.

Printed Page:-4 **Subject Code:- CAS0102/CASH0102**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
B.Tech
SEM: I - THEORY EXAMINATION (2025 - 2026)
Subject: Semiconductor Physics & Devices

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION-A 20

1. Attempt all parts:-

1-a. In a conductor, the valence band and conduction band: (CO1, K2) 1

(a) Are widely separated
(b) Do not exist
(c) Overlap
(d) Are the same

1-b. The majority charge carriers in a p-type semiconductor are: (CO1, K2) 1

(a) Electrons
(b) Protons
(c) Holes
(d) Neutrons

1-c. In a PNP Transistor, the P regions are (CO2, K1) 1

(a) base and emitter
(b) base and collector
(c) emitter and collector
(d) all of the above

1-d. For operation as an amplifier, the base of an NPN Transistor must be (CO2, K2) 1

(a) positive with respect to the emitter
(b) negative with respect to the emitter
(c) positive with respect to the collector
(d) 0 V

1-e. A JFET is a: (CO3, K1) 1

(a) current-controlled device
(b) voltage-controlled device
(c) complementary device
(d) low-input resistance device

1-f. For n-channel JFET, the channel doping and gate doping are (CO3,K2) 1

(a) N-type channel; P-type gates
(b) N-type; N-type
(c) P-type; P-type
(d) P-type channel; N-type gates

1-g. Quantum mechanics treats measurement outcomes as (CO4, K1) 1

(a) Completely predictable
(b) Deterministic
(c) Probabilistic
(d) Arbitrary

1-h. Wave function $|\psi|^2$ gives the idea for (CO4, K1) 1

(a) Probability of finding particle
(b) Energy of particle
(c) Momentum of particles
(d) Energy and momentum of particle

1-i. In superconductivity, the conductivity of a material becomes (CO5, K1) 1

(a) Zero
(b) Finite
(c) Infinite
(d) None of the above

1-j. CNTs mainly use which type of carbon bonding?(CO5, K1) 1

(a) sp^3
(b) sp^2
(c) sp
(d) ionic

2. Attempt all parts:-

2.a. Define Fermi level? (CO1,K1) 2

2.b. Draw the output characteristics of a common emitter Transistor. (CO2, K2) 2

2.c. What is the advantage of junction field effect transistor? (CO3, K2) 2

2.d. What are the Orthogonal and normalization conditions of wave function? (CO4, K1) 2

2.e. What are the properties of type–I superconductors. (CO5, K2) 2

SECTION-B 30

3. Attempt all parts:-

3.a. Answer any one of the following:-

3.a.(i)	A solar cell has an open-circuit voltage of 0.6 volts and a short-circuit current of 3 amperes. The voltage and current at the maximum power point are 0.5 volts and 2.5 amperes, respectively. Calculate the Fill Factor of the solar cell. (CO1,K3)	6
3.a.(ii)	Determine the wavelength of light emitted from LED which is made up of GaAsP semiconductor whose forbidden energy gap is 1.875 eV. Mention the colour of the light emitted (Take h = 6.6×10^{-34} J-S). (CO1,K3)	6
3.b. Answer any one of the following:-		
3.b.(i)	If the base current in a Transistor is 20 μ A when the emitter current is 6.4mA, what are the values of α and β? Also calculate the collector current. (CO2, K3)	6
3.b.(ii)	In a common base connection, current amplification factor is 0.9. If the emitter current is 1mA, determine the value of base current. (CO2, K3)	6
3.c. Answer any one of the following:-		
3.c.(i)	When a reverse voltage of 5 V is applied between gate and source of JFET the gate current is 0.2 μA Determine the resistance between gate and source.(CO3, K3)	6
3.c.(ii)	A depletion-type MOSFET has I_{DSS} = 10 mA and $V_{GS\ (off)}$ = -4 V. Find the drain current (I_D) when V_{GS} = 1 V.(CO3, K3)	6
3.d. Answer any one of the following:-		
3.d.(i)	The wave function of a particle is $\psi(x)=Ax,\ 0 \le x \le 2$ (a) Find the normalization constant. (b) Find the probability of finding the particle between x=1 and x=2 (CO4, K3)	6
3.d.(ii)	Determine the normalization constant of normalized wave function $\psi(x) = A e^{-ax}$ for $0 \le x < \infty$. (CO4, K3)	6
3.e. Answer any one of the following:-		
3.e.(i)	Transition temperature for lead is 7.26 K. The maximum critical field for the material is 8×10^5 A/m. Lead has to be used as a superconductor subjected to a magnetic field of $4x10^4$ A/m. Calculate the critical temperature. (CO5, K3)	6
3.e.(ii)	A superconducting material has a critical temperature of 3.7 K in zero magnetic field and a critical field of 0.02 T at 0 K. Find the critical field at 3 K.(CO5, K3)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	Discuss the formation of energy bands and classify the materials on the basis of energy band gap. (CO1,K2)	10
4-b.	What is photovoltaic effect? Discuss the working and construction of a solar cell. What is fill factor? (CO1,K3)	10

5. Answer any one of the following:-

5-a.	Explain the Common Emitter Configuration. Draw the Input and Output characteristics of CE configuration. (CO2, K3)	10
5-b.	Explain the DC Load line and Q-Point. (CO2, K2)	10

6. Answer any one of the following:-

6-a.	Explain the construction and working of an n-channel JFET with a labelled diagram. (CO3, K3)	10

.

6-b.	Draw and explain the drain & Transfer Characteristic curves of n-channel MOSFET. (CO3, K3)	10

7. Answer any <u>one</u> of the following:-

7-a.	Define Moore's law. Explain the superposition concept of qubits. Also, give properties of the qubits. (CO4, K3)	10
7-b.	Define the wave function and give its physical significance. Also, Derive the time independent Schrodinger wave equations. (CO4, K3)	10

8. Answer any <u>one</u> of the following:-

8-a.	What are fullerenes? Describe the structure, properties, and applications of fullerene (C_{60}). (CO5, K2)	10
8-b.	Explain Meissner effect. Show that superconductors become perfect diamagnetic in an external magnetic field. (CO5, K3)	10