Hall Ticket No | | | | | | | | | | | Question Paper Code: AHSB04

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER - I

First Year B.Tech II Semester End Examinations, May- 2020

Regulations: R18

WAVES AND OPTICS

(Common to **EEE/CE**)

Time: 3 hours **Max. Marks: 70**

Answer ONE Question from each Module
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. a) Write an expression for de-Broglie wave length in terms of momentum and kinetic energy. **[7M]**
   b) Calculate the velocity and kinetic energy of an electron having wavelength of 0.21nm. **[7M]**

2. a) Considering dual nature of electron, Derive Schrodinger's time independent wave equation for the motion of an electron. **[7M]**
   b) Calculate the wavelength of an electron raised to a potential 15kV. **[7M]**

MODULE – II

3. a) Explain the physical significance of wave function which connects the particle nature and wave nature of matter wave. **[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 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 construction of a He-Ne laser in detail, with the help of a neat suitable diagram. **[7M]**
   b) Discuss the importance of lasers in various fields like industry, medicine, science, etc., by giving their applications. **[7M]**

6. 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]**

MODULE – IV

7. a) Describe and explain the formation of Newton's rings in reflected **[7M]**

   b) 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 1m from the slits. **[7M]**

8. a) Explain the construction and working of Michelson interferometer with a neat diagram. **[7M]**

   b) A grating has 6000 lines per cm. Find the angular separation between two wavelengths 500 nm and 510 nm in the 3rd order. **[7M]**

MODULE – V

9. a) What is an electrical harmonic oscillator? Obtain the expression for the frequency of oscillation. **[7M]**

   b) 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. **[7M]**

10. a) What is a transverse wave? Derive the wave equation of transverse wave. **[7M]**

    b) A string has mass of 0.002kg/m and tension of 20 N is applied on it. Compute he frequency of the fork. **[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	Correlate principles and applications of lasers and fiber optics.
III	Meliorate the knowledge of light and optics and also their applications.
IV	Develop strong fundamentals of transverse, longitudinal waves and harmonic waves.

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	Understand the working principle of different types of lasers and optical fibre communication.
CO 4	Explore the different phenomena's of light like interference, diffraction etc.
CO 5	Analyze different harmonic oscillators and gain knowledge of different waves and their wave equation.

COURSE LEARNING OUTCOMES (CLOs):

AHSB04.01	Recall the basic principles of physics and apply these concepts of physics in solving the real-time problems.
AHSB04.02	Acquire knowledge about fundamental in quantum mechanics
AHSB04.03	Interpretation of dual nature of matter wave concept using Davisson & Germer's experiment
AHSB04.04	Estimate the energy of the particles using Schrödinger's wave equation and apply it to particle in potential box.
AHSB04.05	Recollect the conductivity mechanism involved in semiconductors and calculate carrier concentrations.
AHSB04.06	Understand the band structure of a solid and Classify materials as metals, insulators, or semiconductors, and sketch a schematic band diagram for each one
AHSB04.07	Understand the basic principles involved in the production of Laser light and also real time applications of lasers.
AHSB04.08	Recollect basic principle, construction, types and attenuation of optical fibers.
AHSB04.09	Understand the importance of optical fibers in real-time communication system.
AHSB04.10	Apply different laws of radiation to understand the phenomenon behind production of light.
AHSB04.11	Apply the phenomenon of interference in thin films using Newton's rings experiment.
AHSB04.12	Identify diffraction phenomenon due to slits
AHSB04.13	Acquire knowledge of basic harmonic oscillators and discuss in detail different types of harmonic oscillators
AHSB04.14	Describe the steady state motion of forced damped harmonic oscillator
AHSB04.15	Acquire knowledge of reflection and transmission of waves at a boundary of media

MAPPING OF SEMESTER END EXAMINATION - COURSE OUTCOMES

SEE Question No		Course Learning Outcomes		Course Outcomes	Blooms Taxonomy Level
1	a	AHSB04.02	Describe Davisson Germer experiment with a neat diagram and explain how it established the proof for wave nature of electrons.	CO 1	Understand
	b	AHSB04.03	Calculate the velocity and kinetic energy of an electron having wavelength of 0.21nm.	CO 1	Understand
2	a	AHSB04.03	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 $n^2 h^2 / 8 m a^2$.	CO 1	Understand
	b	AHSB04.03	Calculate the wavelength of an electron raised to a potential 15kV.	CO 1	Understand
3	a	AHSB04.06	Explain the origin of energy band formation in solids	CO 2	Understand
	b	AHSB04.06	Using Kronig-Penny model show that the energy spectrum of an electron contains a number of allowed energy bands separated by forbidden bands.	CO 2	Remember
4	a	AHSB04.05	Obtain an expression for carrier concentration of n- type semiconductor.	CO 2	Understand
	b	AHSB04.05	Calculate the density of charge carriers of semiconductor, given the Hall efficient is -6.85×10^{-5} m^3/Coulomb.	CO 2	Understand
5	a	AHSB04.07	Explain the construction of a Ruby laser in detail, with the help of a neat suitable diagram.	CO 3	Understand
	b	AHSB04.07	Discuss the importance of lasers in various fields like industry, medicine, science, etc., by giving their applications.	CO 3	Understand
6	a	AHSB04.08	Define Numerical aperture. Derive an expression for numerical aperture of an optical fiber.	CO 3	Understand
	b	AHSB04.08	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.	CO 3	Understand
7	a	AHSB04.11	Describe and explain the formation of Newton's rings in reflected	CO 4	Understand
	b	AHSB04.11	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.	CO 4	Understand
8	a	AHSB04.12	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.	CO 4	Understand
	b	AHSB04.12	A grating has 6000 lines per cm. Find the angular separation between two wavelengths 500 nm and 510 nm in the 3rd order.	CO 4	Understand
9	a	AHSB04.13	Define a simple harmonic motion. Derive a relation for acceleration of a particle executing S.H.M.	CO 5	Understand
	b	AHSB04.13	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.	CO 5	Understand
10	a	AHSB04.15	Discuss the formation of stationary waves in a string. Deduce the formula for the frequency of these waves.	CO 5	Understand
	b	AHSB04.15	A string has mass of 0.002kg/m and tension of 20 N is applied on it. Compute he frequency of the fork.	CO 5	Understand

Signature of Course Coordinator **HOD, EEE**