Experiment 1: Newton's Rings

1. **What is interference of light?**
   Interference is the overlapping of two light waves resulting in alternate bright and dark regions due to constructive and destructive interference.

2. **Are there any conditions for obtaining interference of light?**
   Yes, the sources must be coherent (same frequency and constant phase difference) and have similar amplitudes.

3. **What do you mean by coherent sources?**
   Coherent sources emit waves that maintain a constant phase difference and the same frequency.

4. **How can you obtain coherent sources?**
   By splitting a single light beam using mirrors or a beam splitter.

5. **What is fringe width?**
   The distance between two consecutive bright or dark fringes in an interference pattern.

6. **Do you get fringes of equal or varying thickness?**
   The fringes have varying thickness because the thickness of the air film changes radially.

7. **What do you understand by wavelength of light?**
   Wavelength is the distance between two consecutive crests or troughs of a light wave, which determines its color.

8. **Why are Newton's rings circular in shape?**
   They are circular due to the symmetrical curvature of the lens on the flat glass plate.

9. **What should be the central spot, brighter or dark? What is it in your apparatus?**
   The central spot is dark due to destructive interference. It is also dark in our apparatus.

10. **Will a plane mirror not serve the purpose better than a plane glass plate?**
    No, a plane mirror reflects all light, while a glass plate allows partial reflection and transmission, necessary for interference.

11. **Why do you make the light fall on the convex lens normally?**
    To ensure symmetrical ring formation and avoid distortion.

12. **What will you get with an ordinary electric lamp instead of a sodium lamp?**
    You will get blurred and colorful fringes due to multiple wavelengths in white light.

13. **What are the precautions to perform Newton's ring experiment?**
    Use clean surfaces, avoid vibrations, and use monochromatic light for clear rings.

14. **What will be the change in the diameter of the rings if a drop of a transparent liquid is put between the lens and the plate?**
    The ring diameter decreases because the refractive index increases.

Experiment 2: LED

1. **Name elements exhibiting LED characteristics.**
   Gallium arsenide (GaAs), gallium phosphide (GaP), gallium nitride (GaN).

2. **What do you mean by cutting voltage?**
   The minimum forward voltage required to turn on the LED.

3. **Explain the graph of I vs V.**
   Current is nearly zero till threshold, then increases rapidly after cutting voltage.

4. **Why can we not see the infrared light? Explain.**
   Infrared has a longer wavelength beyond the visible range, so our eyes cannot detect it.

5. **The cutting voltage for red LED is ~1.54V and for infrared ~0.94V. Justify the relationship with its wavelength.**
   Lower voltage corresponds to longer wavelength (infrared), and higher voltage to shorter wavelength (red).

6. **What is depletion layer?**
   A region around the p-n junction without free charge carriers, acting as an insulator.

7. **What is drift and diffusion current?**
   Drift current is due to electric field; diffusion current is due to carrier concentration difference.

8. **Which charge carriers are conducting in reverse bias mode of a diode?**
   Minority carriers conduct in reverse bias.

9. **Draw the circuit diagram for forward bias.**
   Positive terminal to p-side and negative to n-side of the diode.

10. **What is the difference between LED and LASER?**
    LED emits incoherent, scattered light; LASER emits coherent, focused light.

11. **Why do we get current as milli amperes in forward bias but micro amperes in reverse bias?**
    In forward bias, many carriers move; in reverse bias, only a few minority carriers flow.

12. **Which type of semiconductor is used for construction of LEDs?**
    Direct band gap semiconductors are used because they emit light efficiently.

13. **Which process of electron hole pair is possible for emitting light?**
    Radiative recombination of electron-hole pairs.

14. **What should be the biasing for LED?**
    Forward bias is required for LED to emit light.

15. **Difference between LED and Photodiode?**
LED emits light when forward biased; photodiode detects light when reverse biased.

16. **What is the difference between normal LED and Zener?**
Zener is used for voltage regulation in reverse bias; LED emits light in forward bias.

Experiment 3: Photodiode

1. **What is the function of Photodiode?**
It converts light energy into electric current, used as a light sensor.

2. **What is the function of LDR?**
Its resistance decreases with increasing light intensity.

3. **What is dark current in Photodiode?**
The small current flowing even without light under reverse bias.

4. **What are different modes of operation of Photodiode?**
Photovoltaic (zero bias) and photoconductive (reverse bias) modes.

5. **Different applications of Photodiode in real life.**
Used in solar panels, remote controls, and light sensors.

Experiment 4: Hall Effect

1. **Define Hall effect.**
The production of voltage across a conductor when current flows in a magnetic field.

2. **How to generate magnetic field in experiment?**
Using an electromagnet connected to a power supply.

3. **What is the formula for Vh? Explain each term in it.**
Vh=IBnetV_h = \frac{IB}{net}Vh=netIB, where I = current, B = magnetic field, n = carrier density, e = charge, t = thickness.

4. **Define Rh. Explain its importance.**
Rh is Hall coefficient; it helps determine the type and concentration of charge carriers.

5. **What are the applications of Hall effect?**
Magnetic sensors, current measurement, position sensing.

6. **Explain the steps to perform Hall Effect experiment.**
Set up sample, apply current, magnetic field, measure Hall voltage.

7. **What is the graph plotted in Hall effect experiment and why?**
Vh vs. B or Vh vs. I, to determine Rh from the slope.

8. **Can you perform the experiment by varying magnetic field?**
   Yes, Vh can be measured by varying B while keeping current constant.

9. **What is the unit of Rh?**
   m^3/C (meter cube per coulomb).

10. **State the relation between Rh and Vh.**
    Rh = Vh × t / (I × B); they are directly related.

11. **What parameters are plotted on the graph to find Rh?**
    Hall voltage vs. magnetic field or current.

12. **What is Fleming's left-hand rule?**
    Thumb = force, forefinger = magnetic field, middle = current direction.

13. **Formula for force on a charge in magnetic field?**
    F = qvB (q = charge, v = velocity, B = magnetic field).

14. **Which type of charge carrier has greater mobility? Why?**
    Electrons, because they are lighter than holes.

15. **How is hall potential developed?**
    Due to magnetic force pushing charge carriers sideways.

16. **Is it possible to measure Hall coefficient for metals?**
    Yes, but the value is small.

17. **What will be the value of Hall coefficient for insulators?**
    Very high or undefined due to lack of free carriers.

18. **Define Hall coefficient.**
    Rh = 1 / (ne), where n is carrier density and e is charge.

19. **How does mobility depend on electrical conductivity?**
    Higher mobility means higher conductivity.

20. **What happens to Rh when number of charge carriers decreases?**
    Rh increases as it's inversely proportional to n.

21. **Name one practical use.**
    Position sensors in mobile phones and cars.

22. **Convert Gauss to Weber/m^2.**
    1 Gauss = 10^{-4} Weber/m^2.

Experiment 5: Energy Band Gap

1. **Define Eg.**
   Eg is the energy gap between the valence band and conduction band in a material.

2. **What is the importance of energy gap?**
   It determines whether a material behaves as a conductor, semiconductor, or insulator.

3. **Is the energy gap same for all semiconductors? And why?**
   No, it varies based on material properties like atomic structure and bonding.

4. **Difference between insulator, semiconductor and metal w.r.t energy gap:**
   Insulator: large gap (>5 eV), Semiconductor: small gap (~1 eV), Metal: no gap or overlapping bands.

5. **Energy gap values:**
   Insulator: >5 eV, Semiconductor (Si = 1.1 eV, Ge = 0.66 eV), Metal: 0 eV.

6. **Does energy gap exist in metal? Why?**
   No, because the valence and conduction bands overlap.

7. **What is four probe method and its importance?**
   It measures resistivity accurately by eliminating contact resistance.

8. **Why use four probe over two probe?**
   It avoids voltage drops at contact points, giving accurate results.

9. **Diode used in the lab:**
   Silicon diode.

10. **What happens to f(w/s) if w increases?**
    The value of f(w/s) increases.

11. **Why keep current constant?**
    To study the effect of temperature on resistance without additional variables.

12. **Graph parameters used:**
    ln(R) vs. 1/T is plotted to find Eg.

13. **Resistivity vs temperature:**
    In metals: increases, in semiconductors: decreases, in insulators: remains high.

14. **Effect of doping on bandgap:**
    Doping slightly reduces the bandgap and improves conductivity.

15. **Eg vs temperature:**
    Eg decreases slightly as temperature increases.

16. **Other methods to find Eg:**
    UV-Vis spectroscopy, Tauc plot method.

17. **How is reverse current produced in a p-n junction?**
    By minority carriers moving under reverse bias; depends on doping and temperature.

18. **Differentiate conductor, insulator, semiconductor by Eg:**
    Conductor = 0 eV, Semiconductor = ~1 eV, Insulator = >5 eV.

19. **Factors affecting germanium conductivity:**
    Temperature, doping level, and crystal purity.

20. **Electron conduction in n-type germanium:**
    Electrons from donors move into conduction band and carry current.

Experiment 6: LASER

1. **Acronym for LASER:**
   Light Amplification by Stimulated Emission of Radiation.

2. **What is diffraction grating & grating element?**
   A diffraction grating is an optical device with many lines; the grating element is the distance between two slits.

3. **He-Ne LASER: 3-level or 4-level?**
   4-level system, more efficient for continuous output.

4. **Why are He and Ne compatible?**
   Helium transfers energy to neon atoms efficiently for lasing action.

5. **3-level vs 4-level LASER systems:**
   3-level is less efficient and discontinuous; 4-level gives continuous output with easier population inversion.

6. **Applications of LASER:**
   Surgery, barcode scanners, fiber optics, printing, cutting tools.

7. **Other method to find wavelength:**
   Using diffraction grating or prism to analyze interference pattern.

Experiment 7: Wedge-Shaped Film

1. **Why Newton’s rings are circular, air wedge fringes straight?**
   Newton’s rings are formed by curved surfaces; wedge fringes by flat inclined plates.

2. **Principle involved:**
   Interference due to varying thickness of air film between plates.

3. **Change if mercury source is used instead of sodium lamp:**
   Multiple wavelengths from mercury cause colored, less distinct fringes.

4. **How is air wedge formed?**
   By placing a thin spacer between two glass plates to create a small angle.

Experiment 8: Ultrasonic Distance Measurement

1. **How ultrasonic sensor measures distance?**
   It sends sound waves and calculates distance from the time taken for echo to return.

2. **Why use ultrasonic sensor?**
   It is non-contact, accurate, and works in low-light or dusty environments.

3. **Factors affecting sensor performance:**
   Temperature, surface angle, humidity, air pressure, and object texture.

4. **Formula for distance:**
   Distance = (Speed of sound × Time)/2.

5. **What is piezoelectric effect?**
   Certain crystals generate voltage when mechanically stressed.

6. **How is piezoelectric effect reversible?**
   Applying voltage can cause mechanical deformation or vibrations in the crystal.

7. **Name any piezoelectric crystal:**
   Quartz.

Experiment 9: Fibre Optics

1. **Which light is used in optical fibre?**
   Infrared light or laser light is used for efficient transmission.

2. **Difference between single mode and multimode fibre:**
   Single mode has one light path (long distance); multimode has many paths (short distance).

3. **Principle of fibre optics communication:**
   Total internal reflection keeps light inside the core of the fibre.

4. **Losses in optical fibre:**
   Absorption, scattering, and bending losses.

5. **Explain scattering of light:**
   Light spreads in different directions due to imperfections in the fiber.

6. **Why cladding is coated by buffer?**
   To protect from mechanical damage and maintain signal strength.

7. **Why lasers are used in fibre optics?**
   Lasers provide coherent, focused light with minimal loss.

8. **What do you understand by bending losses?**
   Light escapes the core when fiber is bent too much, causing signal loss.

9. **Which fiber is suitable for long distance: SI or GRIN?**
   GRIN (Graded Index) fiber is better due to lower modal dispersion.

10. **If we notch a fibre and immerse it in water (n_2 replaced by water):**
    Total internal reflection is disrupted, and light escapes, reducing transmission.