SEMESTER – II/IV/VI

19MMU504/19CHU503 PHYSICS – II 4H - 4C

Instruction Hours / week: L: 4 T: 0 P: 0 **Marks:** Internal: **40** External: **60** Total: **100**

End Semester Exam: 3 Hours

Course Objectives:

- To give the basic knowledge on material properties.
- To acquire knowledge on magnetism and digital electronics.
- To educate and motivate the students in the field of science.

Course Outcomes:

Students can able to

- Explain how physics applies to phenomena in the world around them.
- Recognize how and when physics methods and principles can help address problems in their major and then apply those methods and principles to solve problems.

UNIT – I

Electrostatics: Coulombs law – electric field – Gauss's law and its applications – potential – potential due to various charge distribution. Parallel plate capacitors – dielectrics- current – galvanometer – voltmeter – ammeter- potentiometric measurements.

UNIT - II

Magnetism: Magnetic field – Biot Savart's law – B due to a solenoid – Amperes law – Faradays law of induction – Lenz's law. Magnetic properties of matter –Dia, para and ferro - Cycle of magnetization – Hysteresis – B-H curve – Applications of B-H curve.

UNIT - III

Modern Physics: Einstein's Photoelectric effect-characteristics of photoelectron –laws of photoelectric emission-Einstein's photo electric equations- Compton effect-matter waves-De-Broglie Hypothesis. Heisenberg's uncertainty principle-Schrödinger's equation- particle in a box.

UNIT-IV

Atomic and Nuclear Physics: Atom Models : Sommerfield's and Vector atom Models – Pauli's exclusion Principle – Various quantum numbers and quantization of orbits. X-rays : Continuous and Characteristic X-rays – Mosley's Law and importance – Bragg's Law.

Nuclear forces –characteristics - nuclear structure by liquid drop model – Binding energy – mass defect – particle accelerators – cyclotron and betatron – nuclear Fission and nuclear Fusion.

UNIT - V

Digital Electronics: Decimal – binary – octal and hexadecimal numbers– their representation, inter-conversion, addition and subtraction, negative numbers. Sum of products – product of sums – their conversion – Simplification of Boolean expressions - K-Map – min terms – max terms - (2, 3 and 4 variables). Basic logic gates – AND, OR, NOT, NAND, NOR and EXOR gates – NAND and NOR as universal building gates – Boolean Algebra – Laws of Boolean Algebra – De Morgan's Theorems – Their verifications using truth tables.

SUGGESTED READINGS

1. Narayanamurthi, Electricity and Magnetism, The National Publishing Co, First edition,1988.

2. J. B. Rajam, Atomic Physics., S. Chand & Company Limited, New Delhi, First edition, 1990.

3. B. N. Srivastava, Basic Nuclear Physic, Pragati Prakashan, Meerut, 2005.

4. Albert Paul Malvino, Digital principles and Applications, McGraw-Hill International Editions, New York, 2002.

5. Digital fundamentals – by Floyd 8th edition Pearson education 2006

6. R. S. Sedha, A text book of Digital Electronics, S. Chand & Co, New Delhi, First edition ,2004.

UNIT – I

Electrostatics: Coulombs law – electric field – Gauss's law and its applications – potential – potential due to various charge distribution. Parallel plate capacitors – dielectrics- current – galvanometer – voltmeter – ammeter- potentiometric measurements.

Electrostatics:

Coulomb's law

The force between two charged bodies was studied by Coulomb in 1785.Coulomb's law states that the force of attraction or repulsion between two point charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them. The direction of forces is alongthe line joining the two point charges.

One Coulomb is defined as the quantity of charge, which when placed at a distance of 1 metre in air or vacuum from an equal and similar charge, experiences a repulsive force of 9×10^9 N. The forces exerted by charges on each other are equal in magnitude and opposite in direction.

Electric Field

Electric field due to a charge is the space around the test charge in which it experiences a force. The presence of an electric field around a charge cannot be detected unless another charge is brought towards it.

When a test charge $q_o$is placed near a charge q, which is the source of electric field, an electrostatic force F will act on the test charge.

Gauss's law

The law relates the flux through any closed surface and the netcharge enclosed within the surface. The law states that the total flux

1

of the electric field E over any closed surface is equal to ε_o times the net charge enclosed by the surface.

q —

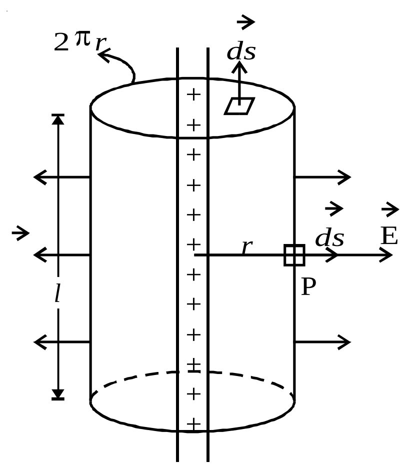
$\varphi = _{\varepsilon o}$

This closed imaginary surface is called Gaussian surface. Gauss's law tells us that the flux of E through a closed surface S depends only on the value of net charge inside the surface and not on the location of the charges. Charges outside the surface will not contribute to flux.

Applications of Gauss's Law

i) **Field due to an infinite long straight charged wire**

Consider an uniformly charged wire of infinite length having a constant linear charge density λ (charge per unit E length). Let P be a point at a distance r from the wire (Fig. 1.17) and E be the electric field at the point P. A cylinder of length *l*, radius r, closed at each end by plane caps normal to the axis is chosen as Gaussian surface. Consider a very *Fig 1.17 Infinitely long* small area *ds* on the Gaussian surface. *straight charged wire* By symmetry, the magnitude of the electric field will be the same at all points on the curved surface of the cylinder and directed radially



outward. $_E$ and *ds* are along the same direction.

The electric flux (φ) through curved surface = $\oint$ E ds cos θ

φ = $\int$ E ds [∵θ= 0;cosθ=1]

= E (2πr*l*)

(∵ The surface area of the curved part is 2π rl)

Since $_E$ and *ds* are right angles to each other, the electric flux through the plane caps = 0

∴ Total flux through the Gaussian surface, φ = E. (2πrl)

The net charge enclosed by Gaussian surface is, q = λl

∴ By Gauss's law,

$E(2\pi rl) = \frac{\lambda l}{\varepsilon o}$ or $E = \frac{\lambda}{2\pi\varepsilon o r}$

The direction of electric field E is radially outward, if line charge is positive and inward, if the line charge is negative.

Electric field due to an infinite charged plane sheet

Consider an infinite plane sheet of charge with surface charge density σ. Let P be a point at a distance *r* from the sheet (Fig. 1.18) and E be the electric field at P. Consider a Gaussian surface in the form of cylinder of cross− sectional area A and length *2r* perpendicular to the sheet of charge. *Fig 1.18 Infinite plane sheet* By symmetry, the electric field is at right angles to the end caps and away from the plane. Its magnitude is the same at P and at the other cap at P′.
Therefore, the total flux through the closed surface is given by

$$\varphi = \iint E\, ds\,\Big|_P + \iint E\, ds\,\Big|_{P'} \qquad (\because \theta = 0, \cos\theta = 1)$$

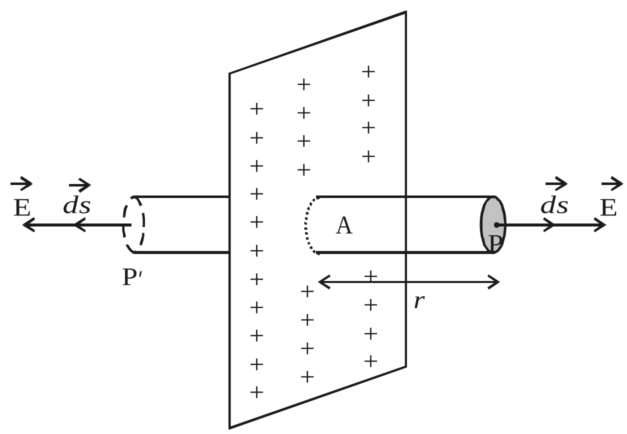
$$= E A + E A = 2 E A$$

If σ is the charge per unit area in the plane sheet, then the net positive charge *q* within the Gaussian surface is, $q = \sigma A$

Using Gauss's law,

$$2 E A = \frac{\sigma A}{\varepsilon_o}$$

$$\therefore E = \frac{\sigma}{2\varepsilon_o}$$



Capacitance of a conductor

When a charge *q* is given to an isolated conductor, its potential will change. The change in potential depends on the size and shape of the conductor. The potential of a conductor changes by V, due to the charge *q* given to the conductor.

$q \alpha$ V or $q = CV$

i.e. $C = q/V$

Here C is called as capacitance of the conductor.

The capacitance of a conductor is defined as the ratio of the charge given to the conductor to the potential developed in the conductor.

The unit of capacitance is farad. A conductor has a capacitance of one farad, if a charge of 1 coulomb given to it, rises its potential by 1 volt.

The practical units of capacitance are μF and pF.

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)
Pollachi Main Road, Eachanari Post, Coimbatore - 641 021, Tamilnadu, India.
Phone : 0422 - 2980011 - 14, 6471113, 14 | Fax : 0422 - 2980022-23 | Email : info@karpagam.com

Principle of a capacitor

Consider an insulated conductor (Plate A) with a positive charge '*q*' having potential V (Fig 1.22a). The capacitance of A is C = q/V. When another insulated metal plate B is brought near A, negative charges are induced on the side of B near A. An equal amount of positive charge is induced on the other side of B (Fig 1.22b). The negative charge in B decreases the potential of A. The positive charge in B increases the potential of A. But the negative charge on B is nearer to A than the positive charge on B. So the net effect is that, the potential of A decreases. Thus the capacitance of A is increased.

If the plate B is earthed, positive charges get neutralized (Fig 1.22c). Then the potential of A decreases further. Thus the capacitance of A is considerably increased. The capacitance depends on the geometry of the conductors and nature of the medium. A capacitor is a device for storing electriccharges.

A A B A
B

++ -++ -
++ -++ -
++ -++ -
++ -++ -
++ -++ -
++ -++ -
++ -++ -
++ -++ -
++ -++ -

Fig 1.22 Principle of capacitor

Capacitance of a parallel plate capacitor

The parallel plate capacitor consists of two parallel metal plates X and Y each of area A, separated by a distance *d*, having a surface charge

density σ (fig. 1.23). The medium
-q
$+q$ is given to the plate X. It induces
a charge $-q$ on the upper surface of *Fig 1.23 Parallel plate capacitor* earthed plate Y. When the plates are very close to each other, the field is confined to the region between them. The electric lines of force starting from plate X and ending at the plate Y are parallel to each other and perpendicular to the plates.

By the application of Gauss's law, electric field at a point between the two plates is,

$$E = \frac{\sigma}{\varepsilon_o}$$

Potential difference between the plates X and Y is

$$V = \int_d^0 -E\, dr = -\int_d^0 \frac{\sigma}{\varepsilon_o} dr = \frac{\sigma d}{\varepsilon_o}$$

The capacitance (C) of the parallel plate capacitor

$$C = \frac{q}{V} = \frac{\sigma A}{\sigma d/\varepsilon_o} \quad \left[\text{since}, \sigma = \frac{q}{A}\right]$$

$$\therefore \quad C = \frac{\varepsilon_o A}{d}$$

The capacitance is directly proportional to the area (A) of the plates and inversely proportional to their distance of separation (d).

Dielectrics and polarization

Dielectrics

A dielectric is an insulating material in which all the electrons are tightly bound to the nucleus of the atom. There are no free electrons to carry current. Ebonite, mica and oil are few examples of dielectrics. The electrons are not free to move under the influence of an external field.

UNIT – II

Magnetism: Magnetic field – Biot Savart's law – B due to a solenoid – Amperes law – Faradays law of induction – Lenz's law. Magnetic properties of matter –Dia, para and ferro - Cycle of magnetization – Hysteresis – B-H curve – Applications of B-H curve.

MAGNETISM

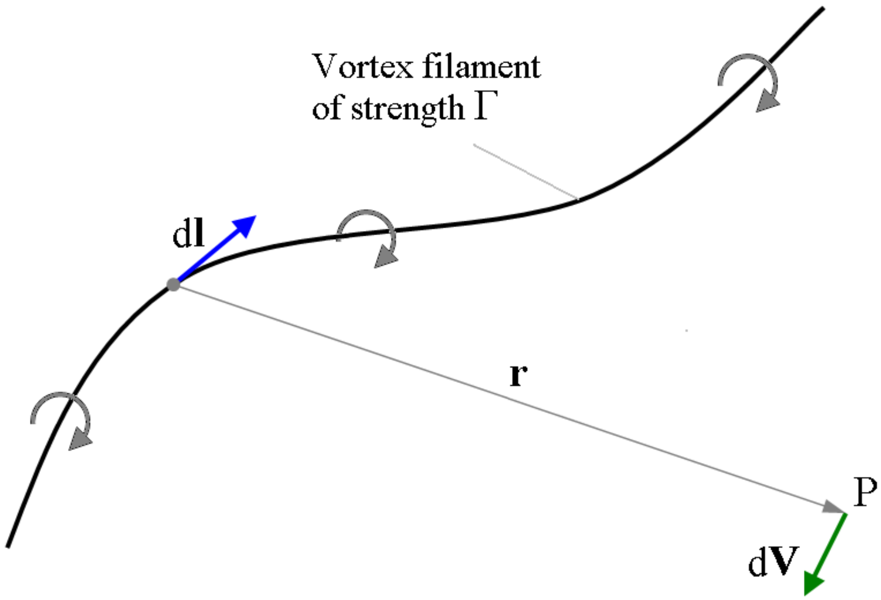
Magnetic field

A vector field in the neighbourhood of a magnet, electric current, or changing electric field, in which magnetic forces are observable. Magnetic fields such as that of Earth cause magnetic compass needles and other permanent magnets to line up in the direction of the field. Magnetic fields force moving electrically charged particles in a circular or helical path. This force—exerted on electric currents in wires in a magnetic field—underlies the operation of electric motors.

The Biot Savart Law states that it is a mathematical expression which illustrates the magnetic field produced by a stable electric current in the particular electromagnetism of physics. It tells the magnetic field toward the magnitude, length, direction, as well as closeness of the electric current. This law is basic to magnetostatics and plays an essential role related to the Coulomb's law in electrostatics. Whenever magneto statics do not apply, then this law must be changed by the equation of Jefimenko's. This law is applicable in the magnetostatic estimate, & is reliable by both Gauss's (magnetism) and Ampere's (circuital) law. The two physicists from French namely "Jean Baptiste Biot" & "Felix Savart" implemented an exact expression intended for magnetic flux density at a position close to a current carrying conductor in the year 1820. Screening a magnetic compass needle deflection, the two scientists completed that every current component estimates a magnetic field in the space (S).

What is Biot Savart Law?

A conductor which carries current (I) with the length (dl), is a basic magnetic field source. The power on one more related conductor can be expressed easily in terms of the magnetic field (dB) due to the primary. The magnetic field dB dependence on the 'I' current, dimension as well as direction of the length dl & on distance 'r' was primarily estimated by Biot & Savart.



Biot Savart Law

Once from end to end observations as well as calculations they derived an expression, that includes the density of magnetic flux (dB), is directly proportional to the element length (dl), the flow of current (I), the sine of the angle θ among the flow of current direction and the vector combining a given position of the field, with the current component is inversely proportional to the square of the distance (r) of the specified point from the current element. This is the Biot Savart law statement.

Magnetic Field Element

Thus, dB is proportional to I dl $\sin\theta / r^2$ or, it can be written as $dB = k\, Idl \sin\theta / r^2$

$dH = \mu 0\ \mu r/4\pi \times Idl \sin\theta / r^2$
$dH = k \times Idl \sin\theta / r^2$ (Where $k = \mu 0\ \mu r/4\pi$)
dH is proportional to $Idl \sin\theta / r^2$
Here, k is a constant, thus the final Biot-Savart law expression is
$dB = \mu 0\ \mu r/4\pi \times Idl \sin\theta / r^2$

Solenoids and Magnetic Fields

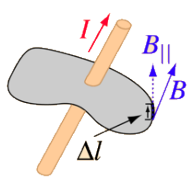
A solenoid is a long coil of wire wrapped in many turns. When a current passes through it, it creates a nearly uniform magnetic field inside.
Solenoids can convert electric current to mechanical action, and so are very commonly used as switches.
The magnetic field within a solenoid depends upon the current and density of turns.
In order to estimate roughly the force with which a solenoid pulls on ferromagnetic rods placed near it, one can use the change in magnetic field energy as the rod is inserted into the solenoid. The force is roughly

$$\text{force on rod} = \frac{\text{change in magnetic field energy}}{\text{distance rod moves into solenoid}}$$

The energy density of the magnetic field depends on the strength of the field, squared, and also upon the magnetic permeability of the material it fills. Iron has a much, much larger permeability than a vacuum.
Even small solenoids can exert forces of a few newtons.

Ampere's Law

The magnetic field in space around an electric current is proportional to the electric current which serves as its source, just as the electric field in space is proportional to the charge which serves as its source. Ampere's Law states that for any closed loop path, the sum of the length elements times the magnetic field in the direction of the length element is equal to the permeability times the electric current enclosed in the loop.



$$\sum B_{||} \Delta l = \mu_0 I$$

Faraday's law of induction

In physics, a quantitative relationship between a changing magnetic field and the electric field created by the change, developed on the basis of experimental observations made in 1831 by the English scientist Michael Faraday.

The phenomenon called electromagnetic induction was first noticed and investigated by Faraday; the law of induction is its quantitative expression. Faraday discovered that, whenever the magnetic field about an electromagnet was made to grow and collapse by closing and opening the electric circuit of which it was a part, an electric current could be detected in a separate conductor nearby. Moving a permanent magnet into and out of a coil of wire also induced a current in the wire while the magnet was in motion. Moving a conductor near a stationary permanent magnet caused a current to flow in the wire, too, as long as it was moving. Faraday visualized a magnetic field as composed of many lines of induction, along which a small magnetic compass would point. The aggregate of the lines intersecting a given area is called the magnetic flux. The electrical effects were thus attributed by Faraday to a changing magnetic flux. Some years later the Scottish physicist James Clerk Maxwell proposed that the fundamental effect of changing magnetic flux was the production of an electric field, not only in a conductor (where it could drive an electric charge) but also in space even in the absence of electric charges. Maxwell formulated the mathematical expression relating the change in magnetic flux to the induced electromotive force (E, or emf). This relationship, known as Faraday's law of induction (to distinguish it from his laws of electrolysis), states that the magnitude of the emf induced in a circuit is proportional to the rate of change of the magnetic flux that cuts across the circuit. If the rate of change of magnetic flux is expressed in units of webers per second, the induced emf has units of volts. Faraday's law is one of the four Maxwell equations that define electromagnetic theory.

Lenz's law states that when an EMF is generated by a change in magnetic flux according to Faraday's Law, the polarity of the induced EMF is such, that it produces an induced current whose magnetic field opposes the initial changing magnetic field which produced it
The negative sign used in Faraday's law of electromagnetic induction, indicates that the induced EMF (ε) and the change in magnetic flux ($\delta\Phi_B$) have opposite signs. The formula for Lenz's law is shown below:

$$\epsilon = -N\frac{\partial \Phi_B}{\partial t}$$

Where:
ε = Induced emf
$\delta\Phi_B$ = change in magnetic flux
N = No of turns in coil

Magnetic Properties Of Matter

All matter exhibits magnetic properties when placed in an external magnetic field. Even substances like copper and aluminum that are not normally thought of as having magnetic properties are affected by the presence of a magnetic field such as that produced by either pole of a bar magnet. Depending on whether there is an attraction or repulsion by the pole of a magnet, matter is classified as being **either paramagnetic or diamagnetic**, respectively. A few materials, notably iron, show a very large attraction toward the pole of a permanent bar magnet; materials of this kind are called **ferromagnetic.**

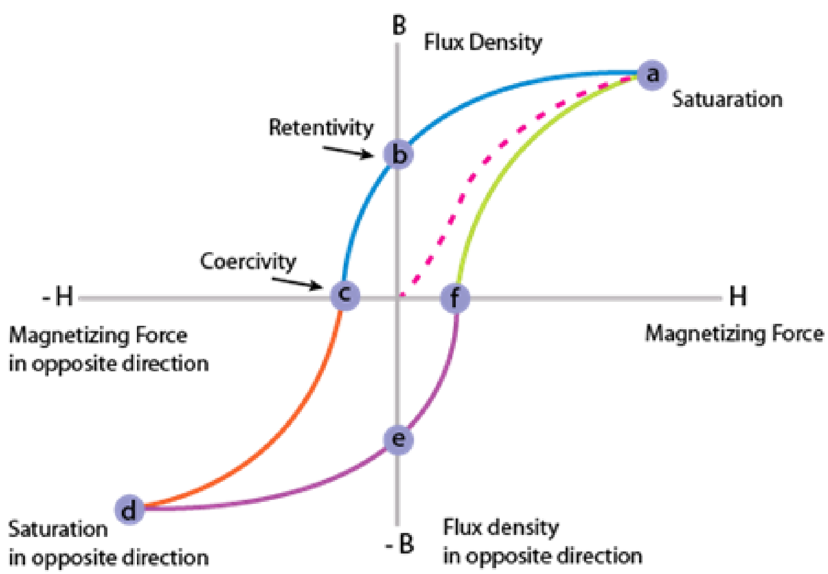
In 1845 Faraday became the first to classify substances as either diamagnetic or paramagnetic. He based this classification on his observation of the force exerted on substances in an inhomogeneous magnetic field. At moderate field strengths, the magnetization $\boldsymbol{M}$ of a substance is linearly proportional to the strength of the applied field $\boldsymbol{H}$. The magnetization is specified by the magnetic susceptibility χ (previously labeled χm), defined by the relation $\boldsymbol{M} = \chi\boldsymbol{H}$. A sample of volume V placed in a field $\boldsymbol{H}$ directed in the x-direction and increasing in that direction at a rate $d\boldsymbol{H}/dx$ will experience a force in the x-direction of $\boldsymbol{F} = \chi\mu_0 VH\,(d\boldsymbol{H}/dx)$. If the magnetic susceptibility χ is positive, the force is in the direction of increasing field strength, whereas if χ is negative, it is in the direction of decreasing field strength. Measurement of the force $\boldsymbol{F}$ in a known field $\boldsymbol{H}$ with a known gradient $d\boldsymbol{H}/dx$ is the basis of a number of accurate methods of determining χ.

Substances for which the magnetic susceptibility is negative (e.g., copper and silver) are classified as diamagnetic. The susceptibility is small, on the order of -10^{-5} for solids and liquids and -10^{-8} for gases. A characteristic feature of diamagnetism is that the magnetic moment per unit mass in a given field is virtually constant for a given substance over a very wide range of temperatures. It changes little between solid, liquid, and gas; the variation in the susceptibility between solid or liquid and gas is almost entirely due to the change in the number of molecules per unit volume. This indicates that the magnetic moment induced in each molecule by a given field is primarily a property characteristic of the molecule.

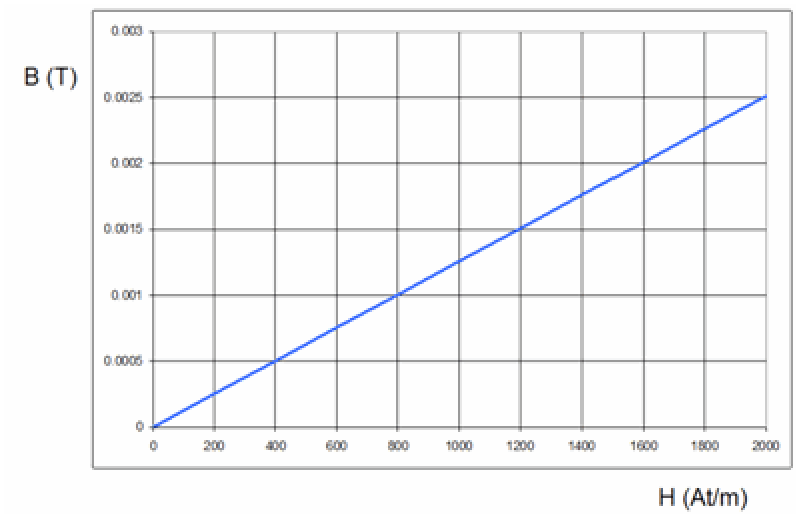
Substances for which the magnetic susceptibility is positive are classed as paramagnetic. In a few cases (including most metals), the susceptibility is independent of temperature, but in most compounds it is strongly temperature dependent, increasing as the temperature is lowered. Measurements by the French physicist Pierre Curie in 1895 showed that for many substances the susceptibility is inversely proportional to the absolute temperature T; that is, $\chi = C/T$. This approximate relationship is known as Curie's law and the constant C as the Curie constant. A more accurate equation is obtained in many cases by modifying the above equation to $\chi = C/(T - \theta)$, where θ is a constant. This equation is called the Curie–Weiss law (after Curie and Pierre-Ernest Weiss, another French physicist). From the form of this last equation, it is clear that at the temperature $T = \theta$, the value of the susceptibility becomes infinite. Below this temperature, the material exhibits spontaneous magnetization—i.e., it becomes ferromagnetic. Its magnetic properties are then very different from those in the paramagnetic or high-temperature phase. In particular, although its magnetic moment can be changed by the application of a magnetic field, the value of the moment attained in a given field is not always the same; it depends on the previous magnetic, thermal, and mechanical treatment of the sample.

Hysteresis

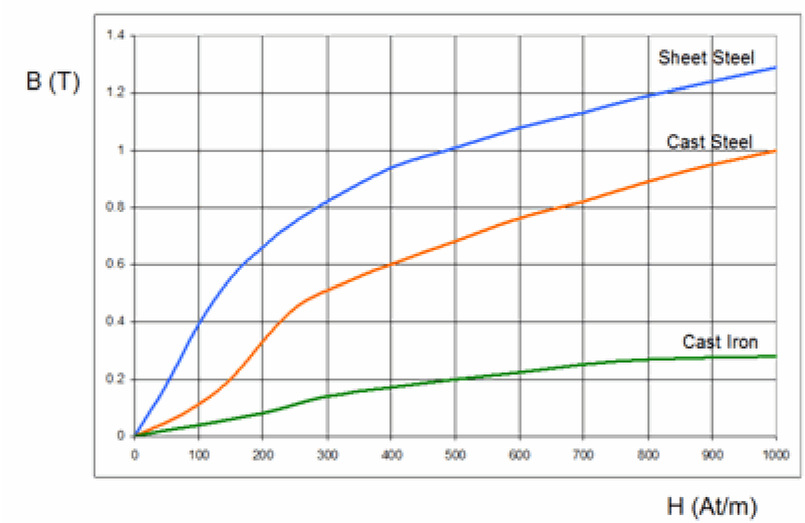
The phenomenon in which the value of a physical property lags behind changes in the effect causing it, as for instance when magnetic induction lags behind the magnetizing force.



The B-H curve is the curve characteristic of the magnetic properties of a material or element or alloy. It tells you how the material responds to an external magnetic field, and is a critical piece of information when designing magnetic circuits. In the plots below, for a vacuum an H of 800 At/m creates a B of 1 mT. With a sheet steel core, an H of 800 At/m creates a B of 1.2 T. A huge increase in B for the same H! The hysteresis comes into play when the material has been magnetized. The B within the material does not go back to what it was before, but is dependent on the history of its magnetization.



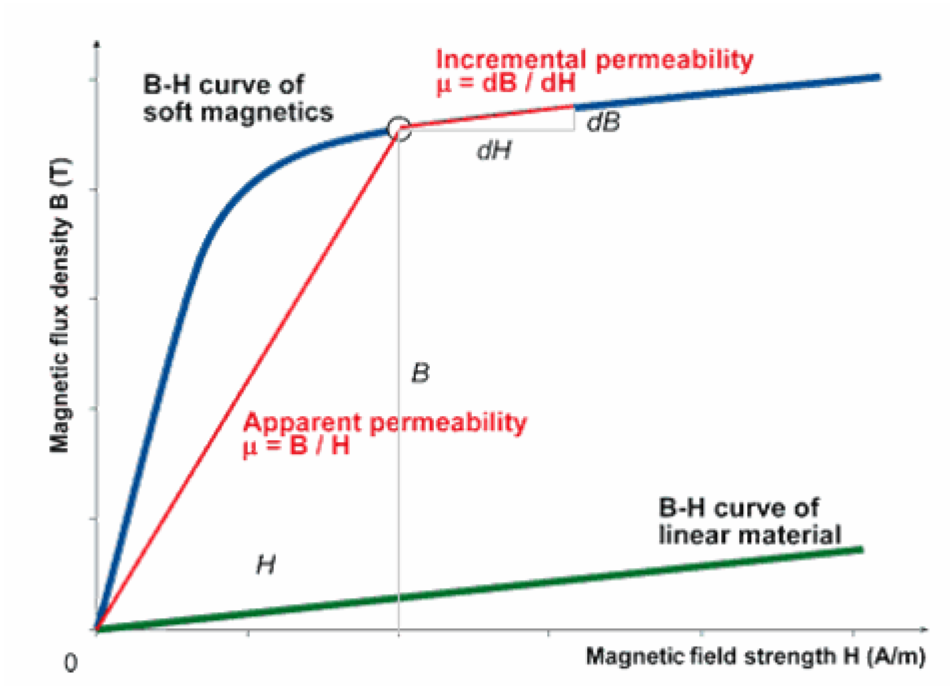
B-H for Vacuum



B-H for various materials

c. The slope of the curve - **Permeability**

The slope of the B-H curve at some location on its curve is its incremental permeability at that location. However, sometimes the permeability is measured from the origin to the location of interest, and that slope is called its apparent permeability, μ.



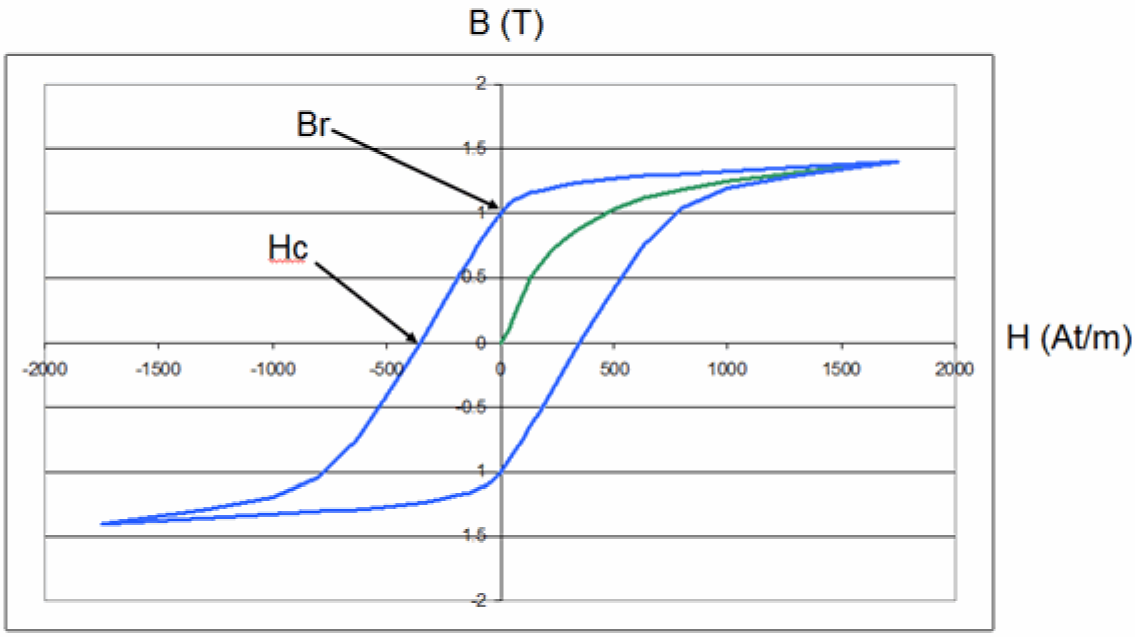
For non-magnetic materials that do not saturate, the curve has a fixed slope approximately equal to μ_0

i. Diamagnetic materials have a slightly smaller slope

ii. Paramagnetic materials have a slightly greater slope

d. Critical points on the curve

For ferromagnetic materials that are non-linear, they have a μ_r that is much greater than 1, but when they saturate their μ_r approaches 1.



i. The residual magnetism, Br, or remanence (or retentivity), is the flux density that is left within the material after it has been magnetized.

ii. A material with a high Br is desired for permanent magnets.
http://en.wikipedia.org/wiki/Remanence
iii. The coercivity, Hc, is the magnetic field intensity that is required to demagnetize the material after it has been magnetized.

iv. A material with a high Hc is desired for permanent magnets to prevent them from being easily demagnetized.

v. Rare earth magnets have a much higher Hc than Alnico magnets.
http://en.wikipedia.org/wiki/Coercivity
vi. The saturation effect of the material occurs when all of the magnetic domains within the material have become aligned with the external magnetic field that surrounds it.
e. Characteristics of soft magnetic material
i. A material with a very low Br and Hc

ii. It does not retain a strong magnetic field (does not make a good permanent magnet), and is easy to demagnetize

iii. The area enclosed by the B-H curve is small, so it has low hysteresis losses or core losses

iv. This material is desired for use in transformers, motors and electromagnets where the magnetic field is always changing.

v. Electrical steels, which contain about 1-2% Si, is a soft magnetic material.
e. Characteristics of hard magnetic material
i. A material with a very high Br and Hc

ii. It retains a strong magnetic field (makes a good permanent magnet), and is difficult to demagnetize

iii. The area enclosed by the B-H curve is large, so it has high hysteresis losses or core losses

iv. This material is desired for use in permanent magnets.

v. Alloys such as AlNiCo and NdFeB are hard magnetic materials.

UNIT – III

Modern Physics: Einstein's Photoelectric effect-characteristics of photoelectron –laws of photoelectric emission-Einstein's photo electric equations- Compton effect-matter waves-De-Broglie Hypothesis. Heisenberg's uncertainty principle-Schrödinger's equation- particle in a box.

Modern Physics

Einstein's Photoelectric effect

The photoelectric effect is a phenomenon where electrons are emitted from the metal surface when the light of sufficient frequency is incident upon. The concept of photoelectric effect was first documented in 1887 by Heinrich Hertz and later by Lenard in 1902. But both the observations of the photoelectric effect could not be explained by Maxwell's electromagnetic wave theory of light. Hertz (who had proved the wave theory) himself did not pursue the matter as he felt sure that it could be explained by the wave theory. It, however, failed on the following accounts:

According to the wave theory, energy is uniformly distributed across the wavefront and is dependent only on the intensity of the beam. This implies that the kinetic energy of electrons increases with light intensity. However, the kinetic energy was independent of light intensity.

Wave theory says that light of any frequency should be capable of ejecting electrons. But electron emission occurred only for frequencies larger than a threshold frequency (ν0).

Since energy is dependent on intensity according to wave theory, the low-intensity light should emit electrons after some time so that the electrons can acquire sufficient energy to get emitted. However, electron emission was spontaneous no matter how small the intensity of light.

Following is the table with link of other experiment related to photoelectric effect:

Einstein's explanation of Photoelectric effect

Einstein resolved this problem using Planck's revolutionary idea that light was a particle. The energy carried by each particle of light (called quanta or photon) is dependent on the light's frequency (ν) as shown:

E = hν

Where *h = Planck's constant = 6.6261 × 10-34 Js.*

Since light is bundled up into photons, Einstein theorized that when a photon falls on the surface of a metal, the entire photon's energy is transferred to the electron.

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)
Pollachi Main Road, Eachanari Post, Coimbatore - 641 021, Tamilnadu, India.
Phone : 0422 - 2980011 - 14, 6471113, 14 | Fax : 0422 - 2980022-23 | Email : info@karpagam.com

A part of this energy is used to remove the electron from the metal atom's grasp and the rest is given to the ejected electron as kinetic energy. Electrons emitted from underneath the metal surface lose some of the kinetic energy during the collision. But the surface electrons carry all the kinetic energy imparted by the photon and have the maximum kinetic energy.
We can write this mathematically as:

Energy of photon
= energy required to eject electron (work function) + Maximum kinetic energy of the electron
E = W + KE
hv = W + KE
KE = hv – w

At the threshold frequency v0 electrons are just ejected and do not have any kinetic energy. Below this frequency there is no electron emission. Thus, the energy of a photon with this frequency must be the work function of the metal.

w = hv_0
Thus, Maximum kinetic energy equation becomes:
KE = 12mv2max=hv–hv_0
12mv2max=h(v−v_0)

Vmax is the maximum kinetic energy of the electron. It is calculated experimentally using the stopping potential. Please read our article on Lenard's observations to understand this part.

Stopping potential = ev_0 = 12mv2max
Thus, Einstein explained the Photoelectric effect by using the particle nature of light.
Stay tuned with BYJU'S to learn more about the photoelectric effect along with engaging video lectures.

Compton effect, increase in wavelength of X-rays and other energetic electromagnetic radiations that have been elastically scattered by electrons; it is a principal way in which radiant energy is absorbed in matter. The effect has proved to be one of the cornerstones of quantum mechanics, which accounts for both wave and particle properties of radiation as well as of matter.

Matter waves

It is **the wave** formed by **matter**, or in another word, particles. Precisely speaking, every **matter** formed by particles, or just particles like electrons, have **wave**-like **property**, which means they can behave both like particles and **waves**. It is only when particles move that they have **wave**-like **property**

De Broglie's Thesis

In his 1923 (or 1924, depending on the source) doctoral dissertation, the French physicist Louis de Broglie made a bold assertion. Considering Einstein's relationship of wavelength *lambda* to momentum *p*, de Broglie proposed that this relationship would determine the wavelength of any matter, in the relationship:

lambda = *h* / *p*

recall that *h* is Planck's constant

This wavelength is called the *de Broglie wavelength*. The reason he chose the momentum equation over the energy equation is that it was unclear, with matter, whether *E* should be total energy, kinetic energy, or total relativistic energy. For photons, they are all the same, but not so for matter.

Assuming the momentum relationship, however, allowed the derivation of a similar de Broglie relationship for frequency *f* using the kinetic energy E_k:

$f = E_k / h$

Alternate Formulations

De Broglie's relationships are sometimes expressed in terms of Dirac's constant, *h-bar* = *h* / (2*pi*), and the angular frequency *w* and wavenumber *k*:

p = *h-bar* * kE_k

= *h-bar* * *w*

Experimental Confirmation

In 1927, physicists Clinton Davisson and Lester Germer, of Bell Labs, performed an experiment where they fired electrons at a crystalline nickel target. The resulting diffraction pattern matched the predictions of the de Broglie wavelength. De Broglie received the 1929 Nobel Prize for his theory (the first time it was ever awarded for a Ph.D. thesis) and Davisson/Germer jointly won it in 1937 for the experimental discovery of electron diffraction (and thus the proving of de Broglie's hypothesis).

Further experiments have held de Broglie's hypothesis to be true, including the quantum variants of the double slit experiment. Diffraction experiments in 1999 confirmed the de Broglie wavelength for the behavior of molecules as large as buckyballs, which are complex molecules made up of 60 or more carbon atoms.

Significance of the de Broglie Hypothesis

The de Broglie hypothesis showed that wave-particle duality was not merely an aberrant behavior of light, but rather was a fundamental principle exhibited by both radiation and matter. As such, it becomes possible to use wave equations to describe material behavior, so long as one properly applies the de Broglie wavelength. This would prove crucial to the development of quantum mechanics. It is now an integral part of the theory of atomic structure and particle physics.

Macroscopic Objects and Wavelength

Though de Broglie's hypothesis predicts wavelengths for matter of any size, there are realistic limits on when it's useful. A baseball thrown at a pitcher has a de Broglie wavelength that is smaller than the diameter of a proton by about 20 orders of magnitude.

The Heisenberg uncertainty principle states that it is impossible to know simultaneously the exact position and momentum of a particle. That is, the more exactly the position is determined, the less known the momentum, and vice versa. This principle is not a statement about the limits of technology, but a fundamental limit on what can be known about a particle at any given moment. This uncertainty arises because the act of measuring affects the object being measured. The only way to measure the position of something is using light, but, on the sub-atomic scale, the interaction of the light with the object inevitably changes the object's position and its direction of travel.

The Schrödinger Equation and a Particle in a Box

The particle in a box model (also known as the infinite potential well or the infinite square well) describes a particle free to move in a small space surrounded by impenetrable barriers. The model is mainly used as a hypothetical example to illustrate the differences between classical and quantum systems. In classical systems, for example a ball trapped inside a large box, the particle can move at any speed within the box and it is no more likely to be found at one position than another. However, when the well becomes very narrow (on the scale of a few nanometers), quantum effects become important. The particle may only occupy certain positive energy levels. The particle in a box model provides one of the very few problems in quantum mechanics which can be solved analytically, without approximations. This means that the observable properties of the particle (such as its energy and position) are related to the mass of the particle and the width of the well by simple mathematical expressions. Due to its simplicity, the model allows insight into quantum effects without the need for complicated mathematics. It is one of the first quantum mechanics problems taught in undergraduate physics courses, and it is commonly used as an approximation for more complicated quantum systems.

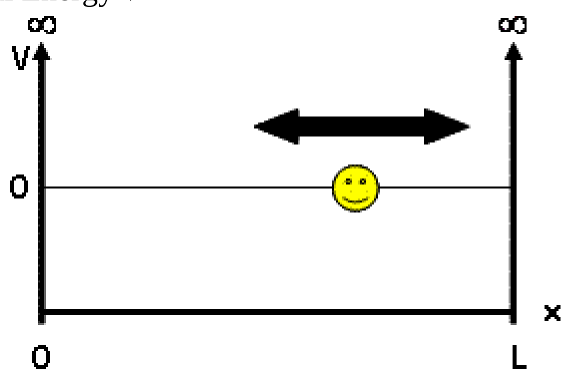
A particle in a 1-dimensional box is a fundamental quantum mechanical approximation describing the translational motion of a single particle confined inside an infinitely deep well from which it *cannot* escape.

The particle in a box problem is a common application of a quantum mechanical model to a simplified system consisting of a particle moving horizontally within an infinitely deep well from which it cannot escape. The solutions to the problem give possible values of E and ψψ that

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)
Pollachi Main Road, Eachanari Post, Coimbatore - 641 021, Tamilnadu, India.
Phone : 0422 - 2980011 - 14, 6471113, 14 | Fax : 0422 - 2980022-23 | Email : info@karpagam.com

the particle can possess. E represents allowed energy values and ψ(x)ψ(x) is a wavefunction, which when squared gives us the probability of locating the particle at a certain position within the box at a given energy level.
To solve the problem for a particle in a 1-dimensional box, we must follow our **Big, Big recipe for Quantum Mechanics:**

Define the Potential Energy, *V*
Solve the Schrödinger Equation
Define the wavefunction
Define the allowed energies
Step 1: Define the Potential Energy *V*



A particle in a 1D infinite potential well of dimension **LL.**

The potential energy is *0 inside the box* (V=0 for 0<x<L) and *goes to infinity at the walls of the box* (V=∞ for x<0 or x>L). We assume the walls have infinite potential energy to ensure that the particle has zero probability of being at the walls or outside the box. Doing so significantly simplifies our later mathematical calculations as we employ these **boundary conditions** when solving the Schrödinger Equation.

Step 2: Solve the Schrödinger Equation
The time-independent Schrödinger equation for a particle of mass *m* moving in one direction with energy *E* is

−ℏ22md2ψ(x)dx2+V(x)ψ(x)=Eψ(x)(1)(1)−ℏ22md2ψ(x)dx2+V(x)ψ(x)=Eψ(x)

with
ℏℏ is the reduced Planck Constant where ℏ=h2πℏ=h2π
m is the mass of the particle
ψ(x)ψ(x) is the stationary time-independent wavefunction
V(x) is the potential energy as a function of position
EE is the energy, a real number

This equation can be modified for a particle of mass *m* free to move parallel to the x-axis with zero potential energy (V = 0 everywhere) resulting in the quantum mechanical description of free motion in one dimension:

−ℏ22md2ψ(x)dx2=Eψ(x)(2)(2)−ℏ22md2ψ(x)dx2=Eψ(x)

This equation has been well studied and gives a general solution of:

ψ(x)=Asin(kx)+Bcos(kx)(3)(3)ψ(x)=Asin(kx)+Bcos(kx)

where A, B, and k are constants.

Step 3: Define the wavefunction

The solution to the Schrödinger equation we found above is the general solution for a 1-dimensional system. We now need to apply our **boundary conditions** to find the solution to our particular system. According to our boundary conditions, the probability of finding the particle at x=0 or x=L is zero. When x=0x=0, sin(0)=0sin(0)=0, and cos(0)=1cos(0)=1; therefore, *B must equal 0* to fulfill this boundary condition giving:
ψ(x)=Asin(kx)(4)(4)ψ(x)=Asin(kx)

We can now solve for our constants (A and k) systematically to define the wavefunction.

Solving for k

Differentiate the wavefunction with respect to x:

dψdx=kAcos(kx)(5)(5)dψdx=kAcos(kx)
d2ψdx2=−k2Asin(kx)(6)(6)d2ψdx2=−k2Asin(kx)
Since ψ(x)=Asin(kx)ψ(x)=Asin(kx), then

d2ψdx2=−k2ψ(7)(7)d2ψdx2=−k2ψ

If we then solve for k by comparing with the Schrödinger equation above, we find:

k=(8π2mEh2)1/2(8)(8)k=(8π2mEh2)1/2

Now we plug k into our wavefunction:

ψ=Asin(8π2mEh2)1/2x(9)(9)ψ=Asin(8π2mEh2)1/2x

KARPAGAM
ACADEMY OF HIGHER EDUCATION
Enable | Enlighten | Enrich
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)
Pollachi Main Road, Eachanari Post, Coimbatore - 641 021, Tamilnadu, India.
Phone : 0422 - 2980011 - 14, 6471113, 14 | Fax : 0422 - 2980022-23 | Email : info@karpagam.com

Solving for A

To determine A, we have to apply the boundary conditions again. Recall that the *probability of finding a particle at x = 0 or x = L is zero.*

When x=Lx=L:

0=Asin(8π2mEh2)1/2L(10)(10)0=Asin(8π2mEh2)1/2L
This is only true when
(8π2mEh2)1/2L=nπ(11)(11)(8π2mEh2)1/2L=nπ
where n = 1,2,3…

Plugging this back in gives us:

ψ=AsinnπLx(12)(12)ψ=AsinnπLx
To determine AA, recall that the total probability of finding the particle inside the box is 1, meaning there is no probability of it being outside the box. When we find the probability and set it equal to 1, we are *normalizing* the wavefunction.
∫L0ψ2dx=1(13)(13)∫0Lψ2dx=1

For our system, the normalization looks like:

A2∫L0sin2(nπxL)dx=1(14)(14)A2∫0Lsin2(nπxL)dx=1
Using the solution for this integral from an integral table, we find our normalization constant, AA:
A=2L−−√(15)(15)A=2L

Which results in the normalized wavefunction for a particle in a 1-dimensional box:

ψ=2L−−√sinnπLx(16)(16)ψ=2LsinnπLx
Step 4: Determine the Allowed Energies

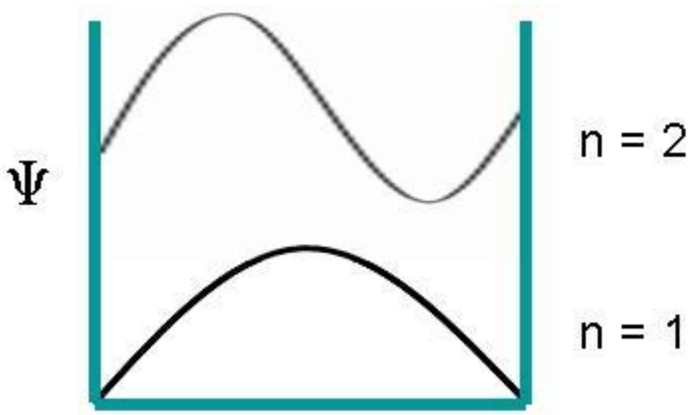
Solving for E results in the allowed energies for a particle in a box:

En=n2h28mL2(17)(17)En=n2h28mL2
This is an important result that tells us:

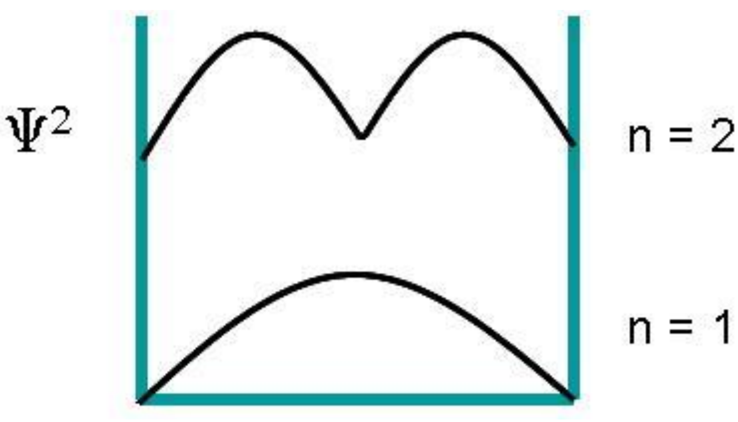
The energy of a particle is quantized and
The lowest possible energy of a particle is **NOT** zero. This is called the **zero-point energy** and means the particle can **never be at rest** because it always has some kinetic energy.

This is also consistent with the Heisenberg Uncertainty Principle: if the particle had zero energy, we would know where it was in both space and time.

The wavefunction for a particle in a box at the n=1n=1 and n=2n=2 energy levels look like this:



The probability of finding a particle a certain spot in the box is determined by squaring ψψ. The probability distribution for a particle in a box at the n=1n=1 and n=2n=2 energy levels looks like this:



Notice that the number of **nodes** (places where the particle has zero probability of being located) increases with increasing energy n. Also note that as the energy of the particle becomes greater, the quantum mechanical model breaks down as the energy levels get closer together and overlap, forming a continuum. This continuum means the particle is free and can have any energy value. At such high energies, the classical mechanical model is applied as the particle behaves more like a continuous wave. Therefore, the particle in a box problem is an example of Wave-Particle Duality.

IMPORTANT FACTS TO LEARN FROM THE PARTICLE IN THE BOX

- The energy of a particle is quantized. This means it can only take on discrete energy values.
- The lowest possible energy for a particle is **NOT** zero (even at 0 K). This means the particle *always* has some kinetic energy.
- The square of the wavefunction is related to the probability of finding the particle in a specific position for a given energy level.
- The probability changes with increasing energy of the particle and depends on the position in the box you are attempting to define the energy for.
- In classical physics, the probability of finding the particle is independent of the energy and the same at all points in the box.

[19MMU203]
KARPAGAM ACADEMY OF HIGHER EDUCATION, COIMBATORE - 641 021
(Under Section 3 of UGC Act 1956)
(For the candidates admitted from 2019 onwards)

B. Sc., DEGREE EXAMINATIONS, APRIL - 2020
Second Semester
DEPARTMENT OF MATHEMATICS
PHYSICS - II

QUESTIONS	OPTION 1	OPTION 2	OPTION 3	OPTION 4	ANSWER
UNIT-I					
If the distance between two charge is doubled the electrostatic force between the charge will be______	fourtime more	four time less	will increase into two times	will decrease into two times	four time less
The field due to a wire of uniform charge density at a perpendicular distance y from it	increases with increase in y	decrease with increaase in y	remains constant	depends upon the length of the wire	decrease with increaase in y
Field due to a uniformly charged ring at an axial point at distance very large as compared to the radius of the ring	independent of x	directly proportional to x	directly proportional to x^2	inversely proportional to x^2	inversely proportional to x^2
Electric charge enclosed by Gaussian surface is	0	1	min	max	0
For gauss's law point charges in closed surface must be distributed	arbitrarily	sequentially	rational	in line	arbitrarily
Electric field intensity outside two charged parallel plate is	$\sigma/2\varepsilon_0$	σ/ε_0	infinity	0	0
The total electric flux over any closed surface is	ε_0	σ/ε_0	ε_0/σ	q/ε_0	q/ε_0
Electric flux lines due to an infinite sheet of charge is	converging	radial	uniform and perpendicular to the sheet	uniform and parallel to the sheet	uniform and perpendicular to the sheet
One electron volt is __________.	1.6 x 10^{-19}joule	1.6 x 10-19volt	1.6 x 10-19joule	1.6 x 10 -21joule	1.6 x 10^{-19}joule
_________ law establishes a relationship between the electric flux and the electrostatic charge.	Lenz’s	Keplers	Faraday	Gauss’s	Gauss’s
The ratio ϵ/ϵ0 is a dimensionless quantity known as ________	relative permeability	relative permittivity	absolute permittivity	permeability	relative permittivity
The electric field lines begin at the __________ charge and terminate at the _________ charge.	positive, negative	negative, positive	both positive	both negative	positive, negative
Total electric flux emanating from a charge q coulomb placed in air is ____________.	q/ϵ_0	ϵ_0 q	q	4πq	q/ϵ_0
Gauss's law due to different charge distribution is used to calculate	electric field	electric charge	electric intensity	electric field lines.	electric intensity

The total flux across a closed surface enclosing charge is independent of	shape of the closed surface		volume of the enclosure	actual spatial argument of charges within the surface	all
The unit of Electric flux is __________.	Gauss's	Weber	$Nm^{-2}c^{-1}$	Nc^{-1}	$Nm^{-2}c^{-1}$
.Mechanical pressure on the surface of a charged conductor having surface charge density σ is __________.	$\epsilon_0 \sigma^2$	σ^2 / ϵ_0	$\sigma^2 / 2\epsilon_0$	$\sigma / 2\epsilon_0$	$\sigma^2 / 2\epsilon_0$
If the separation between two charges is increased the electric potential energy	always decreases	always increases	remains the same	may increase or decrease	may increase or decrease
Electric intensity due to an infinitely long plane sheet of a conductor at appoint close to its surface is	independent of r	proportional to $1/r^2$	proportional to r	inversely proportional to 1/r	independent of r
The total electric flux through a closed surface depends on	location of the charge only	the shape of the closed surface only	the value of the net charge only	both charge and shape	the value of the net charge only
Electric field intensity due to an infinite plane sheet of charge is	σ/ε_0	$q/2\varepsilon_0$	$\sigma/2\varepsilon_0$	q/ε_0	$\sigma/2\varepsilon_0$
Law stated as flux is $^1/_{\varepsilon_0}$ times total charge is	ohms law	newton's law	gauss's law	coulombs law.	gauss's law
A Gaussian sphere closes an electric dipole within it. Then the total flux through the sphere is	half due to a single charge	double due to a single charge	zero	dependent on the position of the dipole	zero
The Flux of electric field is____	scalar	vector	zero	infinity	scalar
Flux density is measured in	Tesla	Weber	Ampere- turn	Maxwell	Tesla
Which of the following quantities are scalar?	dipole moment	electric force	electric field	electric potential	electric potential
A dipole is placed in a uniform electric field with its axis parallel to the field. It experiences	only a net force	only a torque	both a net force and torque	neither a net force nor a torque	neither a net force nor a torque
Electric potential energy U of two point charges is	$q_1q_2/4\varepsilon_0\pi r^2$	$q_1q_2/4\varepsilon_0\pi r$	pEsinθ	pEcosθ	$q_1q_2/4\varepsilon_0\pi r$
If a point lies at a distance x from the midpoint of the dipole, the electric potential at the point is proportional to	$1/x^2$	$1/x^3$	$1/x^4$	$1/x^{3/2}$	$1/x^2$
The law that governs the force between electric charge is called	Amperes	Coulomb law	Faraday	Ohms	Coulomb law
The minimum value of the charge in any object cannot be less than	1.6×10^{-19}coulomb	3.2×10^{-19} Coulomb	4.8×10^{-19}Coulomb	1 coulomb	1.6×10^{-19}coulomb
An electric field can deflect	X rays	neutrons	alpha particle	gamma rays	alpha particle
Inside the hollow spherical conductor, the potential	is constant	varies directly as the distance from the centre	varies inversely as the distance from the centre	varies inversely as the square of the distance from the centre	is constant
The intensity at a point due to a charge is inversely proportional to	amount of the charge	size of the charge	distance of the point	square of the distance from the charge	square of the distance from the charge

The distance between two charge is douled then the force between them would become	half	one-fourth	doubled	four times	one-fourth
A surface enclosed an electric dipole, the flux through the surface is	infinite	positive	negative	zero	zero
Electric potential is a	vector quantity	scalar quantity	neither vector nor scalar	fictitious quantity	scalar quantity
The potential at any point inside a charged sphere is	zero	same as potential on the surface	smaller than the potential on the surface	greater than the potential on the surface	same as potential on the surface
Two smallspheres eaach carrying a charge q are placed r metre apart, one of the spheres is taken around the other one in a circular path, the work done will be equal to	force between them x r	force between them x 2r	force between them / 2nr	zero	zero
State which of the following is correct?	J=Coulomb x volt	J=Coulomb / volt	J= volt/ ampere	J= volt x ampere	J=Coulomb x volt
A positively charged glass rod attracts an object. The object must be	negatively charged	either negative charged or neutral	neutral	positively charged	either negative charged or neutral
A charge q islocated at the centre of a hypothetical cube. The electric flux through any face of the cube is	q/ϵ0	q/2ϵ0	q/4ϵ0	q/4ϵ0	q/4ϵ0
The force between two electrons seperated by a distance r varies as	r^2	relative permittivity	r^-1	r^-2	r^-2
The energy stored per unit volume of the medium of relative permittivity is _____________.	$\epsilon_r\epsilon_0E^2/2$	$\epsilon_0E^2/2$	$\epsilon_r\epsilon_0E/2$	$\epsilon_0E/2$	$\epsilon_r\epsilon_0E^2/2$
All magnetic moments within a domain will point in the __________ direction.	Different	Same	Positive	Negative	Same
The electrical energy consumed by a coil is stored in the form of:	magnetic field	force field	electrostatic field	electrical field	magnetic field
Electricity may be generated by a wire:	carrying current	wrapped as a coil	passing through a flux field	that has neutral domains	passing through a flux field
A magnetic field has:	lines of reluctance	polar fields	lines of force	magnetomotive force	lines of force
The polarity of induced voltage while a field is collapsing is	opposite to the force creating it	independent of the force creating it	identical to the force creating the field	present only if the force is stationary	opposite to the force creating it
What is magnetic flux?	the number of lines of force in webers	the number of lines of force in maxwells	the number of lines of force in flux density	the number of lines of force in teslas	the number of lines of force in webers
The energy stored in the charged capacitor is _________.	$1/2\ CV^2$	1/2qV	v/q	qV	$1/2\ CV^2$
The arrangement in which one conductor is charged and other is earthed is named as ____________.	capacitor	condenser	capacitor/ condneser	comparator	capacitor/ condneser
__________ device is useful to reduce voltage fluctuations in electric power supplies.	capacitor	condenser	converter	comparator	capacitor
The capacitance of a capacitor C is___________	q/v	qv	v/q	v/q	q/v

_______capacitors can bewidely used in the tuning circuits of radio receivers.	mica	electrolytic	paper	variable air	variable air
_______capacitors are used widely in a radia-set as a smoothing capacitors	electrolytic	mica	both mica and electrolytic	variable	both mica and electrolytic
________capacitor is used in a.c bridges	electrolytic	variable air capacitor	both mica and electrolytic	mica	variable air capacitor
___________ device is used to measure electrostatic potentials	electrometers	magnetometers	potentiometer	galvanometer	electrometers
A dielectric slab is introduced between the plates of an isolated charged parallel plate air capacitor.Which of the following quantities will remain unchanged?	charge on the capacitor	p.d across the capacitor	energy of the capacitor	electric field inside the capacitor	charge on the capacitor
The p.d across a capacitor is kept constant.If a dielectric slab of dielectric constant K is introduced between the plates,the stored energy will be __________.	decreases by a factor K	increases by a factor K	remains constant	increases or decreases depending on the nature of the	increases by a factor K
Capacitance has the dimension _____________.	$M^{-1}L^{-2}T^{4}I^{2}$	$ML^{2}T^{-4}I^{-2}$	$MLT^{-3}I^{-1}$	$M^{-1}L^{-1}T^{3}I$	$M^{-1}L^{-2}T^{4}I^{2}$
In gauss's law the electric flux E through a closed surface (s) depends on the value of net charge __________.	Inside the surface	outside the surface	on the surface	in the surface	Inside the surface
The unit of capacitance is ____________.	Farad	coulomb/volt	Farad and Coulomb/Volt	ohm	Farad and Coulomb/Volt
_________ device is used to generate and detect electromagnetic oscillation of high frequency.	capacitor	voltmeter	Resistor	galvanometer	capacitor
The normal component of D are ________________ across the boundary by the surface charge density	continuous	Discontinuous	Random	Discrete	Discontinuous
The tangential component of the electric field is __________ across the boundary.	continuous	Discontinuous	Random	Discrete	continuous
The potential difference between the conductors is proportional to the _______________ on the capacitor.	charge	voltage	current	time	charge
The coaxial cable used in communication system is a common example for which type of capacitor __________.	spherical	cylindrical	Air capacitor	Parallel plate capacitor	Parallel plate capacitor
Variable air capacitor is used in _____________.	A.c bridges	D.c bridges	both a and b	tuning circuits	A.c bridges
_________ capacitors can be used only in unidirectional power supplies.	mica	Electrolytic	paper	variable	Electrolytic
An electron- volt (eV) is a unit of	Energy	Potential difference	Charge	Momentum	Energy
Farad is the unit of	capacitance	self inductance	mutual inductance	conductance of an electrolyte	capacitance
In a charged capacitor the energy is stored in	the field between the plates	positive chaarge	negative charge	neutral	the field between the plates
No current flows between two charged bodies connected together when they have the same	charge	potential	capacitance	resistance	potential

Dielectric materials are	insulating materials	semiconducting materials	magnetic materials	ferroelectric materials	insulating materials
Dielectric constant of vacuum is	infinity	100	one	zero	one
For making a capacitor it is better to select a dielectic having	low permittivity	high permitivitty	permitivity same as that of air	permitivity slightly more thanair	high permitivitty
A dielectric material must be a	resistor	insulator	good conductor	semi conductor	insulator
Which of the following material has highest value of dielectric constant	glass	vacuum	ceramics	oil	ceramics
When a dielectric slab is introduced in a parallel plate capacitor, the potential difference between the plates will	remain unchanged	decrease	increases	becomes zero	decrease
A capacitor consists of	two insulators seperated by a condenser	two conductors seperated by an insulator	2 insulator	2 conductor	two conductors seperated by an insulator

Unit-II

Which of the following material requires least magnetizing field to magnetize it?	Gold	Silver	Tungsten	Cobalt	Cobalt
Basic source of magnetism _______________	Charged particles alone	Movement of charged particles	Magnetic dipoles	Magnetic domains	Movement of charged particles
Units for magnetic flux density	Wb / m^2	Wb / A.m	A / m	Tesla / m	Wb / m^2
Magnetic permeability has units as	Wb / m^2	Wb / A.m	A / m	Tesla / m	Wb / A.m
Magnetic field strength's units are	Wb / m^2	Wb / A.m	A / m	Tesla / m	A / m
Example for dia-magnetic materials	super conductors	alkali metals	transition metals	Ferrites	super conductors
Example for ferro-magnetic materials	super conductors	alkali metals	transition metals	Ferrites	alkali metals
Example for anti-ferro-magnetic materials	salts of transition elements	rare earth elements	transition metals	Ferrites	rare earth elements
Example for ferri-magnetic materials	salts of transition elements	rare earth elements	transition metals	Ferrites	transition metals
Magnetic susceptibility para-magnetic materials is	0.00001	-10^-5	10^5	10^-5 to 10^-2	0.00001
Magnetic susceptibility dia--magnetic materials is	0.00001	-10^-5	10^5	10^-5 to 10^-2	10^-5 to 10^-2

Magnetic susceptibility ferro-magnetic materials is	0.00001	-10^-5	10^5	10^-5 to 10^-2	10^-5 to 10^-2
Typical size of magnetic domains ______ (mm)	1 to 10	0.1-1	0.05	0.001	0.001
Example for magnetic material used in data storage devices	45 Permalloy	CrO2	Cunife	Alnico	CrO2
Susceptibility of a magnetic material is defined as the ratio of _________ induced in material to magnetic field intensity (H)	Intensity of magnetization	magnetizing field	magntic induction	Conductivity	Intensity of magnetization
Those substances which are weakly magnetized in the direction opposite to that of the external magnetic field are called as ___________	ferromagnetic substances	diamagnetic	paramagnet	anti ferro	diamagnetic
The magnetic field that exists in vacuum and induces magnetism is called _____________	magnetic intensity	magnetizing field	magnetic field intensity	magnetization	magnetizing field
The temperature at which the domain structure gets destroyed and ferromagnetic substance is converted into paramagnetic substance is called as ___________	zeropoint temp.	high temperature	curie temperature	domain thoery	curie temperature
The ability of magnetizing field to magnetize a material medium is called ____________	magnetic intensity	magnetic field	magnetic field intensity	magnetization	magnetic field intensity
Relative Magnetic Permeability (μr) = ____________	1+χ	1/χ	1+χ	1+H	1+χ
Those substances which are strongly magnetized in the direction of the external magnetic field are called as ________	paramagnet	anti ferro	diamagnetic	ferromagnetic substances	ferromagnetic substances
Magnetic fields do no interact with ____________.	Moving permanent magnets	Stationary permanent magnets	Moving electric charges	Stationary electric charges	Stationary electric charges
The magnetic permeability of a material is defined as ratio of magnetic induction (B) to ______	susceptibility	magnetic intensity	magnetic field intensity	magnetic field	magnetic intensity
Above Curie temperature, Ferromagnetic substances become _________	magnet	anti ferro	diamagnetic	paramgnetic	paramgnetic
________ is defined as pole strength per unit area of cross section of material	susceptibility	magnetizing field	magnetic field intensity	intensity of magnetization	intensity of magnetization
The Curie Temperature (°K) for Nickel is _________ °K	136	316	613	631	631
The degree or extent to which magnetic field can penetrate or permeate a material is called ___________	magnetic permeability	susceptibility	magntic induction	intensity	magnetic permeability
Total number of magnetic lines of force crossing per unit area normally through a material is called ________	magnetic permeability	susceptibility	magntic induction	intensity	magntic induction
The magnetic energy stored in an inductor is ______ current	Directly proportional to	Inversely proportional to	Directly proportional to the square of	Inversely proportional to the square of	Directly proportional to the square of
The ratio of the permeability of material to the permiabiity of air or vacuum.	Relative permeability	Relative permittivity	Relative conductivity	Relative reluctivity	Relative permeability
The property of magnetic materials of retaining magnetism after withdrawal of the magnetizing force is known as	Retentivity	Reluctivity	Resistivity	Conductivity	Retentivity

The force between two magnetic poles varies with the distance between them. The variation is ______ to the square of that distance.	Equal	Greater than	Directly proportional	Inversely proportional	Inversely proportional
Permeability means	The conductivity of the material for magnetic lines of force	The magnetization test in the material after	the strength of an electromagnet	The strength of the permanent magnet	The conductivity of the material for magnetic lines of force
The magnetic field inside a solenoid	is constant	is uniform	increases with distance from the axis	decreases with distance from the axis	is uniform
Paramagnetic substance has a relative permeability of	Slightly less than one	Equal to one	Slightly greater than one	Very much greater than one	Slightly greater than one
For which of the following substance, the magnetic susceptibility is independent of temperature____	Dia	Para	Ferro	ferri	Dia
Electromagnets are made of soft iron because soft iron has___	high susceptibility and low retentivity	high susceptibility and high retentivity	low susceptibility and low retentivity	low susceptibility and high retentivity	high susceptibility and low retentivity
Magnetic field is always _____________.	solenoidal	Irrotational	harmonic in character	rotational	solenoidal
Magnetic flux has the dimension ___________.	$ML^2T^{-2}I^{-1}$	$MLT^{-2}I^{-1}$	ML^2TI^{-1}	$ML^2T^{-2}I$	$ML^2T^{-2}I^{-1}$
The permeability of free space is _________ WbA-1m-1.	$\mu_0=4\pi$	$\mu_0=4\pi$x107	$\mu_0=4\pi x10^{-7}$	$\mu_0=4\pi$x10 -8	$\mu_0=4\pi x10^{-7}$
The intrinsic magnetic moment of the atoms of a material is not zero.The material _______________.	must be paramagnetic	must be diamagnetic	must be ferromagnetic	may be paramagnetic or ferromagnetic	may be paramagnetic or ferromagnetic
The relative permeability of a material is 0.98.The material must be ________________.	paramagnetic	diamagnetic	ferromagnetic	ferrimagnetic	diamagnetic
Hysteresis refers to the ______ between flux density of the material and the magnetizing force applied.	Leading effect	Ratio	Equality	Lagging effect	Lagging effect
Hydrogen is an example of a _____ material.	Paramagnetic	Diamagnetic	Ferromagnetic	Non- magnetic	Paramagnetic
Cobalt is an example of a ______ material	Paramagnetic	Diamagnetic	Ferromagnetic	Non- magnetic	Ferromagnetic
Magnetic intensity is a	Phasor quantity	Physical quantity	Scalar quantity	Vector quantity	Vector quantity
The core of a magnetic equipment uses a magnetic material with	Least permeability	Low permeability	Moderate permeability	High permeability	High permeability
Which of the following is a paramagnetic material?	Carbon	Copper	Bismuth	Oxygen	Oxygen
._______ crystals are frequently used in computers memory cells.	Ferroelectric	Diamagnetic	Paramagnetic	Ferrielectric	Ferroelectric
Platinum exhibits the property of __________.	diamagnet	ferromagnet	paramagnet	none	paramagnet
Diamagnetic substance are attracted by magnetic field.The attraction is _________.	very strong	weak	zero	negative	weak

A moving charge produces __________.	electric field only	magnetic field only	both electric and magnetic fields	neither electric nor magnetic	both electric and magnetic fields
Differential form of Ampere's law for a steady current is _________.	$\Delta xH=J+\partial D/\partial t$	$\Delta xB=\mu_0 J$	$\Delta.B=0$	$\int B.dl= \mu 0I$	$\Delta xB=\mu_0 J$
The phenomenon by which a magnetic substance becomes a magnet when it is place near a magnet	Magnetic effect	Magnetic phenomenon	Magnetic induction	Electromagnetic induction	Electromagnetic induction
Which of the following materials has permeability slightly less than that of free space?	Paramagnetic	Non- magnetic	Ferromagnetic	Diamagnetic	Diamagnetic
The property of a material which opposes the creation of magnetic flux in it	Resistance	Reluctance	Permeance	Conductance	Reluctance
The susceptibility of a paramagnetic gas varies ________ as the absolute temperature.	directly	inversely	Similarily	opposite	inversely
If the relative permeability is less than 1,then the material will be_______________.	dia	para	ferro	ferri	dia
If the relative permeability is greater than 1,then the material will be_______________.	dia	para	ferro	ferri	para
If the relative permeability is very much greater than 1,then the material will be_______________.	dia	para	ferro	ferri	ferro
Lenz's law is a consequence of the law of conservation of	energy	momentum	mass	charge	energy
Lenz's law does not violate the principle of	conservation of charge	conservation of energy	conservation of mass conservation of momentum		conservation of energy
The direction of the induced emf during electromagnetic induction is determined by	Lenz's law	Amperes law	Maxwell law	Faaradays law	Lenz's law
Alternative current generator is basically based upon	amperes law	Lenz's law	faradays law	coulombs law	faradays law
Moving a coil in and out of magnetic field induces	force	potential difference	emf	voltage	emf
Which two values are plotted on a B-H curve graph?	reluctance and flux density	permeability and reluctance	magnetizing force and permeability	flux density and magnetizing force	flux density and magnetizing force
Faraday's law states that the:	direction of the induced voltage produces an opposition	emf is related to the direction of the current	emf depends on the rate of cutting flux	direction of an induced current produces an aiding effect	emf depends on the rate of cutting flux
What does Faraday's law concern?	a magnetic field in a coil	a magnetic field cutting a conductor	a magnetic field in a conductor	a magnetic field hystersis	a magnetic field cutting a conductor
What is hysteresis?	lead between voltage and current	lag between cause and effect	lag between voltage and current	lead between cause and effect	lag between cause and effect
What type of device consists of a coil with a moveable iron core?	solenoid	armature	read switch	relay	solenoid

UNIT - III

Einstein's theory of photoelectric effect is based on	Newtons corpuscular theory of light	Huygen's wave theory of light	Maxwell's electromagnetic theory of light	Planck's quantum theory of light	Planck's quantum theory of light
The equation E= hν was deduced by:	Heisenberg	de Broglie	Einstein	Planck	Einstein
De Broglie wavelength (λ) associated with moving particles, mass, m, and velocity v is	h/mv	h/√2mEk	h/√2mqV	h/√2mkT	h/mv
Based on quantum theory of light, the bundles of energy =	hν	hλ	h/ν	h/λ	hν
De Broglie wavelength (λ) associated with moving particles of K.E is	h/mv	h/√2mEk	h/√2mqV	h/√2mkT	h/mv
Wave nature is not observed in daily life because we are using ___________.	Microscopic particles	macroscopic particles	molecules	atoms	macroscopic particles
_______ year de Broglie proposed that the idea of dual nature.	1921	1922	1923	1925	1923
de Broglie wavelength (λ) associated with charge q and potential difference of V volts is	h/mv	h/√2mEk	h/√2mqV	h/√2mkT	h/mv
The photoelectric effect was explained by Albert Einstein by assuming that:	light is a wave.	light is a particle.	an electron behaves as a wave.	an electron behaves as a particle.	light is a particle
The Compton Effect supports which of the following theories?	Special Theory of Relativity.	Light is a wave.	Thomson model of the atom.	Light is a particle.	Light is a particle.
Which one of the following objects, moving at the same speed, has the greatest de Broglie wavelength?	Neutron	Electron	Tennis ball	Bowling ball	electron
Which of the following formulas can be used to determine the de Broglie wavelength?	λ = hmv	λ = h/mv	λ = mv/h	λ = hm/c	λ = h/mv
The idea of dual nature of light was proposed by	Plank	De Broglie	Einstein	Maxwell	De Broglie
According to the de Broglie's hypothesis of matter waves, the concepts of energy, momentum and wavelength are applicable to	moving particles but not to radiation (photon)	moving particles as well as to radiation (photon)	radiation (photon) but not to moving particles	neither to moving particles nor to radiation (photon).	moving particles as well as to radiation (photon)
Experimental verification of de Broglie's matter waves was obtained in	Einstein‟s Photoelectric experiment	Davisson and Germer Experiment	Compton‟s Experiment	Plank	Davisson and Germer Experiment
The first experimental evidence for matter waves was given by _______	Einstein	de Broglie	Plancks	Davisson and Germer	Davisson and Germer
The de Broglie wavelength wave length of a moving electron subjected to a potential V is	1.26/V1/2	12.26/V1/2	12.26/V	2.26/V1/2	12.26/V1/2
Compute the de Broglie wavelength of an electron that has been accelerated through a potential difference of 9.0 kV. Ignore relativists effects.	1.3 x 10-11 m	1.7 x 10^{-22} m	1.2 x 10^{-26} m	1.7 x 10 3 m	1.7 x 10^{-22} m
Heisenberg’s uncertainty principle states for the energy and time is	ΔEΔt = h	ΔEΔt = h/2π	ΔEΔt = 2πh	ΔEΔt = 2 π /h	ΔEΔt = h/2π
In which of the following is the radius of the first orbit minimum?	hydrogen atom	A tritium atom	Triply ionized beryllium	Doubly ionized helium	hydrogen atom
The Kinetic energy of electron of mass (m) is given by (T)	p/2m	p^2/2m	2mp	2mp^2	p^2/2m
Heisenberg’s uncertainty principle states for the angular momentum and angle is	ΔJΔɵ = h	ΔJΔɵ = h/2π	ΔJΔɵ = 2πh	ΔJΔɵ = 2 π /h	ΔJΔɵ = h/2π
The radius of the nucleus of any atom is of the order of ____ m	10-8 m	10 -14 cm	10-14m	10-10 m	10-14m
Heisenberg’s uncertainty principle states for the position and momentum is	ΔpΔq = h	ΔpΔq = h/2π	ΔpΔq = 2πh	ΔpΔq = 2 π /h	ΔpΔq = h/2π
The uncertainty in the total energy (ΔE) is	ΔT + ΔV	ΔT - ΔV	ΔT	ΔV	ΔT + ΔV
Based on the uncertainty principle, the minimum momentum (Pmin) =	h/I	ħ	ħl	l/ ħ	ħ
Who proposed the uncertainty principle?	Bohr	De Broglie	Heisenberg	Schroedinger	Heisenberg
The kinetic energy of electron in the atoms is	4 Mev	6 Mev	8 MeV	97 Mev	97 Mev
According to Heisenberg‟s Uncertainty principle, Indeterminism in the measurement of canonically conjugate variables is due to	imperfection in measuring instruments	imperfection in measurement methods	the interminisim inherent in the auantum world itself		imperfection in measuring instruments
The value of ħ is	6.625 x 10^{-34} nm	5 x 10^{-34} nm	1.055 x 10^{34}nm	1.0555 x 10^{-34} nm	1.055 x 10^{34}nm
The mass of an electron is	9 x 10^{-34} nm	9x 10^{-31} m	6 x 10^{-34} nm	6.625 x 10^{-30} nm	9x 10^{-31} m
If we measure the position of a particle accurately then the uncertainty in measurement of momentum at the same instant becomes	0	Infinity	1	constant	Infinity
If we measure the energy of a particle accurately then the uncertainty in measurement of the time becomes	0	Infinity	1	constant	Infinity
Uncertainty principle is applicable to	macroscopic particles	microscopic particles	gases	liquids	microscopic particles
Uncertainty principle can be easily understandable with help of	Dalton's effect	Compton's effect	electron effect	photoelectric effect	Compton's effect
Heisenberg gave his concept in	1923	1927	1957	1933	1927

Heisenberg uncertainty principle is used for	data processing	information processing	data processinerosion	dilation	information processing
The Heisenberg uncertainty principle is concerned with what two properties?	mass and velocity	momentum and position	position and velocity	momentum and mass	momentum and position
Energy of photon is directly related to the	wavelength	wave number	frequency	amplitude	frequency
____ forms of Schroedinger's equation describe the motion of non-relativistic material particle.	$H\psi = E\psi$	$H\psi \neq E\psi$	$H\psi < E\psi$	$H\psi > E\psi$	$H\psi = E\psi$
If ψ_1 and ψ_2 are two different wave functions, both being satisfactory solution of wave equation for a given system, then these functions will be normalized, if	$\psi_j{}^*\psi_j d\tau = 1$	$\psi_j{}^*\psi_j d\tau \neq 1$	$\psi_j{}^*\psi_j d\tau > 1$	$\psi_j{}^*\psi_j d\tau < 1$	$\psi_j{}^*\psi_j d\tau = 1$
Schrodinger suggested seeking solutions of the waves equation which represents ___ waves.	non-progressive	progressive	non-standing	standing	standing
Momentum operator in Schroedinger equation (Pop) is	$\hbar/i$	$\hbar i$	$i/\hbar$	Ħ	$\hbar/i$
The minimum energy of a particle in a box (E) is	$\hbar^2/ml^2$	$\hbar^2/2ml^2$	$ml^2/\hbar^2$	$2ml^2/\hbar^2$	$\hbar^2/2ml^2$
The Schroedinger time-dependent wave equation is	$H\psi = E\psi$	$H\psi \neq E\psi$	$H\psi < E\psi$	$H\psi > E\psi$	$H\psi = E\psi$
The time-dependent Schroedinger equation is partial differential equation having ___ variables.	1	2	3	4	3
The Schroedinger equation for a free particle is	$\Delta^2\psi + (2m/\hbar^2)(E)\psi = 0$	$\Delta^2\psi + (2m/\hbar^2)(E)\psi \neq 0$	$\Delta^2\psi + (2m/\hbar^2)(E)\psi < 0$	$\Delta^2\psi + (2m/\hbar^2)(E)\psi > 0$	$\Delta^2\psi + (2m/\hbar^2)(E)\psi = 0$
The time independent form of Eop is	H	V	U	T	H
Wave function Ψ of a particle is	real quantity	a complex quantity	an imaginary quantity	any one of these	real quantity
Wave function is represented by ________	ψ	E	H	W	ψ
Schroedinger attempt the physical interpretation of ψ in terms of _______	volume density	current density	density	charge density	charge density
In wave function, energy per unit volume is equal to ___	A^2	E^2	H2	ψ^2	A^2
Photon density is ____	hν	A^2/h	A^2/ν	$A^2/h\nu$	$A^2/h\nu$
Photon density is proportional to ______	hν	A^2	h	ν	A^2
Particle density is proportional to ______	hν	ψ^2	h	ν	ψ^2
Schrodinger's equation described the	wave function	complement of the wave function	behavior of "matter" waves	motion of light	behavior of "matter" waves
Solutions to Schrodinger's equation are labeled with	psi	phi	mu	pi	psi
The hypothesis that nuclear forces possess an exchange character was put forward by	Pauli	Rutherford	Heisenberg	Max Plank	Heisenberg
Heisenberg force is due to	exchange of spac	exchange of spin	exchange of spac	exchange of mom	exchange of space
UNIT - IV					
The potential involved outside the nucleus is ____	gravitational	electromagnetic	nuclear	Coulombic	Coulombic
The atomic mass is almost equal to _____	the mass of the electron	the mass of the nucleus	the mass of the protons	the mass of the neutrons	the mass of the nucleus
The nuclear radius is proportional to	A^2/3	A	A^1/3	A^2	A^1/3
The nucleon density at the centre of any nucleus is	proportional to A	proportional A^2	proportional Z	almost the same	almost the same
The force which holds the nucleons together in a nucleus is	elelctromagnetic force	gravitational force	strong nuclear force	weak interaction	strong nuclear force
The non-central part of the nuclear force is called	elelctromagnetic force	tensor force	magnetic force	static force	tensor force
Nuclear exchange forces arise due to	exchange of mesons	exchange of charge	exchange moments	exxchange of strangeness	exchange of mesons
Nucleus is	positively charged	negatively charged	neutral	charge keeps on changing	positively charged
Proton has the charge	1637 times of an electron	1737 times of an electron	1837 times of an electron	1937 times of an electron	1837 times of an electron
Neutrons has the charge	1639 times of an electron	1739 times of an electron	1839 times of an electron	1939 times of an electron	1839 times of an electron
The difference between the total mass of the individual nucleons and the mass of the nucleus is known as	mass defect	binding energy	packing fraction	mass excess	mass defect
The mass of the nucleus is normally -------- the total mass of the nucleons	greater than	equal to	less than	can be anything	less than
Instrument used to measure nuclear masses and their other properties is called	Mass spectrograph	nuclear spectrometer	NMR spectrometer	magnetic spectrometer	Mass spectrograph
The constant nucleon density inside the nucleus supports	liquid drop model of the nucleus	shell model	collective model	unified model	liquid drop model of the nucleus

The constant binding energy per nucleon supports	shell model	collective model	liquid drop model	unified model	liquid drop model
In the liquid drop model, the restoring force after deformation is supplied by	internal force	gravitational attraction	surface tension	repulsion	surface tension
The surface energy is proportional to ---- where A is the mass number	A	A^1/3	A^2/3	A^2	A^2/3
The liquid drop model could not explain satisfactorily ----	surface vibration of the nuclei	surface energy of the nuclei	all the above	low lying discrete energy levels of nuclei	low lying discrete energy levels of nuclei
According to alpha particle model, a nucleus can be considered as	a sphere of individual nucleons	poly-atomic molecule of alpha particles	alpha and beta particles	poly-atomic molecule of beta particles	poly-atomic molecule of alpha particles
Alpha particle model could not describe the ground and excited states of	nuclei other than even-even nuclides	even-even nuclides	even-odd nuclides	odd-even nuclides	nuclei other than even-even nuclides
It is seen that nuclei with ----- nucleons are most stable, where n=1,2,3,….	2n-1	4n-2	4n	2n	4n
The nuclei with Z = ----- and ------ are found to be more than usually stable	50, 20	50,40	20, 40	30, 40	50, 20
The resemblance of the nucleus with a drop of liquid led to the suggestion of ----- model.	Fermi gas model	collective model	liquid drop model	Shell model	liquid drop model
The nuclear fission can be best explained using	shell model	liquid drop model	Fermi gas model	collective model	liquid drop model
As per liquid drop model, if the energy of the incident neutron is less than the critical energy, ----- takes place.	radiative capture	fusion	gamma ray emission	fission	radiative capture
Which model is the combination of liquid drop and shell model	Collective model	Unified model	optical model	Super-conductivity model	Collective model
Nuclei with N or Z near the end of a shell are found in …………. Distinct groups, known as islands of isomerism	three	two	seven	four	four
Alpha particle is emitted from	outside the nucleus	inside the nucleus	from the external orbits	inside a proton	inside the nucleus
The spin of an alpha particle is	1	1-Feb	3-Feb	0	0
Alpha particle is of ----- parity	no parity	odd	even	odd or even	even
The penetrating power of alpha particle is	large	small	medium	zero	small
There are ---- types of beta emission	2	1	3	4	3
The spin of the beta particle is	1-Feb	3-Feb	1	0	1-Feb
What is the most penetrating radiation?	gamma	alpha	beta	positron	gamma
Which types of radiation is the most dangerous?	gamma	alpha	beta	they are equally dangerous	gamma
A particle striking on the target nucleus, is absorbed by it and a new particl	photo disintegrati	radiative capture	elastic scattering	disintegration	disintegration
Emission of alpha and beta rays is an example of	photo disintegrati	radiative capture	spontaneous deca	spallation reaction	spontaneous decay
The strong nuclear force is	charge dependent	both charge and s	charge indendent	size dependent	charge indendent

UNIT-V

Which number system is not a positional notation system?	ROMAN	Binary	decimal	Hexadecimal	ROMAN
The 10’s complement of the octal number 715 is	63	539	285	395	539
The 9’s complement of 381 is	372	508	618	390	618
The 1’s complement of the binary number 1101101 is	10	100010	10011	1101110	100010
The 2’s complement of the binary number 010111.1100 is	101001.11	101000.01	10111.0011	101000.0011	101000.01
Which system has a base or radix of 10:	Binary digit	Hexadecimal digi	Decimal digit	Octal digit	Decimal digit
In which counting, single digit are used for none and one:	Decimal counting	Octal counting	Hexadecimal cour	Binary counting	Binary counting
In which numeral every position has a value 2 times the value f the positic	Decimal	Octal	Hexadecimal	Binary	Binary
In which digit the value increases in power of two starting with 0 to left of t	Hexadecimal	Decimal	Binary	Octal	Binary
Which system is used in digital computers because all electrical and electro	Hexadecimal num	Binary number	Octal number	Decimal number	Binary number
Which number is formed from a binary number by grouping bits in groups	Binary	Octal	Decimal	Hexadecimal	Hexadecimal
Which number system has a base of 16 :	Binary number sy	Octal number syst	Decimal number s	Hexadecimal num	Hexadecimal num
. Counting in hex, each digit can be increment from__________:	0 to F	0 to G	0 to H	0 to J	0 to F
Which number can be converted into binary numbers by converted each he	Binary number	Decimal number	Octal number	Hexadecimal num	Hexadecimal num
. How many system of arithmetic, which are often used in digital syster	5	6	3	4	4
Which are the system of arithmetic, which are often used in digital system:	Binary digit	Decimal digit	Hexadecimal digi	All of these	All of these
A number system that uses only two digits, 0 and 1 is called the_________	Octal number syst	Binary number sy	Decimal number s	Hexadecimal num	Decimal number s
Which of the following gates is known as coincidence detector?	AND	OR	NOT	NAND	AND
An inverter is also called as	NOT	OR	AND	NAND	NOT
Which gate has two or more input signals in which all input must be high t	OR	NAND	AND	NOR	AND
A NOR gate has a high output only when the input bits are	low	high	some low some hi	None of the above	low
A NOR gate is logically equivalent to an OR gate followed by an	AND	NAND	XOR	INVERTER	INVERTER
Boolean expression for NOR gate with two inputs x and y can be written as	(x+y)’	x . y	x+y	xy’ + x’y	(x+y)’
Boolean expression for NAND gate with two inputs x and y can be written	xy	x+y	x’+y’	None of the above	x+y
NAND gates can be used as which type gates?	NOT	OR	AND	All of the above	All of the above
An OR gate can be imagined as	switches connecte	switches connect	MOS transistors c	None of the above	switches connecte

Which gate is known as Universal gate?	NOT	AND	NAND	OR	NAND
Any Boolean expression can be implemented using	only NOR gates	only NAND gates	only AND gates	only XOR gates	only NAND gates
Which digits are used to represent high & low level in digital circuits?	1 0	0 1	0 0	1 1	1 0
Complement of a Variable is represented by _________ over the Letter.	slash	bar	dot	hyphen	bar
What is the value for 1+1 in Boolean Addition?	2	10	1	0	1
Multiplication in Boolean algebra is the same as the __________ function	AND	OR	NOT	NOR	AND
The operation of an inverter is________	Complement Inpu	add +1 to input va	add –1 to input va	minus input varial	Complement Inpu
___________is same as Inversion.	complementation	exclusive	AND	OR	complementation
The output of an AND gate is 1(High) only when both inputs are ________	1 0	0 0	1 1	0 1	1 1
The output of an OR gate is 1(High) only when any one or more of the inpu	high	low	medium	high	high
NAND is a complement of __________	NOT	AND	OR	NOR	AND
NOR is a complement of __________	NOT	AND	OR	NAND	OR
Commutative Law of Addition of 2 variables is written as	A+B=B+A	B+A=B+A	A+B=A + B	AB=AB	A+B=B+A
Commutative Law of Multiplication of 2 variables is written as	AB=BA	BA=BA	AB=AB	AB=A+B	AB=BA
Associative law of addition is stated as	A + (B + C) = (A	(A + B)+ C = (A+	(A+B) C = A (B+	AB+C = A+BC	A + (B + C) = (A+
Associative law of multiplication is stated as	A (BC)=(AB) C	ABC=ACB	AB = BA	ABC=CAB	A (BC)=(AB) C
Distributive Law is stated as	A (B+C) = AB + .	AB + AC = ABC	AB + C= AC + B	(AB) + C = AB +	A (B+C) = AB +
In Boolean algebra A + 0 =?	A	0	–A	1	A
In Boolean algebra A + 1 =?	A	0	–A	1	1
In Boolean algebra A .0 =?	A	0	–A	1	0
In Boolean algebra A .1 =?	A	0	–A	1	A
In Boolean algebra A +A =?	A	0	–A	1	A
In Boolean algebra A + Ā =?	A	0	–A	1	1
In Boolean algebra A .A =?	A	0	–A	1	A
In Boolean algebra A. Ā =?	A	0	–A	1	0
In Boolean algebra A + AB =?	A	0	–A	1	A
In Boolean algebra A + ĀB =?	A	0	B	A + B	A + B
In Boolean algebra (A +B)(A + C) =?	A	0	B	A +BC	A +BC
The Complement of a Sum =	Sum of the Comp	Product of the Co	Complement of th	Sum	Sum of the Compl
Sum of Product expression is	two or more AND	two or more OR f	two or more AND	two or more OR f	two or more AND
Product of Sum expression is	AND of two or r	OR of two or mo	AND of two or m	OR of two or mo	AND of two or n
Boolean expression can be simplified using	Associative law	rules and laws of	Distributive law	None of the above	rules and laws of I
Sum of products expression is implemented with ________	AND-OR logic	OR-AND logic	NAND logic	NOR logic	AND-OR logic
The output of an exclusive – OR gate is HIGH when inputs have	Same state	Opposite State	Complement State	Alternate State	Opposite State
The output of an exclusive – NOR gate is HIGH when inputs have	Same state	Opposite State	Complement State	Alternate State	Same state
Any Logic Expression can be implemented using	NAND / NOR	AND / OR	X-OR / OR	NAND / AND	NAND / NOR
What are the common internal gate failures?	open input or outp	open input or outp	open input or outp	open input or outp	open input or outp
The interconnecting paths represent a common electrical point is known as	Cell	Node	Point	Junction	Junction
The coincidence circuit is otherwise called as	Exclusive-NOR	Exclusive – OR	Exclusive – AND	Exclusive – NAN	Exclusive – OR
NAND & NOR gates are called as	Universal Gates	Functional gates	Logical Gates	Combinational ga	Universal Gates
Sum of products can be done using	demorgan's theore	algebric theorem	demorgan's postul	algebric postulate	demorgan's theore
Two variables will be represented by	eight minterms	six minterms	five minterms	four minterms	four minterms
The output of AND gates in SOP is connected to	NOT gates	OR gates	AND gates	XOR gates	OR gates
The minterms in a karnaugh map are marked with a	y	x	0	1	1
Small circle in a NAND circuit represents	input	bits	output	complement	complement
Tabulation method is adopted for giving simplified function in	subtraction of sun	sum of products	product of sums	subtraction of pro	product of sums
Each square in a karnaugh map represents a	points	values	minterm	maxterm	minterm
Sum of products can be done using	demorgan's theore	algebric theorem	demorgan's postul	algebric postulate	demorgan's theore