

Hall Ticket No

--	--	--	--	--	--	--	--	--	--

Question Paper Code: AHSB13



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech II Semester End Examinations (Regular) - May, 2019

Regulation: IARE – R18

SEMICONDUCTOR PHYSICS

(Common to CSE | IT)

Time: 3 Hours

Max Marks: 70

Answer ONE Question from each Unit

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

UNIT – I

- (a) Discuss about black body radiation. Derive de Broglie wave length of matter waves. [7M]

(b) Calculate the de Broglie wavelength associated with a proton moving with a velocity of $1/10$ of velocity of light. (mass of proton = 1.674×10^{-27} kg). [7M]
- (a) Describe an experiment to establish the wave nature of electrons. [7M]

(b) Calculate the velocity and KE of an electron of wavelength 1.66×10^{-10} m. [7M]

UNIT – II

- (a) Explain origin of energy bands in solids. Discuss the types of electronic materials based on the band formation. [7M]

(b) Calculate Hall voltage developed across the width of the slab of a metallic slab carrying a current of 30A is subjected to a magnetic field of 1.75T. The magnetic field is perpendicular to the plane of the slab and to the current. The thickness of the slab is 0.35cm. The concentration of free electrons in the metal is 6.55×10^{28} electrons/ m^3 . [7M]
- (a) Explain n-type and p-type semiconductors. Indicate on an energy level diagram the conduction and valence bands, donor and acceptor level for intrinsic and extrinsic semiconductors. [7M]

(b) Calculate the density of charge carriers of semiconductor, given the Hall coefficient is -6.85×10^{-5} $m^3/\text{Coulomb}$. [7M]

UNIT – III

- (a) Describe with suitable energy level diagrams relating to the construction of p-n junction diode. Discuss about biasing conditions. [7M]

(b) i. A semiconductor diode has a wavelength of $1.55\mu\text{m}$. Find its band gap in eV.
ii. Calculate the wavelength of emitted radiation from a diode made up of GaAs with a band gap of 1.43eV [7M]
- (a) Mention the principle of photo detector. Explain construction and working mechanism of a solar cell. [7M]

- (b) i. Calculate the density of charge carriers of semiconductor, given the Hall coefficient is $-7.85 \times 10^{-5} \text{ m}^3/\text{Coulomb}$
 ii. Calculate intrinsic carrier concentration for Ge at 37°C . Given E_g in Germanium is 0.6eV .
 [7M]

UNIT – IV

7. (a) Derive Clausius-Mossotti equation in significance to a dielectric material. [7M]
 (b) Calculate the capacitance of a capacitor with a separation between the plates of the capacitor as $1.00 \times 10^{-2} \text{ m}$ and area of the plates is $1.00 \times 10^{-1} \text{ m}^2$. [7M]
8. (a) Classify magnetic materials into diamagnetic, paramagnetic and ferromagnetic materials. [7M]
 (b) A paramagnetic material has a magnetic field intensity of 10^4 A/m . If the susceptibility of the material at room temperature is 3.7×10^{-3} , calculate the magnetisation and flux density in the material. [7M]

UNIT – V

9. (a) Define metastable state. Describe construction and working of Ruby laser with neat diagrams. [7M]
 (b) Calculate the fractional index change for a given optical fiber if the refractive indices of the core and the cladding are 1.563 and 1.498 respectively. [7M]
10. (a) Draw a schematic layout of step - index and graded - index optical fibre and compare them. [7M]
 (b) The numerical aperture of an optical fiber is 0.39. If the difference in the refractive indices of the material of its core and the cladding is 0.05, calculate the refractive index of material of the core. [7M]

Constants

Mass of Electron: $9.1 \times 10^{-31} \text{ Kg}$

Planck's constant: $6.625 \times 10^{-34} \text{ joule-seconds}$

Velocity of light: $3 \times 10^8 \text{ m/s}$

Permittivity of free space: $8.85 \times 10^{-12} \text{ F/m}$

Permeability of free space: $4\pi \times 10^{-7} \text{ N A}^{-2}$

- o o ○ o o -