# UNIT 1

# APPLICATION OF PHYSICS IN OTHER FIELDS

## Introduction

Science is a collection of different scientific fields, or disciplines. It is the union of these fields that helps us to understand the world in which we live. Although there are many scientific disciplines with a special character and history of their own, each discipline is dependent on and reinforces the other disciplines.

⁘ Saayinsiin qorannoowwan saayinsii hedduu walitti makuudha. Qorannoowwan saayinsii hundi damee isaanii irratti bu'uura beekumsa gadi fagoo waan qabaniif yaada waliif wal jijjiiruun waan fooyya'aa hojjechuu danda'u.

## 1.1 Physics and other sciences

Physics is the most essential field of science and it has a strong influence on most scientific developments. We can find different concepts of physics in many of the modern sciences.

Fiiziksiin dameewwan saayinsii barbaachisoo ta'an keessaa tokko yoo ta'u, dameewwan saayinsii biroof gumaacha qaba. Kanaafidha yaadni fiiziksii damee saayinsii adda addaa keessatti kan argannu.

### Physics and chemistry

Physics and chemistry may overlap when the system under study involves matter composed of electrons and nuclei.

Saayinsii keessatti waa'ee atoomotaa yoo qorannu fiiziksii fi keemistrii akka hammannu beekamaadha. Sababni isaas lamaan isaanii damee isaanii keessatti waa'ee boca, amala fi wantoota walqabatan biroo atoomichaa seera bocanii gadi fageenyaan qorataniiru.

The physics of atoms and subatomic particles is critically important for understanding how individual atoms are joined by covalent bonds to form molecules.

- Fakkenyaaf fiiziksiidhan waa'ee atoomii fi subatoomii qorachuun atoomoonni molakiyuulota hidhoo wal tumsaa koovaaleentiidhaan uumuu akka danda'an hubachuuf nu gargaara. Inni biraa fiiziksii fi keemistriin wantii isaan walqabsiisu keemistrii walnyaatiinsa keemikaalaa keessaa bu'uun qoratama, fiiziksiidhaan ammoo walnyaatiinsa keemikaalaa annisaa fi kanneen biroo kan walqabatan barbaada wantoonni ni qoratamu.

## Physics and biology

- To understand how life works, it is essential to understand physics.
- Jireenya illee hubachuuf nama ajaa'iba fiiziksii beekuun barbaachisaadha.
  Fakkeenya:

dhaabbannerf wirtuu alfaatima isaa xiyyeeffannaa qaba jedha

Physics of fluid flow and biology

The physics of fluid flow is very important in understanding the circulation of blood

Furikaa kanneen dhungata aan gadi lagsiisu aan qorataama. Kunis dhungata as dhiigaa bahuu hanga gargaara

Soft bodied animals that lack a firm skeleton use fluid pressure to provide body rigidity

Xiyyeeffannoo bineensota lafee dugdaa hin qabne qajeeltama (pascal principle) waliin waan walfakkaatuuf fiiziksii irraa wacchii isaanii bubachuun nu dandeessa



- Fiiziksii elektiriikii jechuun fiiziiksiin waa'ee elektiriikii gadi fageenyaan dubbatuudha. Ilaa, taateewwan elektiriikii lubbu qabeeyyii keessatti barbaachisoo ta'an sirna narvii keessatti uumamu. Sirna narvii kana keessatti niwuroonoonni odeeffannoo bifa mallattoo elektiriikiitiin





## Optical physics and biology

Light is the electromagnetic radiation in the wavelength region between about 400 nm and 700 nm. Although light is only a tiny part of the electromagnetic spectrum, it is very important in both physics and biology.

**Gama ifaatiin hariiroo fiiziksii fi baayoolojii yeroo ilaallu ifa raadiyeeshinii elektiromaagneetikii jedhamuun beekama. Kanaafuu fiiziksii keessatti bifa dalgeetiin gadi fageenyaan qoratama. Gama tajaajila ifni lubbu qabeeyyiif kennu ilaalchisee, baayoloojii keessatti gadi fageenyaan qoratama. Fakkeenyaaf: fotoosinteensiidhaa fi kaayyoo biraatiifis ni oola.**

## Physics and astronomy

Astrophysics is the study of the physics of heavenly objects, called astronomical objects, in the sky.

**Explanation**: Thermodynamics focuses on heat, energy, and work, which are key in understanding chemical reactions.

2. What physical principle explains why gases in a closed container expand when heated?

a) Newton's First Law

b) Pascal’s Law

c) Boyle’s Law

d) Charles’s Law

Answer: **d) Charles’s Law**

**Explanation**: Charles’s Law states that the volume of a gas increases when temperature increases, provided pressure remains constant.

3. The study of atomic structure and behavior is a connection between which two fields?

a) Physics and biology

b) Physics and astronomy

c) Physics and chemistry

d) Physics and geology

Answer: **c) Physics and chemistry**

**Explanation**: Both physics and chemistry are concerned with atomic structure, but chemistry focuses on chemical bonds, while physics emphasizes atomic energy and forces.

4. Which physical process is essential in the transportation of oxygen in blood cells?

a) Conduction

b) Diffusion

c) Refraction

d) Radiation

Answer: **b) Diffusion**

**Explanation**: Diffusion, a physical process, enables oxygen molecules to pass through cell membranes, a key biological function.

5. What field of physics is vital for understanding how electrical impulses travel through nerves in the human body?

a) Quantum Mechanics

b) Electromagnetism

c) Thermodynamics

d) Optics

Answer: **b) Electromagnetism**

**Explanation**: Electromagnetism explains the flow of electrical signals, crucial for biological processes like nerve communication.

6. How does physics explain the efficiency of the human heart as a pump?

a) Newton's Laws of Motion

b) Laws of Thermodynamics

c) Bernoulli's Principle

d) Pascal's Law

Answer: **c) Bernoulli's Principle**

**Explanation**: Bernoulli's Principle, which explains fluid dynamics, is essential for understanding how blood flows efficiently through the heart.

7. Which physical law is fundamental for explaining planetary orbits in astronomy?

a) Coulomb's Law

b) Newton's Law of Universal Gravitation

c) Snell’s Law

d) Ohm’s Law

Answer: **b) Gravitational Force**

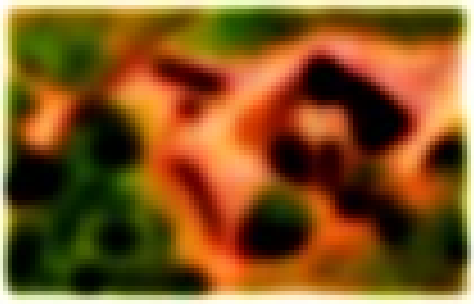
**Explanation**: Gravitational force is the dominant force shaping galaxies, binding stars and other matter together.

## 1.2 Physics and Engineering

Physics generates fundamental knowledge that can be used by different branches of engineering.

Waa'ee injinariingii yeroo kaasnu fiiziksiin barumsa barbaachisaa fi bu'uuraa ta'ee arganna. sababni isaas akkuma dameewwan siiviilii, makaanikaala, keemikaala, elektiriikii, kompiitaraa fi dameewwan injinariingii adda addaa biroo beekumsa bu'uuraa fiiziksii irraa argatu. Beekkumsa bu'uuraa kan akka makaaniksii, teermoodayinaamiksii, elektiroomaagneetizimii, fiiziksii atoomik, fiiziksii molekulaa optikii, fiiziksii niwkilaraa fiiziksii irraa argachuun ni danda'ama. Kanaafuu namni fiiziksii barate tokko akkuma armaan gaditti bu'aa hojii







## Electrical engineering

Electrical engineering involves designing electrical circuits including motors, electronic appliances, optical fiber networks, computers, and communication links.

- Electrical engineering jechuun akkuma mootora, meeshaalee elektirooniiksii, neetworkii faayibara optikaalaa, koompiitaraa fi qunnamtii walitti hidhamiinsa kanqabu sarkiyuutii elektiriikii kana xiyyeeffachuudhaan hojjatu dirree injinaringiidha. Yeroo baay'ee kan



(b)



(c)

elektiriikii injinariingii kan argatan anniisa elektiriikii gara mechanical sababni isaas yeroo jijiiraman anniisa ho'aa fayyadamu. sana gochuuf beekumsa fiiziksii isaan barbaachisa. Humna elektiriikii gara makaanikaalaa yookaan

anniisaa ho'a jijjiiruuf qofa akka elektiromaagneetiizimii, makaaniiksii, fiiziksii, teermodayinaamiksii kan jiran beekkumsa fiiziksii barbaachisa. Kanaafidha fiiziksii injinariingii elektiriikii baay'ee barbaachisa kan jedhamu. Suuraalee armaan gadii kan mul'isan bu'aa elektiriikii injinariingiiti.

## Chemical engineering

Chemical engineering involves the production of products through chemical processes. This includes designing equipment, systems, and processes for refining raw materials and for mixing, compounding, and processing chemicals.

- Keemikaal injinariingiin damee injinariingii adeemsa oomishaalee adda addaa (simiintoo, zayita, dhugaatii...) adeemsa keemikaalaan oomishuuf dizaayinii godhuudha. Meeshaalee jallisii adda addaa qopheessuu fi keemikaalota walitti makuuf nu barbaachisu, sirnaa fi adeemsa hordofuu qabnu kan diizaayinii godhu

fakkaatuutti ilaalchi dabalaa jira isaan dhufu. Fiiziksiin teeknooloojii guddisa fiiziksiin injinariingiis ni guddisa. Injinariingiin ammoo teeknooloojii guddisa. Haala kanaan sadanuu walitti hidhamaniiru. Suuraan armaan gadii kana agarsiisa.

## Teacher's Mind

1. Which area of physics is most important for understanding how bridges support weight?

a) Optics

b) Thermodynamics

c) Statics

d) Electrodynamics

Answer: **c) Statics**

**Explanation**: Statics, a branch of mechanics, deals with forces in equilibrium, which is essential for designing structures like bridges.

d) Acoustics

Answer: **c) Electromagnetism**

**Explanation**: Electromagnetism governs the behavior of electric and magnetic fields, which are fundamental to electrical engineering.

4. What concept in physics helps engineers design buildings to withstand earthquakes?

a) Elasticity

b) Relativity

c) Refraction

d) Entropy

Answer: **a) Elasticity**

**Explanation**: Elasticity is the ability of materials to return to their original shape after being deformed, crucial for earthquake-resistant structures.

d) Fluid Mechanics

Answer: **a) Thermodynamics**

**Explanation**: Thermodynamics is used to study heat transfer and efficiency, which is critical in designing heat exchangers in various industries.

7. In electrical engineering, which law describes the relationship between voltage, current, and resistance?

a) Coulomb's Law

b) Ohm's Law

c) Faraday's Law

d) Kirchhoff's Law

Answer: **b) Ohm's Law**

**Explanation**: Ohm's Law states that the current through a conductor between two points is directly

proportional to the voltage across the two points and inversely proportional to the resistance.

8. What branch of physics helps engineers improve the efficiency of engines?

a) Nuclear Physics

b) Fluid Dynamics

c) Acoustics

d) Thermodynamics

Answer: **d) Thermodynamics**

**Explanation**: Thermodynamics governs the laws of energy conversion, essential for increasing the efficiency of engines.

9. In civil engineering, which physical law helps in determining how water flows through soil or porous materials?

a) Coulomb’s Law

b) Newton's Third Law

c) Darcy's Law

d) Planck’s Law

Answer: **c) Darcy's Law**

**Explanation**: Darcy's Law describes the flow of a fluid through a porous medium, important in groundwater engineering and soil mechanics.

10. Which branch of physics is essential for understanding and improving the structural integrity of materials in construction engineering?

a) Quantum Mechanics

b) Solid Mechanics

c) Acoustics

d) Optics

- (CT scan) altiraasaawundii fi firiikuweensii olaanaa altiraasaawundi fa'a.

## Magnetic Resonance Imaging (MRI)

Magnetic resonance is absorption or emission of electromagnetic radiation by electrons or atomic nuclei in response to the application of certain magnetic fields. MRI uses the physical principle of magnetic resonance that was first described by Felix Bloch and Edward Purcell in 1946. Paul Lauterbur and Peter Mansfield described how to acquire MR images from the human body.

How is MRI working?:

- Gumaacha fiiziksiin akka waliigalaatti fayyaaf qabu keessaa tokko MRI dha. Maagneetiik reezoonaansii jechuun niwukilasii irra kan gadhiisu raadiyaashiniin elektiroomaagneetikii sababa dirree maagneetii wanta tokkootiin dhufu jechuudha. Suuraa maagneetii reezoonaansii fayyadamuun qaama namaa baqaqsanii hodhuu malee arguun ni

Maashiniin kun qaama keenya keessa bishaan waan jiruuf pirootoonii ykn atoomii haayidiroojiinii bilisaa (pirootoonii elektiroonota hin qabne) fayyadamuun hojjata. Pirootoonoonni kunniin amaloota maagneetii tiqqaas qabu. Dhukkubsataan maashinicha keessa yeroo seenu maashinichi dirree maagneetii waan qabuuf pirootonoonni dhukkubsataa keessa jiran amaloota maagneetii waan qabaniif gara dirree maagneetitti socho'u. Sana booda maashinichi sekondii gabaabaaf dambalii raadiyoo dhukkubsataa sanatti yeroo gadi lakkisu pirootonoonni sun ni raafamu. Sana booda, yeroo dambaliin sun badu, annisaan dambalii pirootoonii hundi isaanii hamma adda addaatiin deebi'anii ni gadhiifamu. Maashinichi annisaa isaan gadi lakkisan fudhatee gara suuraatti jijiira.





## X-Ray computerized tomography (CT) scan

An X-ray imaging is based on the absorption of X-rays as they pass through the different parts of a patient's body. Differences in the densities of body tissue allow us to see inside the body by creating a shadow gram.

Gumaan fiiziksiin akka waliigalaatti fayyaaf qabu inni biraan immoo rajii eksiree fayyadamuudha. Maashinii raajii kanaa fayyadamuun kutaalee qaama namaa jajjaboo baqaqsanii hodhuu malee arguun ni danda'ama ture. Fakkeenyaaf, kutaalee qaama keenya akka lafee jechuudha. Maashiniin kun akkamitti akka hojjatu ilaalaa.

- Akkuma suuraa armaan gadii irratti argitan dhukkubsataan kun maashinii raajii jala ciisa. Yeroo x-ray gubbaadhaa bahu scanner dhukkubsataa jala jiru odeeffannoo argata jechuudha. Raajiin eksiree kutaalee qaama keenyaa kan hin jabaanne kan akka foon keenya keessa darbuu danda'a. Raajiin eksiree foon keenya keessa yeroo darbu, iskaanara sana gurraacha godha. Garuu kutaan scanner kan eksireen hin tuqamne adii ta'a. Kana jechuun raajii eksiree lafee keenya keessa darbuu waan hin dandeenyeef bocni lafee keenyaa guutuun iskaanara irratti adii ta'ee mul'ata. Fakkeenyaaf kutaa adii iskaanara irratti sararri guraacha xiqqaan yoo jiraate dhukkubsataan rakkoo lafee





## Clinical uses of sound: stethoscope and ultrasound

**Gumaan fiiziksiin walumaagalatti fayyaaf qabu inni biraan faayidaa sagaleeti. Fiiziksii keessatti sagalee fayyadamuun wanti hedduun hojjatameera.**

### Stethoscope

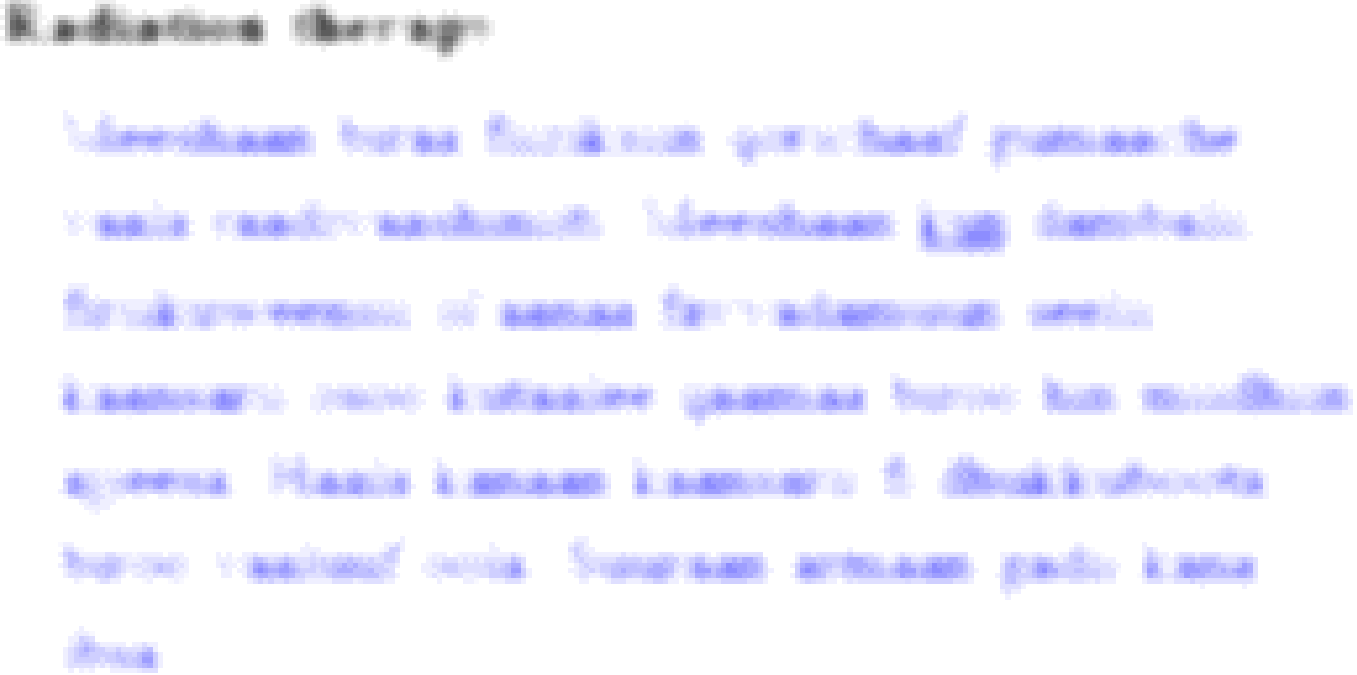
The stethoscope was developed in 1816 by a French physician, Rene Laennec. This instrument consists of a small bell-shaped cavity attached to a hollow flexible tube. The bell is placed on the skin over the source of the body sound.

Fiiziksiin sagalee irratti hunda'ee meeshaalee yaalaaf arjooman keessaa inni tokko isteetoskooppii dha.



**naannoo garaachaa irra deebi'ee dhufuun. Naannoo anechoic jenna bakka echo gadaameessa keessatti hin jirretti. Naannoo dhangala'aa dha. Hypoechoic naannoo echoo xiqqaa ta'eedha. Bakki sagalee guddaa qabu hypoechoic jedhama. Bakka sagaleen olka'aan itti uumamu yoo ta'u, kunis iskiriinii altiraasaawundii irratti adii ta'ee mul'ata. Lafeen bakka itti ta'uudha. Ifa ta'uuf suuraa armaan gadii ilaalaa.**





## Teacher's Mind

1. What type of radiation does an MRI machine use to create images of the body?

a) X-rays

b) Radio waves

c) Gamma rays

d) Infrared radiation

Answer: **b) Radio waves**

**Explanation**: MRI uses strong magnetic fields and radio waves to generate detailed images of soft tissues in the body.

2. Which component of the body's atoms is primarily influenced during an MRI scan?

a) Neutrons

b) Protons

c) Electrons

d) Nuclei

Answer: **b) Protons**

**Explanation**: The protons in the hydrogen atoms of the body align with the magnetic field in an MRI, allowing for image generation.

3. What type of radiation is used in a CT scan to create cross-sectional images of the body?

a) Ultraviolet rays

b) Radio waves

c) X-rays

d) Gamma rays

Answer: **c) X-rays**

**Explanation**: A CT scan uses X-rays to produce detailed cross-sectional images, which can show bone, soft tissue, and blood vessels.

4. Why is a CT scan often preferred over an X-ray for detecting internal injuries?

a) Lower radiation exposure

b) Better soft tissue contrast

c) Faster imaging

d) Non-invasive

Answer: **b) Better soft tissue contrast**

**Explanation**: CT scans provide more detailed images of soft tissues compared to standard X-rays, making them ideal for detecting internal injuries.

5. What type of waves does ultrasound imaging use to create images of the inside of the body?

a) Radio waves

b) Electromagnetic waves

c) Sound waves

d) Gamma rays

Answer: **c) Sound waves**

**Explanation**: Ultrasound imaging uses high-frequency sound waves to create images of internal organs and tissues.

6. Which property of sound waves is most important in ultrasound imaging to visualize different tissues?

a) Wavelength

b) Frequency

c) Amplitude

d) Speed

Answer: **b) Frequency**

a) Gamma rays

b) Microwaves

c) Ultraviolet rays

d) Radio waves

Answer: **a) Gamma rays**

**Explanation**: Gamma rays or high-energy X-rays are used in radiation therapy to kill or damage cancer cells by breaking their DNA.

9. How does radiation therapy specifically target cancerous cells while minimizing damage to healthy tissue?

a) By using high-frequency sound waves

b) By directing beams from different angles

c) By heating cancer cells

d) By using low-energy radiation

Answer: **b) By directing beams from different angles**

**Explanation**: Radiation therapy uses multiple beams from different angles to concentrate the radiation dose on cancer cells while sparing healthy tissue.

10. What device is typically used to deliver precise doses of radiation in radiation therapy?

a) X-ray machine

b) Ultrasound scanner

c) Linear accelerator

d) MRI machine

Answer: **c) Linear accelerator**

**Explanation**: A linear accelerator (LINAC) is used to deliver high-energy radiation in a focused manner to treat cancer.

## 1.4 Physics and defense technology

The modern defense force has different branches like Air Force, Army, Navy and Space Force.

Teeknooloojii ammayyaatiin humni ittisaa gosa hedduutu jira. Fkn humni qilleensaa, waraanaa, humna galaanaa fi humnoonni ittisaa biroo ni jiru. Kunis hundi raayyaan ittisaa akka gaariitti akka hojjetuu fi tajaajila sirrii akka kennu gochuuf.

laser guidance Fi satellite technology, modern electronics, optics, sensing systems, high-energy-density physics, atomic and nuclear physics, hydrodynamics, and physics of advanced materials beekumsi gadi fageenyaa fiiziksii kannen marsee jiru qabaachuun barbaachisaadha. Fakkenyaaf, humna galaanaa gaarii qabaachuuf warri naannoo isaa naana'an kan akka oceanographic physics, the propagation of sound through water, deep-ocean currents, and meteorology beekumsi gadi

fageenyaa fiiziksii barbaachisaadha. Humna qilleensaa(Air force)



ooludha. Fakkeenyaaf, teknooloojiin radar kun hradar bakka dooniiwwan, xiyyaaroonni, misaa'eloonni fi wantootni socho'an kan biroo fageenya tokko tokkoo irratti argaman adda baasu dandeenya. Teeknooloojii radar irra caalaa waan lama fayyadamuudhaan. Isaaniis mallattoo elektiroomagneetikii fi isaan sagalee dhageessisaa dha. Fakkeenyaaf, bakka xiyyaarichi jiru beekuuf radar elektiroomagneetikii mallattoo ni baasa. Sana booda mallattoon kun deebi'e gara radar dhufa. kun echo dha waan jennu. mallattoon xiyyaaricha waliin dhufe yoo yeroo deebi'uu radar jennee waamne. Fakkeenyi imalame "2R" dha. Yoo jenne saffisa inni itti deeme sababni isaas saffisa ifa, xiyyaara fageenya isaa argachuu dandeenya.

$$Speed = \frac{distance}{time}$$

$$Distance = speed \times time$$

$$2R = c \times t$$



## Military applications of Radar

Its major function is to detect target and guiding the defensive and offensive weapons.

- Teeknooloojii radar itti fayyadamnu keessaa inni guddaan waraana. Yeroo humna qileensaa keessatti raadara baay'ee fayyadamnu, bakka barbaannu agarsiisuuf, akkasumas humna ittisa fi haleellaa jirru agarsiisuuf itti fayyadama. Fakkeenyaaf, humnoota waraanaa raadara fayyadaman irraa misaa'ela kessatti caqafameera.

Radar can also be utilized in civilian applications particularly in controlling air traffic, observation of weather, navigation of ship, environment, sensing from remote areas, observation of planetary, etc.

## Teacher’s Mind

1. What type of waves are primarily used in radar systems for detecting objects?

a) Sound waves

b) X-rays

c) Radio waves

d) Gamma rays

Answer: **c) Radio waves**

**Explanation**: Radar systems use radio waves to detect and track objects by bouncing waves off targets and analyzing the reflected signals.

2. The Doppler effect is crucial in radar technology. What does it measure in defense applications?

a) Distance

b) Speed of an object

c) Size of an object

d) Time

Answer: **b) Speed of an object**

4. What is the primary role of radar in missile guidance systems?

a) Detecting enemy communications

b) Navigating terrain

c) Tracking targets and guiding missiles

d) Monitoring weather conditions

Answer: **c) Tracking targets and guiding missiles**

**Explanation**: Radar systems in missile guidance track the target's position and adjust the missile's trajectory to ensure accurate targeting.

5. In missile defense, which technology is used to detect and intercept incoming missiles?

a) Acoustic sensors

b) Infrared sensors

c) Radar systems

d) Optical sensors

Answer: **c) Radar systems**

**Explanation**: Radar is critical for detecting and tracking incoming missiles, providing data to anti-missile systems for interception.

6. What physical principle is used in the guidance of heat-seeking missiles?

a) Electromagnetic induction

b) Infrared radiation detection

c) Radio wave reflection

d) Gravitational pull

Answer: **b) Infrared radiation detection**

**Explanation**: Heat-seeking missiles use infrared sensors to detect and lock onto the heat emitted by targets, such as jet engines.

7. Which of the following techniques is primarily used to make military aircraft “stealthy” and avoid radar detection?

a) Reflecting radio waves

b) Absorbing radar waves

c) Emitting stronger signals

d) Bouncing sound waves

Answer: **b) Absorbing radar waves**

**Explanation**: Stealth technology involves materials and designs that absorb radar waves, reducing the radar cross-section and making the aircraft less detectable.

8. What physical concept does stealth technology exploit to reduce radar cross-section in military vehicles?

a) Refraction

b) Diffraction

**Explanation**: Lasers travel at the speed of light, allowing them to hit targets almost instantaneously compared to conventional projectiles.

10. What physical principle allows directed energy weapons, such as high-power lasers, to disable electronic systems?

a) Thermodynamic heating

b) Electromagnetic pulse

c) Quantum entanglement

d) Acoustic resonance

Answer: **b) Electromagnetic pulse**

**Explanation**: Directed energy weapons can generate electromagnetic pulses (EMPs), disrupting the electronics of targeted systems.



Kanaaf fakkeenya gaariin bilbiloota, koompiitaraa fi TV keenya. All forms of communication technologies demand the knowledge of physics. The demanded physics knowledge depends on the type of message and the medium of transmission.

Teeknooloojiiwwan dabarsuu daataa armaan olitti argine kun hundi beekumsa gadi fagoo fiiziksii barbaadu. Fakkeenyaaf, dambalii raadiyoo, maaykirooweeyii fi dambalii infrared sirna qunnamtii wayaa malee gumaacha guddaa qabu. Waa'ee kana ti'oorii elektiroomaagneetikii karaa fiiziksiitiin qorachuudhani.

## Teacher’s Mind

1. What type of waves are primarily used in wireless communication systems like radio and television?

a) Sound waves

b) X-rays

c) Electromagnetic waves

d) Mechanical waves

Answer: **c) Electromagnetic waves**

**Explanation**: Electromagnetic waves, particularly radio waves and microwaves, are used in wireless communication to transmit information over long distances.

2. Which part of the electromagnetic spectrum is commonly used for mobile phone communication?

a) Infrared waves

b) Gamma rays

c) Microwaves

d) Ultraviolet waves

Answer: **c) Microwaves**

**Explanation**: Microwaves are used in mobile phone communication because they can carry large amounts of data over relatively long distances without significant interference.

3. What is the purpose of modulation in communication systems?

a) To amplify signals

b) To change the frequency of a signal

c) To encode information onto a carrier wave

d) To reduce the speed of data transmission

**Answer**: c) To encode information onto a carrier wave

**Explanation**: Modulation is the process of encoding information onto a carrier wave, allowing the signal to be transmitted over long distances without losing quality.

4. In frequency modulation (FM), what property of the carrier wave is varied to transmit information?

a) Amplitude

b) Frequency

c) Phase

d) Wavelength

Answer: **b) Frequency**

**Explanation**: In frequency modulation (FM), the frequency of the carrier wave is varied in accordance with the information being transmitted.

5. Which physical phenomenon causes radio waves to bend around obstacles, allowing them to be received even when there is no direct line of sight?

a) Reflection

b) Diffraction

c) Refraction

d) Interference

BAnswer: **b) Diffraction**

**Explanation**: Diffraction allows radio waves to bend around obstacles, making it possible for signals to reach areas that are not directly in line with the transmitter.

6. What term describes the fading of communication signals as they travel over long distances?

a) Refraction

b) Attenuation

c) Interference

d) Diffusion

Answer: **b) Attenuation**

**Explanation**: Attenuation is the reduction in the strength of a signal as it travels over long distances,

due to energy loss in the medium through which it propagates.

d) Refraction

Answer: **b) Total internal reflection**

**Explanation**: Total internal reflection ensures that light signals bounce within the optical fiber without escaping, allowing efficient data transmission.

9. What is one key advantage of digital signals over analog signals in communication systems?

a) Digital signals are less affected by noise

b) Digital signals require more bandwidth

c) Digital signals are more difficult to process

d) Digital signals have lower transmission speeds

Answer: **a) Digital signals are less affected by noise**

**Explanation**: Digital signals are less susceptible to noise and interference, making them more reliable for communication, especially over long distances.

10. In digital communication, what is the process of converting an analog signal into a digital one called?

a) Modulation

b) Demodulation

c) Sampling

d) Quantization

Answer: **c) Sampling**

**Explanation**: Sampling is the process of converting an analog signal into a digital one by measuring the signal at regular intervals and representing it in a digital format.

## Unit summary

- ❖ Different scientific fields are dependent on and reinforces the other fields.

- Physics has a strong influence on many scientific developments and many modern sciences arose from physics.
- The study of matter and electricity in physics is fundamental towards the understanding of concepts in chemistry, such as atomic structure, molecular structure, X-ray diffractions, radioactivity, periodic properties of elements, nature of valence, chemical bonds in molecules, crystal structure of solids and others.
- In biology, the motion of animals and their body parts, flow of blood through blood vessels, sound production and transmission as well as receiving by special living tissues, communication networks in the body, reaction of living tissue with light, the development of scientific instrument to study living cell demands different concepts of physics
- Astronomers use the physics of light, atomic physics and Newtonian mechanics for the study of astronomical objects.

- Geologists use basic physics concepts like force, optics, atomic structure, electromagnetic radiation, heat and heat flow, electricity and magnetism, stress and strain, sea waves, acoustics and fluids and fluid flow to study common geological processes and the analytical techniques.
- Physicists discover facts and laws, develop methods of measurement, determine various constants, propose and work out in detail mathematical theories and hypotheses, etc., while engineers later apply some of these valuable facts and theories to design and build machines, construction, and operation of various practical devices.
- In Civil Engineering, the laws of physics can tell you about forces, tension, harmonic vibrations and oscillations, tensile strength, elasticity, and all kinds of other concepts that you can use to make calculations about your designing and construction work.

- As many of the current technologies wouldn't be existed without physics, many modern physics experiments also wouldn't be possible without technology.
- Medical physics is a branch of physics that concerns the applications of principles of physics to medical diagnosing and treating abnormal tissues. The modern medical equipment like X-ray, MRI, CT scan, ultrasound and others are developed by the application of physics knowledge.
- Defense technologies like Radar and Infra-red night vision uses the physics of electromagnetic waves.
- Mechanical Engineering need the concepts of physics like mechanics, dynamics, thermodynamics, materials science, structural analysis, and electricity to design aircraft, watercraft, engines, robotics, weapons, cars, pneumatics, hydraulics and others.

❖ Electrical and electronic engineers demand the basic knowledge of physics in electromagnetism and semiconductor physics.

## End of unit questions

1. Explain the following biological process in terms of some physics knowledge.

- How our brain receives information from the whole body and send information to other body?
- Which part of our body tells us the temperature of our environment?
- What instrument is used to measure the exact value of our body temperature? What is the physics in this instrument?
- What physics knowledge is needed to understand how a sound is created and transmitted to the listener?
- What energy transformation occurs in human body?

- What energy transformation occurs in photosynthesis?

2. List as many concepts of physics that can be used in designing modern vehicles.

3. How physics of light is important to study the astronomical objects?

4. As physics is the basis for the development of many technologies, how technologies contribute for the development of science particularly physics?

5. What major physics knowledge is used in defense radar system to detect the enemy target?

6. List at least three modern medical devices and explain their working principles.

7. List as much physics knowledge and engineering as possible to build a modern building for residence.

8. Identify the difference between the diagnostic and therapeutic medical device.

9. What are the possible applications of radar system?

## Answer

***1. Biological Processes and Physics:***

• ***Brain Communication:*** *Nerves act as electrical conductors, transmitting signals via electrochemical impulses.*

• ***Temperature Sensing:*** *Thermoreceptors in the skin detect temperature changes.*

• ***Body Temperature Measurement:*** *Thermometers utilize the expansion and contraction of materials (like mercury or alcohol) due to temperature changes.*

• ***Sound Creation and Transmission:*** *Sound waves are vibrations that travel through a medium, like air.*

• ***Human Energy Transformation:*** *Chemical energy from food is converted into mechanical energy for movement and heat.*

• ***Photosynthesis Energy Transformation:*** *Light energy is converted into chemical energy stored in glucose.*

## *2. Physics in Modern Vehicles:*

• ***Engines:*** *Thermodynamics, combustion, power transmission.*
• ***Braking:*** *Friction, force, pressure.*
• ***Suspension:*** *Springs, dampeners, forces, motion.*
• ***Aerodynamics:*** *Air resistance, drag, lift.*
• ***Navigation:*** *GPS, electromagnetism, radio waves.*

## *3. Light and Astronomy:*

• ***Electromagnetic Spectrum:*** *Different wavelengths of light reveal different properties of celestial objects.*
• ***Spectroscopy:*** *Analyzing light emitted or absorbed by objects provides information about their composition and temperature.*

## *4. Technology and Science:*

• ***Experimental Tools:*** *New technologies enable*

*more precise measurements, allowing for finer scientific observations and discoveries.*
• ***Data Analysis:*** *Computing power allows for analyzing large datasets, revealing patterns and insights.*

### *5. Physics in Radar Systems:*

• ***Electromagnetic Waves:*** *Radars emit radio waves that bounce off targets, revealing their location and speed.*
• ***Doppler Effect:*** *Changes in the frequency of reflected waves indicate the target's velocity.*

### *6. Modern Medical Devices:*

• ***MRI (Magnetic Resonance Imaging):*** *Uses strong magnetic fields and radio waves to produce detailed images of organs and tissues.*
• ***X-ray:*** *Uses electromagnetic radiation to create images of bones and internal structures.*
• ***Ultrasound:*** *Uses high-frequency sound waves to*

*create images of internal organs and tissues.*

### *7. Building Construction and Physics:*

• ***Structural Integrity:*** *Forces, stress, strain, materials science.*
• ***Thermal Insulation:*** *Heat transfer, convection, conduction, radiation.*
• ***Lighting and Energy Efficiency:*** *Optics, electricity, energy conservation.*

### *8. Diagnostic vs. Therapeutic Devices:*

• ***Diagnostic:*** *Used to identify and analyze medical conditions (e.g., MRI, ultrasound).*
• ***Therapeutic:*** *Used to treat medical conditions (e.g., lasers, radiation therapy).*

### *9. Applications of Radar Systems:*

• ***Air Traffic Control:*** *Tracking aircraft and preventing collisions.*

• ***Weather Forecasting:*** *Detecting storms, precipitation, and wind patterns.*
• ***Navigation:*** *Guiding ships and vehicles.*
• ***Military Applications:*** *Target detection, surveillance, and missile guidance.*