PART – C (1 × 15 = 15 Marks)
Answer **ANY ONE** Questions

		Marks	BL	CO	PO
26.i.	Describe the behaviour of electron in a periodic potential and hence explain the Kroing Penny model in detail with the cases.	10	3	1	1
ii.	Enumerate the working concepts of PN junction and its biasing.	5	4	2	1
27.i.	Derive an expression for optical transition rate due to electron-photon interaction using Fermi's Golden rule.	8	4	3	2
ii.	Write the properties of Carbon nanotubes.	7	4	5	2

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Reg. No.														

B.Tech / M.Tech (Integrated) DEGREE EXAMINATION, JANUARY 2023
First Semester

21PYB102J – SEMICONDUCTOR PHYSICS AND COMPUTATIONAL METHODS
(For the candidates admitted from the academic year 2022-2023)

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.	The classical free electron theory _____. (A) Explains the photoelectric behaviour assuming that electron moves in a constant potential (B) Predicts the electron velocities based on Maxwell-Boltzmann law (C) Was proposed by Arnold sommerfield (D) Could not explain the concept of ferromagnetism	1	1	1	1
2.	Density of states for a given material is _____. (A) Directly proportional to the square root of energy (B) Inversely proportional to the square root of energy (C) Directly proportional to the cube root of energy (D) Inversely proportional to the cube root of energy	1	1	1	1
3.	The _____ is a geometrical construction to the WS primitive cell in the k-space. (A) Direct lattice (B) Brillouin zone (C) Real lattice (D) Phonon zone	1	1	1	1
4.	Which of the following method for the band structure calculation is also known as LCAO approximation? (A) Tight binding method (B) Cellular method (C) APW method (D) Pseudo potential method	1	2	1	1
5.	The Fermi level is _____. (A) An average value of all available energy levels (B) An energy level at the top of the valence band (C) The highest occupied energy level at 0 K (D) The highest occupied energy level at 0°C	1	2	2	1
6.	In _____ semiconductor the maximum energy level of valence band does not aligns with minimum energy level of conduction band. (A) Indirect bandgap (B) Direct bandgap (C) Metal bandgap (D) Optical bandgap	1	2	2	1

7. In p-type semiconductor, numbers of holes are _____ the number of electrons. 1 2 2 2
   (A) Greater than (B) Equal to
   (C) Less than (D) Twice

8. Drift current is due to _____. 1 2 2 2
   (A) Random motion filed over a given distance (B) Random motion of holes
   (C) Applied electric field over a given distance (D) Recombination of holes and electrons

9. Spontaneous emission processes is directly proportional to _____. 1 2 3 4
   (A) Number of atoms in the ground state (B) Number of atoms in the excited state
   (C) Energy density of radiation (D) Number of electrons

10. _____ process directly involves absorption and emission of photons. 1 2 3 1
   (A) Thermal (B) Optical
   (C) Electrical (D) Mechanical

11. Solar cell converts _____ energy into electrical energy. 1 2 3 4
   (A) Sound (B) Mechanical
   (C) Light (D) Magnetic

12. The probability of radiative recombination is very high in _____ semiconductors. 1 2 3 1
   (A) In direct bandgap (B) Intrinsic
   (C) Direct bandgap (D) Extrinsic

13. C-V measurements are capable of yielding information about the _____ and concentration of charge carriers. 1 2 4 1
   (A) Drift potential (B) Diffusion potential
   (C) Bonding (D) Crystal structure

14. A _____ is a quick determination method to identify whether a semiconductor sample is n (negative) type or p (positive) type. 1 2 4 1
   (A) Electrolysis (B) Hot point probe
   (C) Hydrogenation (D) Rectification

15. In two point probe method, the resistivity of the wire = _____. 1 2 4 1
   (A) Rwh (B) 1/Rwh
   (C) Rwh/*l* (D) 1/Rwh *l*

16. In Van der pauw method the _____ and _____ density of material can be measured. 1 1 4 1
   (A) Charge and volume (B) Sheet and surface
   (C) Charge and surface (D) Sheet and charge

17. Due to _____ nanotubes can also be used in scanning probe instruments. 1 2 5 1
   (A) Flexibility (B) Strength
   (C) High chemical reactivity (D) Electrical conductivity

18. An example of 0D material is _____. 1 2 5 1
   (A) Nanowire (B) Nanorod
   (C) Nanosheet (D) Nanoparticle

19. The physical parameter that is probed in AFM resulting from different interactions is _____. 1 2 5 1
   (A) Charge (B) Force
   (C) Potential (D) Current

20. The resolving power of a _____ electron microscope derived from the electrons that pass through the specimen. 1 2 5 1
   (A) TEM (B) SEM
   (C) AFM (D) XRD

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

21. a. What is density of states? Derive an expression for density of states for a semiconducting material. 8 3 1 1

(OR)

b.i. The Fermi level for potassium is 1.9 eV. Calculate the velocity of the electron at the Fermi level. 2 4 1 1

ii. Differentiate neatly direct band gap and indirect band gap semiconductor. 6 3 1 1

22. a. What is an extrinsic semiconductor? Describe the variation of Fermi level with carrier concentration and temperature in an N-type semiconductor. 8 3 2 2

(OR)

b. Explain the principle, construction and working of LED with merits and demerits. 8 3 2 2

23. a. Deduce the relation between Einstein's coefficient by explaining the concepts of absorption and emissions processes with necessary theory. 8 3 3 1

(OR)

b. With a neat diagram explain the principle, construction and working of photovoltaic cell. 8 3 3 2

24. a. Explain the Four-point probe technique-linear method. 8 3 4 2

(OR)

b. Deduce an expression for optical joint density of states. 8 3 4 2

25. a. With neat sketch, explain the synthesis of material by chemical vapour deposition method. 8 3 5 2

(OR)

b. With neat sketch, explain the working concept, source and utilization of Scanning Electron Microscope (SEM). 8 3 5 2