

APPLIED PHYSICS 2 PRACTICAL VIVA VOCE Q/A

Viva Voce Hall Effect

Q: What is the Hall effect?

A: The Hall effect is the production of a voltage difference (Hall voltage) across a conductor or semiconductor perpendicular to the flow of an electric current when a magnetic field is applied perpendicular to the current.

Q: What is the principle behind the Hall effect? A: The Hall effect is based on the Lorentz force, which states that when a charged particle moves through a magnetic field, it experiences a force perpendicular to both its velocity and the magnetic field. In a conductor or semiconductor with a current flowing, the moving charges experience this force, resulting in a voltage difference across the material.

Q: What are the applications of the Hall effect? A: The Hall effect has various applications, including:

Magnetic field measurement: Hall effect sensors are used to measure magnetic fields in devices such as compasses and magnetometers.

Current sensing: Hall effect sensors can be used to measure current in electronic circuits.

Position and motion sensing: Hall effect sensors can detect the position and movement of objects in devices like proximity switches and rotary encoders.

Speed sensing: Hall effect sensors can measure the rotational speed of objects like wheels in automotive applications.

Q: How is the Hall effect experiment set up?

A: The Hall effect experiment typically involves a thin rectangular conductor or semiconductor strip through which a current is passed. The strip is placed in a magnetic field that is perpendicular to the current flow. A voltmeter is connected across the width of the strip to measure the Hall voltage.

Q: What are the factors that affect the Hall voltage in the experiment?

A: The Hall voltage depends on several factors, including:

The strength of the magnetic field applied.

The magnitude of the current passing through the conductor or semiconductor.

The number and type of charge carriers in the material.

The dimensions (width and thickness) of the conductor or semiconductor strip.

Q: How can the sign of the charge carriers in a material be determined using the Hall effect?

A: The sign of the charge carriers in a material can be determined by the polarity of the Hall voltage. If the Hall voltage is positive, it indicates that the charge carriers are positive (conventional current flow). If the Hall voltage is negative, it indicates that the charge carriers are negative (electron current flow).

Q: How can the Hall coefficient be calculated?

Q: How can the carrier density and mobility of charge carriers be determined from the Hall effect experiment?

Q: What are some sources of error in the Hall effect experiment?

A: Some sources of error in the Hall effect experiment include:

Inaccurate measurement of the current and voltage.

Non-uniform magnetic field strength.

Improper alignment of the sample with the magnetic field.

Temperature variations affecting the material properties.

e/m Viva

Q: What is the charge-to-mass ratio of an electron?

A: The charge-to-mass ratio of an electron (e/m) is a physical constant that represents the ratio of the electron's charge (e) to its mass (m). Its value is approximately $1.76 \times 10^{11} \text{ C/kg}$.

Q: What is the principle behind the charge-to-mass ratio of electron experiment?

A: The charge-to-mass ratio of electron experiment is based on the principles of cathode rays and the application of a magnetic field. When a beam of cathode rays (consisting of electrons) passes through a magnetic field, the resulting deflection can be used to determine the charge-to-mass ratio of the electrons.

Q: How is the charge-to-mass ratio of electron experiment set up?

A: The experiment typically involves a cathode ray tube, which consists of a cathode (electron emitter), an anode, and a fluorescent screen. A magnetic field is applied perpendicular to the path of the cathode rays using a Helmholtz coil or other means. The deflection of the cathode rays in the presence of the magnetic field is observed.

Q: What are the factors that affect the deflection of cathode rays in the experiment?

A: The deflection of cathode rays depends on several factors, including:

The strength of the magnetic field applied.

The velocity of the electrons in the cathode rays.

The charge-to-mass ratio of the electrons.

Q: How can the charge-to-mass ratio of electrons be determined from the experiment?

Q: What are some sources of error in the charge-to-mass ratio of electron experiment?

A: Some sources of error in the experiment include:

Inaccurate measurement of the magnetic field strength and deflection.

Variation in the velocity of electrons within the cathode rays.

Distortions in the electron beam due to imperfections in the cathode ray tube.

Magnetic field leakage or non-uniformity.

Q: What are the limitations of the charge-to-mass ratio of electron experiment?

A: The experiment assumes that the cathode rays consist solely of electrons and that they have a uniform velocity. However, there may be some impurities or variations in the cathode ray beam that can affect the accuracy of the results. Additionally, relativistic effects at high velocities can introduce uncertainties.

Q: How does the charge-to-mass ratio of an electron compare to other particles?

A: The charge-to-mass ratio of an electron is much larger than that of most other particles, such as protons or neutrons. This implies that electrons have a significantly lighter mass compared to their charge.

Q: What are the practical applications of the charge-to-mass ratio of electron?

A: The knowledge of the charge-to-mass ratio of electrons has led to numerous practical applications, including:

Cathode ray tubes: Used in old television sets and computer monitors.

Electron microscopes: Enable high-resolution imaging of small structures.

Mass spectrometry: Determines the masses of particles by their charge-to-mass ratios.

Particle accelerators: Employ electromagnetic fields to accelerate charged particles.

Melde's viva

Q: What is Melde's experiment?

A: Melde's experiment is an experiment that demonstrates the principles of standing waves in a stretched string or wire. It involves creating stationary waves by generating two waves of equal frequency and amplitude that travel in opposite directions along the string.

Q: What is the principle behind Melde's experiment?

A: The principle behind Melde's experiment is the superposition of waves. When two waves of the same frequency and amplitude travel in opposite directions along a string, they interfere constructively and destructively, forming stationary waves with distinct nodes and antinodes.

Q: How is Melde's experiment set up?

A: Melde's experiment typically involves a long string or wire that is stretched ...

ΔE viva

Q: What is the energy band gap of a semiconductor?

A: The energy band gap of a semiconductor is the energy difference between the valence band (the highest energy band filled with electrons) and the conduction band (the lowest energy band with vacant states) in the electronic band structure of the semiconductor material.

Q: What is the importance of the energy band gap in semiconductors?

A: The energy band gap is a crucial property of semiconductors as it determines their electrical behavior. It influences the conductivity, optical properties, and the types of electronic transitions that can occur in the material.

Q: How is the energy band gap of a semiconductor experiment set up?

A: The experiment typically involves a light source that emits a range of wavelengths, such as a spectrometer or a monochromatic light source combined with a filter. The light is directed onto the semiconductor sample, and a detector measures the intensity of the transmitted or reflected light. The intensity is then plotted as a function of wavelength.

Q: What are the factors that affect the absorption spectrum in the experiment?

A: The absorption spectrum in the experiment is influenced by several factors, including:

The energy band gap of the semiconductor material.

The nature and concentration of impurities or dopants in the material.

The temperature of the sample.

The purity and crystal structure of the semiconductor material.

Q: How can the energy band gap of a semiconductor be determined from the experiment?

Q: What are some sources of error in the energy band gap of semiconductor experiment?

A: Some sources of error in the experiment include:

Imperfections or impurities in the semiconductor material affecting the absorption spectrum.

Non-uniformity in the thickness or composition of the sample.

Temperature variations affecting the electronic structure of the material.

Q: What are the practical applications of understanding the energy band gap of semiconductors?

A: Understanding the energy band gap of semiconductors has various practical applications, including:

Semiconductor devices: The energy band gap determines the functionality and performance of devices such as diodes, transistors, and solar cells.

Optoelectronics: Knowledge of the energy band gap is crucial for the design and development of LEDs, lasers, and photodetectors.

Semiconductor materials engineering: The energy band gap influences the selection and optimization of semiconductor materials for specific applications.

Q: How does the energy band gap vary among different semiconductor materials?

A: The energy band gap varies among different semiconductor materials and can range from very small (in the order of milli-electron volts) to several electron volts. Materials like silicon have an energy band gap of about 1.1 eV, while gallium nitride has a larger energy band gap of around 3.4 eV.

Sonometer viva

Q: What is a sonometer?

A: A sonometer is an experimental apparatus used to study the properties of vibrating strings. It consists of a hollow wooden box with a string stretched over it, along with adjustable tensioning mechanisms and a means to excite the string.

Q: What is the principle behind the frequency of AC mains by a sonometer experiment?

A: In the frequency of AC mains by a sonometer experiment, the sonometer is used to measure the frequency of the alternating current (AC) mains supply. The string on the sonometer is excited by an external source, and the length of the string is adjusted until resonance occurs. The frequency at which resonance occurs corresponds to the frequency of the AC mains supply.

Q: How is the frequency of AC mains by a sonometer experiment set up?

A: The experiment typically involves connecting the sonometer to the AC mains supply using an appropriate connector or transformer. The sonometer string is excited by a tuning fork, a mechanical driver, or an electronic oscillator. The length of the string is adjusted using movable bridges or sliders until the maximum resonance is obtained.

Q: What are the factors that affect the resonance in the sonometer experiment?

A: The resonance in the sonometer experiment is influenced by several factors, including:

1. The tension in the string: Higher tension results in higher frequencies of resonance.
2. The length of the string: Adjusting the length of the string changes the effective wavelength and affects the resonant frequency.
3. Damping: Excessive damping can dampen the resonance and affect the accuracy of the frequency measurement.

Q: How can the frequency of the AC mains supply be determined from the sonometer experiment?

A: The frequency of the AC mains supply can be determined by adjusting the length of the sonometer string until resonance occurs. The length at which maximum resonance is obtained corresponds to half the wavelength of the AC mains frequency. Equation is $f = \frac{n}{2l} \sqrt{\frac{T}{m}}$, where $n = 1, 2, 3, \dots$

Q: What are some sources of error in the frequency of AC mains by a sonometer experiment?

A: Some sources of error in the experiment include:

1. Inaccurate measurement of the string length.

2. Imperfections or variations in the sonometer string affecting its vibrational properties.
3. Variations in tension or damping during the experiment.
4. Background noise or interference affecting the resonance detection.

Q: What are the practical applications of measuring the frequency of AC mains?

A: Measuring the frequency of AC mains has various practical applications, including:

1. Synchronization of electrical equipment: Many electrical devices and systems require synchronization with the AC mains frequency to operate correctly.
2. Calibration of timekeeping devices: Accurate timekeeping devices often rely on the frequency of the AC mains supply as a reference.
3. Power grid monitoring: Monitoring the frequency of the AC mains supply is important for maintaining stability and grid synchronization in power systems.

Zener diode viva

Q1: What is a Zener diode?

A1: A Zener diode is a specially designed diode that operates in the reverse breakdown region. It is primarily used for voltage regulation and protection against voltage spikes in electronic circuits.

Q2: How does a Zener diode differ from a regular diode?

A2: A regular diode is designed to operate in the forward bias region and allows current to flow in one direction. However, a Zener diode is designed to operate in the reverse bias region and exhibits a controlled breakdown voltage, called the Zener voltage.

Q3: What is the symbol of a Zener diode in a circuit diagram?

A3: The symbol of a Zener diode is similar to a regular diode, but it includes two additional diagonal lines crossing the vertical line, representing the breakdown voltage.

Q4: How can you determine the Zener voltage of a Zener diode experimentally?

A4: The Zener voltage of a diode can be determined by connecting it in reverse bias with a series resistor and gradually increasing the input voltage until the diode starts conducting. At that point, the voltage across the diode is equal to the Zener voltage.

Q5: How can you measure the Zener voltage using a voltmeter in the experiment?

A5: To measure the Zener voltage, connect the voltmeter in parallel across the Zener diode in the reverse bias configuration. Gradually increase the input voltage until the voltmeter reads the Zener voltage.

Q6: What is the purpose of the series resistor in the Zener diode experiment?

A6: The series resistor limits the current flowing through the Zener diode. It helps to protect the diode from excessive current and dissipates excess voltage across itself when the Zener diode starts conducting.

Q7: Why is the Zener diode operated in the reverse breakdown region?

A7: The Zener diode is operated in the reverse breakdown region to maintain a constant voltage across it, irrespective of the variations in the input voltage. It acts as a voltage regulator in electronic circuits.

Q8: What is the significance of the knee voltage in the characteristic curve of a Zener diode?

A8: The knee voltage is the minimum voltage required for a Zener diode to start conducting in the reverse bias region. It indicates the beginning of the breakdown region and helps determine the Zener voltage.

Q9: What are some applications of Zener diodes?

A9: Zener diodes are commonly used in voltage regulation circuits, voltage reference circuits, overvoltage protection, and in various types of power supplies.

Q10: What precautions should be taken while handling Zener diodes during the experiment?

A10: Some precautions include avoiding excessive forward biasing, protecting the diode from static discharge, using proper heat sinking if necessary, and ensuring that the maximum power dissipation limits are not exceeded.

Flashing and quenching of neon lamp viva

Q1: What is the purpose of the flashing and quenching experiment using a neon lamp and a capacitor?

A1: The purpose of this experiment is to demonstrate the phenomenon of flashing and quenching in a neon lamp and understand how a capacitor can influence the behavior of the lamp.

Q2: What is flashing and quenching in a neon lamp?

A2: Flashing is the initial bright glow observed in a neon lamp when a high voltage is applied, while quenching is the subsequent dimming or extinction of the glow.

Q3: How does the neon lamp work?

A3: A neon lamp contains neon gas at low pressure. When a high voltage is applied across the electrodes, the gas ionizes and produces a glowing discharge, creating the characteristic glow of the lamp.

Q4: How does a capacitor affect the flashing and quenching of the neon lamp?

A4: When a capacitor is connected in parallel with the neon lamp, it stores electrical energy during the flashing phase. This stored energy is discharged through the lamp during the quenching phase, influencing the behavior and duration of the glow.

Q5: What happens to the neon lamp when the capacitor is not connected in the circuit?

A5: Without the capacitor, the neon lamp will flash once when the high voltage is initially applied, but the glow will quickly diminish or extinguish due to the absence of stored energy for sustained discharge.

Q6: How does the capacitance value affect the flashing and quenching behavior of the neon lamp?

A6: The capacitance value of the capacitor affects the amount of energy stored and discharged. A higher capacitance value will result in a longer flashing and quenching duration, as more energy is stored and released.

Q7: What is the significance of the resistor connected in series with the neon lamp?

A7: The resistor limits the current flowing through the neon lamp, preventing excessive current that could damage the lamp or other components. It also helps control the discharge characteristics and stabilize the glow.

Q8: What factors affect the flashing and quenching behavior of the neon lamp other than the capacitor?

A8: The voltage applied to the lamp, the gas pressure in the lamp, and the distance between the electrodes can affect the flashing and quenching behavior of the neon lamp.

Q9: What are some practical applications of neon lamps?

A9: Neon lamps are commonly used in indicators, advertising signs, voltage surge protection devices, and decorative lighting due to their distinctive glow and low power consumption.

Q10: How can you observe and record the flashing and quenching behavior in the experiment?

A10: You can observe the flashing and quenching behavior of the neon lamp visually and record the duration and characteristics of the glow using a stopwatch or by capturing the lamp's behavior with a camera or video recorder.

Q14: What is the unit of capacitance?

A14: The unit of capacitance is the farad (F). However, capacitors are commonly denoted in smaller units such as microfarads (μF), nanofarads (nF), or picofarads (pF).

Q15: What factors affect the capacitance of a capacitor?

A15: The capacitance of a capacitor is influenced by the surface area of the plates, the distance between the plates (dielectric thickness), and the dielectric constant of the material between the plates.

Q16: What is the difference between a polarized and non-polarized capacitor?

A16: A polarized capacitor is designed to be connected in a specific polarity in a circuit, as it has a positive and negative terminal. Non-polarized capacitors, on the other hand, can be connected in any direction in a circuit.

Q17: What is the role of a dielectric material in a capacitor?

A17: The dielectric material in a capacitor provides insulation between the plates and determines the capacitance value. It enhances the capacitor's ability to store charge by reducing the electric field strength between the plates.

Q18: How does the capacitance value affect the storage capacity of a capacitor?

A18: The capacitance value directly determines the amount of charge a capacitor can store for a given voltage. A higher capacitance value means a larger charge storage capacity.

Q19: What are some common applications of capacitors?

A19: Capacitors are used in various applications such as energy storage in power supplies, timing circuits, filters, motor starting circuits, coupling and decoupling applications, and noise suppression in electronic circuits.

Q20: How can you test a capacitor using a multimeter?

A20: To test a capacitor using a multimeter, set the multimeter to the capacitance measurement mode and connect the leads to the capacitor terminals. The multimeter will display the capacitance value if the capacitor is in working condition.

Time constant by charging and discharging of capacitor viva

Q1: What is the time constant of a charging or discharging capacitor?

A1: The time constant of a charging or discharging capacitor is the time it takes for the voltage across the capacitor to reach approximately 63.2% of its final value during charging or to decrease to approximately 36.8% of its initial value during discharging.

Q2: How can you determine the time constant experimentally?

A2: To determine the time constant experimentally, you can measure the voltage across the capacitor at different time intervals during charging and discharging and then plot a graph of voltage versus time. The time constant can be calculated as the time it takes for the voltage to reach the aforementioned percentage (63.2% or 36.8%) of its final or initial value.

Q3: What is the formula for calculating the time constant?

A3: The time constant (τ) of a charging or discharging capacitor can be calculated using the formula: $\tau = R * C$, where R is the resistance in the circuit and C is the capacitance of the capacitor.

Q4: What is the significance of the time constant in a charging or discharging capacitor?

A4: The time constant determines the rate at which a capacitor charges or discharges. It indicates how quickly the voltage across the capacitor changes and how long it takes for the capacitor to reach a certain percentage of its final or initial voltage.

Q5: What factors affect the time constant of a charging or discharging capacitor?

A5: The time constant is influenced by the resistance (R) and capacitance (C) values in the circuit. A larger resistance or capacitance will result in a longer time constant, indicating a slower charging or discharging process.

Q6: What precautions should be taken during the experiment to accurately determine the time constant?

A6: Some precautions include ensuring that the capacitor is fully discharged before starting the experiment, using appropriate values for resistance and capacitance, making accurate voltage measurements, and minimizing external disturbances that could affect the results.

Q7: What is the difference between charging and discharging of a capacitor?

A7: Charging of a capacitor refers to the process of increasing the voltage across the capacitor by allowing current to flow into it, while discharging refers to the process of decreasing the voltage across the capacitor by allowing current to flow out of it.

Q8: How does the time constant affect the charging and discharging process?

A8: A larger time constant indicates a slower charging or discharging process, meaning that it will take more time for the capacitor to reach a certain voltage level during charging or to discharge to a certain voltage level during discharging.

Q9: What are some applications of capacitors and their time constant?

A9: Capacitors and their time constant are used in various applications, including timing circuits, filtering circuits, energy storage, and smoothing of power supplies.

Q10: How can you verify the experimentally determined time constant?

A10: You can compare the experimentally determined time constant with the theoretical value calculated using the resistance and capacitance values in the circuit. If the values are reasonably close, it indicates the accuracy of the experimental results.

Q11: What is a capacitor?

A11: A capacitor is an electronic component that stores and releases electrical energy. It consists of two conductive plates separated by an insulating material called a dielectric.

Q12: How does a capacitor work?

A12: A capacitor works by storing electrical charge on its plates when a voltage is applied across it. The charge is stored in the form of an electric field between the plates, and the amount of charge stored is proportional to the applied voltage.

Q13: What is the symbol of a capacitor in a circuit diagram?

A13: The symbol of a capacitor in a circuit diagram is two parallel lines representing the plates, with a gap in between, and a curved line connecting the plates.