victoria university of Bangladesh

Final-Exam

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Ans to the QUiNO: 1

(1) ⓐ

Gauss Law÷ Gauss's law, either of two statements describing electric and magnetic fluxes. Gauss's law for electricity states that the electric flux ϕ across any closed surface is proportional to the net electric charge q enclosed by the surface; that is, $\phi = q / \epsilon_0$,
where, ϵ_0 is the electric permittivity of free space and has a value of 8.854 $\times 10^{-12}$ square coulombs per newton per square metre. the law implies that isolated electric charges exist and that like charges repel one another while unlike charges attract. Gauss's law for magnetism states that the magnetic flux B across any closed

surface is zero; that is, div $B=0$, where div is the divergence operator. This law is consistent with the observation that isolated magnetic poles (monopoles) do not exist.

Mathematical formulations for these two laws - together with Ampere's law (concerning the magnetic effect of a changing electic field or current) and Faraday's law of induction (concerning the electric effect of a changing magnetic field) - are collected in a set that is known as Maxwell's ~~eqa~~ equations, which provide the foundation of unified electromagnetic theory.

(1) (b)

Gauss's Law :-

Gauss's law is a very important law that describes the properties of electric fields, magnetic fields and gravitational fields. The Gauss's law for electric fields states that the electric flux through any closed surface is proportional to the electric charge enclosed by the surface. It can be expressed as $\phi = Q/\epsilon_0$ where ϕ is the total electric flux over the surface; Q is the charge enclosed by the surface, and ϵ_0 is the dielectric constant. To understand this concept, one must first understand the concept of electric flux. The electric flux over a surface is a measurement of the number of electric field line passing through a surface.

This is directly proportional to the number of electric field lines across the surface. The Gau'ss's law for the magnetic fields is a very important law. The Gauss's law for magnetic fields states that the total magnetic flux over any closed surface is zero. This is because magnetic monopoles do not exist. Magnetic poles only exist as dipoles. In any given closed surface, the net magnetic ~~plo~~ polarity is zero. Therefore, the magnetic flux over any closed surface is zero.

coulomb's Law :-

coulomb's law is a law describing the interactions between electrically charged particles. This states that the force between two electrically charged particle is proportional to the charges and inversely proportional to the square of the distance between the two particles. This can be expressed using the equation $F = Q_1 Q_2 / 4\pi r^2 e_0$ where Q_1 and Q_2 are the charges of the particles, r is the distance between the two charges, and e_0 is the dielectic constant of free space. If this equation is defined for a medium other than free space, e_0 should be replaced with e, where e is the dielectric constant of the medium. If these charges were of the same sign, F would be a positive value.

(1) ©

Dielectric strength is defined as the electrical strength of an insulting material. In a sufficiently strong electric field the insulating properties of an insulator breaks down allowing flow of charge. Dielectric strength is measured as the maximum voltage required to produce a dielectric breakdown through a material. Gauss's law for electricity states that the electric flux ϕ across any closed surface is proportional to the net electric charge q enclosed by the surface; that is, $\phi = q/e_0$. where e_0 is the electric permittivity of free space and has a value of 8.854×10^{-12} square coulombs per newton per square metre.

Dielectric strength = v/m
v is the voltage and, m is the thickness per unit.
The dielectric strength is defined as the maximum voltage that can be applied to an insulating material before it goes into between or losses its insulating properties. Also referred to as relative permittivity of a material, the dielectric constant is the ability of an insulating material to store electrical energy. The purpose of a dielectric strength test is to reach the point of breakdown or failure. This happens when the material experiences a sudden change in its resistance to the test voltage. The level of voltage where the barrier allows current to flow

is the dielectric strength of the material. It's basically the number of field lines that pass through a surface. more field lines means a larger flux. so for example, you could use Gauss's law to figure out the electric field created by a charged conducting sphere. In that case, you have a charge surrounded by a spherical surface. The de Dielectric test sets measure leakage current while applying a dc voltage at or above the insulation system's operating level. This measurement aids in determining the insulation system's ability to with stand over voltages such as lightning strikes and switching surges.

Ans to the QU: No: 2

(2) ⓐ

ohm's Law :

The current that flows through most substances is directly proportional to the voltage V applied to it. The German physicist Georg simon ohm (1787-1854) was the first to demonstrate experimentally that the current in a metal wire is directly proportional to the voltage applied:

$$I \propto V.$$

This important relationship is the basis for ohm's law. It can be viewed as a cause-and-effect relationship, with voltage the cause and current the effect. This is an empirical law, which is to say that it is an experimentally observed phenomenon, like friction. such a linear relationship doesn't always occur.

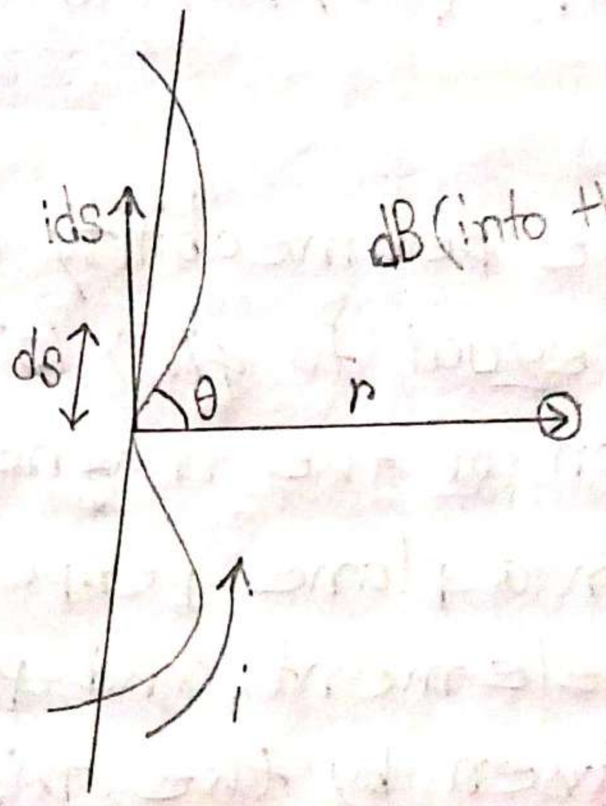
Biot-savart law :-

Biot-savart law is an equation describing the magnetic field generated by a constant electric current. It relates the magnetic field to the magnitude, direction, length, and proximity of the electric current.

The Biot-savart law states how the value of the magnetic field at a specific point in space from one short segment of current-carrying conductor depends on each factor that influences the field.

Biot-savart's law is an equation that gives the magnetic field produced due to a current carrying segment.

This segment is taken as a vector quantity known as the current element :-



consider a current carrying wire 'i' in a specific direction as shown in the above figure. Take a small element of the wire of length ds. The direction of this element is along that of the current so that it forms a vector i ds. To know the magnetic field produced at a point due to this small element, one can apply Biot-savart's Law. Let the position vector of the point in question drawn from the current element be r and the angle between the two be θ. Then,

$$|dB| = (\mu_0/4\pi)(Idl\sin\theta/r^2)$$

where,

μ_0 is the permeability of free space and is equal to $4\pi \times 10^{-7}$ H/m. The direction of the magnetic field is always in a plane perpendicular to the line of element and position vector. It is given by the right-hand thumb rule where the thumb points to the direction of conventional current and the other fingers show the magnetic field's direction.

(2) (b)

Ampere's Law:

The integral around a closed path of the component of the magnetic field tangent to the direction of the path equals μ_0 times the current intercepted by the area within the path

$$\oint \vec{B} \cdot \vec{ds} = \mu_0 I$$

or, in a simplified scalar form

$$\oint B_{\parallel} \cdot ds = \mu_0 I$$

Thus the line integral (circulation) of the magnetic field around some arbitrary closed curve is proportional to the total current enclosed by that curve

Inorder to apply Ampere's Law all currents have to be steady (i.e do not change with time). only currents crossing the area inside the path are taken into account and have some contribution to the magnetic field. currents have to be taken with their algebraic signs (those going "out" of the surface are positive, those going "in" are negative) -use right hand's rule to determine directions and signs. The total magnetic circulation is zero only in the following cases:-

* The enclosed net current is zero.
* The magnetic field is normal to the selected path at any point. the magnetic field is zero.
* Ampere's Law can be useful when calculating magnetic fields of current distributions with a high degree of symmetry.

Faraday's Law :-

The electric fields and magnetic fields considered up to now have been produced by stationary charges and moving charges (currents), respectively. Imposing an electric field on a conductor gives rise to a current which in turn generates a magnetic field. one could then inquire whether or not an electric field could be produced by a magnetic field. In 1831, michael Faraday discovered that, by varying magnetic field with time, an electric field could be generated. The phenomenon is known is known as electromagnetic induction. Faraday showed that no current is registered in the galvanometer when bar magnet is stationary with respect to the loop. However, a current is induced in the loop when a relative motion

exists between the bar magnet and the loop. In particular, the galvanometer deflects in one direction as the magnet approaches the loop, and the opposite, direction as it moves away.
Faraday's experiment demonstrates that an electric current is induced in the loop by changing the magnetic field. The coil behaves as if it were connected to an emf source.
Experimentally it is found that the induced emf depends on the rate of change of magnetic flux through the coil.

Ans to the QUi NO : 3

(3) ⓐ

Quantum theory :

Quantum theory is the theoretical basis of modern physics that explains the nature and behavior of matter and energy on the atomic and subatomic level. The nature and behavior of matter and energy at that level is sometimes referred to as quantum physics and quantum mechanics. organizations in several countries have devoted significant resources to the development of quantum computing, which uses quantum theory to drastically improve computing capabilities beyond what is possible using today's classical computers.

In ~~1900~~ 1900, physicist Max planck presented his quantum theory to the German physical society.

planck had sought to discover the reason that radiation from a glowing body changes in color from red, to orange, and finally, to blue as its temperature rises. He ~~found~~ that by making the assumption that energy existed in individual units in the same way that matter does, rather than just as a constant electromagnetic wave-as had been ~~formerly~~ formerly assumed-and was therefore quantifiable, he could find the answer to his question. The existence of these units become the first assumption of quantum theory. planck wrote a mathematical equation involving a figure to represent these individual units of energy. which he called quanta.

Bohr atomic theory :-

This model was based on the quantum theory of radiation and the classical law of physics. It gave new idea of atomic structure in order to explain the stability of the atom and emission of sharp spectral lines.

postulates of this theory are :-

(i) The atom has a central massive core nucleus where all the protons and neutrons are present. The size of the nucleus is very small.

(ii) The electron in an atom revolves around the nucleus in certain discrete orbits. such orbits are known as stable orbits or non-radiating or stationary orbits.

(iii) The force of attraction between the nucles and the electron is equal to centraifugal force of the moving electron.

Force of attraction towards nucleus = centrifugal force

(iv) An electron can move only in those permissive orbits in which the angular momentum (mvr) of the electron is an integral multiple of h/2π. Thus, mvr $= n\frac{h}{2\pi}$, where, m = mass of the electron, r = radius of the electronic orbit, v = velocity of the electron in its orbit.

(v) The angular momentum can be $\frac{h}{2\pi}, \frac{2h}{2\pi}, \frac{3h}{2\pi}, \ldots\ldots \frac{nh}{2\pi}$. This principal is known is quantization of angular momentum.

(9) (b)

The magnitude E of an electric field depend on the radial distance r according to E=r4A where A is a constant with the unit volt - cubic meter. we can use the equation $E = k|e|r2E = k|e|r2$ to find the magnitude of the electric field. The direction of the electric field is determined by the sign of the charge, which is negative in this case. $E = kQr2$

The Electric field formula that gives its strength on the magnitude of electric field for a charge Q at distance r from the charge is $E = kQr2$, where k is coulombs constant and the units of the electric field are ~~network~~ Newtons/coulomb.

so the electrostatic field at a distance r from a point charge Q is proportional to $1/r^2$. The magnitude of the electric field is simply defined as the force per charge on the test charge. The standard metric units on electric field strength arise from its definition. The electric field between two oppositely charged plates can be calculated : $E = V/d$. Divide the voltage or potential difference between the two plates by the distance between the plates. The SI units are V in volts (v), d in meters (m), and E in v/m. The work done in moving a charge 0.5C through a distance 2m along a direction making an angle 60° with X-axis is 10 J. Then the magnitude of electric field is . ABC is an equailateral triangle.

Ans to the Qu: No: 4

(4) (a)

The electrical potential difference between the two plates is expressed as $V=Ed$, the electric field strength times the distance between the plates. The units in this expression are Newtons/coulomb times meters, which gives the final units Joules/coulomb. Since the voltage and plate separation are given, the electric field strength can be calculated directly from the expression $E=VAB\,d$ $E=VAB\,d$. Once the electric field strength is known, the force on a charge is found using $F=qEF=qE$. The potential difference between points A and B, $\Delta V = V_B - V_A$, defined to be the change in potential energy of a charge q moved from A to B, is equal to the change in potential energy divided by the charge, potential difference is commonly called voltage, represented by the symbol ΔV or often just V. Electric potential difference, also known as voltage, is the external work needed to bring a charge from one location to another location in an electric field. Electric potential difference is the change of potential energy experienced by a test charge that has a value of +1. The equation E=K|Q|/r2 E=K|Q|/r2 says that the electric field gets stronger as we approach the charge that generates it. For example, at 2 cm from the charge Q (r=2 cm), the electric field is four times stronger than at 4 cm from the charge (r=4 cm).