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Article on **Inductor Design**

Vaibhav Saini, *Student,* IIT(BHU), Varanasi

***Abstract***

**We have worked on,**

* **What is an inductor?**
* **Brief History**
* **How are inductors used in practical life**
* **Advantages of using inductors**
* **Steps to design an inductor**
* **A program to determine physical properties of a given inductor, by knowing just the Inductance and current values.**

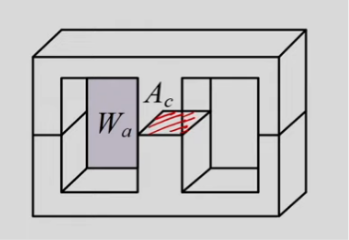
# I. INTRODUCTION

* **An inductor, also called a coil, choke, or reactor, is a passive two-terminal electrical component that stores energy in a magnetic field when electric current flows through it. An inductor typically consists of an insulated wire wound into a coil.**
* ***Faraday* invented the inductor while discovering the phenomenon of electromagnetic-induction nearly two hundred years ago, which subsequently proved crucial for practical large-scale use of electricity for power and telegraph communication.**
* **An electric current flowing through a conductor generates a magnetic field surrounding it. The magnetic flux linkage generated by a given current depends on the geometric shape of the circuit. Their ratio defines the inductance L.**

**A picture containing shape

Description automatically generated**

**The Core of Inductor is generally made up of materials like silicon steel, iron powder and ferrites. It is wound by a wire with several turns. A sketch of inductor is depicted below:-**

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**Uses in practical life**

* **Inductors are used for tuning circuits.**
* **Used as sensors.**
* **Used as energy storage devices, it stores energy in the form of magnetic field.**
* **Used as induction motors.**
* **Combination of inductors is used as transformer.**
* **Inductors are used as filters as well.**
* **They are used in chokes and as ferrite beads as well.**

# II. Math

Our main two objectives are-To design an inductor and to use the program to get appropriate values of the inductor’s physical properties.

## A. Equations

Various equations are used in designing of an inductor. They are listed below accordingly.

* Energy(stored in air gap):- E=[L(Imax)2**]/**2.
* Estimate Area Product(Ap)=AWA.c=2E/(KW\*J\*Bm)

Generally, KW=0.6

* Permeance(λ)=
* Otherwise, λ is calculated using AL factor written on core as: L=λ\*N^2 , λ=L/(N^2)

The terminologies used are explained below

Window Area(AW or Wa): It is the area of window or the hollow section of the core with

coil wire crossing through it

Cross Sectional Area Of Core(Ac): Cross section area of core as given in the

figure.

Area Product (Ap) : It is defined as the product of window area(Aw) and Cross section area of core(Ac).

Current Density(J)

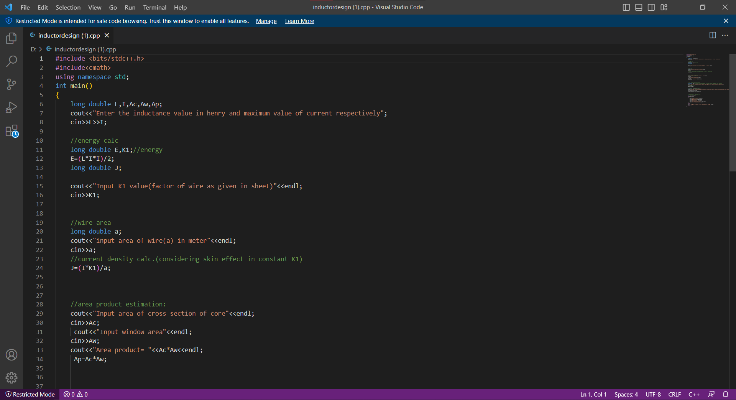
Maximum Flux Density (Bm)

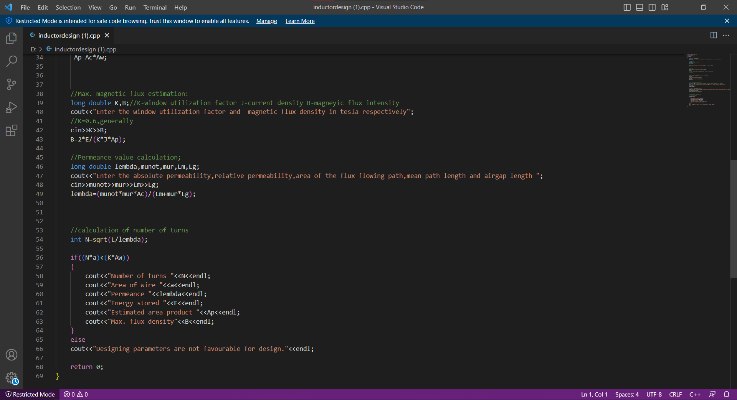
Cross Section Area of Wire(Aw)

Window Utilization Factor (Kw): Its value generally depends upon the fraction of window area occupied by wire of cross section area (Aw).

## B. Algorithms

Screenshots of the code written, which determines the physical properties of the inductor by feeding current and inductance values.





The code is written on the next page.

# III. Conclusion

I have done research in this field and have come to know a lot about inductors and how they are designed in Electrical Engineering. It is of great help to us as Inductors play a big part in our upcoming and ongoing courses.

# IEEE Guidelines and Policies

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# Acknowledgment

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# References

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#include <bits/stdc++.h>

#include<cmath>

using namespace std;

int main()

{

long double L,I,Ac,Aw,Ap;

cout<<"Enter the inductance value in henry and maximum value of current respectively";

cin>>L>>I;

//energy calc

long double E,K1;//energy

E=(L\*I\*I)/2;

long double J;

cout<<"Input K1 value(factor of wire as given in sheet)"<<endl;

cin>>K1;

//wire area

long double a;

cout<<"input area of wire(a) in meter"<<endl;

cin>>a;

//current density calc.(considering skin effect in constant K1)

J=(I\*K1)/a;

//area product estimation:

cout<<"Input area of cross section of core"<<endl;

cin>>Ac;

cout<<"Input window area"<<endl;

cin>>Aw;

cout<<"Area product= "<<Ac\*Aw<<endl;

Ap=Ac\*Aw;

//Max. magnetic flux estimation:

long double K,B;//K-window utilization factor J-current density B-magneyic flux intensity

cout<<"Enter the window utilization factor and magnetic flux density in tesla respectively";

//K=0.6,generally

cin>>K>>B;

B=2\*E/(K\*J\*Ap);

//Permeance value calculation;

long double lembda,munot,mur,Lm,Lg;

cout<<"Enter the absolute permeability,relative permeability,area of the flux flowing path,mean path length and airgap length ";

cin>>munot>>mur>>Lm>>Lg;

lembda=(munot\*mur\*Ac)/(Lm+mur\*Lg);

//calculation of number of turns

int N=sqrt(L/lembda);

if((N\*a)<(K\*Aw))

{

cout<<"Number of turns "<<N<<endl;

cout<<"Area of wire "<<a<<endl;

cout<<"Permeance "<<lembda<<endl;

cout<<"Energy stored "<<E<<endl;

cout<<"Estimated area product "<<Ap<<endl;

cout<<"Max. flux density"<<B<<endl;

}

else

cout<<"Designing parameters are not favourable for design."<<endl;

return 0;

}

1. Vaibhav Saini is with the Indian Institute of Technology,(BHU),Varanasi (e-mail: vaibhav.saini.eee21@iitbhu.ac.in). [↑](#footnote-ref-0)