UNIT 1: INTRODUCTION TO PHYSICS

Physics is the study of natural world. It is the study of basic laws of nature and their manifestation in different phenomena. We can observe the applications of physics in other science branches also.

The relation of physics with other branches:
Chemistry: The science which is the most deeply affected by physics is chemistry. many branches of chemistry such as electrochemistry are based on laws in physics.
Biology: The concept of pressure and its measurement has helped us to know the blood pressure of a human being, which in turn is helpful to know the working of heart.

Geology: The internal structure of various rocks can be known with the study of crystal structure. Age of rocks and fossils can be known easily with the help of radioactivity, i.e., with the help of carbon dating.

Astronomy: Optical telescope has made it possible to study the motion of various planets and satellites in our solar system. Doppler effect predicted the expansion of universe. Kepler's laws are responsible to understand the nature of management of the planets around the sun.

Meteorology: The variation of pressure with temperature leads to forecast the weather.

Seismology: The movement of earth's crust and the types of waves produced help us in studying the earthquake and its effect.

Scientific method:

The scientific method is a structured approach to investigating and understanding the physical world. In physics, it serves as the foundation for research, experimentation, and the development of theories that explain natural phenomena. This method consists of several key steps:

1. **Observation**: The scientific process begins with careful observation of a natural phenomenon or problem. Physicists identify questions or areas of interest, which may be prompted by everyday experiences or gaps in current scientific knowledge.

2. **Hypothesis**: Once a question or problem is identified, physicists formulate a hypothesis. This is an educated guess or a proposed explanation that can be tested through experiments and observations. A well-constructed hypothesis should be specific, testable, and falsifiable.

3. **Experimentation**: Experiments are designed and conducted to test the hypothesis. In physics, experiments often involve controlled conditions, precise measurements, and the manipulation of variables. The results of these experiments provide data that can be analyzed and interpreted.

4. **Data Analysis**: Physicists analyze the data collected during experimentation to draw meaningful conclusions. This involves statistical methods, mathematical modeling, and often the use of specialized equipment and software to process data.

5. **Theory Formulation**: Based on the results of experimentation and data analysis, physicists develop theories or models to explain the observed phenomena. These theories must be consistent with the data and should make predictions that can be tested in future experiments.

6. **Prediction and Testing**: Theories in physics often lead to new predictions about the behavior of physical systems. These predictions are tested through additional experiments, and the cycle continues. If predictions are consistently confirmed, the theory gains more credibility.

7. **Peer Review and Replication**: The scientific method in physics includes a critical peer review process, where other scientists evaluate the research methods and findings. Replication of experiments by independent researchers is crucial to ensure the reliability of results.

Applications in the Study of Physics:

1. **Understanding the Laws of Nature**: The scientific method has been instrumental in discovering and formulating the fundamental laws of physics, such as Newton's laws of motion, Maxwell's equations for electromagnetism, and Einstein's theory of relativity. These laws serve as the basis for understanding how the physical world operates.

2. **Technological Advancements**: Physics and the scientific method have led to countless technological advancements. For example, the study of electromagnetism has given rise to technologies like electric generators, motors, and modern electronics. The principles of quantum mechanics underpin the development of semiconductors and quantum computers.

3. **Space Exploration and Cosmology**: Physics and the scientific method have been essential in exploring the cosmos. The study of astrophysics and cosmology relies on the scientific method to understand the origins of the universe, the behavior of celestial bodies, and the development of theories like the Big Bang Theory.

4. **Medical Imaging and Healthcare**: Physics plays a vital role in the development of medical imaging techniques such as X-rays, MRI, and CT scans. These technologies have revolutionized medical diagnosis and treatment.

5. **Environmental Science**: Physics is crucial for understanding environmental issues such as climate change and renewable energy sources. Scientific methods and models are used to monitor and predict changes in the environment.

Measurement:

Measurement is a technique in which the properties of an object are determined by comparing them to a standard quantity.

Unit: The unit is a standard quantity of same kind with which a physical quantity is compared for measuring it.

Principles of measurements:

The principles of measurements are like the rules for getting measurement correctly:

1. **Accuracy:** Measurement should be as close to the true value as possible. It involves minimizing systematic errors (biases) and random errors (uncertainties)
2. **Precision:** Precision refers to the degree of repeatability or consistency in measurements. A precise measurement yields similar results when repeated under the same conditions, even if those results are not necessarily accurate.
3. **Validity:** Validity concerns whether a measurement actually assesses the property it is intended to measure..
4. **Reliability:** Reliability is the consistency and dependability of measurements. Reliable measurements should produce similar results when repeated over time or under different conditions.
5. **Standardization:** Standardization involves the use of uniform units of measurement. Always use the same units of measurement as everyone else.
6. **Calibration:** Calibration is the process of adjusting and verifying measurement instruments to ensure their accuracy. Measuring instruments are regularly checked and verified to keep them accurate.
7. **Objectivity:** Measurements should be made as objectively as possible, we have to measure the properties without any personal bias or opinions.
8. **Reproducibility:** Reproducibility means the ability of others to take the measurement using the same methods and equipment.
9. **Ethical Considerations:** we have to be responsible and considerate, especially when we are measuring thing related to people or sensitive information.

SI system: (International system of Units)

The international system of units(SI) is the metric system that is used universally as a standard for measurements. In S.I system length, mass, time, Thermodynamic temperature, Electric current, Luminous Intensity and amount of substance are considered as fundamental quantities.
Besides these 7 basic units, there are two supplementary units. They are radian (rad) and steradian (sd). Radian is the S.I unit of plane angle and steradian is the S.I unit of solid angle

(PTO)

Physical quantity	Unit	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Thermodynamic Temperature	Kelvin	K
Electric current	ampere	A
Amount of substance	mole	mol
Luminous Intensity	candela	cd

Differences between vectors and scalars:

Scalar	Vector
1. It has only the magnitude	1. It has both magnitude and direction
2. It is one dimensional	2. It is multi dimensional
3. The scalar quantity changes with the change in magnitude.	3. This changes with magnitude and direction
4. Scalar quantity cannot be resolved	4. It can be resolved in different directions
5. Examples: Distance, Speed, work, Energy etc.	5. Examples: Velocity, Force, weight etc.

Importance of Accurate and precise measurements:

Accurate and precise measurements are fundamental in science, industry, and daily life. Accuracy ensures that a measurement is close to the true value, while precision indicates consistency in repeated measurements. We must understand the importance of both. In science, accurate and precise measurements are vital for reliable experiments and valid conclusions. In industry, they guarantee product quality and safety. Even in everyday activities like cooking or building, accurate measurements lead to successful outcomes. Developing strong measurement skills is crucial, as they underpin scientific discovery, quality control, and the reliability of countless processes and products.

Vector addition:

Vector addition is the operation in which two vectors are added to get their sum. Suppose we take two vectors, $\bar{A}$ and $\bar{B}$, then that can be added together using vector addition, and the resultant vector is $\bar{R} = \bar{A} + \bar{B}$

Conditions of Vector Addition:

- We cannot add vectors and scalars together.
- Vectors can be added only if they are of the same nature. For instance, acceleration should be added with only acceleration and not with force.
- Vector Addition is nothing but finding the resultant of a number of vectors acting on a body.
- Vector Addition is commutative. This means that the resultant vector is independent of the order of vectors i.e. $\bar{A} + \bar{B} = \bar{B} + \bar{A}$.
- If $\bar{A} = A_x i + A_y j + A_z k$ and $\bar{B} = B_x i + B_y j + B_z k$, then the resultant vector $\bar{R} = \bar{A} + \bar{B} = (A_x + B_x)i + (A_y + B_y)j + (A_z + B_z)k$
- Triangle law and parallelogram law are generally used to determine the resultant vector after addition.

Vector Subtraction:

The vector subtraction of two vectors $\bar{A}$ and $\bar{B}$, is represented by $\bar{A} - \bar{B}$ and it is nothing but adding the negative of vector B to the vector $\bar{A}$. i.e.

$$\bar{A} - \bar{B} = \bar{A} + (\overline{-B}).$$

- Any vector subtracted from itself results in a zero vector. i.e., $\bar{A} - \bar{A} = 0$, for any vector a
- The subtraction of vectors is NOT commutative. i.e., $(\bar{A} - \overline{B)}$ is not necessarily equal to $\overline{(B} - \overline{A)}$.

UNIT – II MECHANICS

Displacement: The change in the position of an object in a specific direction is called displacement (s).
CGS units – Centi meter (Cm)
SI units - meter (m)

Velocity: Rate of change of displacement is called velocity(v).
CGS units: cm/s
SI units: m/s

Acceleration: Rate of change of velocity is called acceleration(a).
CGS units: cm/s^2
SI units: $m/\,s^2$

Newton's laws of Motion: Newton proposed 3 basic laws to understand the relation between motion of the body and force acting on the body.

Newton's first law:
"***A body at rest continues to be at rest and a body in motion continues to be in motion with uniform velocity until it is acted upon by an external force***." This law is also called law of inertia.
The first law introduces the concept of inertia, which is the tendency of an object to resist changes in its state of motion. Objects with more mass have greater inertia, making them more resistant to change their position.

Newton's second law:
Newton's Second Law provides a quantitative relationship between force, mass, and acceleration.
According to this law "***Force is defined as rate of change of momentum. Which is numerically equals to the product of mass and velocity". In general it is expressed as***

$$F=ma$$

It states that the acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass. This relationship is crucial for predicting and calculating the motion of objects under the influence of forces.

Newton's third law:
According to this law "***for every action, there is an equal and opposite reaction"*** here action and reaction are forces which acts on different bodies.
Ex: bouncing a ball from the surface when it is dropped from certain height, Rocket motion etc.
Incase of ball, it applies force (action) on the surface, simultaneously floor applies same quantity of force on ball in opposite direction.

Energy:

The capacity to do work is called energy. SI unit of energy is Joule(J). Energy exists in various forms. Here are some common forms of energy.

- **Kinetic energy(KE):**
  Energy possessed by the body due to its motion (velocity) is called kinetic energy. The amount of kinetic energy depends on mass and velocity of the body.
  $$KE = \frac{1}{2}mv^2$$
- **Potential energy (PE) :**
  Energy possessed by the body by virtue of its position is called potential energy.
  $$PE = mgh$$
  Here m is mass of the body
  g – acceleration due to gravity
  h- height from the surface
- **Thermal (Heat) Energy:**
  Thermal energy is the internal energy of a system due to the kinetic energy of its particles. It is associated with the temperature of an object. The higher the temperature, the greater the thermal energy.
- **Chemical Energy:**
  Chemical energy is stored in the bonds between atoms and molecules. It is released or absorbed during chemical reactions. Common examples include the energy stored in food, fuel, and batteries.
- **Electrical Energy:**
  Electrical energy is the energy carried by the flow of electric charge. It is a common form of energy used to power electrical devices and systems.
- **Nuclear Energy:**
  Nuclear energy is released during nuclear reactions, such as nuclear fission (splitting of atomic nuclei) or nuclear fusion (combining of atomic nuclei). This form of energy is the source of power in nuclear reactors and the sun.
- **Electromagnetic (Radiant) Energy:**
  Electromagnetic energy is carried by electromagnetic waves, including radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays. This form of energy plays a crucial role in a wide range of phenomena, from communication to sunlight.
- **Sound Energy:**
  Sound energy is the energy produced by vibrations of particles in a medium (such as air, water, or solids). It is transmitted as waves and is perceived by our ears.
- **Magnetic Energy:**
  Magnetic energy is associated with the position and motion of magnets and magnetic fields. It is involved in various technologies, including electric motors and generators.

Law of conservation of energy:

According to this law "***Energy neither be created, nor be destroyed. But it can be converted from one form to another form***."

Work:
work is defined as the product of force and displacement in the direction of the force applied. Mathematically, the formula for work (W) is given by:

$$\mathbf{W=F\cdot S}$$

Here w is work done by the force, F is force applied and S is displacement.
SI unit of work is Joule.

When work is done along force direction, the work would be maximum
When work is done perpendicular to the force direction, the work would be zero.

Work-Energy theorem:
According to this theorem, "***the net work done on a body is equal to the change in kinetic energy of the body".***

$$\mathbf{W = k_f - k_i}$$

W – work done
K_f – final kinetic energy
K_i – initial kinetic energy

Circular motion:

The motion of a body along a circular path is called circular motion. The following are the key points in circular motion.

- The time taken by the object in circular motion for one complete revolution is called Time period(T)
- Number of revolutions done in one second is called frequency (ν)
- The object in circular motion is acted upon by central force, which is always directed towards centre of the circle. Centripetal force is responsible for keeping the object in circular motion.
- The angle through which an object has rotated in a given time is called angular displacement.
- Rate of change of angular displacement is known as angular velocity.

Centripetal force:

Centripetal force is a force that makes a body to move along circular path, directed towards the centre of the path. It is the force responsible for keeping the object in its circular motion by continuously changing the object's direction, preventing it from moving in a straight line. Mathematically it is expressed as

$$F = \frac{mv^2}{r}$$

Here F – Centripetal force
v – velocity
m – mass of the object
r – radius of the path

Applications of centripetal force:

1. **Planetary orbits**: The gravitational force exerted by the sun on planets acts as a centripetal force, keeping them in their elliptical orbits.
2. **Satellite motion:** Artificial satellites and natural moons are kept in orbit around celestial bodies by the gravitational force acting as a centripetal force.
3. **Banked curves on roads:** On banked curves of roads, the normal force acting on a vehicle provides the required centripetal force for the vehicle to take turn safely.
4. **Cyclotron:** In a cyclotron, charged particles are accelerated in a circular path by a magnetic field. The magnetic force acting on the charged particles provides the centripetal force.
5. **Tetherball game:** In a tetherball game, the tension in the tetherball rope provides the centripetal force, keeping the ball moving in a circular path around the pole.
6. **Conical pendulum:** A conical pendulum is a mass attached to a string and swung in a horizontal circle. The tension in the string provides the centripetal force required for circular motion.

Gravity:

Gravity is the force of attraction between two masses. The larger the masses, the stronger the gravitational force between them. Gravity is a universal force that acts on all objects with mass, pulling them toward one another. It is responsible for the motion of planets, stars, galaxies, and even light.

Newton's universal law of gravitation:

"The force of attraction between any two massive bodies in the universe is directly proportional to the product of their masses and is inversely proportional to the square of the distance between them"

This is expressed mathematically as

$$F = \frac{Gm_1m_2}{r^2}$$

Implications o newton's law of gravitation:

- This law explains the motion of planets and other celestial bodies in orbit around the Sun.
- The gravitational pull between the Earth, the Moon, and the Sun is responsible for the phenomenon of tides. The gravitational force causes the ocean surface to bulge, leading to high and low tides.
- By applying the law of gravitation, astronomers can predict the positions of planets and other celestial bodies at different points in time.
- Newton's law of gravitation is essential for understanding the relationship between weight and mass. The weight of an object is the force of gravity acting on it, and it is proportional to its mass.
- The stability of planetary systems is influenced by the gravitational interactions between celestial bodies. Newton's law helps in predicting and understanding the stability of planetary systems over time.
- Newton's law provides a foundation for classical cosmology, allowing scientists to model the behavior of the universe on large scales.
- The law of gravitation helps in calculating the escape velocity required for an object to break free from the gravitational pull of a massive body. This is crucial for space missions and understanding the dynamics of celestial bodies.

WAVES AND OPTICS

Wave:

A wave is a disturbance or oscillation that travels through space or a medium, transferring energy from one point to another without a net displacement of the medium itself. Waves can take various forms and exist in different mediums, such as air, water, solids, and even electromagnetic fields.

Properties and characteristics of waves:

- **Amplitude:** The maximum displacement of the particle from its mean position is called amplitude. Which is measured in centi meters or meters.
- **Frequency:** The frequency of a wave is the number of oscillations or cycles it completes in a given unit of time, usually measured in Hertz (Hz). High frequency corresponds to high pitch (in sound waves) or high energy (in electromagnetic waves). Which is denoted by ν
- **Wave length:** The wavelength of a wave is the distance between two consecutive points that are in same phase (e.g., two peaks or two troughs). It is often denoted by the symbol λ and is measured in meters.
- **Velocity:** The velocity of a wave is the speed at which the disturbance propagates through the medium. It is typically denoted by the symbol (v) and is measured in meters per second (m/s).

$$v = \vartheta\lambda$$

There are various types of waves.

1. **Longitudinal wave:** If the particles in the medium vibrate along the direction of wave propagation, the nature of the wave is called longitudinal wave. It consists compressions and rarefactions. The distance between two consecutive compressions or two consecutive rarefactions is called wave length. Ex: sound waves
2. **Transverse wave:** If the particles in the medium vibrate perpendicular to the direction of wave propagation, the nature of the wave is called transverse wave. It consists crests and troughs. The distance between two consecutive crests or two consecutive troughs is called wave length. Ex: light waves
3. **Stationary wave:** A stationary wave also known as standing wave is formed when two waves of equal frequency and amplitude travel in opposite directions along the same path. These waves are confined to a fixed region of the medium. Minimum amplitude positions in a stationary wave nodes and maximum amplitude positions are antinodes.
4. **Electromagnetic waves:** These waves are transverse waves in nature. They do not need medium for propagation. They can propagate through vacuum. Ex: light waves, gamma rays, X-rays etc.
5. **Matter waves:** matter waves are associated with particles like electrons and exhibit both particle and wave characteristics.

Wave interference:

1. The principle of superposition of waves states that when two or more waves travel through the same portion of a medium simultaneously, the resultant displacement at any point is the vector sum of the displacements due to individual waves. The modification in the distribution of intensity in the region of superposition is called interference. There are two types of interference
2. When the resultant amplitude is the sum of the amplitudes due to two waves, the interference is known as constructive interference and when the resultant amplitude is equal to the difference of two amplitudes, the interference is known as destructive interference.

Sound wave:

A sound wave is a type of mechanical wave that propagates through a medium, typically air, but it can also travel through liquids and solids. Sound waves are created by vibrating objects, such as vocal cords, musical instruments, or speakers. These vibrations create compressions and rarefactions in the surrounding medium, leading to the transmission of energy in the form of waves.

Nature of sound wave:

- **Mechanical wave:** Sound waves are mechanical waves, meaning they require a medium (solid, liquid, or gas) to travel through. The particles in the medium vibrate as the wave passes through, transferring energy from one particle to the next.
- **Longitudinal wave:** Sound waves are longitudinal waves, which means that the vibrations occur parallel to the direction of wave propagation. In a sound wave, particles of the medium oscillate back and forth along the same axis as the wave travels.
- **Compression and rarefaction:** A sound wave consists of alternating compressions and rarefactions. During compression, particles are close together. In rarefaction, particles are spread apart.
- **Speed of sound wave:** The speed of sound varies depending on the medium through which it travels. In general, sound travels faster in denser materials
- **Pitch:** The frequency of a sound wave determines its pitch. Higher frequencies are perceived as higher-pitched sounds, while lower frequencies are perceived as lower-pitched sounds.
- **Loudness:** The amplitude of a sound wave is related to its intensity or loudness. Larger amplitude waves produce louder sounds, while smaller amplitude waves result in softer sounds.

Doppler effect:

The Doppler effect is the change in the frequency of a wave in relation to an observer who is moving relative to the source of the wave. This phenomenon is commonly observed with sound waves but can also be applied to other types of waves, such as electromagnetic waves.

Applications of Doppler effect:

- In astronomy, the Doppler effect is used to study the motion of celestial objects. When a star or galaxy is moving away from Earth, its light is red shifted. Conversely, objects moving toward Earth exhibit blue shift**.**
- Doppler radar is used in meteorology to track the motion of precipitation. By analyzing the Doppler shifts in the radar signals, meteorologists can determine the speed and direction of rain or snowfall, helping in weather forecasting and severe weather detection.
- In medical applications, the Doppler effect is utilized in Doppler ultrasound. This ultrasound scan detects the growth of the baby in mother’s woomb.
- Police men uses the radar guns to measures the speed of the vehicles.
- The Doppler effect is used in the design of communication systems for aircraft and satellites.
- The Doppler effect is used in spacecraft navigation to measure the velocity of a spacecraft relative to a celestial body or a ground station.

Light:
Light is an electromagnetic wave. Which is transverse in nature. Light exhibits both wave-like and particle-like properties. In certain experiments, such as the double-slit experiment, light behaves as a wave, displaying interference and diffraction patterns. In other situations, such as the photoelectric effect, light behaves as if it consists of discrete particles called photons.

Reflection:
When a ray of light approaches a smooth polished surface and the light ray bounces back, it is called the reflection of light. Here the angle of incidence is equal to the angle of reflection.

Refraction:
The bending of a light wave when it passes from one medium to another due to the change in the speed of the light is called the Refraction of light.

Formation of images by Mirrors:
Mirrors are reflective surfaces that can be either flat (plane mirrors) or curved (concave or convex mirrors). The type of mirror and its curvature influence the characteristics of the images formed.

Plane mirror:
Plane mirrors produce virtual images that are upright and appear to be the same size as the object. Here the image distance and object distance are similar.

Characteristics of the image due to plane mirror:

- Lateral inversion
- Upright(straight) image
- Virtual image
- Object size and image size are same
- Object distance and image distance size are same

Concave mirrors:
Concave mirrors are curved inward, and they are converging mirrors. The focal point (F) is the point where parallel rays either converge or appear to converge after reflecting from the mirror**.**

- If the object is beyond the focal point (F), a real and inverted image is formed between the focal point and the mirror. The image is smaller than the object.
- If the object is between the focal point and the mirror, a real and inverted image is formed beyond the focal point. The image is larger than the object.
- If the object is at the focal point, the reflected rays are parallel, and there is no well-defined image.
- If the object is inside the focal point, a virtual and upright image is formed behind the mirror. The image is larger than the object.

Convex mirrors:
Convex mirrors are curved outward, and they are diverging mirrors. They reflected rays diverging from a focal point behind the mirror.
Convex mirrors always produce virtual, upright, and diminished images, regardless of the object's position.

Formation of images due to lenses:
A lens is a transparent optical element with curved surfaces that refracts or bends light. Lenses are designed to converge or diverge light rays, and they play a crucial role in various optical devices, such as cameras, eyeglasses, microscopes, telescopes, and projectors. The most common types of lenses are convex (converging) and concave (diverging).

Convex lens: Convex lenses have at least one surface that bulges outward. They are converging lenses.

Image formation due to convex lens:

- If the object is beyond the focal point, a real and inverted image is formed on the opposite side of the lens. The image is smaller than the object.
- If the object is at the focal point, the refracted rays are parallel, and there is no well-defined image.
- If the object is between the focal point and the lens, a real and inverted image is formed beyond the focal point. The image is larger than the object.
- If the object is inside the focal point, a real and inverted image is formed on the same side of the lens as the object. The image is larger than the object.

Concave lens:

Concave lenses have at least one surface that curves inward. They are diverging lenses.

Image formation due to concave lens:

Concave lenses always produce virtual, upright, and diminished images, regardless of the object's position. The image appears to be formed on the same side of the lens as the object.

Interference of light:

The principle of superposition of waves states that when two or more light waves travel through the same portion of a medium simultaneously, the resultant displacement at any point is the vector sum of the displacements due to individual waves. The modification in the distribution of intensity in the region of superposition is called interference. There are two types of interference

When the resultant amplitude is the sum of the amplitudes due to two waves, the interference is known as constructive interference and when the resultant amplitude is equal to the difference of two amplitudes, the interference is known as destructive interference.

- Interference is used in interferometers to precisely measure the wavelength of light.
- Fiber-optic communication systems utilize interference phenomenon to separate and manage different wavelengths of light.
- Interference-based techniques are employed in non-destructive testing methods.
- Interference phenomenon is used in construction and recording of holograms.

Diffraction:

When light falls on obstacles or small apertures whose size is comparble with the wavelength of light, the light bends round the corners of the obstacles and enters in the geometrical shadow. This bending of light is called diffraction. Diffraction produces bright and dark fringes known as diffraction bands or fringes.

- X-ray diffraction is widely used to study the structure of crystals.
- Diffraction gratings, which consist of a series of closely spaced slits or rulings, are used to measure the wavelength of the light.
- The information stored on optical storage media like CDs, DVDs, and Blu-ray discs is read using diffraction.
- sound waves can also undergo diffraction. This property is used in various acoustic applications, such as designing concert hall acoustics, noise barriers, and speaker systems.

Polarization:

The phenomenon of confinement of vibrations of light, only to a single plane is called polarisation. Reflection, refraction and double refraction are basic methods to produce polarized light. Nicol’s prism is a common optical device to produce and analyze polarisd light.

- Polarized sunglasses use a special filter to block horizontally polarized light, reducing glare from surfaces such as water, roads, and snow.

- LCD screens in devices like televisions, computer monitors, and smart phones utilize polarized light.
- In 3D movie systems, polarized light is often used to present different images to each eye.
- Polarized light microscopy is a technique used in materials science, geology, and biology. It can reveal information about the optical properties and internal structures of samples
- Polarization imaging is employed in medical diagnostics, such as in detecting changes in tissues' optical properties.

Differences between Interference and diffraction:

Interference	**Diffraction**
1.Two coherent light waves are needed to form interference pattern. 2.Minimum intensity regions are almost perfectly dark 3.The width of the fringes are may or may not be equal 4. All bright fringes have same intensity 5. Obstacles or slits are not used	1.Two secondary wavelets originated from the same wavefront are used to form diffraction pattern 2. Minimum intensity regions are not completely dark 3. The width of the fringes are not equal. 4. Intensities of the bright fringes are not equal 5. . Obstacles or slits are used