| | | | | |
|---|---|---|---|---|
| 25. a. With neat sketch, explain the working concept of physical Vapour Deposition Method (PVD). | 8 | 3 | 5 | 3 |
| **(OR)** | | | | |
| b. With neat sketch, explain the working concept of Atomic Force Microscope (AFM). | 8 | 3 | 5 | 3 |

**PART – C (1 × 15 = 15 Marks)**

Answer **ANY ONE** Question

| | Marks | BL | CO | PO |
|---|---|---|---|---|
| 26. Analyze the Light Emitting Diode: Principle, construction, type, critical angle, materials and wavelength of emission. | 15 | 4 | 2 | 3 |
| 27.i. Analyze the working concept, specimen interaction and utilization of Scanning Electron Microscope (SEM). | 10 | 4 | 5 | 3 |
| ii. Explain the special properties of carbon nanotubes. | 5 | 1 | 5 | 3 |

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| Reg. No. | | | | | | | | | | | | | | |
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**B.Tech / M.Tech (Integrated) DEGREE EXAMINATION, MAY 2023**

First and Second Semester

21PYB102J – SEMICONDUCTOR PHYSICS AND COMPUTATIONAL METHODS

*(For the candidates admitted from the academic year 2022-2023 onwards)*

**Note:**

(i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

(ii) **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours Max. Marks: 75

**PART – A (20 × 1 = 20Marks)**

Answer **ALL** Questions

| | Marks | BL | CO | PO |
|---|---|---|---|---|
| 1. According to sommerfeld, the free electrons move with _____ potential.<br>(A) Zero (B) Constant<br>(C) Infinite (D) Different | 1 | 1 | 1 | 1 |
| 2. The _____ is a geometrical construction to the Wigner-Seitz primitive cell in the K-space<br>(A) Direct Lattice (B) Brillouin Zone<br>(C) Real lattice (D) Phonon zone | 1 | 1 | 1 | 1 |
| 3. At zero Kelvin, F(E) takes the value _____ for any energy level above Fermi level<br>(A) 1 (B) 0<br>(C) 0.5 (D) 0.25 | 1 | 1 | 1 | 1 |
| 4. Identify the shape of the first Brillouin zone in Z-Dimensional lattice<br>(A) Square (B) Triangle<br>(C) Circle (D) Hexagonal | 1 | 1 | 1 | 1 |
| 5. In intrinsic semiconductor, the number of electrons equal to _____.<br>(A) number of protons (B) number of holes<br>(C) number of neutrons (D) number of photons | 1 | 1 | 2 | 1 |
| 6. When T = 0k, the Fermi energy ($E_F$) of n-type semiconductor is equal to _____.<br>(A) $E_F/2$ (B) $(E_c + E_d)/2$<br>(C) $E_a/2$ (D) $E_v/2$ | 1 | 1 | 2 | 1 |
| 7. For a PN junction diode, the current in reverse bias may be _____<br>(A) Few milliamperes (B) Several amperes<br>(C) Few micro amperes to nanoamperes (D) Few milliamperes to several amperes | 1 | 1 | 2 | 1 |

8. The expression for drift current density due to electrons is given by _____. 1 1 2 1

(A) $J = P\mu eE$ (B) $J = P\mu eV$
(C) $J = n\mu eE$ (D) $J = n\mu eV$

9. Which process of the Electron hole pair is responsible for emitting of light? 1 1 3 3

(A) Generation (B) Ionisation
(C) Recombination (D) Diffusion

10. Photon flow per unit area per second _____ 1 1 3 3

(A) Electron density (B) Energy density
(C) Photon flux (D) Photons density

11. _____ is the process where electron hole pairs created and recombined radiatively. 1 1 3 3

(A) Photoluminescence (B) Cathodoluminescence
(C) Bioluminescence (D) Electroluminescence

12. The Fermi's golden rule helps to identify the _____. 1 1 3 3

(A) Velocity of light (B) Momentum of electrons
(C) Absorption energy of electrons (D) Transition rate per unit volume

13. Two probe technique is suitable for measuring electrical resistivity of _____ samples. 1 1 4 1

(A) Low resistivity (B) High resistivity
(C) Magnetic (D) Biological

14. _____ method used to measure the potential barrier of a P-N junction diode. 1 1 4 1

(A) Capacitance – Voltage (B) Four point probe
(C) Two point probe (D) Hot point probe

15. A _____ is a method of determining quickly whether a semiconductor sample is n type (or) p type. 1 1 4 1

(A) Two point probe (B) Four point probe
(C) Hot point probe (D) Capacitance - voltage

16. TCAD is a computer simulation technique that is widely used in the semiconductor industry. TCAD is an acronym for _____. 1 1 4 1

(A) Technology Computer Aided Design (B) Technology Computer Aided Development
(C) Technology Computer Advances Design (D) Technology Computer Applications Design

17. The _____ density of states does not depend on energy. 1 1 5 3

(A) One – dimensional (B) Two – dimensional
(C) Three – dimensional (D) Zero – dimensional

18. An example for One – dimensional material is _____ 1 1 5 3

(A) Nanoparticle (B) Quantum dot
(C) Nanowire (D) Nanosheet



19. In chemical vapour deposition, the precursors are introduced to the reaction chamber in the _____ state. 1 1 5 3

(A) Liquid (B) Solid
(C) Gaseous (D) Semisolid

20. Transmission electron microscope (TEM) provides a _____ dimensional picture. 1 1 5 3

(A) Zero (B) One
(C) Two (D) Three

**PART – B (5 × 8 = 40 Marks)** Marks BL CO PO
Answer **ALL** Questions

21. a. Obtain the expression for density of states of solid. 8 3 1 1

**(OR)**

b.i. Analyze the concept of Eigen function, Eigen value and Eigen equation through an example. 4 4 1 1

ii. Differentiate the localized and delocalized wave functions. 4 3 1 1

22. a. Explain P-type semiconductor with necessary diagram. Analyse the Fermi energy level variation with respect to temperature in P type semiconductor. 8 2 2 1

**(OR)**

b.i. Discuss about the diffusion current and obtain the equation for diffusion current. 4 2 2 1

ii. Calculate the wavelength of light emission from GaN whose band gap is 3.4 eV. 4 3 2 1

23. a. Analyze the expression for ratio between spontaneous and stimulated emissions of Einstein's coefficient. 8 4 3 3

**(OR)**

b.i. Define the concept of Fermi Golden rule. Analyse the equation to find the transition rate per unit volume of a system. 5 4 3 3

ii. Determine the conversion efficiency of the solar cell, if short – circuit current ($I_{sc}$) = 3.5 A, Open – circuit voltage ($V_{oc}$) = 0.6 V, Fill Factor (FF) = 0.7 and Input power (pin) = 10 W. 3 3 3 3

24. a. Discuss the Four point collinear probe method for bulk material and thin sheet resistance. 8 2 4 1

**(OR)**

b. What is Hall effect? Derive an expression of Hall coefficient. 8 2 4 1