**2.3 THE PHYSICS MODELS**

NOTE: The real models have been calculated for before but other parameters needed to be estimated.

Voltage, is a widely known phenomenon, was give to ohm’s mathematically as:

(2.1)

(2.2)

Where I is the current and R is the resistance of the material (Theraja,2005).

Electromotive force E.m.f which is the workdone for a current moving from on terminal to the other, described mathematically as;

(2.3)

(2.4)

(2.5)

Where r is the internal resistance of the material and other have their usual meaning (Mike,2006).

The Resistance of a material is inversely proportional to the cross area of a material, (Mike,2006) express as;

(2.6)

(2.7)

Where l is the length of the material, is the Resistivity of the material and A is the cross sectional area, .

Electric heat generation in conducting material is expressed as

(2.8)

(2.9)

(2.10)

(2.11)

Where J is the current density, t is the time taken and V,I are the voltage and current in the conducting medium. It is measured in Joules.(Thereaja,2005).

Likewise, the magnetic flux density experience by a conductor (Jenkins and Jarvis, 1973) is computed as

Where F is the force field, I is the current flowing through and l is the length of the conductor. It has a unit of .

The resistance of a material at certain temperature is given as

(2.12)

(2.13)

(2.14)

Where is the initial resistance of the material, is a constant defined as 0.0042/ and and are initial and final temperature respectively. It is measured in Ω (john,2003).

However, the heat generated by the resistor component in an electrical device can be calculated using

(2.15)

(2.16)

(2.17)

Where I and R are the current and resistance and t is the time taken respectively.

Nevertheless, the energy stored in a magnetic field coil (Bernard, 1994) is given as;

(2.18)

(2.19)

Where L is the inductance of the field and I is the current flowing through the field.

The electric flux density (John,2003) is also given as

(2.20)

(2.21)

Where Q is the quantity of charges in the field and A is the cross sectional area. It has a unit of .

Moreover, the strength of an electric field (John,2003) can also be estimated using

(2.22)

(2.23)

Where ‘V’ is the voltage supplied to the field and ‘l’ is the length of the field. It is measured in .

The Torque produced in a conducting material (John,1998) is estimated by

(2.24)

(2.25)

Where F is the force field and r is the distance across the conductor. It has a unit of *Nm*.

Furthermore, the induced electromotive force (e.m.f) of coil (John,1998) can be estimated using

(2.26)

(2.27)

(2.28)

Where is the magnetic flux, N is the number of coil and t is the time taken. It has a unit of *volts.*

Also, to calculated the self-inductance of a coil (John,1998), we use

(2.29)

(2.30)

(2.31)

Where I is the current flowing through the coil, is the magnetic flux. It is measure in measured in Henry H.

Observing the self-inductance of a solenoid (Jenkins and Jarvis, 1973)

(2.32)

(2.33)

(2.34)

Where defined as 1.25663706143592 H.

Similarly to mutual inductance of two coaxial solenoid of both secondary and primary solenoid (Jenkins and Jarvis, 1973) is given as

(2.35)

(2.36)

(2.37)

(2.38)

Where and are the number of the two coaxial solenoid respectively.

Computing the induced e.m.f in a magnetic flux of the circuit uses

(2.39)

(2.40)

(2.41)

(2.42)

Where d is the distance apart, l is the length of the magnetic field and B, t are the magnetic flux and time taken respectively, .

Estimating the flux density of a magnetic circuit uses (Mike, 2006)

(2.43)

(2.44)

Where is the magnetic flux intensity and A is the cross sectional area ,.

Capacitor as an electrical component, which the current flowing through it can be measured as a function of time described by the relation (Mike, 2006).

(2.45)

Where I is the initial current of the capacitor, C is the capacitance and R, t are the resistance and time taken, measures in amperes.

Also, the potential across a capacitor is calculated using the relation

(2.46)

Where is the initial potential of the capacitor, t is the time taken and C and R are the capacitance and resistance. Measured in volts, (Mike,2006).

As well as the constant time used in charging a capacitor can be expressed mathematically as (Arthur and Edward)

(2.47)

(2.48)

Where C is the capacitance and R is the Resistance. Measured in sec.

And the charge at that given time in a capacitor is estimate using the expression

(2.49)

Where Q is the capacitor initial charge, t is the time taken and other has their usual meaning (Richard,1992).

Furthermore, the energy stored in a capacitor is estimated using the relation

(2.50)

(2.51)

Where V is the voltage of the capacitor and C is the capacitance. It is measured in joules.

The resistance of a capacitor to charges flowing through it can be estimated using the relation

(2.52)

(2.53)

Where f is the frequency and C is the capacitance. It is measured in Ω (Bernard,1994).

Transformer as a very important tool in electricity, some brief mathematic expressions describing some of the characteristics feature of a transformer are given below;

The current at the primary turns of transformer (Mike, 2006), can be evaluated from this expression

(2.54)

(2.55)

(2.56)

Where,, are the number of turns at the secondary and primary phase of a transformer respectively, is the current measured at the secondary phase. It is measured in A.

In a single phase transformer, both the primary and the secondary current (Russell and Robert, 2007) can be calculated using the relation

(2.57)

(2.58)

(2.59)

Where, are the voltage at both the primary and the secondary turns and is the secondary current. It is measured in amperes A.

Also, the number of turns at both Primary and secondary in relation to the voltage at each phase of the transformer (Russell and Robert,2007) can also be estimated using the relation

(2.60)

(2.61)

(2.62)

Where all the parameters have their usual meanings.

Similarly, the ripple voltage of a transformer (Waterworth, 1988), evaluated using the relation

(2.63)

(2.64)

(2.65)

Where is the direct current (DC) supplied to the transformer, f is the frequency and C is the capacitive ability of the transformer, it is measured in volts.

Moreover, the peak voltage of a transformer in relation to its ripple voltage can also be evaluated using the relation

(2.66)

(2.67)

Where is the voltage supplied to the transformer and is the ripple voltage of the transformer.(Waterworth,1998).

In an electronics devices there are possibilities of emission of various kinds, where the evaluation of the emission current density in a thermionic device (Metha and Robit,2008) using the relation

(2.68)

(2.69)

Where A is the cross sectional area, T is the temperature and b is the distance apart. It is measured in .

Also, the estimation of the quality of a electrical circuit (Mehta and Robit,2008) can be done by the mathematical expression

(2.70)

(2.71)

(2.72)

Where l is the length of circuit, f is the frequency and R is the resistance of the material, measured in.

The hall voltage of a magnetic material can be evaluated (Sharma, 1984) using the relation

(2.73)

(2.74)

(2.75)

(2.76)

Where “t” is the thickness of the material, B is the magnetic field, I is the current and is the hall coefficient which is equal to

(2.77)

(2.78)

Where q is the charges present and n is the number of free electron. It is measured in volts.

Amplifier is an important electronics device, which has a great contribution to electricity. The bandwidth of an amplifier which dictates the quality and the performance level of an amplifier, mathematical given as

(2.79)

(2.80)

Where the resonant is frequent and is the quality factor. It is measured in HZ (Mehta and Robit,2008).

The electron drift velocity of conducting material (Sharma,1984) can be estimated by the relation

(2.81)

(2.82)

Where is the electron mobility and E is the electric field,HZ

In the mass flow of electron through a material, there is always an existence of free electron; the charge density of this free electron is mathematically given as (Sharma,1984).

(2.83)

(2.84)

(2.85)

Where is the conductivity of the material , is the electron mobility and q is the electric charge. It is measured in per cubic meter ().

Lastly, the number of electron per cubic meter in a metal of a magnetic filed B (Sharma,1984) can be estimated using the mathematical expression

(2.86)

(2.87)

(2.88)

(2.89)

(2.90)

Where the Hall voltage, t is the thickness of the metal and B is the magnetic flux, also it is measured in ().