**TUTORIAL SHEET**

**Year: B. Tech. I Year I Semester**

**Subject: Engineering Physics**

**CO1.**Students will be able to explain the basic concepts, theoretical principles and practical applications of interference, diffraction phenomena and their related optical devices in visible range in Wave optics.

**TUTORIAL SHEET NO.1**

Q.1 Light containing two wavelengths λ1 & λ2 falls normally on a plano convex lens of radius of curvature R resting on a glass plate. If the nth dark ring due to λ1 coincides with the (n+1)th dark ring due to λ2. Prove that the radius of nth dark ring due to λ1 is given by 

Q.2 Michelson interferometer is set to form circular fringes with light of wavelength 5000Å. By changing the path length of movable mirror slowly, 50 fringes cross the center of view. How much path length has been changed?

**TUTORIAL SHEET NO.2**

Q.3Michelson interferometer experiment is performed with a source which has two wavelengths 4882Å and 4886Å. By what distance does the mirror have to be moved between two positions of disappearance of fringes?

Q.4 Newton’s rings are observed in reflected light of wavelength 5.9×10-5 cm. The diameter of the 10th dark ring is 0.50 cm. Find the radius of curvature of lense & thickness of air film at the ring.

**TUTORIAL SHEET NO.3**

Q.5 In Newton’s ring experiment the diameter of nth and (n+1)th ring are 4.2 mm and 5 mm. If the radius of curvature of lens is 3 m then find the wavelength of light used.

Q.6In Michelson’s interferometer the scale reading for two successive maxima of fringes were found to be 0.7854 mm and 0.8673 mm. If the mean wavelength of two components of light be 5600Å. Calculate the difference of the wavelength of the component.

**TUTORIAL SHEET NO.4**

Q.7 In Newton’s ring experiment, an air film is formed between two convex surfaces, each of radius of curvature 1m. Newton’s rings are generated by using a light of wavelength 5000 Å. Find the distance between 16th and 9th dark rings.

Q.8 Fraunhofer diffraction due to a single slit is observed with the help of a lens of focal length 2.0 m. The slit width is 0.4 mm. Waves of two wavelengths λ1 and λ2 are present in the incident light. The forth minimum of λ1 coincides with fifth minimum of λ2 and they are formed at a distance of 1cm. from the central maximum. Determine the values of λ1 and λ2.

**TUTORIAL SHEET NO.5**

Q.9 The distance between the first and the sixth minima in the diffraction pattern of a single slit is 0.5 mm. The screen is 0.5 m away from the slit. If the wavelength of light used is 5000Å, determine the slit width.

1. Q.10 A diffraction grating has total rules width 5 cm. for normal incidence. It is found that a line of wavelength 6000Å in a certain order superimposed on another line of wavelength 4500Å of the next higher order. If the angle of diffraction is 300, how many lines are there in the grating?

**TUTORIAL SHEET NO.6**

Q.11A plane transmission grating has 6000 lines/cm. calculate:-

1. The highest order of spectrum which can be seen with light of wavelength 4000Å.
2. The longest wavelength of light for which spectrum can be obtained.

Q.12 How many lines per cm are there is a grating which gives an angle of diffraction of 300 in first order spectrum of light of wavelength 6x10-5cm.

**CO2.** Students will be able to acquire knowledge of fundamental concepts, principles of quantum mechanics to understand numerous atomic and molecular scale phenomena.

**TUTORIAL SHEET NO.1**

Q.1 Derive the Schrodinger time dependent one dimensional wave equation.

Q.2 Find the probability that a particle in a box can be found between 0.45a and 0.55a where a is the width of the box and particles in the first excited state.

**TUTORIAL SHEET NO.2**

Q.3 Solve Schrodinger equation of a particle in a one-dimensional box for eigen values and eigen functions. Show that the particle takes discrete energies.

Q.4 The wave function of a particle in its ground state in one dimensional box of length L is given by Ψ=$\sqrt{\frac{2}{L}}\sin(\frac{πx}{L})$. Calculate probability of finding the particle with in an interval of 1Aо at the center of box of length L=10Å.

**TUTORIAL SHEET NO.3**

Q.5 An electron confined to move in a one dimensional box of length 1Å. Find the zero point energy and momentum of the electron in its ground state.

 Q.6 Derive the Schrodinger time independent one dimensional wave equation.

**TUTORIAL SHEET NO.4**

Q.7 A proton is confined to move in a one dimensional box of length 2Å. Find the first excitation energy and momentum of the electron in its ground state.

Q.8 Show that the energy of a free particle varies as the square of natural numbers in one dimensional box.

**TUTORIAL SHEET NO.5**

Q.9 Determine the expectation value of position of a particle trapped in one dimensional rigid box.

Q.10 The wave function of a particle in its ground state in one dimensional box of length L is given by Ψ=$\sqrt{\frac{2}{L}}\sin(\frac{πx}{L})$. Calculate probability of finding the particle with in an interval of 5Aо at the center of box of length L=25Å.

**TUTORIAL SHEET NO.6**

Q.11 Find the probability that a particle in a box of width ‘a’ can be found between x=0 and x=a/n when it is in the nth state.

Q. 12 Determine the expectation value of momentum of a particle trapped in one dimensional rigid box.

**C0 3** Students will be able to learn all basic aspects of laser action, properties (coherence etc.), types of LASER devices and its applications in fibre optics, holography, medical science and industry etc.

**TUTORIAL SHEET NO.1**

Q.1 Derive an expression for the maximum acceptance angle of an optical fiber .

Q.2 Show that the numerical aperture of step index optical fiber is given by NA= ncore √ 2∆

**TUTORIAL SHEET NO.2**

Q.3 Derive an expression for the numerical aperture angle of an optical fiber .

Q.4 Compare the maximum angle of acceptance and light gathering capacity (NA) of two

fibers characterized by core and cladding indices n1 and n2 to be

(a) n1 = 1.6, n2 = 1.5, (b) n1 = 2.1, n2 = 1.5 (assume n0 = 1)

**TUTORIAL SHEET NO.3**

Q.5 Describe Einstein’s Coefficients and derive the relation between them .

Q.6 For a typical step index multimode fiber the core index is n1=1.45 and the relative refractive index difference of core- cladding (n1-n2) is 0.01. Find the numerical aperture and the maximum acceptance angle?

**TUTORIAL SHEET NO.4**

Q.7 Calculate the refractive indices of core and cladding materials of an optical fiber having NA = .22 and relative refractive index change is .012. Also find the critical angle and maximum acceptance angle.

Q.8 A laser beam has a wave length of 8x10-7 m and aperture 5x10-3m. The laser beam is sent to moon. The distance of the moon from the earth is 4x105 Km. Calculate (i) The angular spread of the beam (ii) The areal spread when it reaches the moon.

**TUTORIAL SHEET NO.5**

Q.9 A laser beam has a power of 50 mW. It has an aperture of 5x10-3m and emits light of

wavelength 7200 A. The beam is focused with a lens of focal length 0.1 m. Calculate the

area and the intensity of the image.

Q.10 Find the intensity of a laser beam of 20mW power and having a diameter of 1.5 mm .

. **TUTORIAL SHEET NO.6**

Q.11 A LASER beam of wavelength 6000 Å on earth is focused by a lens of diameter 2 m on the surface of moon . How big is the moon .(Given distance of moon from earth = 4x105 Km).

Q.12 Compare the maximum angle of acceptance and light gathering capacity (NA) of two

fibers characterized by core and cladding indices n1 and n2 to be

(a) n1 = 1.42, n2 = 1.40, (b) n1 = 1.6, n2 = 1.5 (assume n0 = 1)

**C0 4**Students will be able to describe key concepts, fundamental laws of Hall effect, Fermi Dirac distribution, electrical conductivity, Fermi energy etc. to understand the Physics of semiconductors and materials. Students will also acquire basics of electrostatics and electromagnetism (e.g., Maxwell’s equations) to explain electromagnetic waves propagation and generation in free space, dielectrics and conducting media.

**TUTORIAL SHEET NO.1**

Q.1 What is Hall Effect? Explain the significance and importance of Hall Effect. How Hall coefficient can be determined.

Q.2 A semiconducting crystal 12 mm long, 1 mm wide and 1mm thick has magnetic flux density of 0.5 wb/m2, applied from front to back and perpendicular to target faces. When current of 20 mA flows lengthwise through the specimen, voltage measured across its width is found to be 37 microvolt. What is the hall coefficient of the semiconductor and density of charge carriers?

**TUTORIAL SHEET NO.2**

Q.3 A rectangular n-type semiconductor specimen, 2mm wide and 1mm thick, gives a hall coefficient of 10-2 m3/c. When a current of 1mA is passed through the sample, a hall voltage of 1mV is developed. Find the magnetic field and the hall field.

Q.4 A n-type semiconductor sample has a hall coefficient 0.0125m3c-1 and the mobility of majority charge carriers is 0.36 m2v-1s-1 and a 100 v/m electric field apply on the sample of n-type semiconductor. Find the current density in the sample.

**TUTORIAL SHEET NO.3**

Q.5 The Hall coefficient of a specimen of a doped silicon is found to be 3.66x10-4 m3c-1. The resistivity of the specimen is 8.93x10-3 ohm meter. Find the mobility and density of charge

 carriers.

Q.6 In a semiconductor there are 5x1019electrons and 8x1020 holes per cube meter. If the mobilities of electrons and holes respectively 0.09 and 0.05 m2v-1s-1 the determine the hall coefficient of semiconductor.

**TUTORIAL SHEET NO.4**

Q.7 If E = 20i+10x2  j + 4yk then find curl at (2,4,6).

Q.8 If A= 20x2 i+10y2j+4k then find divergence at point (0,1,0).

**TUTORIAL SHEET NO.5**

Q.9 The Hall coefficient of a specimen of a doped silicon is found to be 5.056x10-3 m3c-1. The resistivity of the specimen is 5.93x10-3 ohm meter. Find the mobility and density of charge carriers.

Q.10 In a semiconductor there are 7x1018 electrons and 4x1022 holes per cube meter. If the mobilities of electrons and holes respectively 0.08 and 0.06 m2v-1s-1 the determine the hall coefficient of semiconductor.

**TUTORIAL SHEET NO.6**

Q.11 If E =42i+10x2  j +15yk then find curl at (3,1,2).

Q.12 If A= 30x2 i+16y2j+7k then find divergence.