Hall Ticket No | | | | | | | | | | |

Question Paper Code: AHSB13

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER - II

B.Tech II Semester End Examinations, May - 2019

Regulations: 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

MODULE – I

1.	a)	Considering dual nature of electron, Derive Schrodinger's time independent wave equation for the motion of an electron.	**[7M]**
	b)	Calculate de-Broglie wavelength of neutron. (Given kinetic energy of the neutron is 0.025eV mass of neutron =1.674 x 10-27 kg).	**[7M]**
2.	a)	Explain the concept of Black body radiation, Photoelectric effect and Compton effect.	**[7M]**
	b)	Find the lowest energy of an electron confined in a square box of side 0.1nm.	**[7M]**

MODULE – II

3.	a)	Using Kronig-Penny model show that the energy spectrum of an electron contains a number of allowed energy bands separated by forbidden bands.	**[7M]**
	b)	Calculate intrinsic carrier concentration for Ge at 27^0C. Given Eg in Germanium is 0.7eV.	**[7M]**
4.	a)	Deduce the mathematical expression for intrinsic carrier concentration and hence show that the Fermi level lies at the middle for an intrinsic semiconductor.	**[7M]**
	b)	Calculate the density of charge carriers of semiconductor, given the Hall efficient is -6.85×10^{-5} m^3/Coulomb.	**[7M]**

MODULE – III

5.	a)	Explain the V-I characteristics of a PN junction diode under forward and reverse biasing.	**[7M]**
	b)	Calculate the wavelength of emitted radiation from a diode made up of GaAs with a band gap of 1.43eV.	**[7M]**
6.	a)	Discuss the Construction of a Avalanche photo diode with a neat diagram. Explain the working principle of it with the help of band diagram.	**[7M]**
	b)	A semiconductor diode laser has a wavelength of 1.55μm. Find its band gap in eV.	**[7M]**

MODULE – IV

7.	a)	What is electronic polarization? Derive an expression for electronic polarizability in terms of the radius of the atom.	**[7M]**
	b)	The dielectric constant of He gas is 1.0000684. Find the electronic Polarizability of He atoms if the gas contains 2.7 x 1025 atoms per m3.	**[7M]**
8.	a)	How would you differentiate dia, para and ferromagnetic substances based on their magnetic behavior?	**[7M]**
	b)	If a magnetic field of strength 300 amp/meter produces a magnetization of 4200 A/m in a ferromagnetic material, find the relative permeability of the material.	**[7M]**

MODULE – V

9.	a)	Explain the construction of a Ruby laser in detail, with the help of a neat suitable diagram.	**[7M]**
	b)	Calculate the wavelength of emitted radiation from a semiconductor diode laser, which has a band gap of 1.68eV.	**[7M]**
10.	a)	Explain in detail, different types of optical fibers based on refractive index profile of core medium.	**[7M]**
	b)	The refractive indices of core and cladding materials of a step index fiber are 1.48 and 1.45 respectively. Calculate i) Numerical aperture ii) Acceptance angle.	**[7M]**

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COURSE OBJECTIVES

The course should enable the students to:	
I	Enrich knowledge in principles of quantum mechanics and semiconductors.
II	Develop strong fundamentals of electronic and optoelectronic materials.
III	Enrich knowledge about measuring resistivity, conductivity and other parameters.
IV	Correlate principles and applications of lasers and fiber optics.

COURSE OUTCOMES (COs):

CO 1	Interpret the concept of quantum mechanics with dual nature of matter.
CO 2	Identify different types of semiconductors and dependence of their Fermi level on various factors.
CO 3	To give knowledge about semiconductor physics and discus working and applications of basic devices, including p-n junctions, PIN, Avalanche photodiode, Solar cell
CO 4	Ability to identify appropriate magnetic, and dielectric, materials required for various engineering applications.
CO 5	Understand the working principle of different types of lasers and optical fibre communication.

COURSE LEARNING OUTCOMES (CLOs):

Students, who complete the course, will have demonstrated the asking to do the following:

AHSB13.01	Recall the basic principles of physics and apply these concepts of physics in solving the real-time problems.
AHSB13.02	Acquire knowledge about fundamental in quantum mechanics.
AHSB13.03	Interpretation of dual nature of matter wave concept using Davisson & Germer's experiment.
AHSB13.04	Estimate the energy of the particles using Schrödinger's wave equation and apply it to particle in potential box.
AHSB13.05	Recollect the conductivity mechanism involved in semiconductors and calculate carrier concentrations.
AHSB13.06	Understand the band structure of a solid and Classify materials s metals**,** insulators, or semiconductors, and sketch a schematic band diagram for each one.
AHSB13.07	Understand the basic principles involved in the production of Laser light and also real-time applications of lasers.
AHSB13.08	Recollect basic principle, construction, types and attenuation of optical fibers.
AHSB13.09	Understand the importance of optical fibers in real-time communication system.
AHSB13.10	Apply different laws of radiation to understand the phenomenon behind production of light.
AHSB13.11	Apply the phenomenon of interference in thin films using Newton's rings experiment.
AHSB13.12	Identify diffraction phenomenon due to slits.
AHSB13.13	Acquire knowledge of basic harmonic oscillators and discuss in detail different types of harmonic oscillators.
AHSB13.14	Describe the steady state motion of forced damped harmonic oscillator.
AHSB13.15	Acquire knowledge of reflection and transmission of waves at a boundary of media.

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		Course Outcomes		Blooms Taxonomy Level
1	a	AHSB13.03	Describe Davisson Germer experiment with a neat diagram and explain how it established the proof for wave nature of electrons.	Understand
	b	AHSB13.03	Calculate the velocity and kinetic energy of an electron having wavelength of 0.21nm.	Understand
2	a	AHSB13.04	Assuming that a particle of mass *m* is confined in a field free region between impenetrable walls in infinite height at $x = 0$ and $x = a$, show that the permitted energy levels of a particle are given by $n^2 h^2 / 8 m a^2$.	Understand
	b	AHSB13.03	Calculate the wavelength of an electron raised to a potential 15kV.	Understand
3	a	AHSB13.06	Explain the origin of energy band formation in solids	Remember
	b	AHSB13.06	Using Kronig-Penny model show that the energy spectrum of an electron contains a number of allowed energy bands separated by forbidden bands.	Remember
4	a	AHSB13.05	Obtain an expression for carrier concentration of n- type semiconductor.	Remember
	b	AHSB13.05	Calculate the density of charge carriers of semiconductor, given the Hall efficient is -6.85×10^{-5} m^3/Coulomb.	Remember
5	a	AHSB13.07	Explain the construction of a Ruby laser in detail, with the help of a neat suitable diagram.	Remember
	b	AHSB13.07	Discuss the importance of lasers in various fields like industry, medicine, science, etc., by giving their applications.	Remember
6	a	AHSB13.08	Define Numerical aperture. Derive an expression for numerical aperture of an optical fiber.	Understand
	b	AHSB13.08	Calculate the refractive indices of core &cladding of an optical fiber with a numerical aperture of 0.33 and their fractional differences of refractive indices being 0.02.	Understand
7	a	AHSB13.11	Describe and explain the formation of Newton's rings in reflected	Remember
	b	AHSB13.11	Two slits separated by a distance of 0.2 mm are illuminated by a monochromatic light of wavelength 550 nm. Calculate the fringe width on a screen at distance of 1 m from the slits.	Remember
8	a	AHSB13.12	Give the theory of Fraunhofer diffraction due to a single slit and hence obtain the condition for maxima and minima. Using this obtain intensity distribution curve.	Remember
	b	AHSB13.12	A grating has 6000 lines per cm. Find the angular separation between two wavelengths 500 nm and 510 nm in the 3rd order.	Understand
9	a	AHSB13.14	Define a simple harmonic motion. Derive a relation for acceleration of a particle executing S.H.M.	Remember
	b	AHSB13.14	A body executing S.H.M has its velocity 16cm/s when passing through its centre mean position. If it goes 1 cm either side of mean position, calculate its time period.	Understand
10	a	AHSB13.15	Discuss the formation of stationary waves in a string. Deduce the formula for the frequency of these waves.	Understand
	b	AHSB13.15	A string has mass of 0.002kg/m and tension of 20 N is applied on it. Compute he frequency of the fork.	Understand

Signature of Course Coordinator

HOD, IT