ELECTRONICS & COMMUNICATION, LASER

Electronics has become a part of our daily life. All gadgets like mobile phones, computers, televisions, music systems etc work on the electronic principles.

Evolution of Electronics:

The history of electronics began with the invention of vacuum diode by J.A. Fleming in 1897. This was followed by a vacuum triode implemented by Lee De Forest to amplify electrical signals. This led to the introduction of tetrode and pentode tubes.

Subsequently, the transistor era began with the invention of bipolar junction transistor by Bardeen, Brattain and Shockley in 1948 for which Nobel prize was awarded in 1956.

The emergence of Germanium and Silicon semiconductor materials made this transistor gain popularity, in turn its application in different electronic circuits. The following years witnessed the invention of the integrated circuits (ICs) that helped to integrate the entire electronic circuit on a single chip which is small in size and cost-effective.

Digital integrated circuits became another robust IC development that enhanced the architecture of computers. All these radical changes led to the introduction of microprocessor in 1969 by Intel.

Energy band diagram of solids:

This band of very large number of closely spaced energy levels in a very small energy range is known as energy band. The energy band formed due to the valence orbitals is called valence band and that formed due to the unoccupied orbitals is called the conduction band. The energy gap between the valence band and the conduction band is called forbidden energy gap. Electrons cannot exist in the forbidden energy gap.

The electrons in the valence band are less bound to the nucleus and can be easily excited.

Classification of materials:

Insulators

The valence band and the conduction band are separated by a large energy gap. The forbidden energy gap is approximately 6 eV in insulators. The gap is very large that electrons from valence band cannot move into conduction band even on the application of strong external electric field or the increase in temperature. Therefore, the electrical conduction is not possible as the free electrons are almost nil and hence these materials are called insulators. Its resistivity is in the range of 10^{11}–10^{19} Ωm.

Metals

Hence, electrons can move freely into the conduction band which results in a large number of free electrons in the conduction band. Therefore, conduction becomes possible even at low temperatures. The application of electric field provides sufficient energy to the electrons to drift in a particular direction to constitute a current. For metals, the resistivity value lies between 10^{-2} and 10^{-8} Ωm.

SEMICONDUCTORS:

In semiconductors, there exists a narrow-forbidden energy gap between the valence band and the conduction band. At a finite temperature, thermal agitations in the solid can break the covalent bond between the atoms (covalent bond is formed due to the sharing of electrons to attain stable electronic configuration). This releases some electrons from valence band to conduction band. Since free electrons are small in number, the conductivity of the semiconductors is not as high as that of the conductors. The resistivity value of semiconductors is from 10^{-5} to 10^{6} Ωm.

When the temperature is increased further, more number of electrons is promoted to the conduction band and increases the conduction. Thus, we can say that the electrical conduction increases with the increase in temperature.
In other words, resistance decreases with increase in temperature. Hence, semiconductors are said to have negative temperature coefficient of resistance. The most important elemental semiconductor materials are Silicon (Si) and Germanium (Ge). The forbidden energy gaps for Si and Ge at room temperature are 1.1 eV and 0.7 eV respectively.

TYPES OF SEMICONDUCTRORS:

Intrinsic semiconductors:

A semiconductor in its pure form without impurity is called an intrinsic semiconductor. Each Silicon atom has four electrons in the outermost orbit and is covalently bonded with the neighbouring atoms to form the lattice.

An intrinsic semiconductor behaves like an insulator at 0 K. The increase in temperature increases the number of charge carriers (electrons and holes).

Extrinsic semiconductors:

The carrier concentration in an intrinsic semiconductor is not sufficient enough to develop efficient electronic devices. Another way of increasing the carrier concentration in an intrinsic semiconductor is by adding impurity atoms. The process of adding impurities to the intrinsic semiconductor is called doping. It increases the concentration of charge carriers (electrons and holes) in the semiconductor and in turn, its electrical conductivity. The impurity atoms are called dopants and its order is approximately 100 ppm (parts per million).

n-type semiconductor:

A n-type semiconductor is obtained by doping a pure Germanium (or Silicon) crystal with a dopant from group V pentavalent elements like Phosphorus, Arsenic, and Antimony. The dopant has five valence electrons while the Germanium atom has four valence electrons. During the process of doping, a few of the Germanium atoms are replaced by the group V dopants. Four of the five valence electrons of the impurity atom are bound with the 4 valence electrons of the neighbouring replaced Germanium atom. The fifth valence electron of the impurity atom will be loosely attached with the nucleus as it has not formed the covalent bond.

At room temperature, these electrons can easily move to the conduction band with the absorption of thermal energy.

p-type semiconductor:

Here, a trivalent atom from group III elements such as Boron, Aluminium, Gallium and Indium is added to the Germanium or Silicon substrate. The dopant with three valence electrons is bound with the neighbouring Germanium atom. As Germanium atom has four valence electrons, one electron position of the dopant in the Germanium crystal lattice will remain vacant. The missing electron position in the covalent bond is denoted as a hole.

To make complete covalent bonding with all four neighbouring atoms, the dopant is in need of one more electron. These dopants can accept electrons from the neighbouring atoms. Therefore, this impurity is called an acceptor impurity.

For each acceptor atom, there will be a hole in the valence band in addition to the thermally generated holes. In such an extrinsic semiconductor, holes are the majority carriers and thermally generated electrons are minority carriers. The semiconductor thus formed is called a p-type semiconductor.

DIODES:

A p-n junction is formed by joining n-type and p-type semiconductor materials. Since the n-region has a high electron concentration and the p-region a high hole concentration, electrons diffuse from the n-side to the p-side. This causes diffusion current which exists due to the concentration difference of electrons. The electrons diffusing into the p-region may occupy holes in that region and make it negative. The holes left behind by these electrons in the n-side are equivalent to the diffusion of holes from the p-side to the n-side. If the electrons and holes were not charged, this diffusion process would continue until the concentration of electrons and holes on the two sides were the same, as happens if two gasses come into contact with each other.

On the n-side, positive ion cores are exposed and, on the p,- side, negative ion cores are exposed. An electric field E forms between the positive ion cores in the n-type material and negative ion cores in the p-type material. The electric field sweeps free carriers out of this region and hence it is called depletion region as it is depleted of free carriers. A barrier potential Vb due to the electric field E is formed at the junction.

As this diffusion of charge carriers from both sides continues, the negative ions form a layer of negative space charge region along the p-side. Similarly, a positive space charge region is formed by positive ions on the n-side. The positive space charge region attracts electrons from p-side to n-side and the negative space charge region attracts holes from n-side to p-side. This moment of carriers happen in this region due to the formed electric field and it constitutes a current called drift current. The diffusion current and drift current flow in the opposite direction and at one instant they both become equal. Thus, a p-n junction is formed.

The strength of the electric potential difference across the depletion region keeps increasing with the crossing of each electron until equilibrium is reached; at this point, the internal repulsion of the depletion layer stops further diffusion of free electrons across the junction. This difference in potential across the depletion layer is called the barrier potential as shown in Figure 9.10. At 25 0 C, this barrier potential approximately equals 0.7 V for Silicon and 0.3 V for Germanium.

Biasing a diode

Biasing means providing external energy to charge carriers to overcome the barrier potential and make them move in a particular direction. The charge carriers can either move towards the junction or away from the junction. The external voltage applied to the p-n junction is called bias voltage. Depending on the polarity of the external source to the p-n junction we have two types of biasing

1. Forward bias
2. Reverse bias

At room temperature, a potential difference equal to the barrier potential is required before a reasonable forward current starts flowing across the diode. This voltage is known as threshold voltage or cut-in voltage or knee voltage (Vth). It is approximately 0.3 V for Germanium and 0.7 V for Silicon.

The current flow is negligible when the applied voltage is less than the threshold voltage. Beyond the threshold voltage, increase in current is significant even for a small increase in voltage

The graph clearly infers that the current flow is not linear and is exponential. Hence it does not obey Ohm's law.

Thus, the diode behaves as a conductor when it is forward biased.

However, if the applied voltage is increased beyond a rated value, it will produce an extremely large current which may destroy the junction due to overheating. This is called as the breakdown of the diode and the voltage at which the diode breaks down is called the breakdown voltage. Thus, it is safe to operate a diode well within the threshold voltage and the breakdown voltage.

Under reverse bias, a very small current in μA, flows across the junction. This is due to the flow of the minority charge carriers called the leakage current or reverse saturation current. Besides, the current is almost independent of the voltage. The reverse bias voltage can be increased only up to the rated value otherwise the diode will enter into the breakdown region.

Rectification:

Rectification is the process of converting alternating current into direct current is called rectification. In this section, we will discuss two types of rectifiers namely, half wave rectifier and full wave rectifier.

The output of the half wave rectifier is not a steady dc voltage but a pulsating wave. This pulsating voltage is not sufficient for electronic equipment's. A constant or a steady voltage is required which can be obtained with the help of filter circuits and voltage regulator circuits.

Efficiency (η) is the ratio of the output dc power to the ac input power supplied to the circuit. Its value for half wave rectifier is 40.6 %. Hence in a full wave rectifier both positive and negative half cycles of the input signal pass through the circuit in the same direction. Though both positive and negative half cycles of ac input are rectified, the output is still pulsating in nature.

The efficiency (η) of full wave rectifier is twice that of a half wave rectifier and is found to be 81.2 %. It is because both the positive and negative half cycles of the ac input source are rectified.

Zener breakdown:

The reverse current or the reverse saturation current due to the minority charge carriers is small. If the reverse bias applied to a p-n junction is increased beyond a point, the junction breaks down and the reverse current rises sharply. The voltage at which this happens is called the breakdown voltage.

When a reverse voltage across this junction is increased to the breakdown limit, a very strong electric field of strength 3×10^7 V m^{-1} is set up across the narrow layer. This electric field is strong enough to break or rupture the covalent bonds in the lattice and thereby generating electron-hole pairs. This effect is called Zener effect.

Even a small further increase in reverse voltage produces a large number of charge carriers. Hence the junction has very low resistance in the breakdown region. This process of emission of electrons due to the rupture of bands in from the lattice due to strong electric field is known as internal field emission or field ionization. The electric field required for this is of the order of 10^6 V m^{-1}.
Zener diode is a reverse biased heavily doped Silicon diode named after its inventor C. Zener. It is specially designed to be operated in the breakdown region. The doping level of the Silicon diode can be varied to have a wide range of breakdown voltages from 2 V to over 1000 V.

Applications

The zener diode can be used as

1. Voltage regulators
2. Peak clippers
3. Calibrating voltages
4. Provide fixed reference voltage in a network for biasing

5. Meter protection against damage from accidental application of excessive voltage.

Light Emitting Diode (LED)

LED is a p-n junction diode which emits visible or invisible light when it is forward biased. Since, electrical energy is converted into light energy, this process is also called electroluminescence. It consists of a p-layer, n-layer and a substrate. A transparent window is used to allow light to travel in the desired direction. An external resistance in series with the biasing source is required to limit the forward current through the LED. In addition, it has two leads; anode and cathode.

When the p-n junction is forward biased, the conduction band electrons on n-side and valence band holes on p-side diffuse across the junction. When they cross the junction, they become excess minority carriers (electrons in p-side and holes in n-side). These excess minority carriers recombine with oppositely charged majority carriers in the respective regions, i.e., the electrons in the conduction band recombine with holes in the valence band.

During recombination process, energy is released in the form of light (radiative) or heat (non-radiative). For radiative recombination, a photon of energy hν is emitted. For non-radiative recombination, energy is liberated in the form of heat. The colour of the light is determined by the energy band gap of the material. Therefore, LEDs are available in a wide range of colours such as blue (SiC), green (AlGaP) and red (GaAsP). Now a days, LED which emits white light (GaInN) is also available.

Applications

Indicator lamps on the front panel of the scientific and laboratory equipment's.
Seven-segment displays.
Traffic signals, exit signs, emergency vehicle lighting etc.
Industrial process control, position encoders, bar graph readers.

Photodiodes

A p-n junction diode which converts an optical signal into electric current is known as photodiode. Thus, the operation of photodiode is exactly opposite to that of an LED. Photo diode words in reverse bias. The direction of arrows indicates that the light is incident on the photo diode. The device consists of a p-n junction semiconductor made of photosensitive material kept safely inside a plastic. It has a small transparent window that allows light to be incident on the p-n junction. Photodiodes can generate current when the p-n junction is exposed to light and hence are called as light sensors.

When a photon of sufficient energy strikes the depletion region of the diode, some of the valence band electrons are elevated into conduction band, in turn holes are developed in the valence band. This creates electron-hole pairs. The number of electron-hole pairs generated depends on the intensity of light incident on the p-n junction. These electrons and holes are swept across the p-n junction by the electric field created by reverse voltage before recombination takes place. Thus, holes move towards the n-side and electrons towards the p-side. When the external circuit is made, the electrons flow through the external circuit and constitute the photocurrent. When the incident light is zero, there exists a reverse current which is negligible. This reverse current in the absence of any incident light is called dark current and is due to the thermally generated minority carriers.

Applications

- Alarm system
- Count items on a conveyer belt
- Photoconductors
- Compact disc players, smoke detectors
- Medical applications such as detectors for computed tomography etc.

Solar cell

A solar cell, also known as photovoltaic cell, converts light energy directly into electricity or electric potential difference by photovoltaic effect. It is basically a p-n junction which generates emf when solar radiation falls on the p-n junction. A solar cell is of two types: p-type and n-type.

Both types use a combination of p-type and n-type Silicon which together forms the p-n junction of the solar cell. The difference is that p-type solar cells use p-type Silicon as the base with an ultra-thin layer of n-type Silicon, while n-type solar cell uses the opposite combination. The other side of the p-Silicon is coated with metal which forms the back electrical contact. On top of the n-type Silicon, metal grid is deposited which acts as the front electrical contact. The top of the solar cell is coated with anti-reflection coating and toughened glass.

In a solar cell, electron–hole pairs are generated due to the absorption of light near the junction. Then the charge carriers are separated due to the electric field of the depletion region. Electrons move towards n–type Silicon and holes move towards p-type Silicon layer. The electrons reaching the n-side are collected by the front contact and holes reaching p-side are collected by the back electrical contact. Thus, a potential difference is developed across solar cell. When an external load is connected to the solar cell, photocurrent flows through the load.

Many solar cells are connected together either in series or in parallel combination to form solar panel or module. Many solar panels are connected with each other to form solar arrays. For high power applications, solar panels and solar arrays are used.

Applications:

- Solar cells are widely used in calculators, watches, toys, portable power supplies, etc.
- Solar cells are used in satellites and space applications
- Solar panels are used to generate electricity.

THE BIPOLAR JUNCTION TRANSISTOR [BJT]:

Introduction:

In 1951, William Shockley invented the modern version of transistor. It is a semiconductor device that led to a technological revolution in the twentieth century. The heat loss in transistor is very less. This has laid the foundation of integrated chips which contain thousands of miniaturized transistors. The emergence of the integrated chips led to increasing applications in the fast-developing electronics industry.

The three regions formed are called as emitter, base and collector which are provided with terminals or ohmic contacts labeled as E, B, and C. As a BJT has two p-n junctions, two depletion layers are formed across the emitter-base junction (JEB) and collector-base junction (JCB) respectively. The circuit symbol carries an arrowhead at the emitter lead pointing from p to n indicating the direction of conventional current.

Emitter:

The main function of the emitter is to supply majority charge carriers to the collector region through the base region. Hence, emitter is more heavily doped than the other two regions.

Base:

Base is very thin (10^{-6} m) and very lightly doped compared to the other two regions.

Collector:

The main function of collector is to collect the majority charge carriers supplied by the emitter through the base. Hence, collector is made physically larger than the other two as it has to dissipate more power. Its is moderately dopped.

There are three types of circuit connections for operating a transistor based on the terminal that is used in common to both input and output circuits

1) Common-Base configuration
2) Common-Emitter configuration
3) Common-Collector configuration

APPLICATIONS:

Transistor as a switch
Transistor as an amplifier
Transistor as an oscillator

COMMUNICATION SYSTEMS

Communication exists since the dawn of life in this world. Growth in science and technology removed the locational disadvantage effectively. Information can be exchanged from one person to another anywhere on this Earth. Right from the developments made in communication by great scientists like J.C. Bose, G. Marconi, and Alexander Graham Bell, communication has witnessed leaps and bounds. The communication industry is one of the largest in size and is the oldest since communication through telegraph (1844), telephone (1876), and Radio (1887) started centuries back. The intensive research in the mid- and late nineteenth century leads to the development of long-distance transmission in the shortest possible time. However, the 20th century witnessed a leap over the development of communication, meeting the demands of speed and secured transfer of data. Every sector in the world is experiencing a significant profit with the advent of Global Positioning System (GPS), satellite, mobile, and optical communications. This unit provides a glimpse of the basic concepts of electronic communication and its applications.

MODULATION:

The transmission of information through short distances does not require complicated techniques. The energy of the information signal is sufficient enough to be sent directly. However if the information, for example, audio frequency (20 to 20,000 Hz) needs to be transmitted to long distances across the world, certain techniques are required to transmit the information without any loss. For long distance transmission, the low frequency baseband signal (input signal) is superimposed onto a high frequency radio signal by a process called modulation.

In the modulation process, a very high frequency signal called carrier signal (radio signal) is used to carry the baseband signal.

There are 3 types of modulation based on which parameter is modified. They are

i. amplitude modulation,
ii. frequency modulation,
iii. phase modulation.

AMPLITUDE MODULATION (AM):

If the amplitude of the carrier signal is modified according to the instantaneous amplitude of the baseband signal, then it is called amplitude modulation. Here the frequency and the phase of the carrier signal remain constant. Amplitude modulation is used in radio and TV broadcasting.

Advantages of AM

i. Easy transmission and reception
ii. Lesser bandwidth requirements
iii. Low cost

Limitations of AM

i. Noise level is high
ii. Low efficiency
iii. Small operating range

FREQUENCY MODULATION (FM)

The frequency of the carrier signal is modified according to the instantaneous amplitude of the baseband signal in frequency modulation.

Here the amplitude and the phase of the carrier signal remain constant. Increase in the amplitude of the baseband signal increases the frequency of the carrier signal and vice versa. This leads to compressions and rarefactions in the frequency spectrum of the modulated wave.

Advantages of FM

i. Large decrease in noise. This leads to an increase in signal-noise ratio.
ii. The operating range is quite large.
iii. The transmission efficiency is very high as all the transmitted power is useful.
iv. FM bandwidth covers the entire frequency range which humans can hear. Due to this, FM radio has better quality compared to AM radio.

Limitations of FM

i) FM requires a much wider channel.
ii) FM transmitters and receivers are more complex and costly.
iii) In FM reception, less area is covered compared to AM.

PHASE MODULATION (PM)

The instantaneous amplitude of the baseband signal modifies the phase of the carrier signal keeping the amplitude and frequency constant is called phase modulation. This modulation is used to generate frequency modulated signals. It is similar to frequency modulation except that the phase of the carrier is varied instead of varying frequency.

BANDWIDTH

The frequency range over which the baseband signals or the information signals such as voice, music, picture, etc. is transmitted is known as bandwidth. Each of these signals has different frequencies.

PROPAGATION OF ELECTROMAGNETIC WAVES:

The information signal modulated with the carrier wave (radio wave) is transmitted by an antenna. This travels through space and is received by the receiving antenna at the other end. The frequencies from 2 kHz to 400 GHz are transmitted through wireless communication. The strength of the electromagnetic wave keeps decreasing while traveling from transmitter to the receiver. The electromagnetic wave transmitted by the transmitter travels in three different modes to reach the receiver according to its frequency range:

- Ground wave propagation (or) surface wave propagation (nearly 2 kHz to 2 MHz)
- Sky wave propagation (or) ionospheric propagation (nearly 3 MHz to 30 MHz)
- Space wave propagation (nearly 30 MHz to 400 GHz)

GROUND WAVE PROPAGATION

If the electromagnetic waves transmitted by the transmitter glide over the surface of the earth to reach the receiver, then the propagation is called ground wave propagation. The corresponding waves are called ground waves or surface waves.

The frequency of the ground waves is mostly less than 2 MHz as high frequency waves undergo more absorption of energy at the earth's atmosphere.

The medium wave signals received during the day time use surface wave propagation. It is mainly used in local broadcasting, radio navigation, for ship-to-ship, ship-to-shore communication and mobile communication.

SKY WAVE PROPAGATION

The mode of propagation in which the electromagnetic waves radiated from an antenna, directed upwards at large angles gets reflected by the ionosphere back to earth is called sky wave propagation or ionospheric propagation. The corresponding waves are called sky waves.

The shortest distance between the transmitter and the point of reception of the sky wave along the surface is called as the skip distance. There is a zone in between where there is no reception of electromagnetic waves neither ground nor sky, called as skip zone or skip area.

SPACE WAVE PROPAGATION

The process of sending and receiving information signal through space is called space wave communication. The electromagnetic waves of very high frequencies above 30 MHz are called as space waves.

The communication systems like television broadcast, satellite communication, and RADAR are based on space wave propagation. Microwaves having high frequencies (super high frequency band) are used against radio waves due to certain advantages: larger bandwidth, high data rates, better directivity, small antenna size, low power consumption, etc.

SATELLITE COMMUNICATION

The satellite communication is a mode of communication of signal between transmitter and receiver via satellite. The message signal from the Earth station is transmitted to the satellite on board via an uplink (frequency band 6 GHz), amplified by a transponder and then retransmitted to another earth station via a downlink (frequency band 4 GHz).

The high-frequency radio wave signals travel in a straight line (line of sight) may come across tall buildings or mountains or even encounter the curvature of the earth. A communication satellite relays and amplifies such radio signals via transponder to reach distant and far off places using uplinks and downlinks. It is also called as a radio repeater in sky.

Applications:

Satellites are classified into different types based on their applications. Some satellites are discussed below.

i) Weather Satellites: They are used to monitor the weather and climate of Earth. By measuring cloud mass, these satellites enable us to predict rain and dangerous storms like hurricanes, cyclones etc.
ii) Communication satellites: They are used to transmit television, radio, internet signals etc. Multiple satellites are used for long distances.
iii) Navigation satellites: These are employed to determine the geographic location of ships, aircrafts or any other object.

FIBRE OPTIC COMMUNICATION:

The method of transmitting information from one place to another in terms of light pulses through an optical fiber is called fiber optic communication.

Light has very high frequency (400 THz – 790 THz) than microwave radio systems. The fibers are made up of silica glass or silicon dioxide which is highly abundant on Earth.

Now it has been replaced with materials such as chalcogenide glasses, fluor aluminate crystalline materials because they provide larger infrared wavelength and better transmission capability. As fibers are not electrically conductive, it is preferred in places where multiple channels are to be laid and isolation is required from electrical and electromagnetic interference.

Applications

Optical fiber system has a number of applications namely, international communication, inter-city communication, data links, plant and traffic control and defense applications.

Merits

i) Fiber cables are very thin and weigh lesser than copper cables. ii) This system has much larger band width. This means that its information carrying capacity is larger. iii) Fiber optic system is immune to electrical interferences. iv) Fiber optic cables are cheaper than copper cables.

Demerits

i) Fiber optic cables are more fragile when compared to copper wires. ii) It is an expensive technology.

RADAR AND APPLICATIONS

Radar basically stands for Radio Detection and Ranging System. It is one of the important applications of communication systems and is mainly used to sense, detect, and locate distant objects like aircraft, ships, spacecraft, etc. The angle, range, or velocity of the objects that are invisible to the human eye can be determined.

Radar uses electromagnetic waves for communication. The electromagnetic signal is initially radiated into space by an antenna in all directions. When this signal strikes the targeted object, it gets reflected or reradiated in many directions. This reflected (echo) signal is received by the radar antenna which in turn is delivered to the receiver. Then, it is processed and amplified to determine the geographical statistics of the object. The range is determined by calculating the time taken by the signal to travel from RADAR to the target and back.

Applications:

Radars find extensive applications in almost all fields. A few are mentioned below. i) In military, it is used for locating and detecting the targets. ii) It is used in navigation systems such as ship borne surface search, air search and weapons guidance systems. iii) To measure precipitation rate and wind speed in meteorological observations, Radars are used. iv) It is employed to locate and rescue people in emergency situations.

MOBILE COMMUNICATION:

Mobile communication is used to communicate with others in different locations without the use of any physical connection like wires or cables. It allows the transmission over a wide range of area without the use of the physical link. It enables the people to communicate with each other regardless of a particular location like office, house, etc. It also provides communication access to remote areas.

Applications:

i) It is used for personal communication and cellular phones offer voice and data connectivity with high speed.
ii) Transmission of news across the globe is done within a few seconds.
iii) Using Internet of Things (IoT), it is made possible to control various devices from a single device. Example: home automation using a mobile phone.
iv) It enables smart classrooms, online availability of notes, monitoring student activities etc. in the field of education.

INTERNET:

Internet is a fast-growing technology in the field of communication system with multifaceted tools. It provides new ways and means to interact and connect with people. Internet is the largest computer network recognized globally that connects millions of people through computers. It finds extensive applications in all walks of life.

Applications:

i) Search engine: The search engine is basically a web-based service tool used to search for information on World Wide Web.
ii) Communication: It helps millions of people to connect with the use of social networking: emails, instant messaging services and social networking tools.
iii) E-Commerce: Buying and selling of goods and services, transfer of funds is done over an electronic network.

GLOBAL POSITIONING SYSTEM:

GPS stands for Global Positioning System. It is a global navigation satellite system that offers geolocation and time information to a GPS receiver anywhere on or near the Earth.

GPS system works with the assistance of a satellite network. Each of these satellites broadcasts a precise signal like an ordinary radio signal. These signals that convey the location data are received by a low-cost aerial which is then translated by the GPS software. The software is able to recognize the satellite, its location, and the time taken by the signals to travel from each satellite.

The software then processes the data it accepts from each satellite to estimate the location of the receiver.

Applications

Global positioning system is highly useful many fields such as fleet vehicle management (for tracking cars, trucks and buses), wildlife management (for counting of wild animals) and engineering (for making tunnels, bridges etc).

APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGY IN AGRICULTURE, FISHERIES AND MINING:

(i) Agriculture :

The implementation of information and communication technology (ICT) in agriculture sector enhances the productivity, improves the living standards of farmers and overcomes the challenges and risk factors.

a. ICT is widely used in increasing food productivity and farm management.
b. It helps to optimize the use of water, seeds and fertilizers etc.
c. Sophisticated technologies that include robots, temperature and moisture sensors, aerial images, and GPS technology can be used.
d. Geographic information systems are extensively used in farming to decide the suitable place for the species to be planted.

(ii) Fisheries

a. Satellite vessel monitoring system helps to identify fishing zones.
b. Use of barcodes helps to identify time and date of catch, species name, quality of fish.

(iii) Mining

a) ICT in mining improves operational efficiency, remote monitoring and disaster locating system.
b) Information and communication technology provides audio-visual warning to the trapped underground miners.
c) It helps to connect remote sites.

Practice Questions

1. WIMAX is related to which one of the following?

a. Biotechnology
b. Space technology
c. Missile technology
d. Communication technology

WIMAX என்பது பின்வருவனவற்றில் எந்த தொழில் நுட்பத்தைச் சார்ந்தது?

a. Biotechnology
b. Space technology
c. Missile technology
d. Communication technology

2. A metal semiconductor junction diode is called
a. Schottky diode
b. Photo diode
c. Tunnel diode
d. P-N Junction diode

ஒரு உலோக குறைகடத்தி சந்தி டையோடு _____ எனப்படும்?

a. சாட்கி டையோடு
b. போட்டோ டையோடு
c. டனல் டையோடு
d. P-N சந்தி டையோடு

3. In a transistor, if the value of α is 0.9 then what is the value of β?
a. 9 b. 90 c. 0.9 d. 900

Solution:

$$\beta = \frac{\alpha}{1-\alpha}$$

$$= \frac{0.9}{1-0.9} = \frac{0.9}{0.1}$$

$$\beta = 9$$

ஒரு டிரான்சிஸ்டரில், α-ன் மதிப்பு 0.9 என்றும் β-ன் மதிப்பு என்ன?

a. 9 b. 90 c. 0.9 d. 900

4. R-C coupling is used for
a. Voltage amplification
b. power amplification
c. current amplification
d. Direct amplification

R-C பிணைப்பின் பயன்பாடு

a. மின்னழுத்த பெருக்கம்
b. ஆற்றல் பெருக்கம்
c. மின்னூட்ட பெருக்கம்
d. நேர் பெருக்கம்

5. Thermistor is a
a. Material with positive Thomson effect
b. Material with a negative temperature co-efficient
c. Material with a positive temperature co-efficient
d. Material with a negative Thomson effect

தெர்மிஸ்டார் என்பது?

a. நேர் தாம்சன் விளைவு கொண்டது.
b. எதிர்க்குறி மின்தடை வெப்பநிலை எண் கொண்டது.
c. நேர்க்குறி மின்தடை வெப்பநிலை எண் கொண்டது.
d. எதிர் தாம்சன் விளைவு கொண்டது.