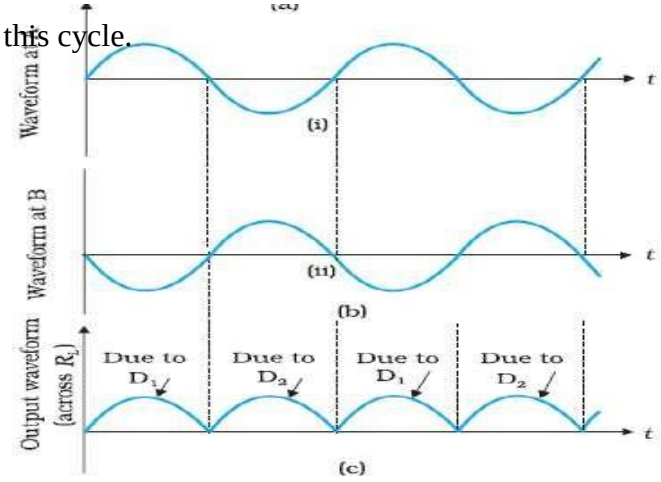
The working principle of the full-wave rectifier is as follows.

The ac source is connected to the ac source that produces an emf and the respective current through the transformers. The secondary winding of the transformed is center tapped which means that it provides the current with two paths to travel in during the positive and negative halves of the cycle respectively.

This means that during the positive half of the cycle the potential at A will be at a positive potential and hence the p junction of the diode is connected to the positive terminal and hence it is forward biased which makes the diode D_2 reverse biased and hence current will only flow through the path with the D_1.

Similarly when the polarity gets shifted during the negative half of the cycle the diode D_2 gets forward biased and current flows though path shown by the dotted lines in the diagram since Bwill be at positive potential in this cycle.

This in-turn produces a pulsating dc signal and filters can be further applied to converting into a complete dc signal. Hence, the principle behind a full wave rectifier is to convert ac to dc signal.



The input waveform (ac source)

given tothe is shown below

(5 MARKS)

21. A p-n diode is forward biased if p-side is at a higher potential than n-side.
    (a) The p-side is at a higher potential (+7V) than the n-side (+ 5V) the diode is forward biased.
    (b) The p-side is at a higher potential (zero, earthed) than the n-side (+ 2V), the diode isreverse-biased.
    (c) The p-side is at a lower potential (- 10 V) than the n-side (zero), the diode is reverse biased.
    (d) The p-side is at a higher potential (- 5V) than the n-side (-12V), the diode is forward biased.
    (e) The p-side is at a higher potential (zero) than the n-side (-10V), the diode is forward-biased.

22. i) The conduction level of any element depends on the energy gap between its conduction band and valence band. In conductors, there is no energy gap between conduction band and valence band. For insulator, the energy gap is large and for semiconductor the energy gap is moderate. Theenergy gap for Sn is 0 eV, for C is 5.4 eV for Si is 1.1 eV and for Ge is 0.7 eV related to their atomic size. Therefore, Sn is a conductor, C is an insulator and Ge and Si are semiconductors.

ii) The potential barrier of germanium junction diode is 0.3 V and of silicon is 0.7 V. Both germanium and silicon are forward biased. Therefore, for conduction the minimum potential difference across junction diode is 0.3 V.

Maximum reading of voltmeter connected across R = 12-0.3 = 11.7