**Question Bank**

**Interference**

Q 1: What are Newton rings? Explain how these rings can be used to find the wavelength of light? Derive an expression for the diameter of dark Newton's ring.

Q 2: Interference fringes are observed with a biprism of refracting angle 10 and refractive index 1.5 on screen 80 cm away from it. If the distance between source and biprism is 20 cm, calculate the fringe width for light of wavelength 600 nm.

Q3: Why two independent sources cannot produce observable interference pattern?

Q 4: What is the effect of increasing the angle of biprism on the fringes, explain?

Q5: Newton's ring are formed between a plain surface of glass and lens. The diameter of third dark ring is 10-2 m. When a light of wavelength 589 nm is used as such an angle that the light passes through the air film at angle of 300 to the normal, find the radius of the lens?

Q 6: What are Haidinger fringes?

Q 7: Light containing two wavelengths fall normally on a Plano- convex lens of radius of curvature R resting on a glass plate. If the nth dark ring due to one wavelength coincides with (n+1)th dark ring due to other, prove that the radius of the nth dark ring of first wavelength is given as:

Q 8: Consider the superposition of two simple harmonic disturbances and show that the resultant in intensity is not just the sum of intensities due to separate disturbances. On the basis of this result explain why coherence disturbance interfere and incoherent disturbances do not?

Q 9: Draw neat ray diagram showing clearly how coherent sources are produced in a Fresnel's biprism.

Q 10: A beam of Monochromatic light of wavelength 582 nm falls normally on a glass wedge with the wedge angle 20'' of arc. If the refractive index of the glass is 1.5, find the number of dark fringes per cm of the wedge length.

**Diffraction**

Q 1: Define following (a) Resolving power of a grating (b) Plane transmission grating.

Q 2: What are the conditions of missing order spectra in diffraction grating?

Q 3. Discuss the phenomena of Fraunhofer diffraction at a single slit and show that the intensity of first order maxima is about 4.5 % of that of principal maxima.

Q 4: A plane diffraction grating of length 6 cm has 15,000 LPI. Calculate the smallest wavelength difference that can be resolved for the wavelength of light 500 nm.

Q 5: Explain the difference between interference and diffraction phenomena.

Q 6: In a Fraunhofer Diffraction due to narrow slit a screen is placed 2 m away from the lens to obtain the pattern. If the slit width is 0.2 mm and the first minima lie on either side of central maxima. Find the wavelength of light?

Q 7: Why can we readily observe diffraction effects for sound waves but not for light?

Q 8: The wavelength of the visible spectrum are approximately 400 nm to 700 nm (red). Find the angular width of the first order visible spectrum produced by a plane grating with 600 slit per mm when white light falls normally on grating.

Q 9: In a plane transmission grating the angle of diffraction for second order maxima for wavelength 5 x 10-5 cm is 300. Calculate the number of lines in 1 cm of a grating surface.

Q 10: Show that the intensity pattern due to N slits is a product of two terms the diffraction pattern due to single slit and interference pattern due to N slits.

**Polarisation**

Q 1: What is the phenomena of double refraction? Explain with proper ray diagram, how the Nicole prism is used as polariser and an analyser? what are its limitations.

Q 2: Give the construction and working of Lorentz's half shade polarimeter.

Q 3: Define (i) principle section, (ii) Optic axis of a crystal and (iii) Specific rotation.

Q 4: Calculate the thickness of HWP. Given µo and µex are 1.5442 and 1.5533 respectively, where wavelength of light used is 589 nm.

Q 5: How do you distinguish between plane, circularly and elliptically polarised?

Q 6: A sugar solution in a tube of length 20 cm produces optical rotation of 130. The solution is then diluted to 1/3rd of its previous concentration, find optical rotation produced by 30 cm long tube containing the dilute solution.

Q 7: What do you understand by a quarter and half wave plate? If you are given a quarter wave plate, half wave plate and a simple glass plate, how will you proceed to distinguish them from each other.

Q 8: Two Nicols are oriented with their planes making an angle 600. What % of incident light will pass through the system.

Q 9: What is a polarised light? Explain linear, elliptical and circular polarisation.

Q 10: A certain length of 5% solution causes the optical rotation of 200. How much length of 10 % solution of the same substance will cause 350 rotation?

**Laser**

Q 1: Is it possible to have a lasing in a two-level active medium? Briefly describe the working of a three-level laser

Q 2: What is the fundamental difference in the light emission process in an ordinary light and laser light source? Briefly explain (i) metastable states (ii) resonant cavity (iii)spontaneous and stimulated emission (iv) Einstein's A and B coefficients.

Q 3: For an emission at a wavelength of 500 nm, at what temperature will both spontaneous and stimulated emissions be at the same rate?

Q 4: What is the pumping mechanism in He-Ne Laser.

Q 5: What are the main components of laser ? Describe the construction and working of He-Ne Laser.

Q 6: A source is emitting 100 W of green light at wavelength of 500 nm. How many photons per second are emerging from the source?

Q 7: Show that when the atoms are in thermal equilibrium, the emission (at optical frequencies) is predominantly due to spontaneous transitions.

Q 8: Explain with neat sketches. principle, construction and working of He- Ne laser with energy level diagram.

Q 9: Find the ratio of the population of the states in He-Ne ;laser that produces a light of wavelength of 632.8 nm at 27°C.

Q 10: Explain the principle of lasers. State whether a laser is an amplifier or an oscillator.

**Fibre optics**

Q 1: What is the numerical aperture for an optical fibre if the refractive indices of the core and cladding are 1.55 and 1.50 respectively? How is numerical aperture related to the light gathering power of a fibre?

Q 2: Give the working of an optical fibre. Describe total internal reflection in it. How is it related to acceptance angle?

Q 3: What are the advantages of using a graded index fibre over a step index fibre?

Q 4: Illustrate with a schematic diagram, the dependence of refractive index on the radial distance for a graded index optical fibre.

Q 5: Define and explain acceptance angle, acceptance cone and numerical aperture for an optical fibre.

Q 6: What is the role of the core in the optical fibre?

Q 7: An optical fibre cable has an acceptance angle of 30° and a core index of refraction 1.4. Calculate the refractive index of cladding.

Q 8: An optical fibre with numerical aperture of 0.20 and a cladding refractive index of 1.59 is placed in water. What will be the acceptance angle of optical fibre?(refractive index of water = 1.33)

Q 9: Can a light propagate through an optical fibre at an angle of incidence greater than the acceptance angle?

Q 10: Enumerate few advantages of optical fibre over conventional copper cables.

**Theory of relativity**

Q 1: Derive length contraction and time dilation from Lorentz transformation.

Q 2: A space craft is moving relative to earth. An observer on earth finds that between 1 pm to 2 pm according to her clock, 3601 sec elapse on the space craft's clock. What is the space craft's speed relative to the earth.

Q 3: Derive Lorentz transformation. Explain every symbol.

Q 4: Show that is Lorentz invariant.

Q 5: Calculate the velocity of a rod when its length appears 3/4th of its proper length.

Q 6: Explain Michelson Morley experiment. Stating clearly its aim and results derived therein. How did the result of the experiment led to the special theory of relativity?

Q 7: A cube has a proper volume of 1000 cm3. Find the volume as determined by an observer O' who moves at a velocity of 0.8c relative to the cube in a direction parallel to 1 edge.

Q 8: State and prove law of equivalence mass and energy.

Q 9: A particle of rest mass m0 moves with a speed of 0.9c. What are its mass, momentum, total energy and kinetic energy?

Q 10: A relativistic electron (m0=0.511 MeV/c2) and a photon (m0=0) both have momentum of 2.00 MeV/c. Find the total energy of each.

**Ultrasonics**

Q 1: What is piezoelectric effect ? Explain the production of ultrasonic waves using piezoelectric method.

Q 2: How are ultrasonic waves generated and detected?

Q 3: Write notes on (a) application of ultrasonic wave (b) Piezoelectric effect (c) Magnetostriction effect

Q 4: An ultrasonic interferometer based is used to measure the velocity of ultrasonic waves in sea water. The distance between two consecutive anti nodes is found to be 0.4 mm. Calculate the velocity of waves in sea water. Frequency of waves generated by crystal is 1.5 mHz.

Q 5: What are the properties of ultrasonic waves?

Q 6: What is audible range of frequency and hence state what ultrasonic waves are?

Q 7: With the help of a need diagram, explain the working of a magnetostriction oscillator for generating ultrasonic.

Q 8: Describe the application of ultrasonic waves in engineering.

Q 9: Discuss the advantage and disadvantages of piezoelectric and magnetostriction methods in production of ultrasonic waves.

**Basic nuclear physics**

Q 1: Explain the term mean life time of a radioactive substances. Show that the mean life of a radioactive substance is reciprocal to its decay constant. Hence obtain the relation between mean time and half time of a radii active decay.

Q 2: Can a cyclotron be used to accelerate electrons? If not why?

Q 3: Describe the principle, construction and working of a Geiger-Muller counter. What are its limitations?

Q 4: Half life of Co60 is nearly 5.25 years. Find the duration it will take for the activity of the sample to decrease to 1/2 of its original value.

Q 5: Cyclotron is used to accelerate protons having a mass half that of the deuterons (a) if the magnetic field has the intensity of 2 Tesla, what is the change in the frequency of the oscillating electric field? (b) What is the maximum energy acquired by the proton, if the potential applied across the D's of cyclotron are 25 KV?

Q 6: The binding energy per nucleon for U238 is about 7.5 MeV, whereas it is about 8.5 MeV for nuclei of half that mass. If U238 nucleus was split into two equal size nuclei about how much energy would be released in the process?

Q 7: What do you understand by Q value of a nuclear reaction? What is its physical significance?

Q 8: What is ionization? How ionization produced by charged particle can be used to detect the particle?

Q 9: Why is the energy of α-particle discrete in α-decay?

Q 10: What do you understand by α-decay, β-decay and γ-decay?