+2 differnces and point type questions (can expect any one for publics exam)

1. Differences between electrostatic force and gravitational force

- The gravitational force between two masses is always attractive but Coulomb force between two charges can be attractive or repulsive, depending on the nature of charges.

- The value of the gravitational constant $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}. The value of the constant k in Coulomb law is $k = 9 \times 10^9$ N m^2 C^{-2}. Since k is much more greater than G, the electrostatic force is always greater in magnitude than gravitational force for smaller size objects.

- The gravitational force between two masses is independent of the medium. For example, if 1 kg of two masses are kept in air or inside water, the gravitational force between two masses remains the same. But the electrostatic force between the two charges depends on nature of the medium in which the two charges are kept at rest.

2. Properties of electric field lines of forces

• The electric field lines start from a positive charge and end at negative charges or at infinity. For a positive point charge the electric field lines point radially outward and for a negative point charge, the electric field lines point radially inward.
• The electric field vector at a point in space is tangential to the electric field line at that point
• The electric field lines are denser (more closer) in a region where the electric field has larger magnitude and less dense in a region where the electric field is of smaller magnitude. In other words, the number of lines passing through a given surface area perpendicular to the lines is proportional to the magnitude of the electric field in that region.

• No two electric field lines intersect each other. If two lines cross at a point, then there will be two different electric field vectors at the same point.
• The number of electric field lines that emanate from the positive charge or end at a negative charge is directly proportional to the magnitude of the charges.

3. Properties of equipotential surfaces.
(i) The work done to move a charge q between any two points A and B, $W = q(V_B - V_A)$. If the points A and B lie on the same equipotential surface, work done is zero because $V_A = V_B$.
(ii) The electric field is normal to an equipotential surface. If it is not normal, then there is a component of the field parallel to the surface. Then work must be done to move a charge between two points on the same surface. This is a contradiction. Therefore the electric field must always be normal to equipotential surface.

4. properties a conductor at electrostatic equilibrium
(i) The electric field is zero everywhere inside the conductor. This is true regardless of whether the conductor is solid or hollow.
(ii) There is no net charge inside the conductors. The charges must reside only on the surface of the conductors.
(iii) The electric field outside the conductor is perpendicular to the surface of the conductor and has a magnitude of $\frac{\sigma}{\varepsilon_0}$ where σ is the surface charge density at that point.
(iv) The electrostatic potential has the same value on the surface and inside of the conductor.

5. Applications of capacitors.
(a) Flash capacitors are used in digital cameras for taking photographs. The flash which comes from the camera when we take photographs is due to the energy released from the capacitor, called a flash capacitor
(b) During cardiac arrest, a device called heart defibrillator is used to give a sudden surge of a large amount of electrical energy to the patient's chest to retrieve the normal heart function.
(c) Capacitors are used in the ignition system of automobile engines to eliminate sparking
(d) Capacitors are used to reduce power fluctuations in power supplies and to increase the efficiency of power transmission.

6. Applications of Seebeck effect

1. Seebeck effect is used in thermoelectric generators (Seebeck generators).These thermoelectric generators are used in power plants to convert waste heat into electricity.
2. This effect is utilized in automobiles as automotive thermoelectric generators for increasing fuel efficiency.
3. Seebeck effect is used in thermocouples and thermopiles to measure the temperature difference between the two objects.

7. Elements of the Earth's magnetic field.

(a) magnetic declination (D)
(b) magnetic dip or inclination (I)
(c) the horizontal component of the Earth's magnetic field (B_H)

8. Properties of magnet

1. A freely suspended bar magnet will always point along the north-south direction.
2. A magnet attracts or repels another magnet or magnetic substances towards itself. The attractive or repulsive force is maximum near the end of the bar magnet. When a bar magnet is dipped into iron filling, they cling to the ends of the magnet.
3. When a magnet is broken into pieces, each piece behaves like a magnet with poles at its ends.
4. Two poles of a magnet have pole strength equal to one another.
5. The length of the bar magnet is called geometrical length and the length between two magnetic poles in a bar magnet is called magnetic length. Magnetic length is always slightly smaller than geometrical length. The ratio of magnetic length and geometrical length is 5/6 .

9. Properties of Magnetic field lines

1. Magnetic field lines are continuous closed curves. The direction of magnetic field lines is from North pole to South pole outside the magnet and from South pole to North pole inside the magnet.
2. The direction of magnetic field at any point on the curve is known by drawing tangent to the magnetic field lines at that point.
3. Magnetic field lines never intersect each other. Otherwise, the magnetic compass needle would point towards two different directions, which is not possible.

4. The degree of closeness of the field lines determines the relative strength of the magnetic field. The magnetic field is strong where magnetic field lines crowd and weak where magnetic field lines are well separated.

10. The properties of diamagnetic materials

i) Magnetic susceptibility is negative.
ii) Relative permeability is slightly less than unity.
iii) The magnetic field lines are repelled or expelled by diamagnetic materials when placed in a magnetic field.
iv) Susceptibility is nearly temperature independent.

11. The properties of paramagnetic materials

i) Magnetic susceptibility is positive and small.
ii) Relative permeability is greater than unity.
iii) The magnetic field lines are attracted into the paramagnetic materials when placed in a magnetic field.
iv) Susceptibility is inversely proportional to temperature.

12. The properties of ferromagnetic materials

i) Magnetic susceptibility is positive and large.
ii) Relative permeability is large.
iii) The magnetic field lines are strongly attracted into the ferromagnetic materials when placed in a magnetic field.
iv) Susceptibility is inversely proportional to temperature.

13. Special features of magnetic Lorentz force

1. $\vec{F}_m$ is directly proportional to the magnetic field $\vec{B}$
2. $\vec{F}_m$ is directly proportional to the velocity $\vec{v}$ of the moving charge
3. $\vec{F}_m$ is directly proportional to sine of the angle between the velocity and magnetic field
4. $\vec{F}_m$ is directly proportional to the magnitude of the charge q
5. The direction of $\vec{F}_m$ is always perpendicular to $\vec{v}$ and $\vec{B}$ as $\vec{F}_m$ is the cross product of $\vec{v}$ and $\vec{B}$
6. The direction of $\vec{F}_m$ on negative charge is opposite to the direction of $\vec{F}_m$ on positive charge provided other factors are identical as shown Figure 3.44 (b)
7. If velocity $\vec{v}$ of the charge q is along magnetic field $\vec{B}$ then, $\vec{F}_m$ is zero

14. Differences between soft and hard ferromagnetic materials

Table 3.2 Differences between soft and hard ferromagnetic materials

S.No.	Properties	Soft ferromagnetic materials	Hard ferromagnetic materials
1	When external field is removed	Magnetisation disappears	Magnetisation persists
2	Area of the loop	Small	Large
3	Retentivity	Low	High
4	Coercivity	Low	High
5	Susceptibility and magnetic permeability	High	Low
6	Hysteresis loss	Less	More
7	Uses	Solenoid core, transformer core and electromagnets	Permanent magnets
8	Examples	Soft iron, Mumetal, Stalloy etc.	Carbon steel, Alnico, Lodestone etc.

15. Differences between electric field (from Coulomb's law) and magnetic field (from Biot-Savart's law)

S. No.	Electric field	Magnetic field
1	Produced by a scalar source i.e., an electric charge q	Produced by a vector source i.e., current element $I d\vec{l}$
2	It is directed along the position vector joining the source and the point at which the field is calculated	It is directed perpendicular to the position vector $\vec{r}$ and the current element $Id\vec{l}$
3	Does not depend on angle	Depends on the angle between the position vector $\vec{r}$ and the current element $Id\vec{l}$

16. Limitations of cyclotron

(a) the speed of the ion is limited
(b) electron cannot be accelerated
(c) uncharged particles cannot be accelerated

17. Application of eddy currents

Though the production of eddy current is undesirable in some cases, it is useful in some other cases. A few of them are

i. Induction stove
ii. Eddy current brake
iii. Eddy current testing
iv. Electromagnetic damping

18. Methods of producing induced emf.

induced emf can be produced by changing magnetic flux in any of the following ways.

(i) By changing the magnetic field B
(ii) By changing the area A of the coil and
(iii) By changing the relative orientation θ of the coil with magnetic field

19. Advantages of stationary armature-rotating field alternator

1) The current is drawn directly from fixed terminals on the stator without the use of brush contacts.
2) The insulation of stationary armature winding is easier.
3) The number of sliding contacts (slip rings) is reduced. Moreover, the sliding contacts are used for low-voltage DC Source.
4) Armature windings can be constructed more rigidly to prevent deformation due to any mechanical stress.

20. Advantages of three phase alternator

1) For a given dimension of the generator, three-phase machine produces higher power output than a single-phase machine.
2) For the same capacity, three-phase alternator is smaller in size when compared to single-phase alternator.
3) Three-phase transmission system is cheaper. A relatively thinner wire is sufficient for transmission of threephase power.

21. conditions for total internal reflection

(i) light must travel from denser to rarer medium,

(ii) angle of incidence in the denser medium must be greater than critical angle ($i > i_c$).

21. Advantages and disadvantages of AC over DC

Advantages:

(i) The generation of AC is cheaper than that of DC.

(ii) When AC is supplied at higher voltages, the transmission losses are small compared to DC transmission.

(iii) AC can easily be converted into DC with the help of rectifiers.

Disadvantages:

(i) Alternating voltages cannot be used for certain applications such as charging of batteries, electroplating, electric traction etc.

(ii) At high voltages, it is more dangerous to work with AC than DC.

23. Analogies between electrical and mechanical quantities

Electrical system	Mechanical system
Charge q	Displacement x
Current $i = \frac{dq}{dt}$	Velocity $v = \frac{dx}{dt}$
Inductance L	Mass m
Reciprocal of capacitance $\frac{1}{C}$	Force constant k
Electrical energy $= \frac{1}{2}\left(\frac{1}{C}\right)q^2$	Potential energy $= \frac{1}{2}kx^2$
Magnetic energy $= \frac{1}{2}Li^2$	Kinetic energy $= \frac{1}{2}mv^2$
Electromagnetic energy $U = \frac{1}{2}\left(\frac{1}{C}\right)q^2 + \frac{1}{2}Li^2$	Mechanical energy $E = \frac{1}{2}kx^2 + \frac{1}{2}mv^2$

24. Properties of electromagnetic waves

1. Electromagnetic waves are produced by any accelerated charge.
2. Electromagnetic waves do not require any medium for propagation. So electromagnetic wave is a non-mechanical wave.
3. Electromagnetic waves are transverse in nature. The oscillating electric field vector, oscillating magnetic field vector and propagation vector (gives direction of propagation) are mutually perpendicular to each other. For example, if the electric and magnetic fields are as shown in Figure 5.8, then the direction of propagation will be along x-direction.
4. Electromagnetic waves travel with speed which is equal to the speed of light in vacuum or free space, $c = \frac{1}{\sqrt{\epsilon_0 \mu_0}} = 3 \times 10^8 \, \mathrm{m\,s^{-1}}$, where ϵ_o is the permittivity of free space or vacuum and μ_o is the permeability of free space or vacuum (refer Unit 1 for permittivity and Unit 3 for permeability).
5. In a medium with permittivity ε and permeability μ, the speed of electromagnetic wave v is less than that in free space or vacuum ($v < c$).

In a medium of refractive index,

$$n = \frac{c}{v} = \frac{1/\sqrt{\epsilon_0 \mu_0}}{1/\sqrt{\epsilon \mu}} \quad \therefore n = \sqrt{\epsilon_r \mu_r}$$

where ϵ_r is the relative permittivity of the medium (also known as dielectric constant) and μ_r is the relative permeability of the medium.

6. Electromagnetic waves are not deflected by electric field or magnetic field.
7. Electromagnetic waves can exhibit interference, diffraction and polarization.
8. Like other waves, electromagnetic waves also carry energy, linear momentum and angular momentum.
9. If the electromagnetic wave incident on a material surface is completely absorbed, then the energy delivered is U and momentum imparted on the surface is $p = \frac{U}{c}$.
10. If the incident electromagnetic wave of energy U is totally reflected from the surface, then the momentum delivered to the surface is $\Delta p = \frac{U}{c} - \left(-\frac{U}{c}\right) = 2\frac{U}{c}$.

25. Laws of reflection

(i) The incident ray, reflected ray and normal to the reflecting surface are all coplanar (ie. lie in the same plane).

(ii) The angle of incidence i is equal to the angle of reflection r.

$$i = r \quad (6.1)$$

26. Characteristics of the image formed by plane mirror

(i) The image formed by a plane mirror is virtual, erect and laterally inverted sidewise (left / right).

(ii) The size of the image is equal to the size of the object.

(iii) The image distance behind the mirror is equal to the object distance in front of the mirror.

(iv) If an object is placed between two plane mirrors inclined at an angle θ, then the number of images n formed

27. Cartesian sign convention

(i) The Incident light is taken as if it is travelling from left to right (i.e. object on the left of mirror).

(ii) All the distances are measured from the pole of the mirror (pole is taken as origin).

(iii) The distances measured to the right of pole along the principal axis are taken as positive.

(iv) The distances measured to the left of pole along the principal axis are taken as negative.

(v) Heights measured upwards perpendicular to the principal axis are taken as positive.

(vi) Heights measured downwards perpendicular to the principal axis, are taken as negative.

28. Laws of reflection

(i) The incident ray, refracted ray and normal to the refracting surface are all coplanar (ie. lie in the same plane).

(ii) The ratio of sine of angle of incident i in the first medium to the sine of angle of refraction r in the second medium is equal to the ratio of refractive index n_2 of the second medium to the refractive index n_1 of the first medium.

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1} \qquad (6.18)$$

29. The techniques to produce coherent sources

(i) Wavefront division

(ii) Intensity (or) Amplitude division

(iii) Source and Images.

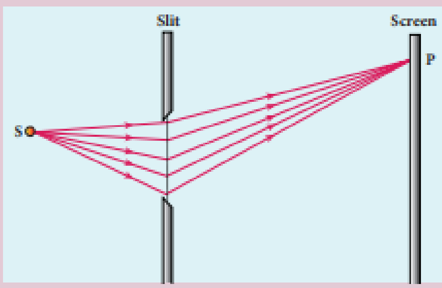
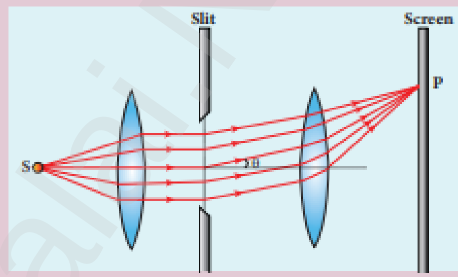
30. Conditions for obtaining clear and broad interference fringes

(i) The distance D between the screen and double slit should be as large as possible.

(ii) The wavelength λ of light used must be as long as possible.

(iii) The distance d between the two slits must be as small as possible.

31. Difference between Fresnel and Fraunhofer diffractions

S.No.	Fresnel diffraction	Fraunhofer diffraction
1	Spherical (or) cylindrical wavefront undergoes diffraction	Plane wavefront undergoes diffraction
2	Light wave is from a source at finite distance	Light wave is from a source at infinity
3	Convex lenses need not be used for laboratory conditions	Convex lenses are to be used in laboratory conditions
4	Difficult to observe and analyse	Easy to observe and analyse
5		

32. Difference between interference and diffraction

S.No.	Interference	Diffraction
1	Equally spaced bright and dark fringes	Central bright is double the size of other fringes
2	Equal intensity for all bright fringes	Intensity falls rapidly for higher order fringes
3	Large number of fringes are obtained	Less number of fringes are obtained

33. Characteristics of polarised light and unpolarised light

S.No	Polarised light	Unpolarised light
1	Consists of waves having their electric and magnetic field vibrations in a single plane normal to the direction of ray.	Consists of waves having their electric and magnetic field vibrations in all directions normal to the direction of ray.
2	Asymmetrical about the ray direction.	Symmetrical about the ray direction.
3	It is obtained by converting unpolarised light using polaroids.	Produced by conventional light sources.

34. Uses of polaroids

1. Polaroids are used in goggles and cameras to avoid glare of light.
2. Polaroids are used to take 3D pictures i.e., holography.
3. Polaroids are used to improve contrast in old oil paintings.
4. Polaroids are used in optical stress analysis.
5. Polaroids are used as window glasses to control the intensity of incoming light.
6. Polarised laser beam acts as needle to read/write in compact discs (CDs).
7. Polarised light is used in liquid crystal display (LCD).

35. Drawbacks of Nicol prism

(i) Its cost is very high due to scarcity of large and flawless calcite crystals.

(ii) Due to extraordinary ray passing obliquely through it, the emergent ray is always displaced a little to one side.

(iii) The effective field of view is quite limited.

(iv) The light emerging out of it is not uniformly plane polarised.

36. Laws of photoelectric effect

i) For a given metallic surface, the emission of photoelectrons takes place only if the frequency of incident light is greater than a certain minimum frequency called the threshold frequency.

ii) For a given frequency of incident light (above threshold value), the number of photoelectrons emitted is directly proportional to the intensity of the incident light. The saturation current is also directly proportional to the intensity of incident light.

iii) Maximum kinetic energy of the photo electrons is independent of intensity of the incident light.

iv) Maximum kinetic energy of the photo electrons from a given metal is directly proportional to the frequency of incident light.

v) There is no time lag between incidence of light and ejection of photoelectrons.

37. Characteristics of photons

i) The photons of light of frequency ν and wavelength λ will have energy, given by

$$E = h\nu = \frac{hc}{\lambda}.$$

ii) The energy of a photon is determined by the frequency of the radiation and not by its intensity and the intensity has no relation with the energy of the individual photons in the beam.

iii) The photons travel with the speed of light and its momentum is given by

$$p = \frac{h}{\lambda} = \frac{h\nu}{c}$$

iv) Since photons are electrically neutral, they are unaffected by electric and magnetic fields.

v) When a photon interacts with matter (photon-electron collision), the total energy, total linear momentum and angular momentum are conserved. Since photon may be absorbed or a new photon may be produced in such interactions, the number of photons may not be conserved.

38. Applications of photo cells

- Photo cells have many applications, especially as switches and sensors.
- Automatic lights that turn on when it gets dark use photocells, and street lights that switch on and switch off according to whether it is night or day use photocells.

- Photo cells are used for reproduction of sound in motion pictures and are used as timers to measure the speeds of athletes during a race.
- Photo cells of exposure meters in photography are used to measure the intensity of the given light and to calculate the exact time of exposure.

39. Applications of x-rays

1) Medical diagnosis

X-rays can pass through flesh more easily than through bones. Thus an x-ray radiograph containing a deep shadow of the bones and a light shadow of the flesh may be obtained. X-ray radiographs are used to detect fractures, foreign bodies, diseased organs etc.

2) Medical therapy

Since x-rays can kill diseased tissues, they are employed to cure skin diseases, malignant tumours etc.

3) Industry

X-rays are used to check for flaws in welded joints, motor tyres, tennis balls and wood. At the custom post, they are used for detection of contraband goods.

4) Scientific research

X-ray diffraction is important tool to study the structure of the crystalline materials – that is, the arrangement of atoms and molecules in crystals.

40. Drawbacks of Rutherford model

(a) This model fails to explain the distribution of electrons around the nucleus and also the stability of the atom.

Hence, Rutherford model could not account for the stability of atoms.

(b) According to this model, emission of radiation must be continuous and must give continuous emission spectrum but experimentally we observe only line (discrete) emission spectrum for atoms.

41. Postulates of Bohr atom model

(a) The electron in an atom moves around nucleus in circular orbits under the influence of Coulomb electrostatic force of attraction. This Coulomb force gives necessary centripetal force for the electron to undergo circular motion.

(b) Electrons in an atom revolve around the nucleus only in certain discrete orbits called stationary orbits and electron in such orbits do not radiate electromagnetic energy. Only those discrete orbits allowed are stable orbits.

(c) Energy of the electron in orbits is not continuous but only discrete. This is called the quantization of energy. An electron can jump from one orbit to another orbit by absorbing or emitting a photon whose energy is equal to the difference in energy (ΔE) between the two orbital levels (Figure 9.16)

42. Properties of cathode rays

(1) Cathode rays possess energy and momentum and travel in a straight line with high speed of the order of 10^7 ms^{-1}. It can be deflected by application of electric and magnetic fields. The direction of deflection indicates that they contain negatively charged particles.

(2) When the cathode rays are allowed to fall on matter, heat is produced. Cathode rays affect the photographic plates and also produce fluorescence when they fall on certain crystals and minerals.

(3) When the cathode rays fall on a material of high atomic weight, x-rays are produced.

(4) Cathode rays ionize the gas through which they pass.

(5) The speed of cathode rays is up to $\left(\frac{1}{10}\right)^{th}$ of the speed of light.

43. Limitations of Bohr atom model

(a) Bohr atom model is valid only for hydrogen atom or hydrogen like-atoms but not for complex atoms.

(b) When the spectral lines are closely examined, individual lines of hydrogen spectrum are accompanied by a number of faint lines. This is called **fine structure**. This cannot be explained by Bohr atom model.

(c) Bohr atom model fails to explain the intensity variations in the spectral lines.

(d) The distribution of electrons in various levels cannot be completely explained by Bohr atom model.

44. Important inferences from of the average binding energy curve

(1) The value of $\overline{BE}$ rises as the mass number increases until it reaches a maximum value of 8.8 MeV for A = 56 (iron) and then it slowly decreases.

(2) The average binding energy per nucleon is about 8.5 MeV for nuclei having mass number lying between A = 40 and 120. These elements are comparatively more stable and not radioactive.

(3) For higher mass numbers, the curve drops slowly and $\overline{BE}$ for uranium is about 7.6 MeV. Such nuclei are unstable and exhibit radioactive.

From Figure 9.24, if two light nuclei with A<28 combine with a nucleus with A<56, the binding energy per nucleon is more for final nucleus than initial nuclei. Thus, if the lighter elements combine to produce a nucleus of medium value A, a large amount of energy will be released. This is the basis of nuclear fusion and is the principle of the hydrogen bomb.

(4) If a nucleus of heavy element is split (fission) into two or more nuclei of medium value A, the energy released would again be large. The atom bomb is based on this principle and huge energy of atom bombs comes from this fission when it is uncontrolled. Fission is explained in the section 9.7

45. Properties of neutrinos

· It has zero charge

· It has an antiparticle called anti-neutrino.

· Recent experiments showed that the neutrino has very small mass.

· It interacts very weakly with the matter. Therefore, it is very difficult to detect it. In fact, in every second, trillions of neutrinos coming from the sun are passing through our body without causing interaction.

46. Applications the zener diode

- as voltage regulator
- for calibrating voltages
- to provide fixed reference voltage in a network for biasing
- to protect of any gadget against damage from accidental application of excessive voltage.

47. Applications the light emitting diodes

- indicator lamps on the front panel of the scientific and laboratory equipments.
- seven-segment displays.
- traffic signals, emergency vehicle lighting etc.
- remote control of television, air-conditioner etc.

48. Applications the photodiodes

- alarm system
- count items on a conveyor belt
- photoconductors
- compact disc players, smoke detectors
- medical applications such as detectors for computed tomography etc.

49. Applications Solar cells

i) Solar cells are widely used in calculators, watches, toys, portable power supplies, etc.

ii) Solar cells are used in satellites and space applications.

iii) Solar panels are used for commercial production of electricity.

50. Advantages and disadvantages of AM (Amplitude Modulation)

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

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

51. Applications Optical fiber communiction

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

52. Advantages and disadvantages of FM (Frequency Modulation)

Advantages of FM

i) In FM, there is a 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.

53. Applications Satellites communication

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 distance communication.

iii) **Navigation satellites:** These are employed to determine the geographic location of ships, aircrafts or any other object.

54. Merits and demerits of optical fibre communication

Merits

i) Fiber cables are very thin and weigh less 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.

55. Applications of RADAR communication

Radars find extensive applications in many fields.

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 missile guidance systems.

iii) Radars are used to measure precipitation rate and wind speed in meteorological observations.

iv) It is employed to locate and rescue people in emergency situations.

56. Applications of Mobile communication

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.

57. Applications of Internet

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 are done over an electronic network.

58. Advantages of Robotics

1. The robots are much cheaper than humans.
2. Robots never get tired like humans. It can work for 24 x 7. Hence absenteeism in work place can be reduced.
3. Robots are more precise and error free in performing the task.
4. Stronger and faster than humans.
5. Robots can work in extreme environmental conditions: extreme hot or cold, space or underwater. In dangerous situations like bomb detection and bomb deactivation.
6. In warfare, robots can save human lives.
7. Robots are significantly used in handling materials in chemical industries especially in nuclear plants which can lead to health hazards in humans.

59. Disadvantages of Robotics

1. Robots have no sense of emotions or conscience.
2. They lack empathy and hence create an emotionless workplace.
3. If ultimately robots would do all the work, and the humans will just sit and monitor them, health hazards will increase rapidly.
4. Unemployment problem will increase.
5. Robots can perform defined tasks and cannot handle unexpected situations
6. The robots are well programmed to do a job and if a small thing goes wrong it ends up in a big loss to the company.
7. If a robot malfunctions, it takes time to identify the problem, rectify it, and even reprogram if necessary. This process requires significant time.
8. Humans cannot be replaced by robots in decision making.
9. Till the robot reaches the level of human intelligence, the humans in work place will exit.