ACHARYA NARENDRA DEV COLLEGE

University of Delhi

NAAC Grade 'A' | DBT STAR College | All India NIRF Ranking 2021– '20'

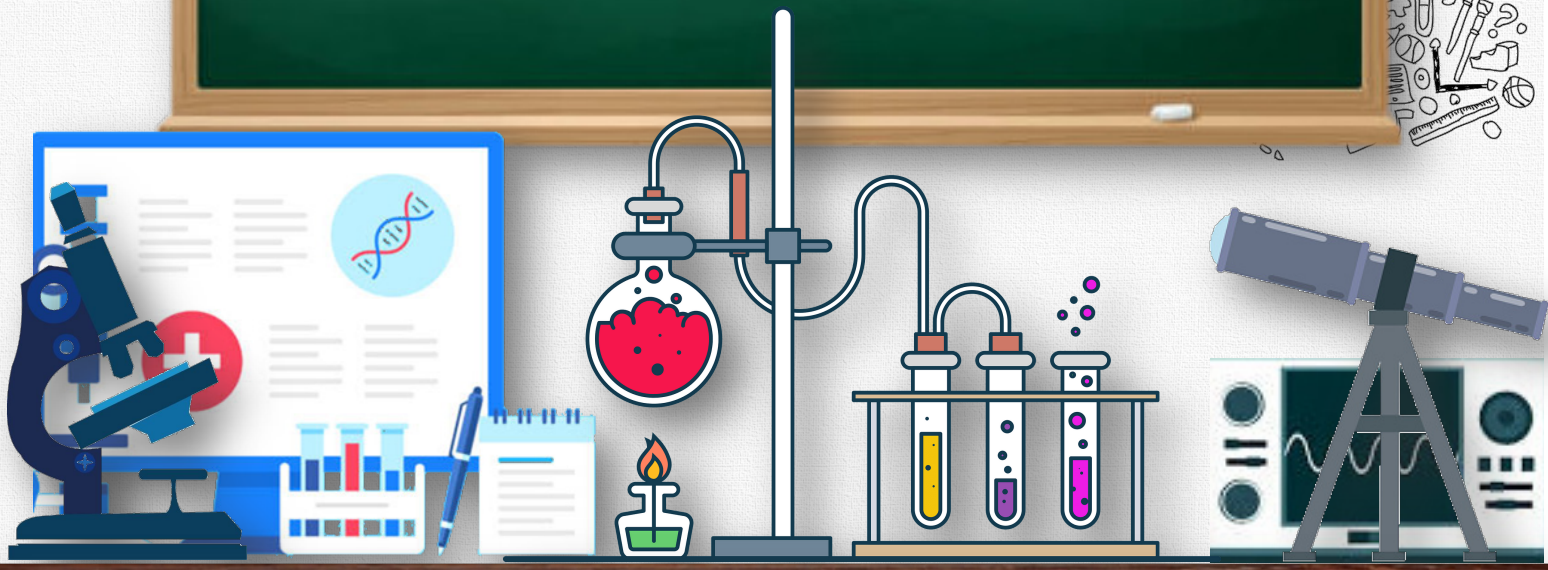
Science Adda

One-day Interaction Programme

December 20, 2021

Organized under

DBT STAR College Scheme



Azadi Ka Amrit Mahotsav

WORKSHOP MANUAL

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WORKSHOP MANUAL

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Chemistry Department

Hands-on Demonstration of Paper Chromatography Protocols

Aim: To separate the components from the mixture of Amino Acids by Radial Paper Chromatography

Requirements:

1. Whatman No.1 chromatography paper
2. Chromatography solvent (Isopropanol: water)
3. Visualizing reagent/spraying reagent (dissolve 0.2 g ninhydrin in 100 ml of acetone just before use) with Sprayer
4. Standard amino acids: prepare 10 ml of 1% solution of each amino acid (Proline and Histidine) in water. Sometimes a drop of acid or alkali is needed to bring the compound in to solution. Mix the equal amounts (2-2 ml) of both types of amino acids in a separate test tube.
5. Capillary tubes
6. Petri-dish set
7. Cotton
8. Any pin
9. Pencil and scale
10. Oven

Theory and Principle:

Chromatography is a common technique for separating chemical substances. The prefix "chroma," which suggests "color," comes from the fact that some of the earliest applications of chromatography were to separate components of the green pigment, chlorophyll. First demonstrated by Michael Tswett, a Russian botanist who reports the separation of plant pigments (coloring agents) by this method in 1903, chromatography has since been applied to every conceivable type of compound in a wide variety of uses.

Chromatography is a method of separation of the components of a mixture, due to differential distribution of the components between two phases, one of which is stationary while the other is a mobile phase. Stationary phase (solid or liquid) adsorbs the components of the mixture and the second, the mobile phase (liquid here) which while passing through the stationary phase transports the components of the mixture on to it. The components of the mixture are transported at different rates. The more strongly adsorbed components move slowly with the moving phase and the weakly adsorbed components move faster along with the moving phase. Chromatography is partially characterized by the medium on which the separation occurs. This medium is commonly identified as the "stationary phase". Stationary phases that are typically used include moisture or water present in the pores of cellulose fibres of paper (as in paper chromatography in this experiment). The compositions of the stationary and mobile phases define a specific chromatographic method. Indeed, many different combinations are possible. However, all of the methods are based on the rate at which the analyzed substances migrate while in simultaneous contact with the stationary and mobile phases. The relative affinity of a substance for each phase depends on properties such as molecular weight, structure and shape of the molecule, and the polarity of the molecule.

In this experiment, very small volumes of mixture of amino acid solution will be applied (this process is called "**spotting**") at the centre of the circular paper. After the solutions have been applied, a cotton wick is inserted at the centre and the paper will be placed on petri-dish that contains a few milliliters of the liquid mobile phase. For this separation, a solution containing isopropanol and water is used as optimised mobile phase. As soon as the paper is placed in the mobile phase, the solution (sometimes called the eluting solvent) will begin to spread on the paper horizontally (radially) to form the concentric rings of different compounds.

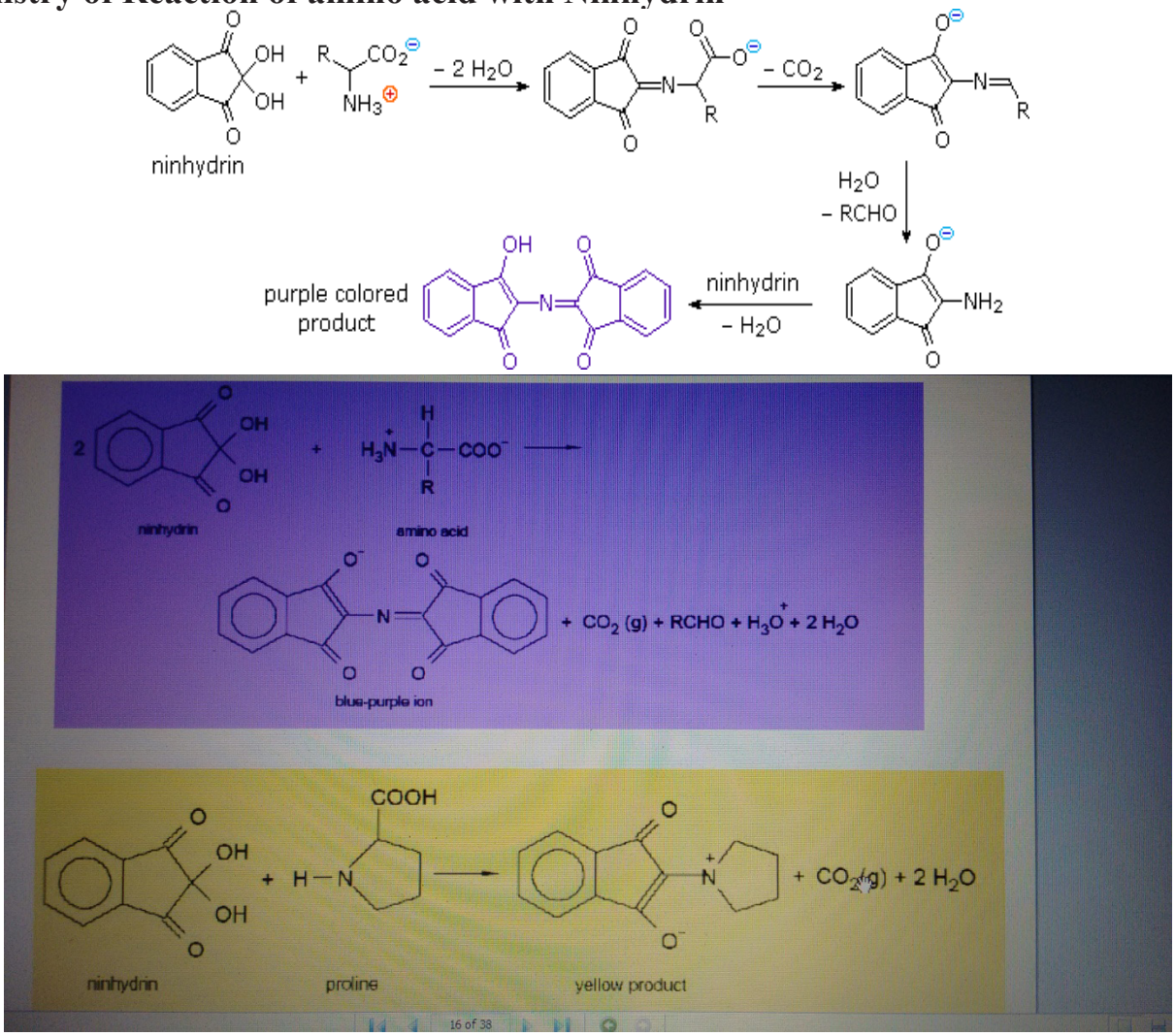
The movement of each amino acid in the mixture depends on the affinity of each substance for the mobile and stationary phases. If an amino acid has a higher affinity for the mobile phase than the stationary phase, it will tend to travel with the solvent and be relatively less hindered by the filter paper. In contrast, if the amino acid has a higher affinity for the paper than the solvent, it will tend to "stick" to the paper and travel more slowly than the solvent. The differences in the amino acid affinities led to their separation on the paper. The affinities of these amino acids for the mobile phase can be correlated to the solubility of the different amino acids in the solvent (i.e., an amino acid that is highly soluble in the solvent will have a higher affinity for the mobile phase

than an amino acid that is less soluble in the solvent).

When the solvent has moved near the periphery of the filter paper, the paper is removed from the petri-dish. Then mark the dotted circle (using pencil only) upto which the solvent has been moved. This circle has been taken to calculate the distance travelled by the solvent (mobile phase) and then allowed to dry. At this point, amino acids are invisible which further can be visualized by spraying the paper with a compound called ninhydrin. Ninhydrin reacts with amino acids to form a blue-violet compound. Therefore, the sprayed filter paper should show the rings, each one corresponding to an amino acid. The farther the ring from the centre, the higher the affinity of the amino acid for the mobile phase and the faster it's migration.

The relative extent to which solute molecules move in a chromatography experiment is indicated by Rf values (retardation or retention factor). The Rf value for a component is defined as the ratio of the distance moved by that particular component divided by the distance moved by the solvent. The R_f values provide a useful index for comparing two compounds.

Chemistry of Reaction of amino acid with Ninhydrin



Radial chromatography is a successful and user-friendly approach because of its low solvent consumption, reproducibility and time efficiency.

Procedure:

- Take a circular chromatography paper and mark the centre of the paper (using a pencil) without folding it and avoiding more of touching (We can make a thumb mark at the paper and will always use this to hold.
- Prepare the solvent system i.e., isopropanol:water (70:30)v/v and pour into smaller piece of the petri-dish set.
- Allow this system to saturate with solvent system before introducing the paper.
- Use the capillary tubes and place small amount of mixture solution of amino acid at the marked centre. And air dry this spot. Repeat the same procedure twice.
- Let the paper dry for few minutes in air.
- Make a cotton wick and insert this wick from the centre with the help of all-pin as shown in **Figure 1**.
- Then place this paper carefully in the chamber of solvent considering that sufficient amount of the wick should be dipped in the solvent system.
- Allow the solvent to run through the chromatography paper until it reaches close to the periphery of the paper.
- Take out the chromatogram and air dry.
- Spray with the visualizing reagent on chromatogram and keep in oven at 100 °C for 2 minutes.
- After getting rings on paper, use pencil and scale to draw two lines passing through centre and at 90 degree to each other (making a cross symbol) upto the solvent front (line) as shown in **Figure 2a**.
- Measure the distances travelled by the solvent in all 4 directions and take average of those values.
- Similarly measure the distances travelled by the amino acids **A** and **B** from centre to the rings in all 4 directions along the cross mark and take the average value to further calculate Rf as shown in **Figure 2b**.

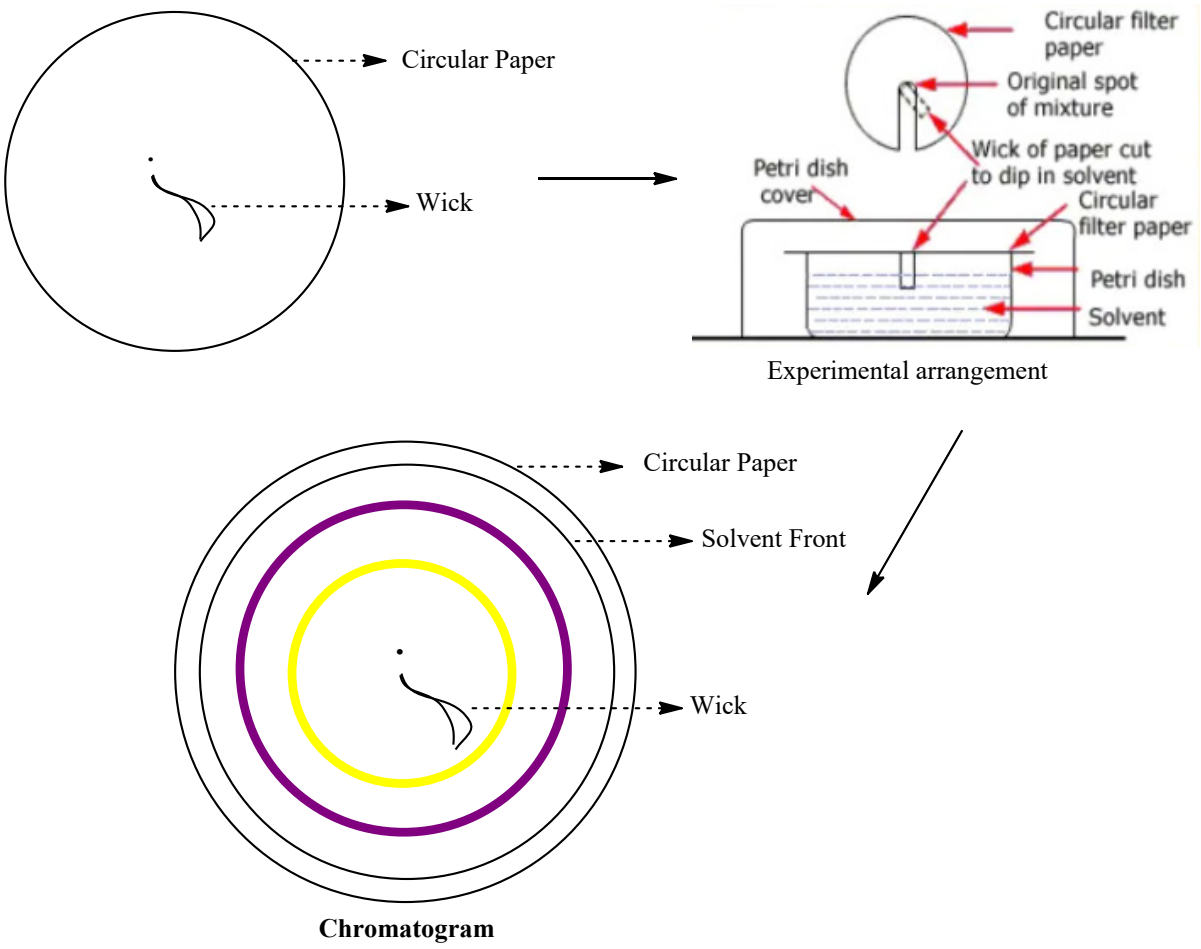


Figure 1: Experimental arrangement and developed chromatogram

Observations:

The purple and yellow (brown) colored concentric rings appeared on the chromatogram. Calculate the Rf values of the components moved using rings and record your observations on the report sheet.

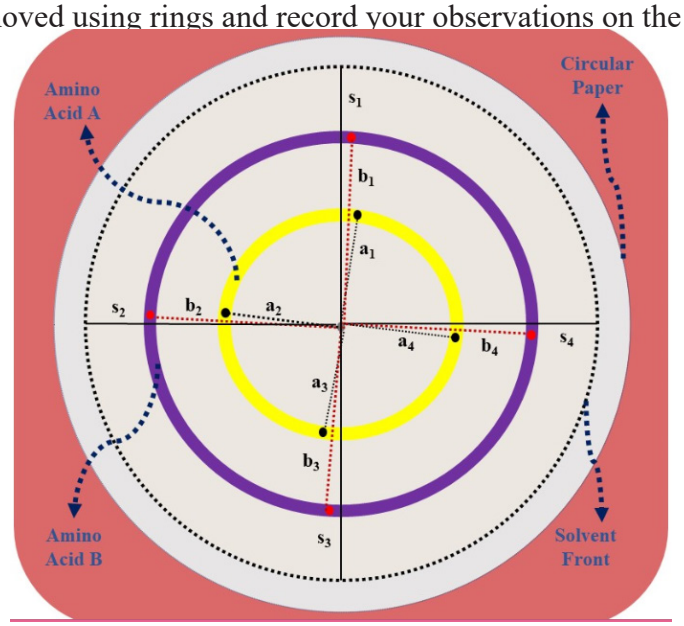


Figure 2a: Way to measure the distance travelled by amino acids and solvent

$$\text{Average distance travelled by A (X in Cm)} = \frac{a_1 + a_2 + a_3 + a_4}{4}$$

$$\text{Average distance travelled by B (Y in Cm)} = \frac{b_1 + b_2 + b_3 + b_4}{4}$$

$$\text{Average distance travelled by Solvent (S in Cm)} = \frac{s_1 + s_2 + s_3 + s_4}{4}$$

$$R_f \text{ of Amino Acid}(A) = \frac{X}{S} \; ; \; R_f \text{ of Amino Acid}(B) = \frac{Y}{S}$$

Figure 2b: Calculation of Rf of amino acid A and amino acid B

Note that Rf values can range from 0 to 1.

Distance travelled by the solvent = ….. cm
Distance travelled by the components = ……cm

Amino acid	Color of the ring	Average distance travelled by the ring (cm)
Proline	Yellow	X
Histidine	Purple	Y

Calculations:

Rf = Distance travelled by solute/ Distance travelled by solvent

Rf value of Proline (A) =

Rf value of Histidine (B) =

Results and Discussion:

Measurements are made from the centre at which the spotting was done to the circles obtained after spraying. Commonly all amino acids except proline, undergo a unique reaction with ninhydrin which is a visualizing agent. The products of this reaction are purple colored imino derivatives, which provide a useful color test for these colorless amino acids. As the solvent moves away from centre, the sample compounds are carried along at a rate which is characteristic of their functionality, size and interaction with the cellulose matrix of the paper and solvent. Some compounds move rapidly on the paper, while others may not. Different amino acids usually have different Rf values because of the different side chain. Both acidic and basic groups tend to promote water solubility, though the solubility will be pH dependent.

Precautions:

- Use plastic gloves to protect your hands from ninnhydrin solution. If you get ninhydrin on your skin it will turn purple and the color will take several days to wear off.
- Do not touch the chromatography paper with the finger tip.
- Allow first amino acid drop to dry and then put the next one.

Computer Science Department

Demonstration of Android App, BMI Calculator

INTRODUCTION

The app stands for an ***"application,"*** which is equivalent to a software program. Apps are built for mobile devices, such as smartphones, tablets, LED, etc. **Android Studio** is the official Integrated Development Environment (IDE) for android application development. A single activity in an app consists of two files.

- **DESIGN FILE (activity_main.xml)**: Using Android's XML vocabulary, one can quickly design User Interface Layouts. The screen elements such as text box, label, button, etc are placed in the same way as one creates web pages in HTML .

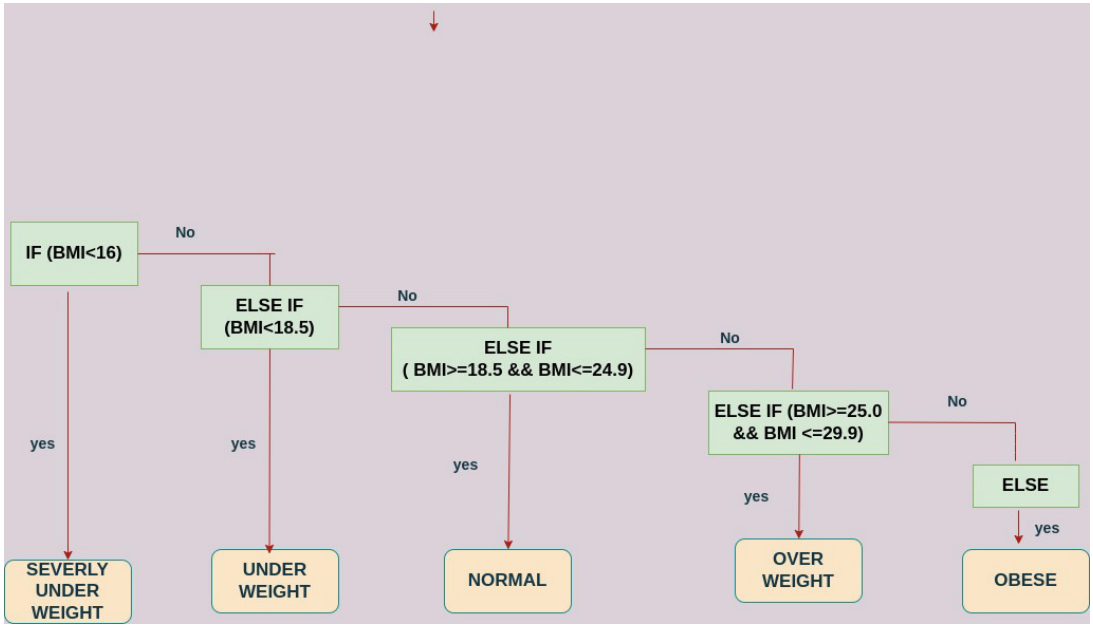
- **CODE FILE (MainActivity.java)**: It works as the engine of an app. It gets the input data from the activity_main.xml file. After processing the task, it displays the output to the user interface.

PRINCIPLE

BODY MASS INDEX (BMI), formerly called the **Quetelet index**, is a measure for indicating nutritional status in adults. It is defined as a person's weight in kilograms divided by the square of the person's height in meters as shown below.

$$\textbf{BMI} = \textbf{weight (kg)} / \textbf{height}^2\ (\textbf{m}^2)$$

PROCESS



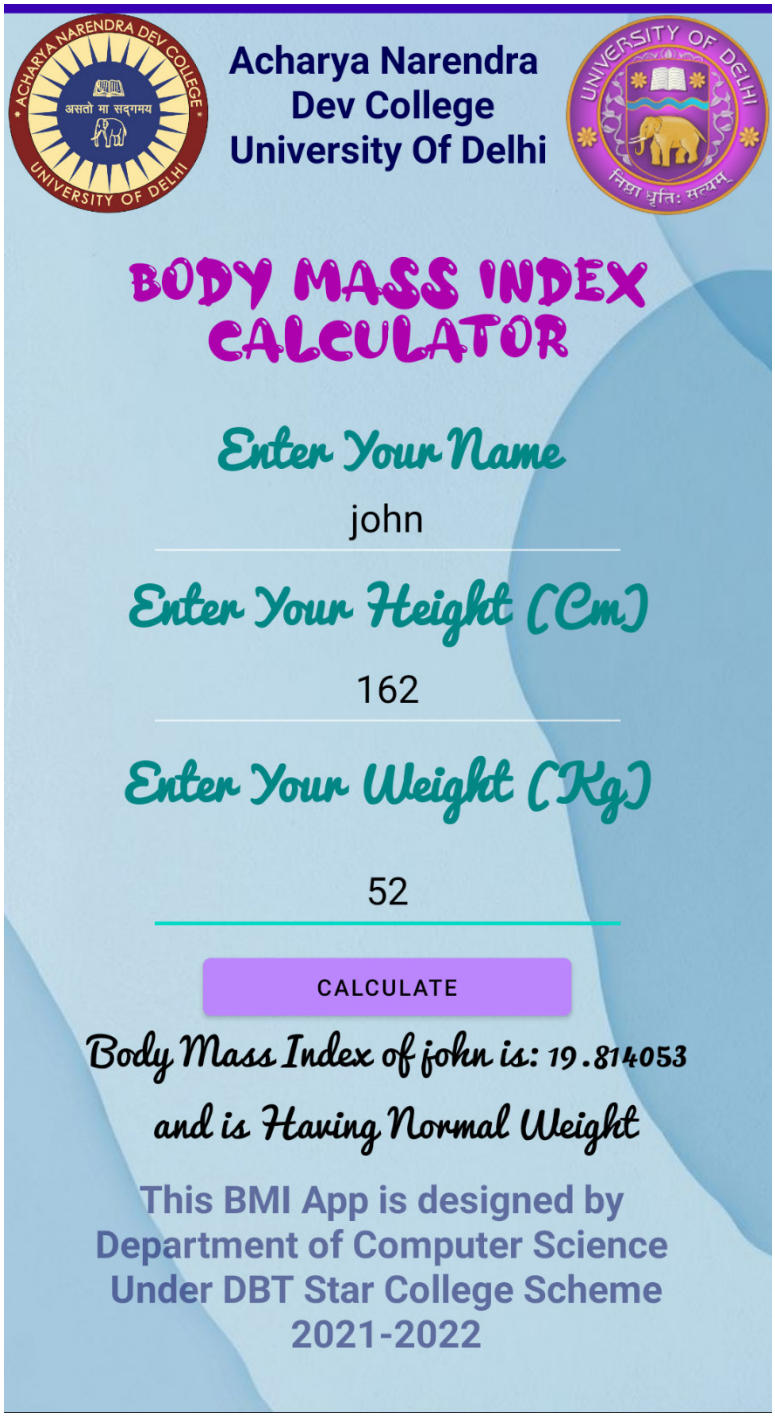
RESULT

For example,

An adult who weighs 70 kg and whose height is 1.75 m will have a BMI of 22.9.

70 (kg)/1.752 (m^2) = 22.9 BMI

Nutritional status: Normal



Physics Department

Hands-on Demonstration of Optics

Aim of Experiments:

1. To study the phenomenon of total internal reflection using laser light.
2. To study diffraction pattern of laser using plane transmission grating.
3. To study diffraction pattern of laser using plane reflection grating and measure its wavelength using a ruler as grating.
4. To study the flow of water through narrow tube.

Apparatus:

LASER sources (3) with power supplies, Water Container, water storage tank, transmission grating, reflection grating, mechanical supports for all devices/ components, screen, wooden table, Bench for mechanical mounts, etc.

Theory

Wikipedia defines diffraction as various phenomena that occur when a wave encounters an obstacle or opening. It is defined as the bending of waves around the corners of an obstacle or through an aperture into the region of geometrical shadow of the obstacle/aperture. Typically diffraction involves spreading out of waves as they pass through an aperture or around objects. It occurs when the size of the aperture or obstacle is of the same order of magnitude as the wavelength of the incident wave. For very small aperture sizes, the vast majority of the wave is blocked. For large apertures the wave passes by or through the obstacle without any significant diffraction. In an aperture with width smaller than the wavelength, the wave transmitted through the aperture spreads all the way round and behaves like a point source of waves.

Typical examples of diffraction patterns studied in physics include the following:

a) Single Slit diffraction

b) Young's double slit diffraction

c) Diffraction Grating

Brief description of each experiment:

1. To study the phenomenon of total internal reflection using laser light:

Total internal reflection:

Total internal reflection in physics, complete reflection of a ray of light within a medium such as water or glass from the surrounding surfaces back into the medium. The phenomenon occurs if the angle of incidence is greater than a certain limiting angle, called the critical angle. In general, total internal reflection takes place at the boundary between two transparent media when a ray of light in a medium of higher index of refraction approaches the other medium at an angle of incidence greater than the critical angle. For a water-air surface the critical angle is 48.5°. Because indices of refraction depend on wavelength, the critical angle (and hence the angle of total internal reflection) will vary slightly with wavelength and, therefore, with colour. At all angles less than the critical angle, both refraction and reflection occur in varying proportions.

The critical angle is the smallest angle of incidence that yields total reflection, or equivalently the largest angle for which a refracted ray exists. For light waves incident from an "internal" medium with a

single refractive index n_1, to an "external" medium with a single refractive index n_2, the critical angle is given by {\displaystyle \theta _{{\text{c}}\!}=\arcsin(n_{2}/n_{1})}, **θc = arc sin (n_2/n_1),** and is defined if $n_2 \leq n_1$. For some other types of waves, it is more convenient to think in terms of propagation velocities rather than refractive indices. The explanation of the critical angle in terms of velocities is more general and will therefore be discussed first.

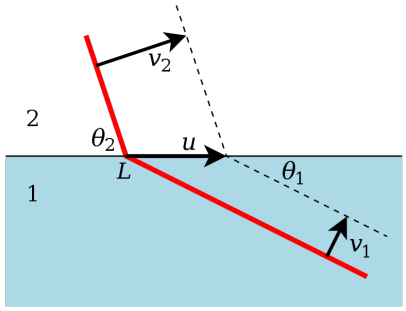


Fig.1. Refraction of a *wavefront* (red) from medium 1, with lower normal velocity v_1, to medium 2, with higher normal velocity v_2. The incident and refracted segments of the wavefront meet in a common line *L* (seen «end-on»), which travels along the interface at velocity *u*.

When a wavefront is refracted from one medium to another, the incident (incoming) and refracted (outgoing) portions of the wavefront meet at a common line on the refracting surface (interface). Let this line, denoted by *L*, move at velocity *u* across the surface, where *u* is measured normal to *L* (Fig.1.). Let the incident and refracted wavefronts propagate with normal velocities {\displaystyle v_{1}}v_1 and v_2 (respectively), and let them make the dihedral angles θ_1 and θ_2 (respectively) with the interface. From the geometry, {\displaystyle v_{1}}v_1 is the component of *u* in the direction normal to the incident wave, so that {\displaystyle v_{1\!}=u\sin \theta _{1}}$v_1 = u \sin \theta_1$. Similarly, {\displaystyle v_{2}=u\sin \theta _{2}}$v_2 = u \sin \theta_2$. Solving each equation for 1/*u* and equating the results, we obtain the general law of refraction for waves:

$$(\sin \theta_1) / v_1 = - (\sin \theta_2) / v_2 \quad \ldots. (1)$$

But the dihedral angle between two planes is also the angle between their normals. So θ_1 is the angle between the normal to the incident wavefront and the normal to the interface, while θ_2 is the angle between the normal to the refracted wavefront and the normal to the interface; and Eq. (**1**) tells us that the signs of these angles are in the same ratio as the respective velocities.

This result has the form of "Snell's law", except that we have not yet said that the ratio of velocities is constant, nor identified θ_1 and θ_2 with the angles of incidence and refraction (called θ_i and θ_t above). However, if we now suppose that the properties of the media are *isotropic* (independent of direction), two further conclusions follow: first, the two velocities, and hence their ratio, are independent of their directions; and second, the wave-normal directions coincide with the *ray* directions, so that θ_1 and θ_2 coincide with the angles of incidence and refraction as defined above.

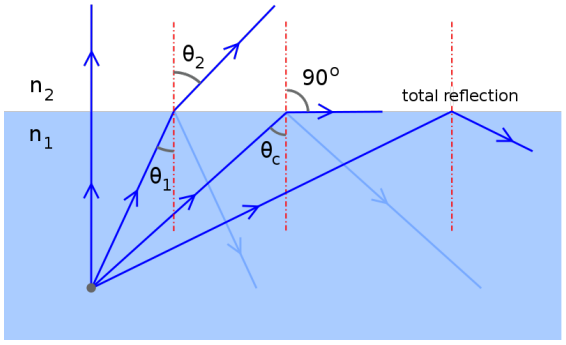


Fig.2. Behavior of a ray incident from a medium of higher refractive index n_1 to a medium of lower refractive index n_2, at increasing angles of incidence.

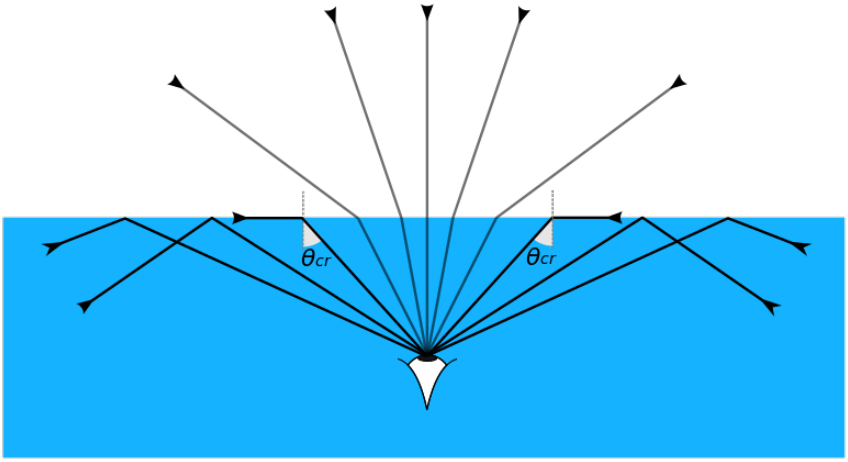


Fig.3. The angle of refraction for grazing incidence from air to water is the critical angle for incidence from water to air.

Obviously the angle of refraction cannot exceed 90°. In the limiting case, we put $\theta_2 = 90°$ and $\theta_1 = \theta_c$ in Eq. (**1**), and solve for the critical angle:

$$\theta_c = \textbf{arc sin } (v_1/v_2) \qquad \textbf{……. (2)}$$

In deriving this result, we retain the assumption of isotropic media in order to identify θ_1 and θ_2 with the angles of incidence and refraction.

For electromagnetic waves, and especially for light, it is customary to express the above results in terms of *refractive indices*. The refractive index of a medium with normal velocity {\displaystyle v_{1}}v1 is defined as {\displaystyle n_{1\!}=c/v_{1}}n_1 = c/v_1, where *c* is the speed of light in a vacuum. Hence {\displaystyle v_{1\!}=c/n_{1}}v_1 = c / n_1. Similarly, {\displaystyle v_{2}=c/n_{2}}v_2 = c / n_2. Making these substitutions in Eqs. (**1**) and (**2**), we obtain

$$\mathbf{n_1 = \sin \theta_1 = n_2 \sin \theta_2} \quad \textbf{….. (3)}$$

and

$$\theta c = \textbf{arc sin } (n_2/n_1) \quad \textbf{…… (4)}$$

Eq. (**3**) is the law of refraction for general media, in terms of refractive indices, provided that θ_1 and θ_2 are taken as the dihedral angles; but if the media are *isotropic*, then n_1 and n_2 become independent of direction while θ_1 and θ_2 may be taken as the angles of incidence and refraction for the rays, and Eq. (**4**) follows. So, for isotropic media, Eqs. (**3**) and (**4**) together describe the behavior in Fig. 2.

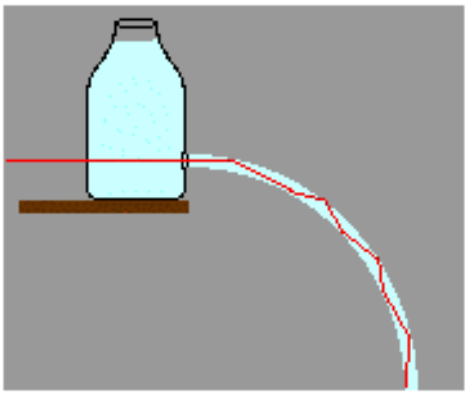
According to Eq. (**4**), for incidence from water ($n_1 \approx 1.333$) to air ($n_2 \approx 1$), we have $\theta_c \approx 48.6°$, whereas for incidence from common glass or acrylic ($n_1 \approx 1.50$) to air ($n_2 \approx 1$), we have $\theta_c \approx 41.8°$.

The arcsin function yielding θ_c is defined only if $n_2 \leq n_1$ {\displaystyle (v_{2}\geq v_{1})}($v_2 \geq v_1$). Hence, for isotropic media, total internal reflection cannot occur if the second medium has a higher refractive index (lower normal velocity) than the first. For example, there cannot be TIR for incidence from air to water; rather, the critical angle for incidence from water to air is the angle of refraction at grazing incidence from air to water (Fig. 3).

The medium with the higher refractive index is commonly described as optically *denser*, and the one with the lower refractive index as optically *rarer*. Hence it is said that total internal reflection is possible for "dense-to-rare" incidence, but not for "rare-to-dense" incidence.

Experimental Setup

A common Physics demonstration involves the use of a large jug/bottle filled with water and a laser beam. The jug has a pea-sized hole drilled in its side such that when the cork is removed from the top of the jug, water begins to stream out the jug's side. The beam of laser light is then directed into the jug from the opposite side of the hole, through the water and into the falling stream. The laser light exits the jug through the hole but is still in the water. As the stream of water begins to fall as a projectile along a parabolic path to the ground, the laser light becomes trapped within the water due to total internal reflection. Being in the denser medium (water) and heading towards a boundary with a less dense medium (air), and being at angles of incidence greater than the critical angle, the light never leaves the stream of water. In fact, the stream of water acts as a light pipe to pipe the laser beam along its trajectory.



The laser beam stays internal to the water, continuously reflecting at each boundary.

2. To study the diffraction pattern of laser light using plane transmission grating:

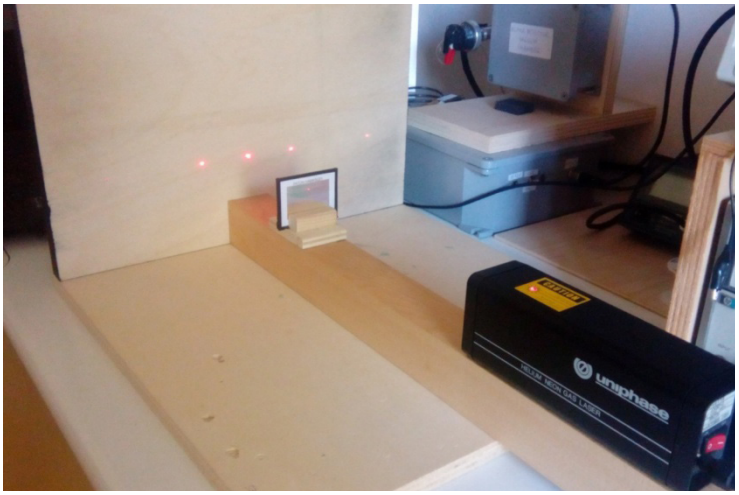
Diffraction:

When a collimated beam of light passes through an aperture, or if it encounters an obstacle, it spreads out and the resulting pattern contains bright and dark regions. This effect is called *diffraction*, and it is characteristic of all wave phenomena. It can be understood by considering the interference between different parts of the wavefront, which was altered in passing through the aperture. The angle of diffraction is of order λ / d with λ the wavelength and d the dimension of the aperture. Thus, for visible light, apertures in the range 10-100μm produce easily resolved diffraction patterns.

Experimental Setup

The experimental setup is very simple and consists in pointing the beam laser emitted from the He-Ne source on the diffraction grating. The beam undergoes diffraction and produces on the screen behind the grating the diffraction pattern with the first and second order maxima. Measuring the distance between the grating and the screen and measuring the position of the maxima is immediate to obtain the angles θ_m and from these we can calculate the grating pitch, knowing that λ is 632.8 nm.

In the image below you can see the laser, the diffraction grating and the screen on which you can see the luminous spots corresponding to the diffraction maxima.



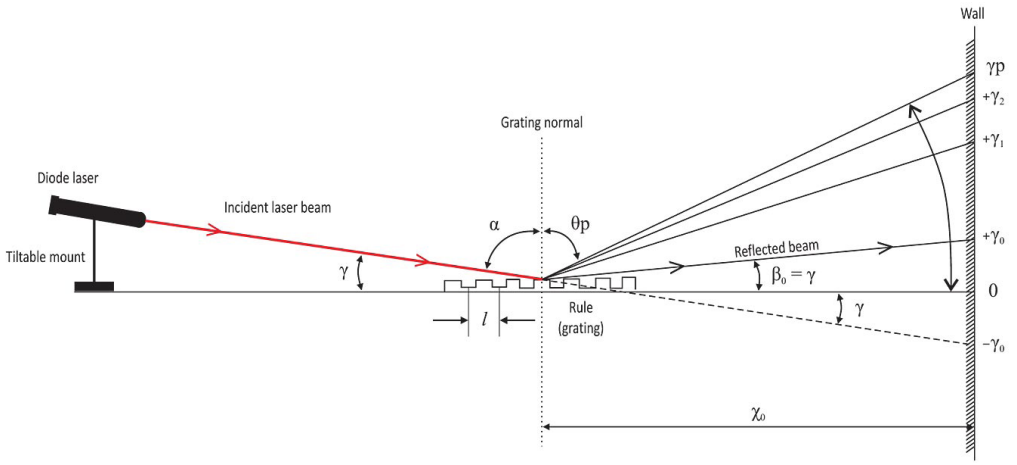
3. To study the diffraction pattern of laser light using plane reflection grating and to measure the wavelength of laser light using a millimeter scale as grating:

Wavelength of laser (λ) is given by

$$\lambda = (d / (2Z_0)^2) ((Y_m^2 - Y_0^2) / m)$$

$\mathbf{Z_0}$ is the distance between the regions of incidence at the scale and screen, **d** is the grating spacing, **m** is the diffraction order.

The diffraction spots are taken to lie along **Y** axis and position of $\mathbf{m^{th}}$ spot is represented by $\mathbf{Y_m}$.



Experimental Setup

4. To study the flow of water through narrow tube:

What is Bernoulli's Principle?

Bernoulli's principle states that

The total mechanical energy of the moving fluid comprising the gravitational potential energy of elevation, the energy associated with the fluid pressure and the kinetic energy of the fluid motion, remains constant.

Bernoulli's principle can be derived from the principle of conservation of energy.

Bernoulli's Principle Formula

Bernoulli's equation formula is a relation between pressure, kinetic energy, and gravitational potential energy of a fluid in a container.

The formula for Bernoulli's principle is given as:

$$p + \frac{1}{2}(\rho v^2) + \rho g h = \text{constant}$$

Where,

- p is the pressure exerted by the fluid
- v is the velocity of the fluid
- ρ is the density of the fluid
- h is the height of the container

Bernoulli's equation gives great insight into the balance between pressure, velocity and elevation.

Principle of Continuity

According to the principle of continuity

If the fluid is in streamline flow and is in-compressible then we can say that mass of fluid passing through different cross sections are equal.

In a container having two different inlet and outlet sizes:

The rate of mass entering = Rate of mass leaving

The rate of mass entering = $\rho A_1 V_1 \Delta t$—— (1)

The rate of mass leaving = $\rho A_2 V_2 \Delta t$—— (2)

Using the above equations,

$$\rho A_1 V_1 = \rho A_2 V_2$$

This equation is known as the Principle of continuity.

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b) Diffraction Gratings and Applications (Optical Science and Engineering Book 58) - by Erwin G. Loewen and Evgeny Popov

c) Elementary Wave Optics (Dover Books on Physics) - by Robert Howard Webb

Electronics Department

Familiarization of basic electronic components & B. Study of current-voltage characteristics of a diode

EXPERIMENT I

TITLE

A. Familiarization of basic Electronic Components
- Understanding of Resistance Color Coding and Measurement of Resistance
- Measurement of Capacitance using Multimeter

B. Study of current-voltage characteristics of a diode

INTRODUCTION

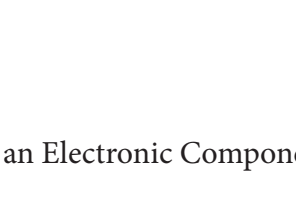
How do you define an Electronic Component?

Any device or circuit element having two or more terminals through which it can be connected to other electrical components to form a complete circuit.

A. Familiarization of basic Electronic Components

Understanding of Resistance Color Coding and Measurement of Resistance

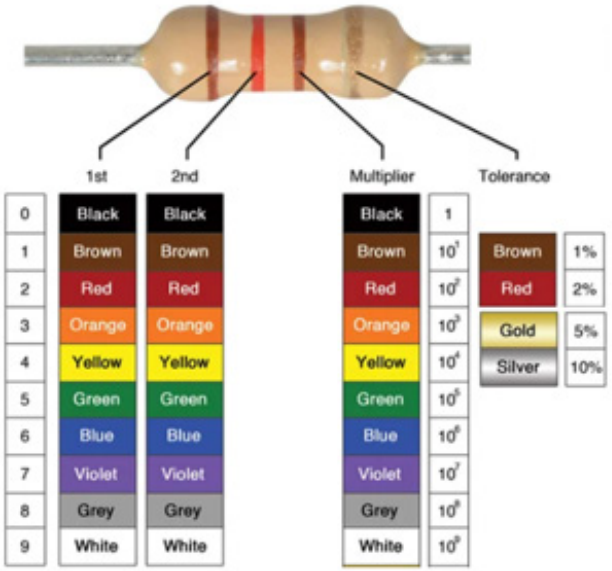
- Ability of a component or a circuit to resist or cause obstruction to the flow of current is called 'Resistance'



$$V \propto I$$

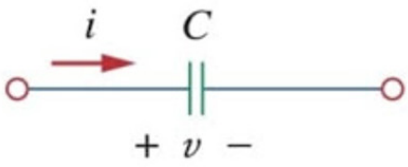
$$V = IR$$

Ohm's Law



Measurement of Capacitance using Multimeter

- Ability of a component or a circuit to collect and store energy in the form of charge is called 'Capacitance'



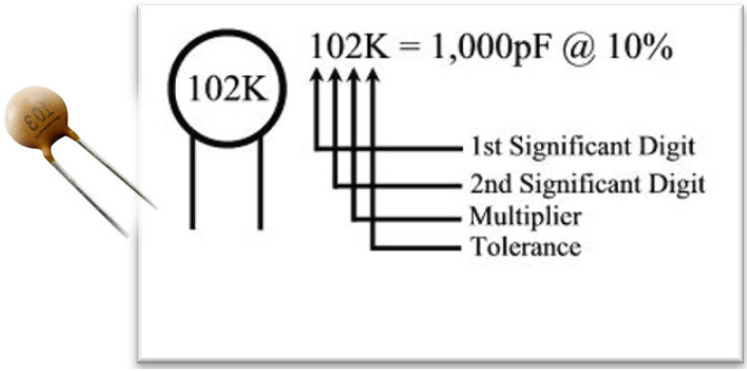
$$q \ \alpha \ v$$

$$q = Cv$$

$$\int idt = CV$$

$$i = C\frac{dV}{dt}$$

Identifying Capacitor Value using Coding



CODE	Tolerance
C	±0.25pF
J	±5%
K	±10%
M	±20%
D	±0.5pF
Z	+80% / -20%

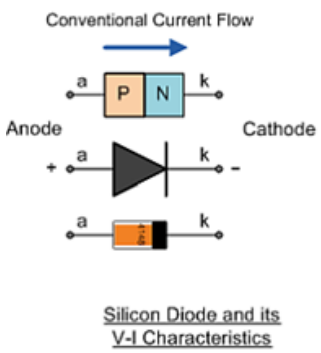
B. STUDY OF CURRENT-VOLTAGE CHARACTERISTICS OF A DIODE

AIM: Obtain I-V characteristics of a p-n diode and draw a linear plot of I-V characteristics

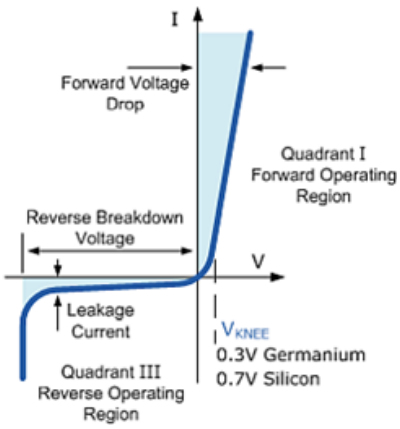
Material and Equipment:

Breadboard, Variable Power Supply, Voltmeter (0-30 V), Ammeter (0-25 mA), Ammeter (0-1mA), 1N4007 Diode, 100 Ω Resistor (¼ Watt).

Circuit Symbol and Characteristics:



Silicon Diode and its V-I Characteristics



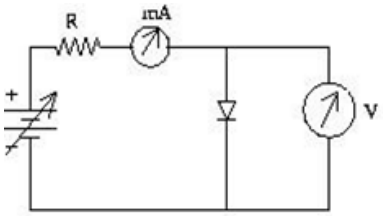


Fig: 1 Forward Biased diode

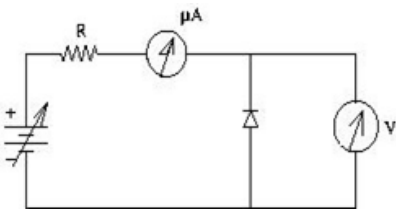
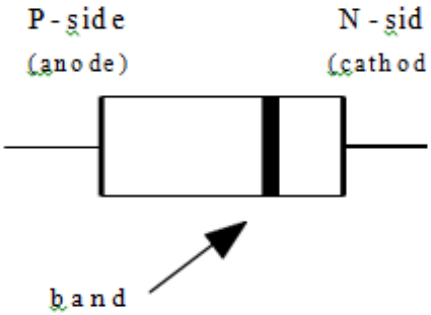


Fig: 2 Reverse Biased diode

Principle and Guidelines:

1. To identify the cathode and anode terminals for an ordinary and zener diode, look for a band which is closest to an end of the diode body, this is the N-side or the cathode terminal. The other end of the device is hence the p-side or the anode terminal as shown.



2. For forward biases, use a series resistance of approximately 100Ω to protect the device and do not exceed a forward current of I=15 mA even if this occurs before a forward voltage drop of 1 Volts.

Procedure:

FORWARD BIAS MODE:

1. Wire the circuit in figure 1 on the breadboard. Use R=100Ω and a 1N4007 diode.
2. Starting from zero, increase the voltage supplied to the circuit by the variable power supply V1 in steps of 0.1 V upto 1 Volts and with a step of 1 Volts thereof, and measure the voltmeter and ammmeter readings. Put all the data in the table.
3. Calculate the dynamic resistance Rd for each reading as mentioned in the observation table.
4. Plot the observed readings on a graph with x-axis plotted as diode voltage and y-axis as diode current, hence giving the I-V characteristics of the diode during forward bias.
5. Compare the graph with the ideal diode characteristics and justify the variations observed if any.

Observations:

Forward Bias

S.No.	Supply Voltage V_{BB} (V)	Diode Voltage V_d (mV)	Diode Current I_d (mA)	Diode Resistance $R_d(\text{mohms}) = V_d/I_d$
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				

Reverse Bias Mode:

1. Wire the circuit in figure 2 on the breadboard. Use R=100Ω and a 1N4007 diode.
2. Starting from zero, increase the voltage supplied to the circuit by the variable power supply V1 in steps of 1 Volts upto 30 Volts, and measure the voltmeter and ammeter readings. Put all the data in the table.
3. Calculate the dynamic resistance R_d for each reading as mentioned in the observation table.
4. Plot the observed readings on a graph with x-axis plotted as diode voltage and y-axis as diode current, hence giving the I-V characteristics of the diode during reverse bias.
5. Compare the graph with the ideal diode characteristics and justify the variations observed if any.

Observations:

Reverse Bias

S.No.	Supply Voltage V_{BB} (V)	Diode Voltage V_d (mV)	Diode Current I_d (mA)	Diode Resistance R_d(mohms) $=V_d/I_d$
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				

Result:

The cut-in voltage of the diode under forward bias is mV

Experiment and Activity to be performed in Science Adda

Department of Electronics

ACTIVITY

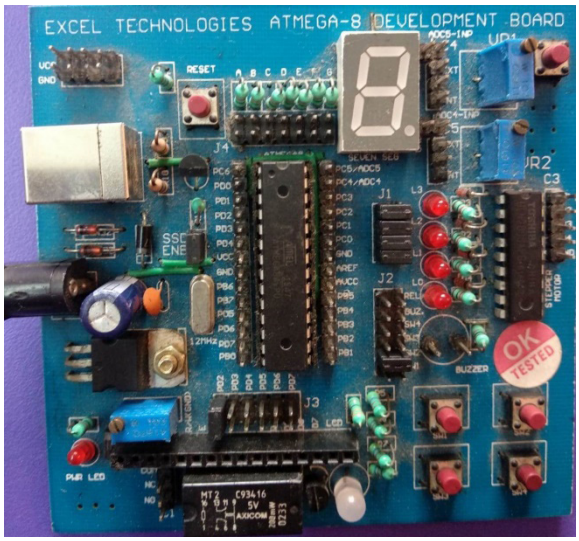
Demonstration of Interfacing of Electronic components with Microcontroller

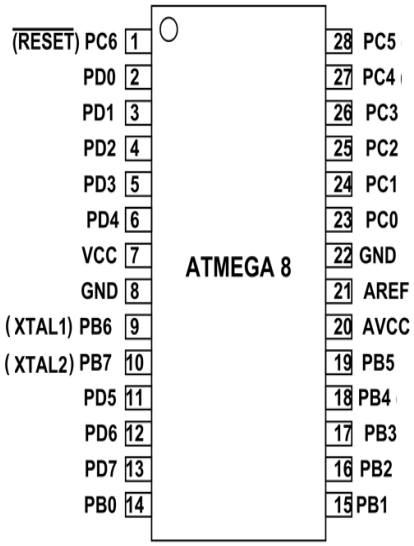
Microcontroller

- **SYSTEM ON CHIP (SoC)**
- All the components of a complete system are integrated onto a single wafer

CPU	RAM	ROM
I/O ----- ADC	Timer	Serial COM Port

Microcontroller Unit (MCU)





ATMEGA8 (Microcontroller) Training board

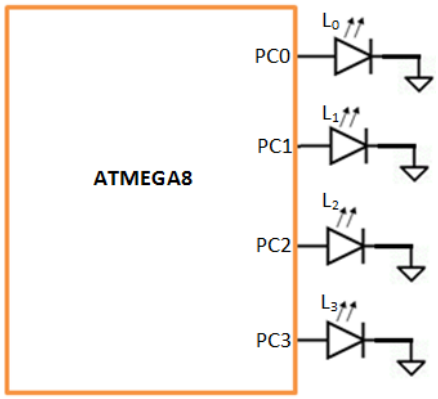
Experiment and Activity to be performed in Science Adda

Department of Electronics

LED INTERFACING

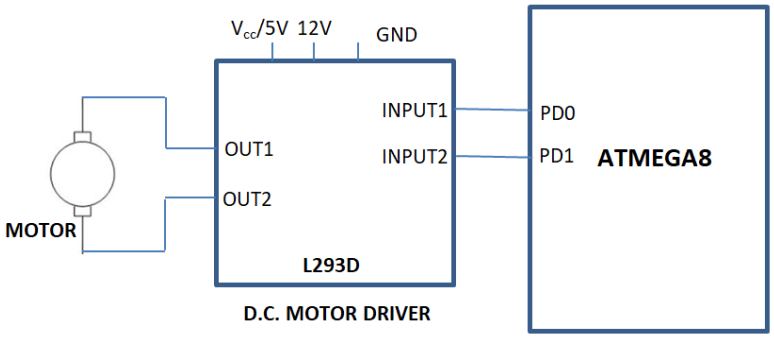
Interfacing of LED with microcontroller (ATMEGA8)

- Program to cause blinking of LEDs



D.C. MOTOR INTERFACING

Program to rotate a d.c. motor in clockwise and anti-clockwise direction



Zoology Department

Hands-on Demonstration of DNA Isolation

Aim: To isolate Genomic DNA from Plant Tissue (Cauliflower) by Spooling Method

Principle

There are several basic steps required for isolation of chromosomal DNA from cells. To extract the chromosomal DNA, both the cell membrane and the nuclear membrane must be lysed, or broken open. This is accomplished by disrupting the membranes with a solution of detergent and salt, creating a cell homogenate. Once the DNA is released from the nucleus, it must be protected from nucleases, enzymes which will degrade the DNA. Keeping the cell homogenate cold and various chemical components of the homogenization medium help restrict the action of these nucleases. The final step of this protocol involves precipitation of DNA from the homogenate. When the homogenization medium is added in the first step, the positive ions of the salts (sodium chloride and sodium citrate) bind to the negatively charged DNA backbone, creating a DNA molecule with a neutral charge. When a cold polar solvent, like ethanol, is added to the DNA solution, the DNA is precipitated out of solution, leaving other cell components behind (proteins, lipids, polysaccharides, general cell debris).

DNA can be isolated and precipitated using tissue from cauliflower. The cells are disrupted by manually homgenizing it in homogenization medium. Ice cold ethanol/isopropanol is added to this homogenate to precipitate the DNA. The DNA can then be isolated by slowly stirring a glass stirring rod in the homogenate, literally spooling the DNA onto the glass rod.

Requirements

Biological

Cauliflower, kept at -70 ^{o}C for at least 3-4 hrs

Chemicals

SDS extraction Buffer (100ml):

- 1M Tris, pH 7.210.0 ml
- 0.5 M EDTA04.0 ml
- 3 M NaCl16.7 ml
- 10% SDS17.0 ml

Raise the volume to 100 ml with autoclaved water.

- 5M potassium acetate
- Chloroform
- Isoamyl alcohol
- Isopropanol or ethanol

Glassware/Plasticware

All glassware and plastic ware used should be sterilized

- Conical flasks (100 ml)

- Petri plates
- Eppendorffs
- Microtips
- Pipettes

Instruments/ Equipment

- pH meter
- Weighing balance
- Centrifuge
- Micropipettes
- Mortar and pestle

Procedure

- Take 5 g of frozen sample (Cauliflower).
- Grind the tissue completely using mortar and pestle.
- Put the homogenate in10 ml of preheated (65^{o}C) extraction buffer for 30 minutes.
- Add 5 ml of potassium acetate and invert mix for 5 minutes.
- Add equal volume of (25 ml) chloroform : isoamyl alcohol (24:1)and invert mix for 5 minutes.
- Centrifuge at 3000 rpm for 20 minutes at room temperature.
- Collect the supernatant and repeat the extraction step once more.
- To the final supernatant add equal volume of chilled isopropanol and mix gently by inversion.
- Spool out the DNA by glass rod and dissolve the DNA in 5-10 ml of TE buffer.

Result

Nucleic acids are the most polar of the biopolymers and are therefore soluble in polar solvents and precipitated by non-polar solvents. The extracted DNA was dissolved in TE buffer. The quality of DNA was judged by the electrophoresis. On electrophoresis one band will be observed near the well which clearly indicates that the band is of high molecular weight and thus it's a genomic DNA. Since only one band is seen on the gel, so no shearing of DNA has taken place.

Precautions:

- Use caution when operating the centrifuge.
- Dispose of used reagents according to local ordinances.
- Wear latex gloves and goggles during the procedure.
- The laboratory surfaces should be very clean during all procedures used in this activity.
- Use thoroughly clean instruments and glassware. Rinse all equipment with isopropyl alcohol or acetone.
- Ethanol is highly flammable; take caution.

Answer the following questions

1. Why is it important to keep the cell homogenate and the solutions cold?

2. The homogenizing solution contains high concentrations of liquid detergent and salt. What does the detergent do to the cells? Why is it important to have a lot of salt in the solution?

3. What do you know about the DNA molecule that makes it possible to spool it out of the homogenate? Why don't other molecules in the homogenate do this?

4. Can you think of a way to prove that the molecule you have isolated is DNA? Design an experiment to show this.

Flow Chart of the Procedure

Take 5 g of frozen sample (Cauliflower)

↓

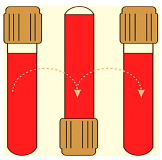
Grind the tissue completely using mortar and pestle

↓

Put the homogenate in10 ml of preheated (65ºC) extraction buffer for 30 minutes

↓

Add 5 ml of potassium acetate and invert mix for 5 minutes



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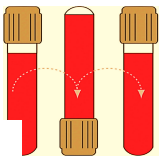
Add equal volume of (25 ml) chloroform: isoamyl alcohol (24:1)and invert mix for 5 minutes



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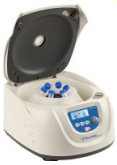
Centrifuge @ 3000 rpm for 20 minutes at RT



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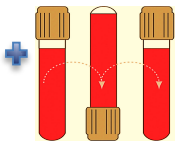
Collect supernatant and repeat the extraction step once more

↓

Add equal volume of chilled isopropanol and mix gently by inversion



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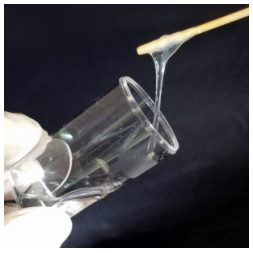
Spool out the DNA by glass rod and dissolve the DNA in 5-10 ml of TE buffer



Biomedical Science Department

Hands-on Demonstration of Forensic Techniques

Expt No. 1

Aim: To verify the authenticity of a bank cheque and a bank note.

Principle: In forensic science, questioned document examination (QDE) is the examination of documents potentially disputed in a court of law.Various security features have been incorporated into printed documents such as bankcheque, banknotes, Stamp paper, CBSE educational certificates etc.which can be verified by different techniques.

Introduction

Questioned Document

QDEis done to provide evidence about a suspicious or questionable document using scientific processes and methods. Evidence might include alterations, the chain of possession, damage to the document, forgery, origin, authenticity, or other questions that come up when a document is challenged in court.

Various security features have been incorporated into printed documents such as bankcheque, banknotes, Stamp paper,CBSE educational certificatesetc., to protect them against counterfeiting.

Some common security Features in documents (eg bank cheque and bank notes)

Cheque

Picture taken under normal white light

Picture taken under UV light

Security features in a Bank Cheque (as seen in Ultra Violet light)

1. Parts seen under UV
2. Special ink paper
3. Micro printed lines
4. Anti copy feature (pantographic image).
5. Watermarks (mirror image of bank logo or name).
6. Water soluble ink and UV feature.
7. UV dull paper

Fig. 1. A bank cheque with security features as seen in (A) white transmitted light and (B) in ultra violet (UV) light. Numerals are (1) Parts seen under UV (2) Special ink paper (3) Micro printed lines (4) Anti copy feature (pantographic image). (5) Watermarks (mirror image of bank logo or name (6) Water soluble ink and UV feature (7) UV dull paper

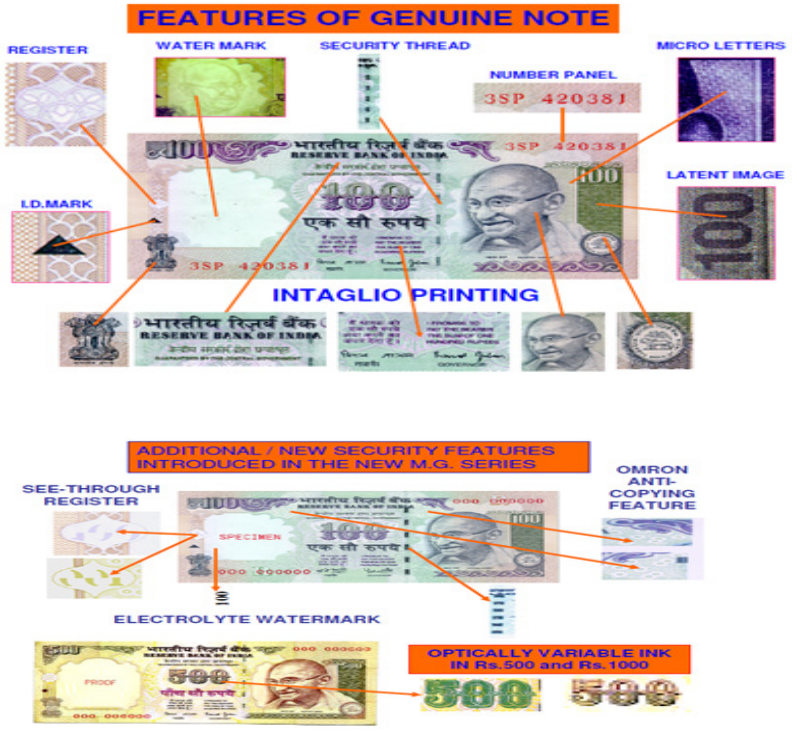


Fig. 2. Various security features on a bank note

1. **Ultra Violet light features (under UV light):** These patterns can be bank's logo, bank's name, Rupee column and sometimes the micro lettering at the background of the cheque. Coloured photocopies or Scanned print copies of cheque will glow blue under the UV light (Fig. 1)

2. **Special ink paper:** Solvent removal of written figures damages paper fibers and can be easily observed under UV light.

3. **Micro printed lines:**In a cheque, the underlines of the pay column, date columns, rupee column or amount box are not mere simple lines but they are a series of micro printing, which may be name of the bank. The micro printing is visible only under magnification.

4. **Anti-copy feature (Pantographic Image):** This image consists of cris-cross lines in a unique pattern which is actually an anti-copying feature. If a cheque is copied by any photocopier machine it will show as ***"VOID"*** or ***"COPY"*** inside the pantographic image making the value of that copied cheque null and void and forgery is detected immediately by any cashier or banker.

5. **Watermarks:** In the modern cheques watermarks are prominently present and they are visible under the transmitted light source (Bank name or logo as mirror image).

6. **Water soluble ink and UV feature:**The inks used in printing cheques are water soluble which dissolves in water. When the exposed portion of cheque was observed under the UV light, it showed blue fluorescence which was however of low intensity. This is a common feature of both, old as well as modern cheques.

7. **UV dull paper:** The paper used for the manufacture of cheques are carbon less and UV dull, i.e., it does not glow under the UV light.

8. **Braille mark/Intaglio printing (Raised):** The features can be felt by touch. Seal of Reserve Bank of India, Promissory Note by the Governor of India, Braille Mark are intaglio printed features. For ₹500 the Braille mark is a circle with denominational numeral printed in the middle of it

9. **Latent image:** Latent image of ₹500 (or ₹2000) are at the bottom left position of the banknotes (Magnifying glass)

10. **Security thread:** Complete length of security thread is present in ₹100/500/2000 banknotes which fluoresce under U.V. light.

11. **See-through transmitted light:** Present at bottom left position on a banknote and showed no overlapping pattern.

12. **Growing serial number:** The serial number printed in exploding font show yellow fluorescence under U.V. light.

13. **Variable color optical fibers:** Optical fibres are arranged in random fashion showing multi-coloured fluorescence under U.V. light.

14. **Omron rings:** An image consisting of rings of about 1mm in diameter. These are geometrical marks and

are anti-copying features.

15. **Embossed(Pressed)printing**: Process of creating raised relief images and designs in paper and other materials. Bleed lines, Reserve Bank of India printed both in English and Hindi, Denominational value 500 and 2000 in the respective banknotes printed with Optically Variable Ink and that printed in Hindi Devnagari are embossed features.

Observation and Results

Questioned document identification and validation is usually carried in a background of white fluorescent light which help us to see various water marks and other hidden features. For analyzing the micro-printing on a document, we can use simple hand lens or a dissecting microscope. All UV and Infra red fluorescent features can be revealed by exposing document to respective wavelength emitting torch or placing inside UV/IR lamp fitted chambers. Exposure of questioned document under such light revealed all the hidden UV/IR active feature on a document**.**

Expt No. 2

Title: Development and upliftment of fingerprints from a piece of paper/glass slide.

Principle: The palm side of our fingers containsa series of lines leading to formation of hills (ridges) and valleys (grooves). Each skin ridge is populated by a single row of pores through which perspiration/oils is discharged and deposited on the surface of the skin. It is these fluids which leave an impression on any surface upon touching and are called as fingerprints. The binding of components present in this fluid to some chromogenic substances forms the basis for development and visualization of fingerprints.

Requirements: Glass slide, black paper, white paper, black powder, white powder, two soft brushes, cello tape, scissors, magnifying glass.

Introduction:

Fingerprints and Criminalistics

Fingerprints are impressions that are left on various surfaces due to the oil which is deposited by a person's touch. Every living person has a unique pattern of ridges and depressions on the tips of their fingers. This makes it possible to positively identify an individual victim or criminal or prove the presence of a suspect at a crime scene. No two persons have the same patterns of ridges and depressions.With a high quality print and a known set of prints for comparison, such as from a victim or from AFIS data base, positive ID of a body, suspect or individual's presence at a crime scene is possible. Without a known set for comparison, fingerprints can provide direction for an investigation.

The individuality of a fingerprint is not only determined by its general shape or pattern but by a careful study of its **ridge characteristics (also known as minutiae).** The identity, number, and relative location of characteristicsis unique in every individual.

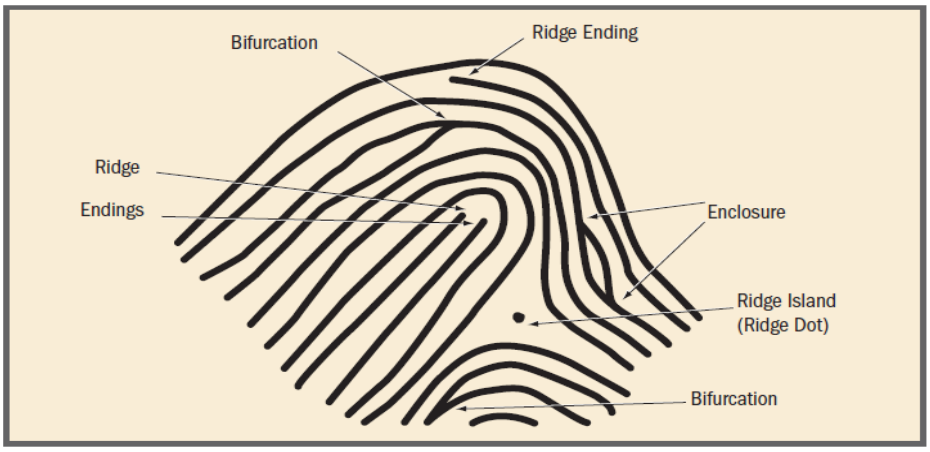
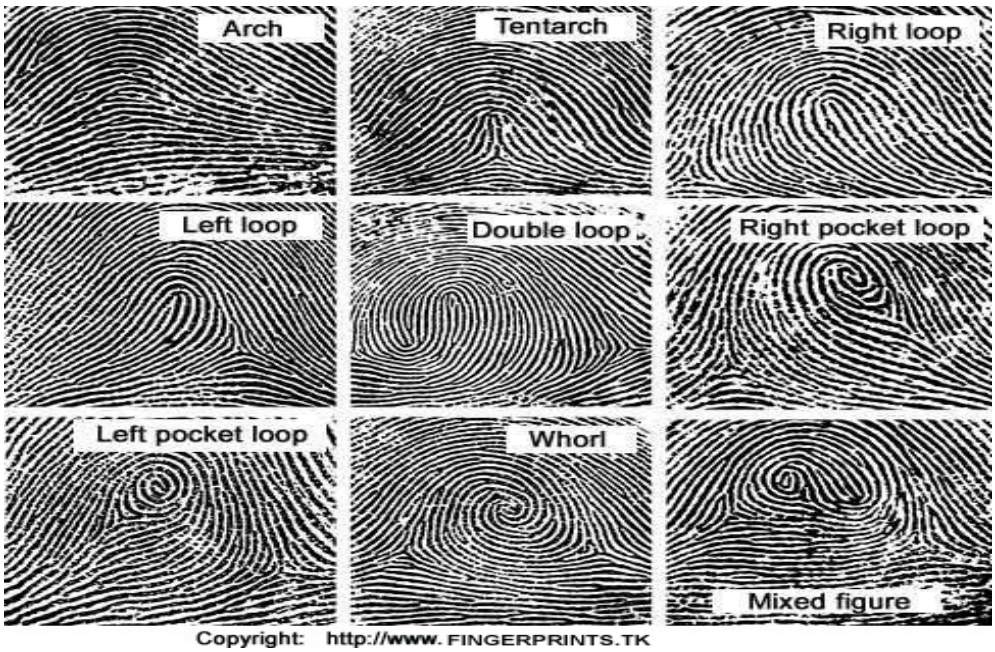


FIGURE 8-1 Fingerprint ridge characteristics. *Courtesy Sirchie Fingerprint Laboratories, Youngsville, NC, www.sirchie.com*

Types of Prints

1. All fingerprints are divided into three classes on the basis of their general pattern: loops, whorls and arches. Sixty to 65 percent of the population has loops, 30 to 35 percent have whorls and about 5 percent have arches. These three classes form the basis for all tenfinger classification systems presently in use.



A. Loop:

A loop must have one or more ridges entering from one side of the print, recurving, and exiting from the same side. If the loop opens toward the little finger, it is called an *ulnar loop; if it opens toward the thumb, it is a radial loop.* The pattern area of the loop is surrounded by two diverging ridges known as *type lines.* The ridge point at or nearest the type-line divergence and located at or directly in front of the point of divergence is known as the *delta* .All loops must have one delta. The *core,* as the name suggests, is the approximate center of the pattern.

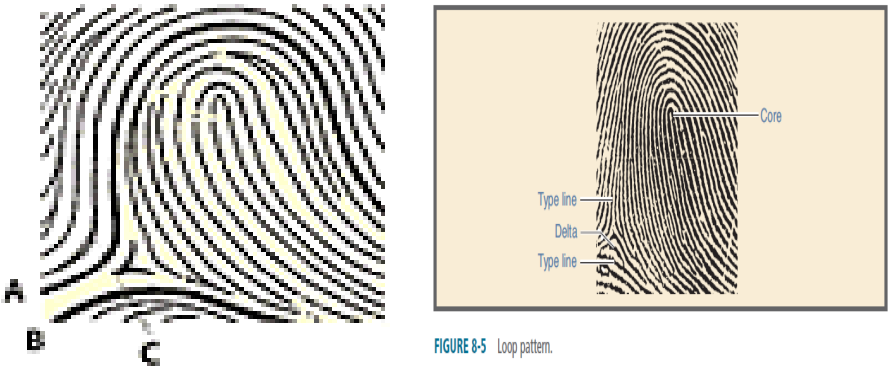
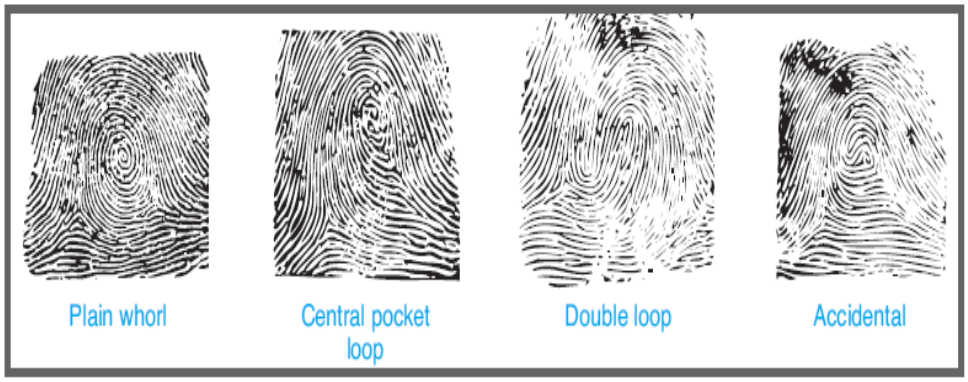


FIGURE 8-5 Loop pattern.

B. **Whorls**: are actually divided into four distinct groups: Plain, central pocket loop, double loop, and accidental. All whorl patterns must have type lines and at least two deltas. A plain whorl and a central pocket loop have at least one ridge that makes a complete circuit. This ridge may be in the form of a spiral, oval, or any variant of a circle.



C. **Double loop:**

As the name implies, the double loop is made up of two loops combined in one fingerprint. Any whorl classified as an accidental either contains two or more patterns (not including the plain arch) or is a pattern not covered by other categories. Hence, an accidental may consist of a combination of a loop and a plain whorl or a loop and a tented arch.

D. **Arches**, the least common of the three general patterns, are subdivided into two distinct groups: plain arches and tented arches. The plain arch is the simplest of all fingerprint patterns; it is formed by ridges entering from one side of the print and exiting on the opposite side. Generally, these ridges tend to rise in the center of the print, forming a wavelike pattern. The tented arch is similar to the plain arch except that instead of rising smoothly at the center, there is a sharp upthrust or spike, or

FIGURE 8-7 Arch patterns.

Procedure:

1. Take an impression of your thumb on a white and a black paper each.
2. Use a soft brush to pick and dust white powder on black sheet and black powder on white sheet where the thumb impression has been taken.
3. Once the print is visible, dust out the extra powder from the surrounding area.
4. Take a piece of cello tape and paste it on the print. Gently press it.
5. Carefully remove the tape and paste it on a clean sheet of paper, along with the details of the person for reference.

Result: Fingerprints showing ridges and various minutae will be observed.

Discussion: Fingerprint analysis is based on the facts that a fingerprint is an individual characteristic & no two fingers are found to have identical ridge patterns. Fingerprints remain unchanged during the life time of an individual. They exhibit a unique pattern and count of ridge characteristics. Hence, fingerprints have become gold standard for personal identification in forensic community.

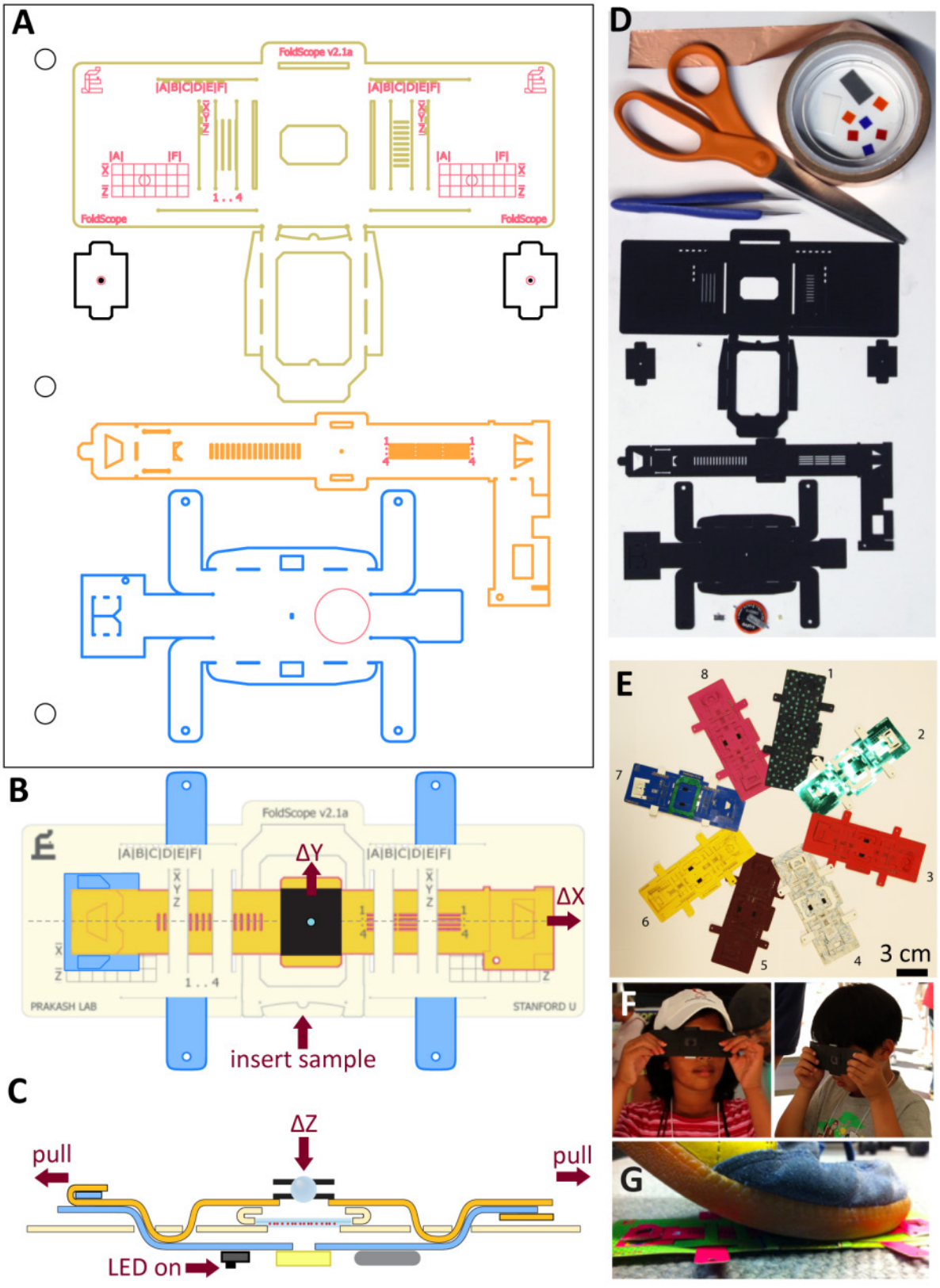
Development of fingerprints depends largely upon the surface where they are present. The development techniques are different for fingerprints on metal surfaces, paper, glass, cloth etc. For instance, iodine fuming is a technique used for obtaining prints on porous and semiporous surfaces such as paper, cardboard, and unfinished wood but not on metallic surfaces. Development of more and more methods to retrieve even faint prints from tough surfaces has strengthened the use of fingerprint analysis in forensic science.

Botany Department

Hands-on Demonstration of Foldscope

Foldscope: Unraveling the World Unavailable to the Naked Eye

Microscopes are fantastic tools that connect us to the world which is hidden from us due to the limitation of human eye. Do you think it's cumbersome to take the conventional microscope for field studies? Did you ever fancy you could somehow fold the lab microscope take it home and see or show the world around? A science enthusiast did it! (Google if you want to know his name!) It is called foldscope! Foldscope is the paper microscope that began as an idea to make science more accessible. It has now grown into a company that delivers low-cost tools around the world! Foldscope has reached over 1.5 million people and created an online community of explorers unlike any other.



The Foldscope comprises of three stages cut from paper — illumination, sample-mounting, and optics — and assembled via folding. This includes primary components *viz* a spherical ball lens (or other micro-lenses), lens-holder apertures, an LED with diffuser or condenser lens, a battery, and an electrical switch. The three stages are weaved together to form an assembled Foldscope, with the following features: fully-constrained X–Y panning over a 20×20 mm^2 region, flexure-based focusing via Z-travel of the optics stage relative to the sample-mounting stage, and a vernier scale for measuring travel distances across the sample slide with 0.5 mm resolution. The total optical path length from the light source to the last lens surface is about 2.7 mm, only 1% that of a conventional microscope. Flat polymeric sheets and filters can also be inserted into the optical path, including diffusion filters for improving illumination uniformity, Fresnel lenses as condensers for concentrating illumination intensity, color filters for fluorescence imaging, and linear polarizers for polarization imaging.

Today, we will learn to assemble the foldscope and explore the hidden world.


ACHARYA NARENDRA DEV COLLEGE
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UNIVERSITY OF DELHI

About the College

The college is 30 years old and through all these years, it has helped to unfold the enormous potentialities of the students and empower them to meet the challenges of the future. ANDC is considered as one of the top colleges in India. This is evident from the NAAC score of 3.31 and 20th NIRF-2021 ranking. Besides, India Today and Week rankings are also testimony to this. The College has one of the best infrastructure & research facilities. Our pedagogy is student centric. The College provides ample opportunities for students to excel in both academics and co-curricular activities. Several flagship schemes like Paramarsh, Unnat Bharat Abhiyan and DBT STAR COLLEGE SCHEME of Government of India have been sanctioned to the College. This year College has been granted DBT STAR STATUS by Department of Biotechnology. Collaborations like SPIE (USA) Chapter, Science Setu Programme and NPTEL-SWAYAM chapter continue to report robust progress at the national and international level.

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