Vidya Jyothi Institute of Technology (Autonomous)

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Aziz Nagar, C.B.Post, Hyderabad -500075

Department of Physics

B.Tech First Year II Semester-2020-21

QUESTION BANK

Subject: Applied Physics

UNIT-I (Wave Optics)	
SHORT ANSWER QUESTIONS	
1	Write the principle of superposition.
2	What is interference of light?
3	Write the conditions for constructive and destructive interference.
4	Two interfering beams have amplitude ratios of 2:1, calculate the intensity ratio of bright and dark fringes.
5	Write the conditions to produce sustained interference.
6	Two waves having their intensities in the ratio of 9:1 produce interference. Determine the ratio of maxima to minima in the interference pattern.
7	Define phase difference and write its relation with path difference.
8	What are coherent sources and how they are realized in practice.
9	If phase difference between two waves is 2 nπ, then find out path difference between them.
10	Define resolving power of a plane grating.
11	What is grating element?
12	Define Diffraction.
13	Write the conditions required to observe diffraction pattern.
14	Differentiate interference and diffraction.
15	Differentiate Fresnel and Fraunhofer diffraction.
16	On what factors do the width of central fringe depends in a single slit diffraction pattern?
17	For a grating of grating element 2μm, calculate the maximum number of orders of diffraction pattern that can be seen for the wavelength 5890 Å.
18	Define plane of polarization and plane of vibration.
19	Explain double refraction in calcite crystal.
20	Why do we get dark ring at the center of the Newton's rings?
21	Define polarization and Write any two applications of polarization.
LONG ANSWER QUESTIONS	
1	Write about superposition principle, interference and discuss the conditions for sustained interference.
2	a) Explain interference in thin film with a neat diagram and derive the condition for dark and bright fringe. b) A soap film of thickness $5x10^{-5}$ cm is viewed at an angle of 35^0 to the normal. Find the wavelengths of visible light that will be absent from the reflected light(μ=1.33)
3	What is the thickness of the thinnest film of 1.33 refractive index in which destructive interference of yellow light (6000 Å) of a normally incident beam in air can take place by reflection?

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4	a) Explain the formation of Newton's rings with suitable theory. b) A convex lens on a plane glass plate is exposed to monochromatic light. The diameter of the 10^{th} dark ring is 0.433 cm. Find the wavelength of light used if the curvature of the lens is 70 cm.
5	a) Derive the formula $\lambda = \frac{D_m^2 - D_n^2}{4R(m-n)}$ where D_m and D_n, the diameters of m^{th} and n^{th} Newtonrings. b) In case of Newton's rings experiment, wavelength of light source is 5400 Å and the radius of the 8^{th} dark ring is $3.6x10^{-3}$m. Find the radius of curvature of the lens.
6	a) Discuss in detail about Fraunhofer diffraction due to single slit. b) The first diffraction minima due to a single slit is at $\theta = 30°$ for a light of wavelength 5000 Å Find the width of the slit.
7	a) Write the theory of diffraction due to N-slits (Grating). b) For a grating, the angle of diffraction for the second order principal maximum for the wave length 5×10^{-5} cm is 30°. Find the number of lines per cm of the grating.
8	Derive the equation to determine the wavelength of light source using diffraction grating Theory
9	Describe the construction and working of a Nicol's prism
10	What is polarization? Write some applications of Polarization.

UNIT-II (Free electron theory and Introduction to Quantum Mechanics)	
SHORT ANSWER QUESTIONS	
1	Write the postulates of Lorentz-Drude free electron theory.
2	Bring out the major difference between classical free electron theory and quantum theory.
3	Define drift velocity and relaxation time.
4	Define mobility and write the electrical conductivity equation in terms of mobility
5	Discuss the de Broglie hypothesis of duality of matter particles
6	If the mobility of the electron is $7x10^{-3}m^2/Vs$, when accelerated by a field E= 1V/cm, then find out drift velocity
7	Calculate the minimum energy of a particle of mass $6x10^{-34}$ Kg enclosed in a 1-D box of width 1.2 Å.
8	Determine the wavelength of matter wave associated with electron accelerated by a potential of 100V.
9	State and explain Heisenberg's uncertainty principle.
10	Write time independent Schrodinger wave equation for a free particle

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11	Write the difference between a matter wave and an electromagnetic wave.
12	When an electron is accelerated, if de Broglie wave-length is 1 Å , then find out the voltage applied.
13	Calculate the de Broglie wavelength of a proton whose kinetic energy is 1 MeV
14	Calculate the wavelength associated with an electron with energy 2000 eV
15	An electron is bound in 1 dimensional box of size 4 X 10^{-10} m. what will be its minimum energy?
16	An electron is moving under a potential field of 15 kv. Calculate the wavelength of the electron waves
17	Calculate the energy required to pump an electron from ground state to the 2nd excited state in a metal of length 10^{-10} m
18	Calculate the minimum energy of free electron trapped in a 1-dimensional box of width 0.2 nm
19	Find the energy of an X-ray photon whose wavelength is 2 X 10^{-11} m
20	Find out the resistivity of metal, if it has $5.8x10^{28}$ conduction electrons per m^3 and their mobility is $0.5x10^{-2}m^2/Vs$
LONG ANSWER QUESTIONS	
1	Explain classical free electron theory and discuss merits and demerits.
2	Derive Ohm's law based on Drude and Lorentz free electron theory.
3	Describe the concept of de-Broglie hypothesis - matter waves and derive the expression for de-Broglie wavelength
4	What are matter waves? Explain their characteristics
5	Explain spectral distribution of black body radiation.
6	Derive Schrodinger time independent wave equation.
7	Explain the physical significance of wave function.
8	Derive the following equations $\lambda = \frac{h}{p}$, $\lambda = \frac{h}{\sqrt{2mE}}$, $\lambda = \frac{12.26}{\sqrt{V}}$
9	Show that the energies of a particle in a1-D box are quantized.
10	Derive wave function for the particle which is moving in one- dimensional potential box

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UNIT-III (Band theory of solids and Semiconductors)	
SHORT ANSWER QUESTIONS	
1	Discuss the motion of electrons in a periodic potential.
2	Write the conclusions of Kronig-Penny model.
3	Draw the graph of potential function of a moving electron in periodic lattice.
4	Write the value of energy gap of semiconductors and insulators with examples
5	Draw the energy band diagrams of metals, semiconductors and insulators
6	Draw E-K diagram for semiconductor
7	Calculate the probability for an electronic state to be occupied at 20^0C, if the energy state lies 0.11eV above fermi level.
8	Define effective mass of an electron and write the expression for effective mass of electron
9	Evaluate the fermi function for energy KT above the fermi energy.
10	Fermi level for a metal is 5.5eV. Find out the energy for which the probability of occupancy is 0.9 at 300K.
11	In case of Kronig-Penny model, if scattering power P $\rightarrow$ 0, Explain the variation in the size of allowed energy bands
12	what is the finding probability of electron at Fermi level in the following cases a) at 0 K temperature b) at any temperature other than 0 K
13	Write expression for Fermi-distribution function. Show that at all temperatures (T>0K) probability of occupancy of Fermi level is 50%
14	Distinguish between intrinsic and extrinsic semiconductors
15	Explain the effect of temperature on the conductivity of semiconductors
16	The intrinsic carrier concentration in Ge is 2.37x $10^{19}/m^3$. If the electron and hole mobilities 0.38 and 0.18 m^2V^{-1} s^{-1} respectively. Calculate the conductivity
17	Derive expression for Fermi level in intrinsic semiconductor and show that at 0k temperature Fermi level lies midway between valence band and conduction band
18	Explain the difference between metals and semiconductors from the consideration of temperature and coefficient of resistivity
19	Draw the energy band diagrams for i) intrinsic semiconductor ii) n-type semiconductor iii) p-type semiconductor
20	Write a note on Extrinsic semiconductors
LONG ANSWER QUESTIONS	
1	Discuss the Kronig-Penny model for the motion of an electron in a periodic potential.

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2	a) Draw E-K diagram for a semiconductor and identify various Brillouin zones b) Explain the conclusions of Kronig-Penny model
3	Explain the origin of energy bands formation in solids.
4	Explain the classification of metals, semiconductors and insulators based on band theory.
5	Derive an expression for effective mass of an electron.
6	Explain the Fermi-Dirac distribution function for electrons in a metal and discuss it's variation with temperature
7	Derive an expression for the density of holes in the valence band of an intrinsic semiconductor.
8	Derive an expression for the density of electrons in the conduction band of an intrinsic semiconductor
9	Derive an expression for the carrier concentration of an intrinsic semiconductor.
10	Derive an equation for electrical conductivity of an intrinsic semiconductor.

UNIT-IV (Semiconductor devices)	
SHORT ANSWER QUESTIONS	
1	Draw the energy level diagram of PN junction.
2	What are minority carriers in a PN junction diode and how they are related to reverse current?
3	Discuss the basic principle of LED.
4	List out the advantages of LED.
5	What are direct and indirect band gap semiconductors?
6	Draw the E-k graph of direct and indirect band gap semiconductors.
7	Write any two applications of Photo diode.
8	Write the specific applications of LED.
9	What is the difference between photo diode and solar cell
10	Write the basic principle of photodiode.
11	Write some applications of Hall Effect.
12	Draw the I-V Characteristics of photodiode
13	Write the applications of solar cell
14	What is Hall Effect?
15	Define efficiency of solar cell.
16	Mention the factors responsible for efficiency of solar cell.
17	Write the typical energy gap values of various semiconductors used in various optoelectronic devices.
18	A silicon plate of thickness 1mm, breadth l0mm and length 100mm is placed in

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	perpendicular magnetic field of 0.5 Wb/m^2. If 10^{-2} A current flow along its length, calculate the Hall voltage developed if the Hall coefficient is $3.66x10^{-4}m^3$/coulomb.
19	Calculate the wavelength of radiation emitted by LED made up of GaAs with band gap energy 1.43 eV
20	Give some examples of optoelectronic devices.
LONG ANSWER QUESTIONS	
1	Explain the different methods to form a semiconductor p-n junction
2	Draw the energy level diagram of p-n junction and explain
3	Draw the V-I characteristic curve of a PN junction diode and explain.
4	Explain Hall Effect and its applications.
5	Explain the construction and working of semiconductor laser.
6	Explain the construction and working of LED
7	Explain about working and efficiency of the solar cell
8	Explain the construction and working of Photo diode
9	Write about various applications of Hall effect
10	Explain direct and indirect band gap semiconductors with the E-k graphs.

UNIT-V (Fiber Optics and Lasers)	
SHORT ANSWER QUESTIONS	
1	What is the basic principle of an optical fiber
2	Write any three applications of optical fibers.
3	Define Acceptance angle of an optical fiber.
4	Draw the structure of optical fiber.
5	Define numerical aperture of an optical fiber.
6	Define acceptance cone of an optical fiber.
7	Write the advantages of optical fibers over the conventional coaxial cables in communication
8	Draw the refractive index profile of step index optical fiber.
9	Draw the refractive index profile of graded index optical fiber.
10	Write the merits and demerits of graded index fibers.

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11	Write the characteristics of laser.
12	Define spontaneous emission of radiation.
13	Define stimulated emission of radiation.
14	Define population inversion.
15	Write various methods to achieve population inversion.
16	Write any two applications of laser.
17	Write a note on the important components of laser
18	Calculate the numerical aperture and acceptance angle of an optical fiber with core and cladding refractive indices being 1.48 and 1.45 respectively.
19	An optical fiber has a core material of refractive index 1.55 and cladding material of refractive index 1.50. The light is launched into it in air. Find out its numerical aperture
20	An optical fiber has refractive indices of core and cladding are 1.60 and 1.59 respectively. find the numerical aperture of the fiber in water which has refractive index 1.33
LONG ANSWER QUESTIONS	
1	Derive an expression for the numerical aperture of optical fibers.
2	Write the differences between multimode step index and multimode graded index fiber.
3	Classify and explain the types of optical fibers
4	Describe the different types of fibers by giving the refractive index profiles and propagation details.
5	Write the applications of optical fibers.
6	Differentiate spontaneous and stimulated emission of radiation.
7	Explain the construction and working of Ruby laser.
8	Explain the construction and working of He – Ne laser.
9	a) Explain the components which are used to produce the laser. b) Write the applications of laser.
10	The refractive index of core of step index optical fiber is 1.50 and the fractional change in the refractive index is 4%. Determine i) the refractive index of the cladding ii) numerical aperture and iii) acceptance angle