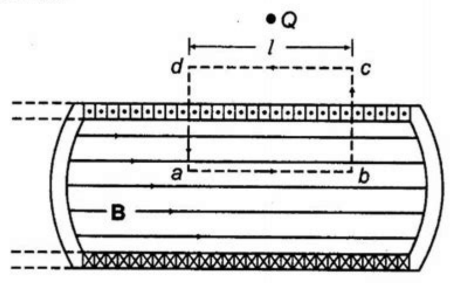
Applications of ampere' s circuital law pdf

Figure shows the longitudinal sectional view of long current carrying solenoid. The current comes out of the plane of paper at points marked.



The **B** is the magnetic field at any point inside the solenoid.

Considering the rectangular closed path *abcda*. Applying Ampere's circuital law over loop *abcda*. **(1)**

$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 \times$ (Total current passing through loop *abcd*)

$$\int_a^b \mathbf{B} \cdot d\mathbf{l} + \int_b^c \mathbf{B} \cdot d\mathbf{l} + \int_c^d \mathbf{B} \cdot d\mathbf{l} + \int_d^a \mathbf{B} \cdot d\mathbf{l} = \mu_0 \left(\frac{N}{L} li\right)$$

where, $\frac{N}{L}$ = number of turns per unit length

$ab = cd = l$ = length of rectangle.

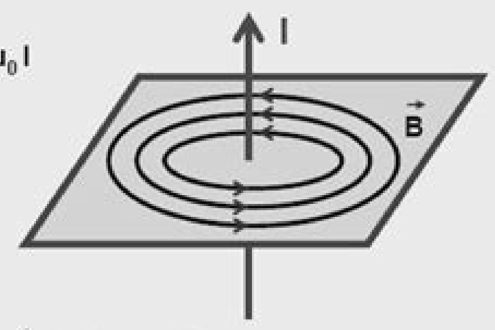
$$\int_a^b Bdl \cos 0° + \int_b^c Bdl \cos 90° + 0 + \int_d^a Bdl \cos 90° = \mu_0 \left(\frac{N}{L}\right) li$$

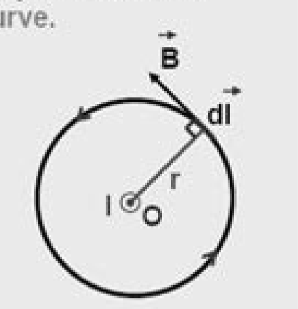
$$B \int_a^b dl = \mu_0 \left(\frac{N}{L}\right) li \Rightarrow Bl = \mu_0 \left(\frac{N}{L}\right) li$$

$$\Rightarrow \quad B = \mu_0 \left(\frac{N}{L}\right) i \quad \text{or} \quad B = \mu_0 ni$$ **(1)**

The line integral $\oint \vec{B} \cdot \vec{dl}$ for a closed curve is equal to μ_0 times the net current **I** threading through the area bounded by the curve.

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





Current is emerging out and the magnetic field is anticlockwise.

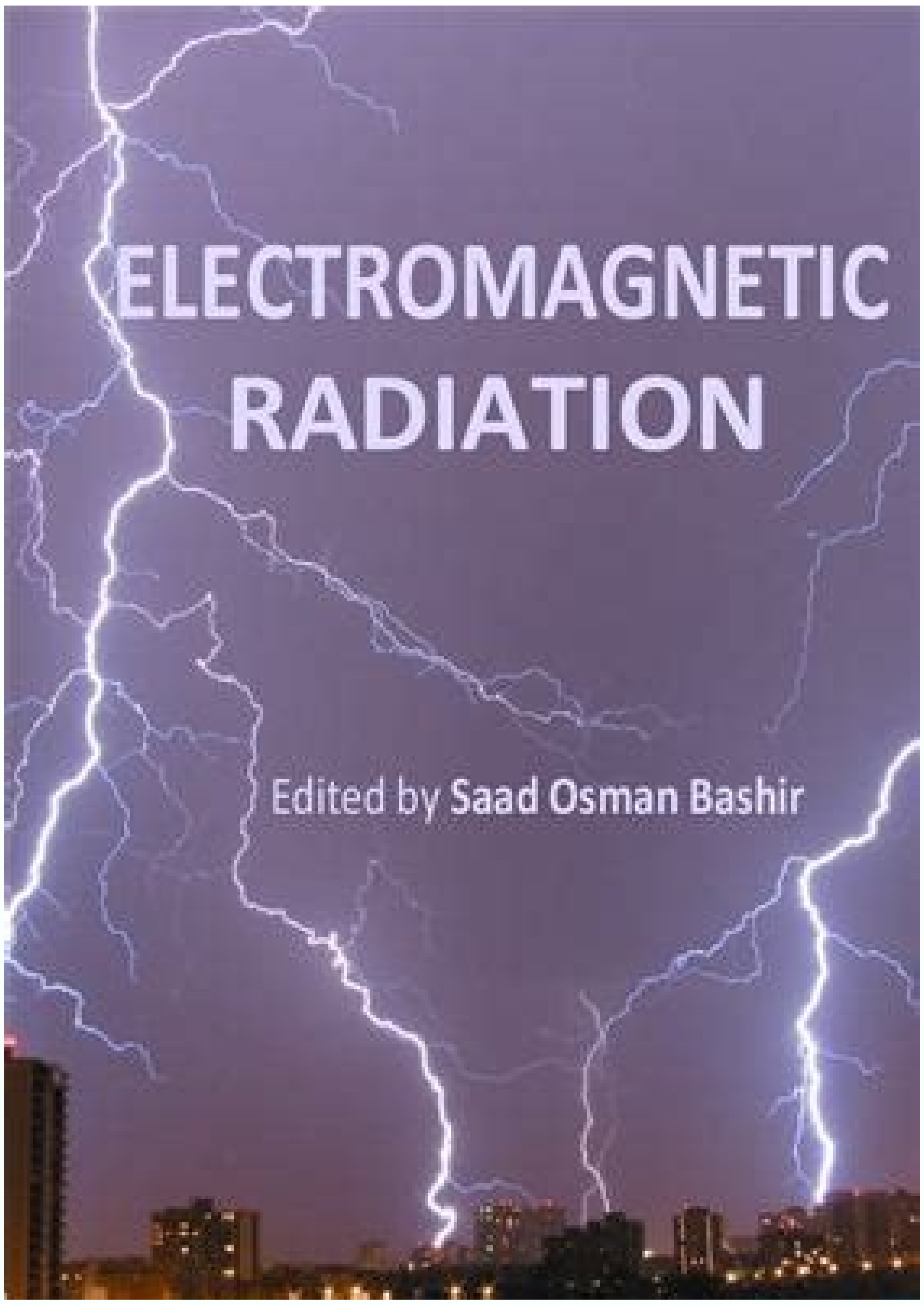
Proof:

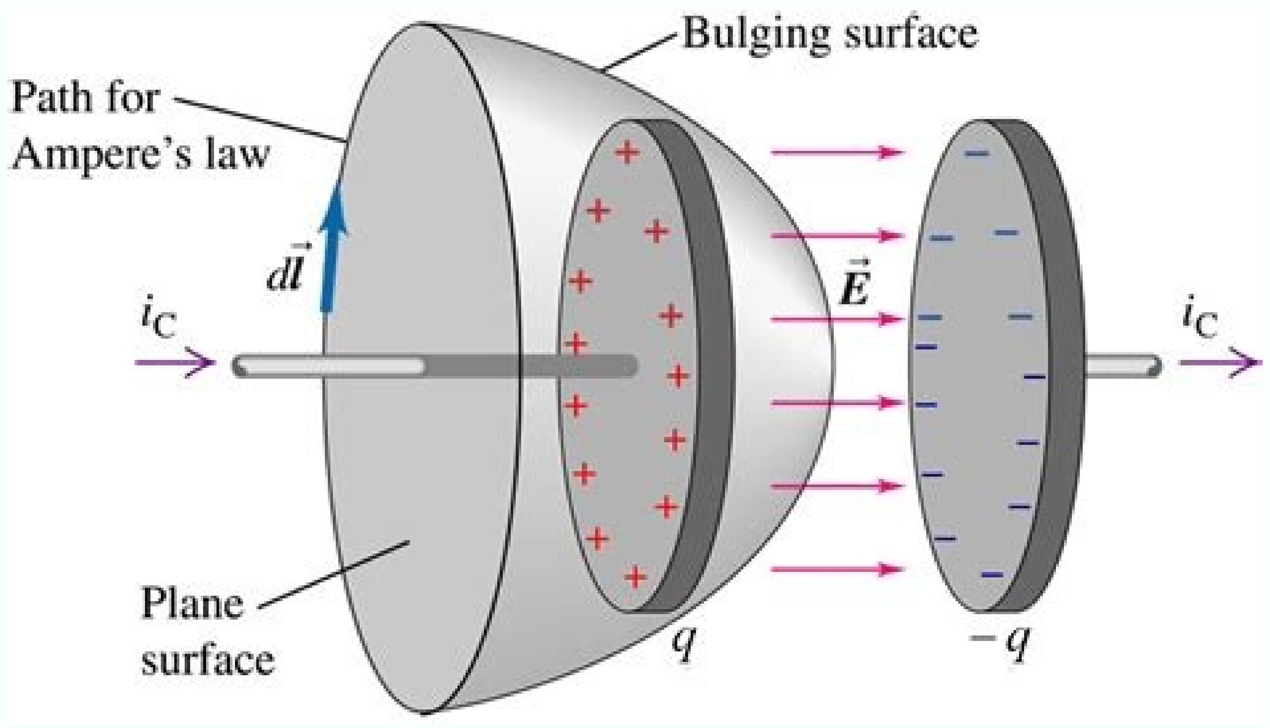
$\oint \vec{B} \cdot \vec{dl} = \oint B \cdot dl \cos 0°$

$= \oint B \cdot dl = B \oint dl$

$= B (2\pi r) = (\mu_0 I / 2\pi r) \times 2\pi r$

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





Applications of ampere's circuital law class 12. Applications of ampere's circuital law. Why we use ampere's law.

The main usage is of course calculating the magnetic field generated by an electric current. Well it's simple. Let's consider a "square" integration path like this one: Image source: Ampere's law gives us: where only the "parallel" to the axis "section" inside of the solenoid gives us a non-zero value! By integrating in a length L (a -> b) the integral gives us L, similar to the previous calculations where we had the circumference of a circle. The magnetic field is constant and equal at all the points, which means that Bds is also constant. The integral form of the law is: And so we calculate a line, closed loop integral of the magnetic field B inside of which a total current Iencl is enclosed. If r > R we are outside of the wire, which means that we get the same results as before for a standard thin wire. The radius is R. This means that Ampere-Maxwell's law is one of the four Maxwell equations! So why do we need this "other" law? The total enclosed current on the other hand is Iencl = nLI that we will explain in later articles, I guess! :) Torodial Solenoid Let's now consider a donut-shaped torodial soleniod with N turns of wire and carrying a current I. For Ampere's law we consider paths of current elements or the magnetic field over an entire path. Let's find the magnetic field at all points. So, think of Ampere's law as the analogous of Gauss's law in Electrostatics! Gauss's law helped us when calculating electric fields, cause it allowed symmetry. Integral(Bdl) = 0 doesn't necessarily mean that the magnetic field B is zero, but only that the current flow is zero! The extended version contains the concept of displacement current that we will cover in the following up articles and makes the equation look far more complicated! Applications Ampere's law has many practical applications. Electric flux is computed over a Gaussian surface. What is the magnetic field now if the total current is I again? By enclosing it in the total circumference from 0 to 2πr the integral gives us 2πr and so we finally have: which is exactly the same that we calculated using Biot-Savart's law! Cylindrical conductor / Thick wire Let's consider the same wire as before, but now with thickness! The outer radius of the wire is R and the current is distributed uniformly along the wire. We again choose a circular Amperian loop of radius r, centered this time at the axis of the wire. The same way Biot-Savart's law can be applied to any configuration of magnetic fields due to current-carrying conductors/wires, but mostly requires a complicated sum of infinitesimal current elements. Note that the choice of the Amperian loop is very important, the same way as Gaussian surfaces where important in Gauss's law! To use this equation you can use any closed path that you want and it's very important that this path is closed! Because we sum/add up we sometimes also write it as an actual sum: From the equations we can see that: Increasing the current flowing through a closed path, increased the total magnetic field By knowing the magnetic field we can add it up around the path and calculate the current flowing through this closed path. Image source: Introduction Hello it's a me again Drifter Programming! Today we continue with Electromagnetism to get into the Ampere's law and Applications of this law! So, without further do, let's get straight into it! Ampere's law In the previous posts we used the Biot-Savart law which is: An alternative expression of the relation between the magnetic field and the current that produces it is Ampere's law, named in honour of Andre-Marie Ampere! The formal definition states that: "the line integral of the magnetic field around an arbitrarily chosen path is proportional to the net electric current enclosed by the path". In calculations that could be done using Biot-Savart's law, Ampere's law simplifies the calculation process by using a certain symmetry. By that I mean why is Biot-Savart's law not enough? Being a loop an Amperian loops needs to be orientated. Let's get into some calculations! Straight wire The magnetic field "circles" around the wire, which means that we choose an circular Amperian loop of radius r centered at the wire (consider that the wire has no thickness). So, let's say that r Coulomb's law, superposition principle, Coulomb constant, how to solve problems, examples Electric fields and field lines -> Electric fields, Solving problems around Electric fields and field lines Electric dipoles -> Electric dipole, torque, potential and field Electric charge and field Exercises -> examples in electric charges and fields Electric flux: Electric flux and Gauss's law -> Electric flux, Gauss's law Applications of Gauss's law (part 1) -> applying Gauss's law, Gauss applications Applications of Gauss's law (part 2) -> more Gauss applications Electric flux exercises -> examples in electric flux and Gauss's law Electric potential: Electric potential energy -> explanation of work-energy, electric potential energy Calculating electric potentials -> more stuff about potential energy, potential, calculating potentials Equipotential surfaces and potential gradient -> Equipotential surface, potential gradient Millikan's Oil Drop Experiment -> Millikan's experiment, electronvolt Cathode ray tubes explained using electric potential -> cathode ray tube explanation Electric potential exercises (part 1) -> applications of potential Electric potential exercises (part 2) -> applications of potential gradient, advanced examples Capacitance: Capacitors (Condensers) and Capacitance -> Capacitors, capacitance, calculating capacitance How to solve problems around Capacitors -> combination, solving problems, simple example Electric field energy and density -> Electric field energy, energy density Dielectric materials -> Dielectrics, dielectric constant, permittivity and strength, how to solve problems Electric capacitance exercises -> examples in capacitance, energy density and dielectrics Current, resistance and EMF: Electric current -> Electric current, current density Electrical resistivity and conductivity -> Electrical resistivity, conductivity, thermal coefficient of resistivity, hyperconductivity Electric resistance -> Resistance, temperature, resistors Electromotive Force (EMF) and Internal resistance -> Electromotive force, internal resistance Power and Wattage of Electronic Circuits -> Power in general, power/wattage of electronic circuits Electric current, resistance and emf exercises -> exampes in all those topics Direct current (DC) circuits: Resistor Combinations -> Resistor combinations, how to solve problems Kirchhoff's laws with applications -> Kirchhoff's laws, how to solve problems, applications Electrical measuring instruments -> what are they?, types list, getting into some of them, an application Electronic circuits with resistors and capacitors (R-C) -> R-C Circuit, charging, time constant, discharging, how to apply RC circuit exercises -> examples in Kirchhoff, charging, discharging capacitor with/without internal resistance Magnetic field and forces: Magnetic fields -> Magnetism, Magnetic field Magnetic field lines and Gauss's law of Magnetism -> magnetic field lines, mono- and dipoles, Flux, Gauss's law of magnetism The motion of charged particles inside of a magnetic field -> straight-line, spiral and helical particle motion Applications of charged particle motion -> CERN, Cyclotrons, Synchrotrons, Cavity Magetron, Mass Spectrometry and Magnetic lens Magnetic force applied on Current-Carrying Conductors -> magnetic force on current-carrying conductors/wires, proofs Magnetic force and torque applied on current loops (circuits) -> magnetic force on current loops, magnetic moment and torque Explaining the Physics behind Electromotors -> tesla, history and explaining the physics behind them Magnetic field exercises -> examples in magnetic force, magnetic flux, particle motion and forces/torque on current-carrying conductors Magnetic field sources: Magnetic field of a moving charged particle -> moving charge, magnetic field, force between parallel charged particles Magnetic field of current-carrying conductors -> magnetic field of current, Biot-Savart law Force between parallel conductors and the magnetic field of a current loop -> force between parallel conductors, magnetic field of current loop And this is actually it for today's post! Next time I'm thinking of getting into Magnetic materials, but we might also get into Displacement current first...Either way after these two posts it's Exercise-Time again! :) Bye! For that we are using the right hand "curl" rule.

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