18PYB103J-Short Answer Question (3 Marks)

Module-I

1. What are the postulates of classical free electron theory?
2. Write the success of classical free electron theory.
3. Write any three failures of classical free electron theory.
4. What are the postulates of quantum free electron theory?
5. Write the success of quantum free electron theory.
6. Write a short note on Band theory of solids.
7. Explain three types of E-K diagram.
8. What is meant by Brillouin Zone? Explain.
9. Write any three differences between direct and indirect band gap semiconductor.
10. Write a short note on Phonons.
11. What is effective mass? Obtain the expression for effective mass of electron.
12. Explain probability of occupation in a given energy level using Fermi-Dirac distribution
13. Write any three differences between N-type and P-type semiconductors
14. Explain direct band gap and indirect band gap in materials with the help of E-K diagram.
15. Write the classification of electronic materials on the basis of band theory.
16. Evaluate the Fermi function for energy K_BT above the Fermi energy. (Ans: 0.2689).

Module-II

1. What is intrinsic semiconductor?
2. Explain atomic structure and energy level diagram of intrinsic semiconductor?
3. Where the Fermi energy level does lies in intrinsic semiconductor. How does it varies with respect to temperature.
4. What is Extrinsic semiconductor?
5. Explain N - type semiconductor with diagram
6. Explain P - type semiconductor with diagram

7. Where the Fermi energy level does lies in P - type semiconductor. How does it varies with respect to temperature.
8. Where the Fermi energy level does lies in N - type semiconductor. How does it varies with respect to temperature.
9. Describe the difference between P-type and N-type semiconductor materials?
10. Explain about carrier generation
11. Explain about recombination.
12. Discuss about drift current.
13. Discuss about diffusion current.
14. Explain concepts of p-n junction.
15. Write note on forward bias p-n junction.
16. Write note on reverse bias p-n junction.
17. What happens to the bands when we make contact between metals and semiconductors?
18. What is a rectifying contact? Explain with diagram.
19. Write note on photocurrent in p-n junction?
20. Write note on Organic LED?
21. Write note on LED?
22. Write the construction of LED
23. Write the working of LED.
24. Write the merits of LED.
25. Write the demerits of LED.
26. Write the applications of LED.
27. Define and write the principle of LED.
28. Write the construction of OLED
29. Write the working of OLED.

30. Write the merits of OLED.
31. Write the demerits of OLED.
32. Write the applications of OLED.

Module-III

1. What do you mean by Band to band and impurity to band transition in semiconductors?
2. Define optical absorption process in semiconductor with diagram.
3. Define the types of optical emission process with diagram.
4. What is Optical recombination process? Write three optical properties in which optical recombination process is observed.
5. Using the relation $N_1Q\ B_{12} = N_2A_{21}+N_2QB_{21}$, derive the expression for ratio between spontaneous and stimulated coefficient.
6. What is optical joint density of states? Write the expression for finding optical joint density of states and state how it is relates with energy band gap of materials.
7. What is Density of states for photons? Write the expression to find density of state for photons in-terms of energy and frequency.
8. Define the concept of Fermi Golden rule. Write the equation to find transition rate per unit volume of a system.
9. What is photovoltaic effect? Draw the diagram to show p-n junction under illumination.
10. Define the given terms used to find efficiency of solar cell: (i) Short circuit current, (ii) Open circuit voltage and (iii) Fill factor.
11. Determine the Open-Circuit Voltage V_{oc} of the solar cell, if Saturation Current (I_s) = $0.75x10^{-10}$ A, Light Generated Current(I_L) = 0.65 A, Ideality Factor (n) = 0.9, and Temperature (T) = 310K. (Answer: V_{oc}= 0.55V)
12. Determine the Conversion Efficiencyη of the solar cell, if Short-Circuit Current (I_{sc}) = 3.5A, Open-Circuit Voltage (V_{oc})= 0.6V, Fill Factor (FF) = 0.7 and Input Power (P_{in}) = 10W. (Answer: Conversion Efficiencyη=14.7%)
13. Define the efficiency of solar cell. Write the expression and a plot to show variation of efficiency with band gap of materials
14. Define any three losses which decreases the efficiency of solar cell.

15. Make a short note on postulates of Drude model for electrical conductivity of material.
16. Define the term (i) Drift Velocity, (ii) Relaxation time of electron. Write the expression to find electrical conductivity using Drude model.
17. Determine the Conductivity (σ) of the Intrinsic Semiconductor. The given parameters are: $\mu_e = 0.145\ m^2/V\text{-}s$; $\mu_h = 0.055\ m^2/V\text{-}s$; $n_i = 1.5625\times10^{16}/m^3$; $q = 1.602\times10^{-19}$ C. (Answer: 5×10^{-4} mhos/m).

Module-IV

1. Explain resistivity of a given material determined using two probe method.
2. Mention any three advantages of Four Point Probe over two point probe method.
3. Explain how the sample is connected to the probes in Four Point Probe method.
4. State Hall Effect with diagram.
5. Derive the expression for the Hall coefficient of n type semiconductor
6. Write any three applications of Hall Effect.
7. A silicon plate of thickness 1 mm, breath 10mm and length 10mm is placed in a magnetic field of 0.5 Wb/m^2 acting perpendicular to its thickness. If $1x10^{-3}A$ current flows along its length, calculate the Hall voltage developed if the Hall coefficient is $3.66x\ 10^{-4}\ m^3/C$.
8. An n-type semiconductor has Hall coefficient = $4.16\ x10^{-4}\ m^3C^{-1}$. The conductivity is $10^8\ ohm^{-1}m^{-1}$. Calculate its charge carrier density and electron mobility at room temperature.
9. Explain the working principle of hot point probe method.
10. Explain the principle of capacitance-voltage measurement method.
11. How does the capacitance of p-n junction diode vary in forward bias and reverse bias.
12. Explain forward biasing and reverse biasing of p-n junction diode.
13. Write a short note on I-V characteristics of p-n junction diode in reverse bias.
14. What are Shallow Level Traps and Deep Level Traps?
15. State combined Beer Lambert Law.

16. Write any three applications of U-V spectroscopic technique.
17. What is Photoluminescence? And how it is classified in to?

Module-V

1. What do you mean by Density of states?
2. What are low dimensional systems?
3. Brief the DOS in low dimensional systems?
4. Compare the DOS in OD,1D and 2D systems.
5. Discuss about quantum well, quantum wire and quantum dot.
6. What are the different allotropes of carbon?
7. Write the properties of CNT.
8. How will you synthesize CNT by Laser ablation?
9. Give any 3 Applications of CNT.
10. Brief on the working of CVD
11. Differentiate heterogenous and homogenous reactions in CVD
12. Differentiate Hot wall reactor and cold wall reactor in CVD
13. Classify CVD based on the operating pressure
14. Brief on the working of PVD
15. What are the four 4 processes in PVD?
16. State Bragg's law
17. What is the method of Powder XRD?
18. What is the principle of SEM?
19. How are backscattered, secondary and Auger electrons utilised in SEM?
20. What is the principle of TEM?
21. How does unscattered, elastically scattered and inelastically scattered electrons provide information in TEM?
22. What is the principle of AFM?
23. Comment on the working concept of AFM

24. Define Diffusion
25. Define ion implantation
26. Define epitaxial growth
27. Shortly discuss theband diagrams of dissimilar single layer p-n junction.
28. Shortly discuss theband diagrams of dissimilar double layer p-n junction.