UNIT-I

1: What is interference? Derive an expression of max^m & min^m for reflected light in case of thin transparent film of uniform thickness.

2: Explain the generation of ultrasonic wave using Piezoelectric effect

3: What are stationary waves? Explain the diff b/w stationary & travelling waves.

4: Derive an expression for n^{th} dark ring in Newton's ring expt.

5: Derive an expression for resolving power of a plane transmission grating.

6: With a neat ~~lab~~ diagram discuss the construction & working of Michelson's interferometer. Mention its applications.

7: With the neat schematic diagram, explain the mechanism of flaw detection in a solid by NDT using ultrasonic waves.

5: Define the term differaction of light. Distinguish b/w Fresnel & Fraunhoffer differaction.

6: Obtain an expression for fringe width in the interference pattern of a wedge shaped film.

7: Explain the terms a: Geometrical path b: Optical phath c: Phase difference

8: Discuss the diff ~~to~~ methods of generating ultrasonic waves.

Numericals.

1: In a newton's ring expt, diameter of 10^{th} dark ring was observed to be 0.5 cm. Calculate the radius of curvature of the lens, if the wavelength of incident light is 6000 A°.

2: Fringes of equal thickness are observed in a thin glass wedge of R.I 1.50. The fringe spacing is 0.2 mm & the wavelength of light being 5893 A°. Calculate wedge angle.

3: A monochromatic light of wavelength 5000 A° is incident on a plane differaction grating $\bar{c}$ grating const 5.0×10^{-5} cm. Calculate the max^m order of spectrum that can be observed.

4: In a Newton's ring expt the diameter of 12^{th} ring was found to be 5.146cm & that of 4^{th} ring was 5.007cm. If the radius of plano convex lens is 75cm, Calculate the wavelength of light used.

5: When a light of wavelength 633nm undergoes differ^n at a plane diffraction grating, it results into a second order max^m at an angle of 50°. Evaluate the grating constant.

6: In a Newton's ring expt, for a wavelength of light 655nm, the dia of 12^{th} & 3^{rd} ring is observed to be 0.8cm & 0.34cm resply. Calculate radius of curvature of the plano-convex lens used.

~~7: Calculate~~

7: For a plane differaction grating, 2^{nd} order diffra^n max^m is observed at a certain angle for the light of wavelength 650nm. If the grating const is 1.67×10^{-4} cm, evaluate the angle of diffraction.

8: The sodium yellow doublet has wavelengths 5890A° & 5896A°. Calculate the resolving power of a grating.

UNIT - II.

1: Derive an expression for velocity of electromagnetic waves using Maxwell's equations.
2: Discuss the construction & working of semiconductor laser $\bar{c}$ energy level diagram.
3: Derive an expression for energy density of radiation in terms of Einstein co-efficients.
4: Discuss the types of optical fibers.
5: What does numerical aperture signify? Derive an expression for numerical aperture of an optical fiber.
6: What is attenuation in a fiber? Discuss the factor contributing to the attenuation.
7: Explain the construction & working of a CO_2 Laser $\bar{c}$ a neat diagram.
8: Explain the terms numerical aperture & fractional index change, ~~Derive~~
9: What is LIDAR?
10: Why do we need material of higher R.I for the core of an optical fiber?
11: Prove the following relations for Einstein coefficients.

$$\frac{A_{21}}{B_{12}} = \frac{8\pi h\nu^3}{c^3} \quad \& \quad B_{12} = B_{21}$$

12: Explain the construction & working of LIDAR.
13: With neat ray diagram derive the condition for propagation of light in an optical fiber.
14: Explain the terms stimulated absorption, spontaneous ~~absor~~ emission & stimulated emission $\bar{c}$ suitable energy level diagrams.
15: Discuss the conditions for laser action & requisites for a laser system.
16: Distinguish b/w spontaneous emission & stimulated emission of radiation.

Numericals unit - 2

1: The angle of acceptance of an optical fiber is 30° when kept in air Calculate the angle of acceptance when it is in a medium of R.I 1.33.

2: A pulsed laser emits photons of ~~???~~ wavelength 790nm $\bar{c}$ 20mW average power. Calculate the number of photons contained in each pulse if the pulse dur^n is 20ns.

3: In an optical fiber the R.I of the core & clad are 1.55 & 1.49 resply. Calculate the numerical aperture, angle of acceptance & FIC.

4: Calculate the ratio of population density of two energy states in a material that produces a laser beam of wavelength 6328Å at an ambient temp of 27°C.

5: Assume that light signal of power 100mW passes through 500m length optical fiber & only 80mW power is detected at other end. Calculate fiber loss.

6: What is critical angle at core-cladding boundary, if the R.I of core & cladding are 1.563 & 1.498 resply.? Find numerical aperture & angle of acceptance of the fiber.

7: The ratio of population of two energy levels is 1.059×10^{-30}. Calculate the wavelength of light emitted by spontaneous emission at 300K.

8: The attenuation of light in an O.F is 3.8 dB/km. What fraction of its initial intensity remains after 800m?

9: An optical signal loses 15% of its power after propagating through a fiber of length 0.5km. What is the fiber loss?

10: Find the ratio of pop^n of two energy states of a medium in thermal equilibrium, the transition b/w $\underline{c}$ results in the stimulated emission of wavelength 9.6 μm, assuming the ambient temp to be 27°C.

UNIT-III

1: Explain de Broglie Hypothesis.

2: Apply Schrodinger wave eq^{n} to a particle in 1D potential well of infinite height & obtain the expression for Eigen function & Eigen value.

3: State & explain Heisenberg's uncertainty principle. Give Elementary Proof.

4: Define phase velocity & group velocity. Obtain relation b/w them.

5: Explain the elementary operators in quantum mechanics.

6: Explain the term group velocity. Show that group velocity is same as particle velocity.

7: Give the Max Born interpretation of wave fun^{n}. Derive an expr^{n} for eigen values for a particle in 1D potential well of ∞ height.

8: Describe the Davisson-Germer expt to confirm the wave nature of e^-.

9: On the basis of Heisenberg's uncertainty principle, ST e^- don't exist inside the nucleus.

10: Mention the properties of matter waves & wave function.

11: Using Schrodinger time independent wave eq^{n} & normaliz^{n} cond^{n} for a particle in an infite potential well of width L, ST $\psi = \sqrt{2/L}\sin\left(\frac{n\pi x}{L}\right)$

12: what are the cond^{n} for allowed wave fun^{n}?

13: Explain the phenomenon of tunneling through a potential barrier. Discuss one of its applications in brief.

→ 14: Discuss the probability of occupation of various energy states by e^- for the cases $E<E_f$, $E>E_f$, at $T=0$ & $E=E_f$ at $T>0$ on the basis of Fermi factor.

→ 15: Show that the sum of the probability of occupancy of an energy state at ΔE below Fermi level & that at ΔE above Fermi level is unity

→ 16: State the assumptions of Classical theory of electrical conductivity in metals. Discuss the variation of Fermi factor c temp & energy.

Numericals unit-3.

1: An e^- & 200g base ball travelling at 250m/s measured to an accuracy of 0.05%. Calculate uncertainty in position of each & interpret the result.

2: Calculate the lowest the three energy states for an e^- confined in the ∞ potential well of width 10^{a} A° (ii) A grain dust of mass 10^{-6} g moving in potential well of width 0.1mm.

3: An e^- is bound in 1D potential well of width 20 A°, but of infinite height. Calculate its energy value in the ground state & also in the first 2 excited states

4: A particle of mass 0.80 MeV/c^2 has a K.E of 100eV. Find the de-Broglie wavelength of the particle.

5: An e^- is confined to a potential well of 12nm. Calculate the min uncertainity in its velocity.

6: ~~An~~ Estimate Potential difference required to accelerate an e^-, so that its de-Broglie wavelength will be equal to 1.65A°.

8: Electrons of energy of 0.5eV are incident on a potential barrier of 0.3eV high & 0.1nm wide. Find approximate probability for these e^-s to penetrate the barrier.

9: A particle is in the 2^{nd} excited state of an infinite potential well of width 'a'. Calculate the probability of finding the particle in b/w $x = a/3$ & $x = 2a/3$.

from 3. → 10: Fermi energy of silver is 5.5eV. Estimate the energy of the level whose prob of occupancy is (i) 0.89 & (ii) 0.11 at 300K.

10: For a metal having ~~6.2~~ 6.2×10^{28} cond^n e^-s per m^3, calculate the relaxation time of the e^-. If the metal ~~metal~~ resistivity is 1.48×10^{8} Ω m.

11: Calculate the prob of e^- occupancy of an energy level at 3×10^{-2} eV below the fermi level at an ambient temp 29°C. Also find the prob of non-occupancy of the same energy level.

UNIT- IV.

1: With a neat lab diagram, explain the band form^n in Si & diamond.
2: Derive an expression for conductivity in an intrinsic semiconductor.
3:* Discuss the dependence of Fermi factor on temp & energy.
4: Explain BCS theory of superconductivity.
5: S.T Fermi level lies in the middle of the forbidden gap in case of an intrinsic semiconductor.
6: ~~Explain BCS~~ With the relevant diagrams explain ~~T~~ Meissner effect
~~7: A Josephson junction c̄ a~~
7:* Explain the term Fermi energy. Discuss the variation of Fermi factor c̄ energy & energy.
8: With neat diagram, explain band form^n in case of Li & discuss the electrical conductivity.
9: Discuss any two properties of superconductors. Distinguish b/w Type I & Type II superconductors.
10: Discuss why Si is semiconductor & diamond is insulator.
11: What is SQUID? Describe its working.
12: Define Hall effect. Derive an expression for Hall co-efficient.
13: Explain the merits of quantum free e⁻ theory.
14: Write a note on Maglev vehicle.
15: S.T energy below Fermi level are completely filled & those above Fermi level are completely empty at OK.
16: ~~EA~~

Numericals of unit-04

1: If the critical current passing through a 0.4mm diameter superconducting wire is 20A. estimate the critical magnetic field for superconductor

2: The hall co-efficient & conductivity of an n-type Si specimen are 2.65×10^{-3} m^3/C & $102/\Omega m$ resply. Calculate the charge carrier density & e^- mobility.

3: Calculate the critical current of a material having a diameter of 2mm at 4.2K. The critical temperature of a material is 6.98K & critical mag field at 0K is 5.38×10^4 A/m.

4: The resistivity & Hall coefficient of a Si sample are $8.9 \times 10^{-3}\ \Omega m$ & ~~3.6~~ 3.6×10^{-4} m^3/C resply. Calculate the charge carrier density & mobility.

5: A Josephson junction c̄ a voltage difference of 635 μV radiates electro-magnetic radiation. Calculate freq of the EM waves.

6: The Hall coefficient of a material is -3.68×10^{-5} m^3/C. Evaluate the carrier concentration in the material & comment on the type of charge carriers.

7: In Hall effect expt, 250 mA current flows through a sample of thickness 1mm & 5cm wide. The Hall volt of -0.20mV was recorded for a magnetic field of 0.3 Tesla. Calculate i) current density ii) carrier concentration iii) Hall co-efficient

UNIT- V

1: Discuss density of states for various quantum structure.
2: Describe the construction & working of a scaning e⁻ microscope. (SEM)
3: Explain the construction & working of G.M counter.
4: Explain top down & bottom up approaches of synthesis of nano materials.
5: Discuss the construction & working of linear accelerator

Numericals

1: A G.M counter collects 10^6 e⁻s per discharge when the counting rate is 600 couns/min. Calculate the averge current in the center
2: The maximum path radius of a cyclotron is 0.3 & it has a mag. field strength of magnitude 1.5 Wb/m² as the cyclotron is used to accelerate the protons, calculate the frequency of the alternating voltage applied to the dees & maximum particle energy.
3: In a linear accelerator, proton accelerated thrice by a potential 40KV leaves a tube & enters an accelerating space of length 30cm before entering the next tube. Calculate the freq of the r.f voltage & length of the tube entered by the proton.
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