

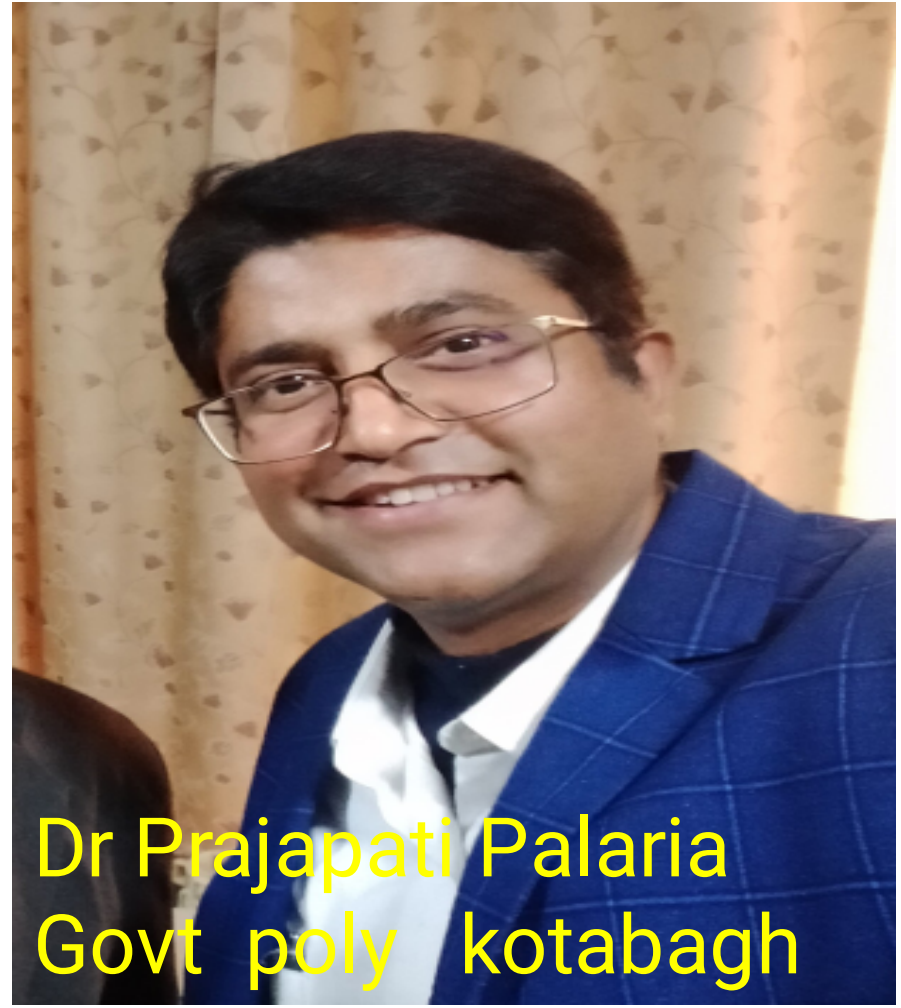
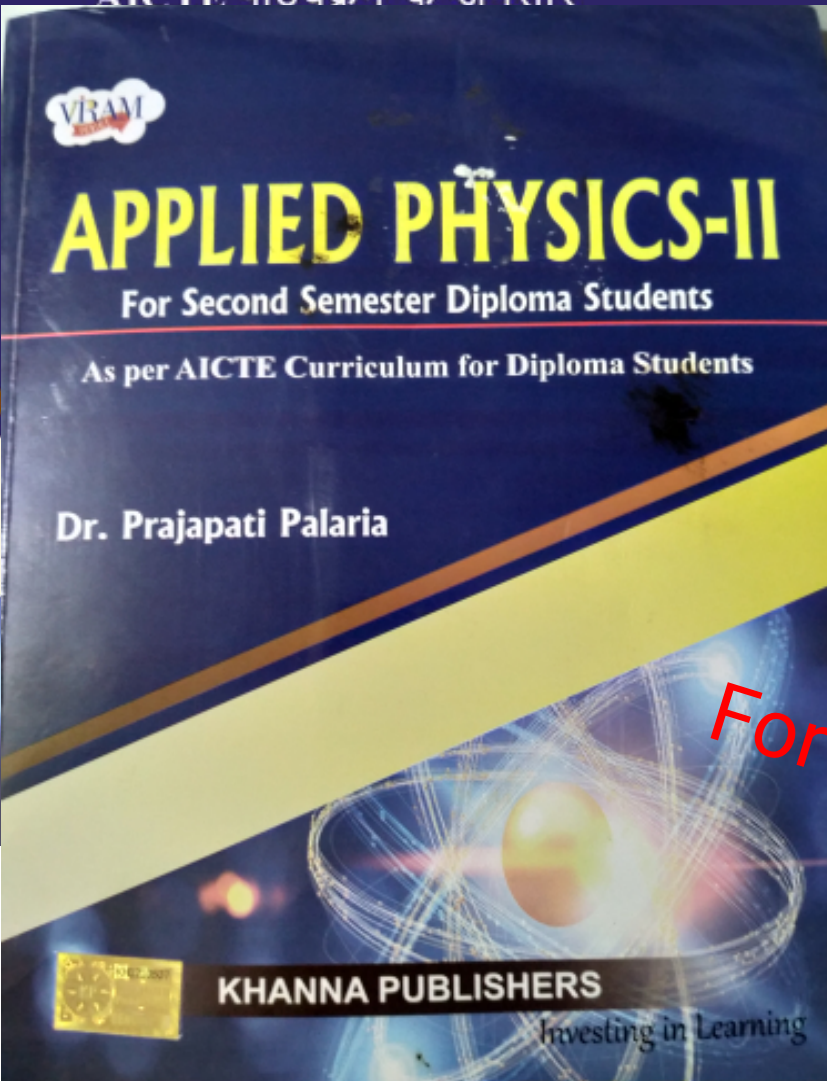


अनुप्रयुक्त भौतिकी-II

Hindi ver. In press

द्वितीय सेमेस्टर डिप्लोमा विद्यार्थियों के लिए

AICTE पाठ्यक्रम के अनुसार



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For polytechnic diploma students



Electromagnetism वैधुत चुम्बकत्व

* Oersted, (1826) discovered that electric current i can produce magnetic field.

* Solenoid is artificial electromagnet. 🖱️

* Region round a magnet where magnetic (चुम्बकीय बल) force occurred called magnetic field.

*. Unit of magnetic field is Tesla T

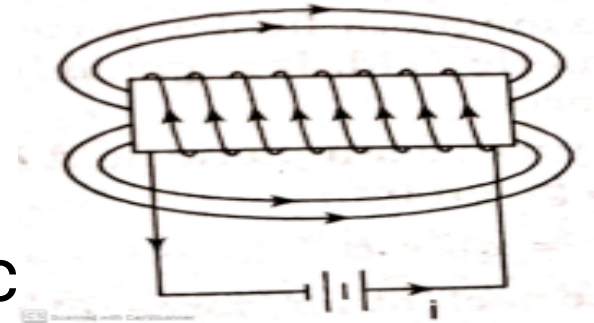
$$1 \text{ T} = 10^4 \text{ gauss}$$

*Magnetic force, $f = qv \times B$

$$F = il \times B$$

Biot savart law:

$$dB = \frac{\mu_0}{4\pi} \frac{i dl \sin \theta}{r^2}$$



Cyclotron , moving charge perpendicular to field is making circluar path

If a charge q enters perpendicularly into a magnetic field B with a velocity v . Then

$$F = qvB$$

Since the force is perpendicular to velocity it changes only the direction of velocity. Thus particle moves in a circular path of radius r and experiences a centripetal force (Fig. 4.5).

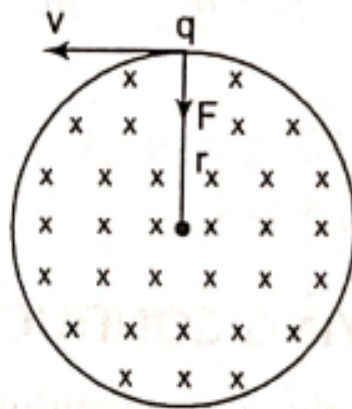


Fig. 4.5

$$F = qvB = \frac{mv^2}{r}$$

where, m is the mass of the particle

Solving

$$r = \frac{mv}{qB}$$



Example. 1. In electron with a speed $5 \times 10^7 \text{ ms}^{-1}$ perpendicular to a magnetic field of intensity $5 \times 10^{-3} \text{ T}$. Calculate the radius of the path of the electrons.

Solution. As electron enters perpendicular to the field so, it will move in the circular path.

then

$$qvB = \frac{mv^2}{r}$$

$$r = \frac{mv}{qB}$$

$$= \frac{9.1 \times 10^{-31} \text{ kg} \times 5 \times 10^7 \text{ ms}^{-1}}{1.6 \times 10^{-19} \text{ C} \times 5 \times 10^{-3} \text{ T}}$$

$$= 5.7 \times 10^{-2} \text{ m}$$



👉 यहां यह भी स्पष्ट है कि कण कि त्रिज्या , r उसके वेग v के समानुपाती है..

Scanned with CamScanner

Example. 3. A short conductor of length 15.0 cm is placed parallel to a long conductor length 1.5 m near its centre. The conductors carry currents 4.0 ampere and 3.0 ampere respectively in the same direction. What is the total force experienced by these conductors when they are 3.0 cm apart?

Solution. Force per unit length,

$$F' = \frac{\mu_0 i_1 i_2}{2\pi r}$$

$$F' = \frac{2 \times 10^{-7} \times 4 \times 3}{0.03} \text{ Nm}^{-1}$$

or, $F' = 8 \times 10^{-5} \text{ Nm}^{-1}$

The effective length of conductors is only 15 cm

Hence force experienced by the both conductors is

$$F = 8 \times 10^{-5} \times 0.15 = 1.2 \times 10^{-5} \text{ N}$$

$$= 1.2 \times 10^{-5} \text{ N, nature is attractive.}$$

Example. 3. The wire shown in the figure carries a current of 60 A. Determine the magnitude of the magnetic field at C. Given, radius $r = 2$ cm.

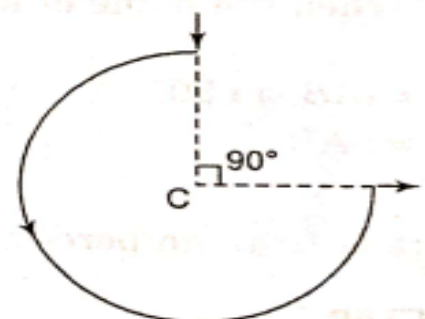


Fig. 4.13



Solution. Magnetic field B at $C = \frac{\mu_0}{4\pi} \frac{i}{r^2} \int dl$

$$B = \frac{\mu_0}{4\pi} \frac{i}{r^2} 2\pi r \cdot \frac{3}{4} \quad \left[\int dl = 2\pi r \cdot \frac{270^\circ}{360^\circ} \right]$$

$$= 3.14 \times 10^{-7} \times \frac{60}{2 \times 10^{-2}} \cdot \frac{3}{2}$$

$$= 1.4 \times 10^{-3} \text{ T}$$

वाल्टमीटर एवं अमीटर

* voltmeter is a device to measure potential difference , वोल्टेज between two points.



* Connect parallel समानांतर to the circuit.

* High resistance

* गैल्वेनोमीटर के श्रेणी series में उच्च high resistane जोड़ने पर उसको वाल्टमीटर में बदला जा सकता है।

Ammeter is a device to measure current in a circuit.

इसको series श्रेणी क्रम में लगाते है।

resistane बहुत कम होता है

गल्वेनोमीटर के समानांतर क्रम में कम मान का low resistance प्रतिरोध लगाने पर वह अमीटर की तरह कार्य कर सकता है।

Force between two Parallel Current

Carrying Conductors दो धारावाही समानांतर तारों के मध्य बल

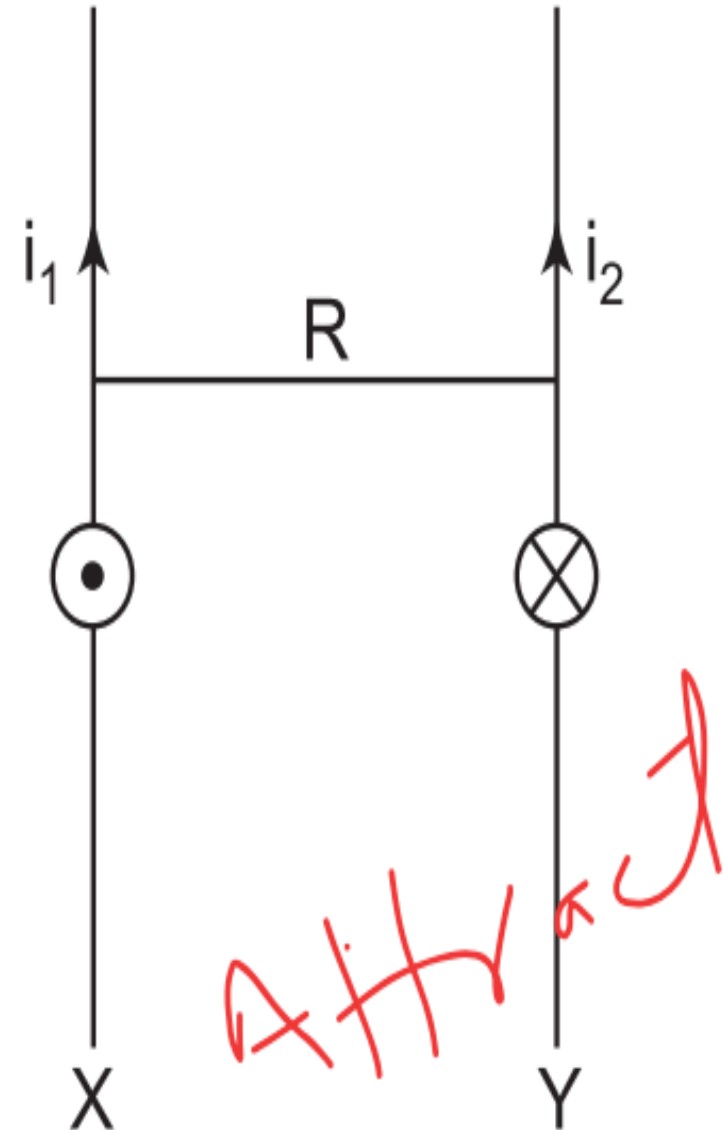


If current is in same direction-
attract each other

If current in opposite - repels

If the currents in both wires is 1
ampere, $R = 1\text{ m}$

Force /unit length = $2 \times 10^{-7}\text{ N/m}$



Faraday law


i. whenever the magnetic flux linked with closed circuit changes an induced emf is set up in the circuit and lasts until changes last.

किसी बंद परिपथ में फ्लक्स परिवर्तन होने पर प्रेरित विद्युत वाहक बल पैदा होता है, जो फ्लक्स परिवर्तन होने तक रहता है।

ii. induced emf is directly proportional to change of flux.
प्रेरित वि वा बल फ्लक्स परिवर्तन की दर के समानुपाती होता है।

in self induction (स्वतः प्रेरण) induction is in the coil.
In mutual induction, induction is induced in another coil.

Loops of electrical currents in a solid body is called eddy current. used in train brakes system.

Electromagnetism is used in - making very high  superconduct electromagnet, cyclotrons, MRI machines, in memory chips, electric generators ;for ac production

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Exercise 4

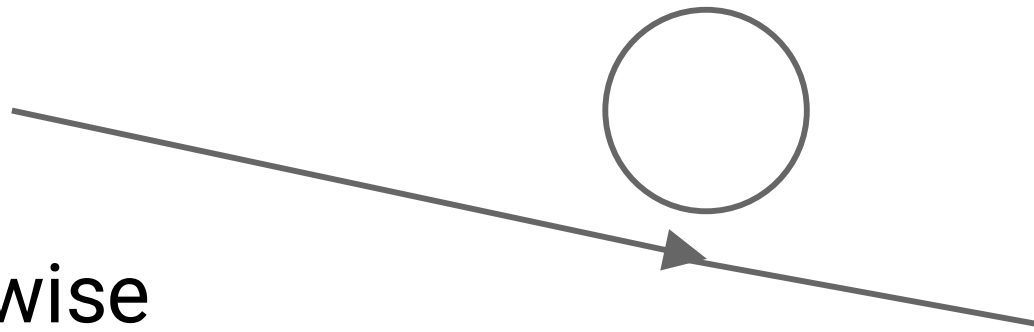
Q. State Biot savart law. Deduce the magnetic field at the center of a coil having radius r and carrying current i .

Q. How a moving coil galvanometer is converted into , i. an Ammeter, ii. a voltmeter

Q. An electron moving at right angles to a uniform field completes a circular orbits in 3.2×10^{-6} s. Find field.

Q. Define one ampere.

Q. The current in the wire is increasing what will be the direction of induced current.



Ans. Clockwise

Q. What are the uses of electromagnetism?

True/ False statements..

* 1 Tesla is equal to 10^4 Gauss. F, 10^7

* Neutron moving in magnetic field experiences a force. F
charge= 0

* A moving proton produces both electric and magnetic field. T

* Value of $\mu_0 / 4\pi = 10^{-7}$ Wb/ A-m. F 10^{-7} Wb/ A-m



* Lenz law is law of conservation of energy. T

* Cyclotron is device to accelerate charge particle. T

* $F = qvB \sin \theta$. Where θ is angle between ___ and ___. v, B

* voltmeter, galvanometer, ammeter में वाल्टमीटर का प्रतिरोध सबसे अधिक होता है। T

* दो (magnetic lines) बल रेखाएं एक दूसरे को intersect काटती नहीं हैं। T



Thanks

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