Course: Physics-V (8671) **Semester: Spring, 2023**

Level: BEd (2.5 & 4 Years)

Total Marks: 100 **Pass Marks: 50**

ASSIGNMENT No. 2

(Units: 11–24)

Q. 1 Explain steps in Determination of index for glass prims by using spectrometer. **(25)**

Determining the refractive index of a glass prism using a spectrometer involves several steps. Here's a step-by-step guide:

- **Setup**: First, set up the spectrometer on a stable surface. Ensure that the spectrometer is level by adjusting the leveling screws.
- **Alignment**: Align the collimator of the spectrometer to the telescope. This is done by focusing the telescope on a distant object and then adjusting the collimator until the cross-wires are sharp and clear.
- **Prism Placement**: Place the glass prism on the prism table of the spectrometer. The refracting edge of the prism should be perpendicular to the collimator.

- **Initial Angle Measurement**: Rotate the telescope until it is directly opposite the collimator. Look through the telescope and rotate the prism table until the refracting edge of the prism is aligned with the cross-wires. This is the initial angle of the prism.

- **Angle of Minimum Deviation**: Rotate the prism table slowly and observe the spectrum through the telescope. The color bands will move. Continue rotating until the color bands stop moving and start to reverse direction. This is the angle of minimum deviation (D).

Measure the Angle of Minimum Deviation: Record the reading on the spectrometer scale. Repeat this process for different colors (wavelengths) of light to get a range of minimum deviation angles.

Calculation: Use the formula for the refractive index (n) of the prism:

$$n = \sin[(A+D)/2] / \sin(A/2)$$

where A is the prism angle and D is the angle of minimum deviation.

- **Repeat for Different Wavelengths**: Repeat steps 5-7 for different wavelengths of light. The refractive index of the prism will vary slightly with the wavelength of light due to dispersion.

- **Average**: Calculate the average refractive index from the values obtained for different wavelengths.

- **Data Analysis**: Once you have obtained the refractive index values for different wavelengths, analyze the data. Look for any patterns or trends in the refractive index values as the wavelength changes. This can provide insights into the dispersion properties of the glass prism.

- . **Error Analysis**: Perform an error analysis to assess the accuracy and precision of your measurements. Calculate the uncertainties associated with the angle measurements and the refractive index values. Consider sources of error such as parallax, instrumental errors, and environmental factors.

- **Comparison**: Compare your experimental refractive index values with the known refractive index values for the type of glass used in the prism. This will help validate the accuracy of your measurements and identify any discrepancies.

- **Report and Conclusion**: Summarize your findings in a report. Include details about the experimental setup, the measured angles, the calculated refractive index values, and any sources of error. Draw conclusions based on your results and discuss the significance of your findings.

It's important to note that the specific steps and procedures may vary depending on the type of spectrometer and prism being used. Always refer to the manufacturer's instructions and any relevant scientific literature for detailed guidance.

Q. 2 Write processes for conversion of galvanometer into vomiter. **(25)**

It seems there might be a misunderstanding or confusion regarding the term "vomiter" in this context. A "vomiter" is not a standard term in the field of electronics or instrumentation. I assume you may be referring to "voltmeter" instead, which is an instrument used to measure voltage.

If that's the case, I can provide you with steps to convert a galvanometer into a voltmeter. A galvanometer is an instrument that detects and measures small electric currents, and with some modifications, it can be transformed into a voltmeter to measure voltage. Here are the processes to do that:

Materials Needed:

1. Galvanometer
2. High-impedance resistor (appropriate value depending on the desired voltage range)
3. Connecting wires
4. Voltmeter (for calibration/reference)

Step 1: Determine the Galvanometer Sensitivity

Find out the sensitivity of the galvanometer, which is usually given in terms of the deflection angle for a specific current. For example, if the galvanometer's sensitivity is 1 division for 1 mA of current, it means the deflection angle changes by one division for every 1 mA of current passing through it.

Step 2: Choose the Voltage Range

Decide on the voltage range you want your voltmeter to measure. For example, if you want a voltmeter to measure up to 10 volts, you need to choose a high-impedance resistor that will convert a given voltage into a current within the galvanometer's sensitivity range.

Step 3: Calculate the Resistor Value

Use Ohm's Law to calculate the value of the high-impedance resistor needed. The formula to calculate the resistor value is $R = V/I$, where V is the voltage range, and I is the galvanometer sensitivity (current corresponding to one division).

Step 4: Connect the Resistor in Series

Connect the chosen high-impedance resistor in series with the galvanometer. This is typically done by breaking the galvanometer circuit and inserting the resistor in between.

Step 5: Calibration

Calibrate the converted voltmeter using a reliable reference voltmeter. Apply known voltages to the converted voltmeter and adjust the calibration if needed to ensure accurate readings.

Step 6: Mark the Scale

If your galvanometer doesn't have a calibrated scale for voltage, you may need to mark a scale on the meter face corresponding to the voltage values based on the calibration.

Important Note: The conversion process described above is a basic outline. Depending on the specific type and design of the galvanometer, additional adjustments or modifications might be necessary for a precise and accurate voltmeter conversion.

If you meant something different by "vomiter," please provide more context or clarification so that I can better assist you.

Q. 3 Write details for exploring the characteristics of Semiconductor Diode (compare with Si & Ge diode) **(25)**

Exploring the characteristics of semiconductor diodes, specifically comparing silicon (Si) and germanium (Ge) diodes, involves understanding their electrical properties, temperature dependencies, and applications. Below are the details for exploring these characteristics:

Material Properties:

Silicon Diode (Si): Silicon diodes are widely used due to their stability, higher breakdown voltage, and wider temperature range. The bandgap energy of silicon is around 1.1 eV, which determines its electrical properties.

Germanium Diode (Ge): Germanium diodes have a lower bandgap energy of around 0.67 eV compared to silicon. This leads to higher reverse leakage current and lower breakdown voltage, making them less suitable for certain applications compared to silicon diodes.

Forward Voltage Drop (Vf):

Si Diode: The forward voltage drop of a silicon diode is typically around 0.6 to 0.7 volts.

Ge Diode: The forward voltage drop of a germanium diode is lower, usually around 0.2 to 0.3 volts. This characteristic makes germanium diodes more suitable for low-power applications.

Reverse Leakage Current (IR):

Si Diode: Silicon diodes generally have a lower reverse leakage current, which means they exhibit better rectification properties and lower leakage when reverse biased.

Ge Diode: Germanium diodes have higher reverse leakage current compared to silicon diodes, which can limit their use in certain high-performance applications.

Temperature Dependence:

Si Diode: Silicon diodes have a relatively low temperature coefficient of forward voltage drop (around -2 mV/°C), making them more stable across a wide temperature range.

Ge Diode: Germanium diodes have a higher temperature coefficient of forward voltage drop (around -2.5 mV/°C), making their characteristics more temperature-dependent.

Breakdown Voltage:

Si Diode: Silicon diodes have higher breakdown voltage capabilities, typically in the range of tens to hundreds of volts.

Ge Diode: Germanium diodes have lower breakdown voltages, usually in the range of a few volts. This limits their use in high-voltage applications.

Applications:

Si Diode: Silicon diodes are widely used in various electronic circuits, including power rectifiers, signal rectifiers, voltage regulators, and light-emitting diodes (LEDs).

Ge Diode: Germanium diodes were historically used in early electronic devices, but due to their lower performance in comparison to silicon diodes, their usage has diminished over time. However, they can still be found in some niche applications such as in certain infrared detectors and radio-frequency (RF) applications.

Reverse Recovery Time:

Si Diode: Silicon diodes typically have longer reverse recovery times compared to germanium diodes, which may affect their switching characteristics in high-frequency applications.

Ge Diode: Germanium diodes have faster reverse recovery times, making them more suitable for some high-frequency rectification and switching applications.

silicon diodes offer better overall performance, stability, and wider temperature range compared to germanium diodes. However, germanium diodes still find specific applications in certain niche areas due to their lower forward voltage drop and faster reverse recovery times. Choosing the appropriate diode depends on the specific requirements of the circuit or application at hand.

Q. 4 Design and verify the truth tables for NAND and NOR gates. **(25)**

let's design and verify the truth tables for NAND and NOR gates.

1. NAND Gate:

A NAND gate is a digital logic gate that performs the logical AND operation followed by a logical NOT operation. It has two or more inputs and one output.

Truth Table for 2-input NAND Gate:

Input A	Input B	Output
0	0	1
0	1	1
1	0	1
1	1	0

The output is 1 (HIGH) only when both inputs A and B are 0. For all other input combinations, the output is 0 (LOW).

2. NOR Gate:

A NOR gate is a digital logic gate that performs the logical OR operation followed by a logical NOT operation. It has two or more inputs and one output.

Truth Table for 2-input NOR Gate:

Input A	Input B	Output
0	0	1
0	1	0
1	0	0
1	1	0

The output is 1 (HIGH) only when both inputs A and B are 0. For all other input combinations, the output is 0 (LOW).

Verification of NAND Gate:

Let's verify the NAND gate truth table using a simple example. We'll use the 2-input NAND gate:

Input A	Input B	Output (A NAND B)
0	0	1
0	1	1
1	0	1
1	1	0

Now, let's check the output of the NAND gate using the truth table:

For (A = 0, B = 0):

Output = NOT (0 AND 0) = NOT (0) = 1

For (A = 0, B = 1):

Output = NOT (0 AND 1) = NOT (0) = 1

For (A = 1, B = 0):

Output = NOT (1 AND 0) = NOT (0) = 1

For (A = 1, B = 1):

Output = NOT (1 AND 1) = NOT (1) = 0

The output values match the truth table, confirming that the NAND gate functions correctly.

Verification of NOR Gate:

Similarly, let's verify the NOR gate truth table using the 2-input NOR gate:

Input A	Input B	Output (A NOR B)
0	0	1
0	1	0
1	0	0
1	1	0

Now, let's check the output of the NOR gate using the truth table:

For (A = 0, B = 0):

Output = NOT (0 OR 0) = NOT (0) = 1

For (A = 0, B = 1):

Output = NOT (0 OR 1) = NOT (1) = 0

For (A = 1, B = 0):

Output = NOT (1 OR 0) = NOT (1) = 0

For (A = 1, B = 1):

Output = NOT (1 OR 1) = NOT (1) = 0

The output values match the truth table, confirming that the NOR gate functions correctly.

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