To Measure the Resistance & Impedance Of An Inductor With Or Without Iron Core

Aim

To measure the resistance and impedance of an inductor with or without iron core.

Apparatus and material

Apparatus. A battery, a high resistance rheostat, D.C. ammeter, D.C. voltmeter, one way key, variable A.C. source (variac), A.C. ammeter, A.C. voltmeter, connecting wires.
Material. A high resistance and large number of turns coil wrapped on a hollow cylindrical asbestos core, a soft iron rod fitting into the asbestos core.

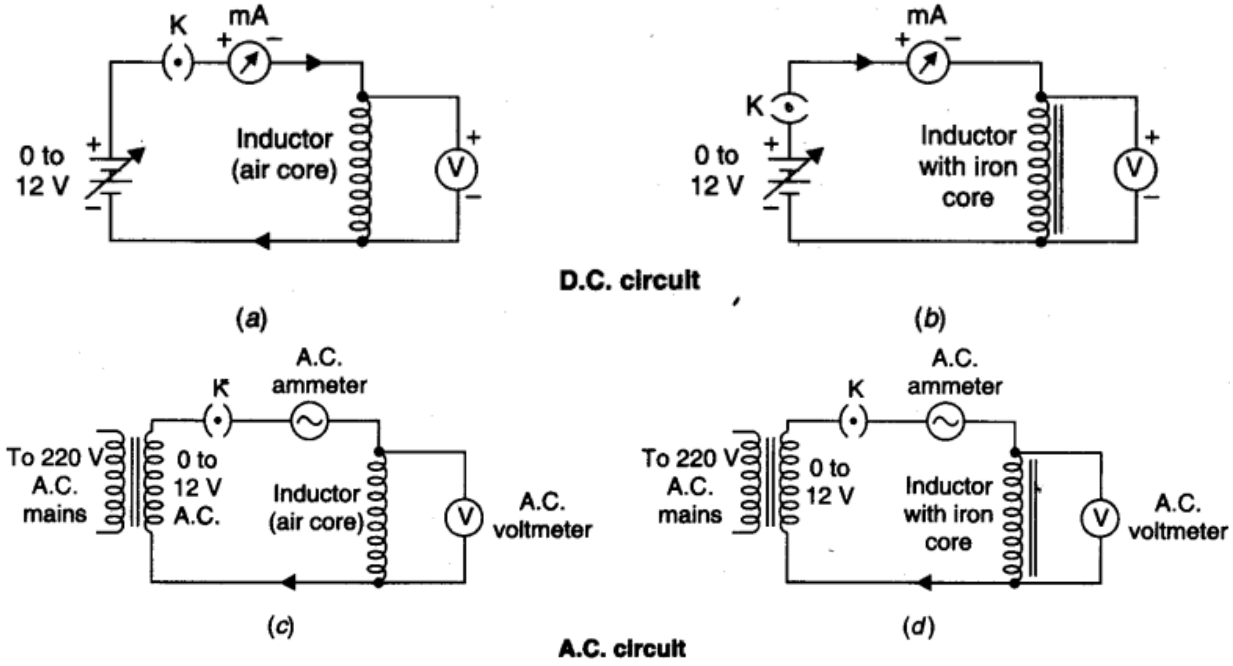
Procedure

Measurement of resistance:
Make circuit as shown in circuit diagram (figure (a) and figure (6)) and determine resistance applying Ohm's law.

Measurement of impedance without iron core:
Make circuit as shown in circuit diagram (figure (c) and figure (d)). The variac (variable output A.C. source) is connected to A.C. Mains, A.C. ammeter and A.C. voltmeter are used for measuring A.C. current and voltage.
The circuit will obey Ohm's law. The ratio of the voltmeter reading to the corresponding ammeter reading will give the impedance of the inductor (without iron core).

Measurement of impedance with iron core:
Now insert the iron core inside the hollow cylindrical asbestos core of the inductor. Repeat the above steps to find the impedance of the inductor with iron core.

Circuit diagram



Observations

Least count of D.C. ammeter = ……..
Least count of A.C. ammeter = ……..
Least count of D.C. voltmeter = ……..
Least count of A.C. voltmeter = ……..
Zero correction for D.C. ammeter = ……..
Zero correction for A.C. ammeter = ……..
Zero correction for D.C. voltmeter = ……..
Zero correction for A.C. voltmeter = ……..

1. Measurement of Resistance

Table for D.C. Ammeter and D.C. Voltmeter Readings

Serial No. of Obs. (1)	*Ammeter Reading I (A)*		*Voltmeter Reading V (V)*		$R = \frac{V}{I}$
	Observed (2a)	*Corrected* (2b)	*Observed* (3a)	*Corrected* (3b)	*(Ohm)* (4)
1– 6					

2. Measurement of Impedance (without iron core)
   Table for A.C. Ammeter and A.C. Voltmeter Readings (Similar to above table—write Z for R).
3. Measurement of Impedance (with iron core)
   Table for A.C. Ammeter and A.C. Voltmeter Readings (Similar to above table)

Conclusion

1. The resistance of inductor coil is about same with and without soft iron core in flow of
   D.C. and is…….. ohm.
2. Impedance of inductor with iron core is much more higher than without it for the flow
   of A.C. and are : …… Ω and……. Ω.

Explanation

The inductor having inductance L without iron core has inductance μL with iron core, (μ being magnetic (reactive permeability of iron which is about 1700).

The impedance, $Z = \sqrt{R^2 + (\omega L)^2}$ without iron core becomes $Z' = \sqrt{R^2 + (\mu\omega L)^2}$

For negligible resistance R, $Z' = \mu Z$.