Hall Ticket No | | | | | | | | | | | Question Paper Code: AHSB13

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER - I

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) Describe Davisson Germer experiment with a neat diagram and explain how it established the proof for wave nature of electrons. **[7M]**
   b) Calculate the velocity and kinetic energy of an electron having wavelength of 0.21nm. **[7M]**

2. a) 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 $n^2 h^2 / 8 m a^2$. **[7M]**
   b) Calculate the wavelength of an electron raised to a potential 15kV. **[7M]**

MODULE – II

3. a) Explain the origin of energy band formation in solids **[7M]**
   b) Using Kronig-Penny model show that the energy spectrum of an electron contains a number of allowed energy bands separated by forbidden bands. **[7M]**

4. a) Obtain an expression for carrier concentration of n- type semi conductor. **[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 Construction of a LED with a neat diagram, also discuss the working principle of it with the help of band diagram. **[7M]**
   b) Calculate the wavelength of emitted radiation from a semiconductor diode laser, which has a band gap of 3eV. **[7M]**

6. a) Explain the Construction of a photo diode with a neat diagram, and discuss 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)	Obtain an expression for the internal field experienced by an atom inside a dielectric material subjected to an external field by using Lorentz method.	**[7M]**
	b)	Find the electric susceptibility of a dielectric gas having dielectric constant of 1.000041.	**[7M]**
8.	a)	Draw the hysteresis loop for a ferromagnetic material and explain the loop based on domain theory of ferromgnetism.	**[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)	Discuss the importance of lasers in various fields like industry, medicine , science, etc., by giving their applications.	**[7M]**
	b)	Explain the construction of a Ruby laser in detail, with the help of a neat suitable diagram.	**[7M]**
10.	a)	Define Numerical aperture. Derive an expression for numerical aperture of an optical fiber.	**[7M]**
	b)	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.	**[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	Acquire knowledge about fundamentals in semiconducting devices
AHSB13.09	Understand the basics of a p-n junction and construction of optoelectronic devices like LED, photo diode, solar cell.
AHSB13.10	Recollect the concept of electric polarization and classify dielectric materials.
AHSB13.11	Recollect the concept of magnetization and classify magnetic materials.
AHSB13.12	Apply different laws of radiation to understand the phenomenon behind production of light.
AHSB13.13	Understand the basic principles involved in the production of Laser light and also Real-time applications of lasers.
AHSB13.14	Recollect basic principle, construction, types and attenuation of optical fibers.
AHSB13.15	Understand the importance of optical fibers in real-time communication system.

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 - CSE**