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Utilization of mathematical proficiencies for solving problems in Electrical Engineering Domain

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ABSTRACT

Usance of mathematical based tools and related functions in various aspects of electrical and electronics engineering applications is prominent by everyone. In this research paper, an effective amount of illustrations pertaining to applying the concepts related to mathematics in electrical engineering domain area have been projected. The motive behind this research work is to correlate the advantages of using mathematical tools to electrical engineering field of study. Now-a-days, many engineering pursuing students usually think and they are in opinion that, applying mathematics related concepts in electrical engineering field is cumbersome and tedious task. But infact, this paper explains clearly about the importance of utilizing the mathematical background to evaluate and investigate various electrical parameters like current, power, voltage, electrical RL & RC based circuits, concepts pertaining to electro-magnetic fabricating and canvassing circuits. It is very important for every electrical and electronics engineering aspirants to have know-how on mathematical based background in order to solve various engineering related problems and to handle them carefully and skillfully.

Index Terms- engineering problems, investigate electrical parameters, mathematical tools.

1. Introduction

The field of Electrical and electronics engineering mainly establishes the employment of electricity and assiduities on systems for generating and transmitting vast electrical currents and switching over them into different eccentrics of energy such as mechanical energy [1], [2].

Electrical engineering has blend of application areas with which it can be utilized for solving various day to day needs like designing smart system, fabrication of complex automated systems, electronic gadgets like computers, mobile phones, .integrated circuits, sensors etc [3]. But for understanding the nature and behavior of electrical related circuits, it is very essential to know the mathematical and analytical methods which basically help in understanding the operation of electrical based circuitry [4].

Hence, it is undoubtedly conveyed that, mathematics is one such powerful weapon which helps in solving many engineering related hurdles. For example, the concepts related to Fluid mechanics, the topics pertaining to electro-magnetic waves are not possible without the intervention of mathematical exposure [5].

2. Applications of Mathematics In Electrical Arena

We can simply state that, electrical engineering without maths is treated as nothing. The know-how of Calculus is predominantly essential in solving the Electrical engineering related issues. From network theory to the concepts of control systems, from topics of thermodynamics to circuit related microprocessors or microcontrollers, further added areas like digital signal processing, high voltage engineering, solar photovoltaic energy, every field of study aforementioned mainly includes basic fundamentals of mathematics.

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Many trigonometric identities were being utilized in areas like transient analysis of RL and RLC circuits. Linear algebra concepts are extensively used in area of digital signal processing as well as communication systems. Even concepts owing to differential equations play a vital role in electrical engineering. In arena of electromagnetism, basically we utilize the knowhow of Vector Algebra.

Few mathematical essential tools that are being utilized in electrical engineering are listed below: namely:

• Calculus domain

• Coordinate Geometry area

• Vector analysis part

• Complex variable analysis

• Probability and Eigen vector analysis

• Linear algebra related concepts

• Differential based Equations

• Fourier series and Laplace transform based concepts

• Trigonometric ratios and trigonometric related functions

Calculus

Calculus is very essential mathematical tool to analyze the output of integrated circuits. In the figure given below, it is demonstrated clearly about the usage of differential and integrator circuits and the output waveforms are depicted on CRO (cathode ray oscilloscope).

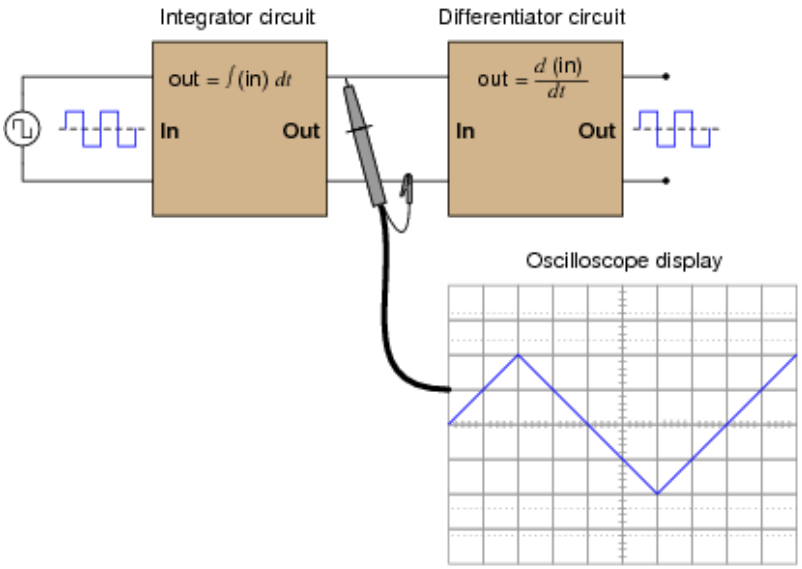

Fig: Differentiation and integration illustration

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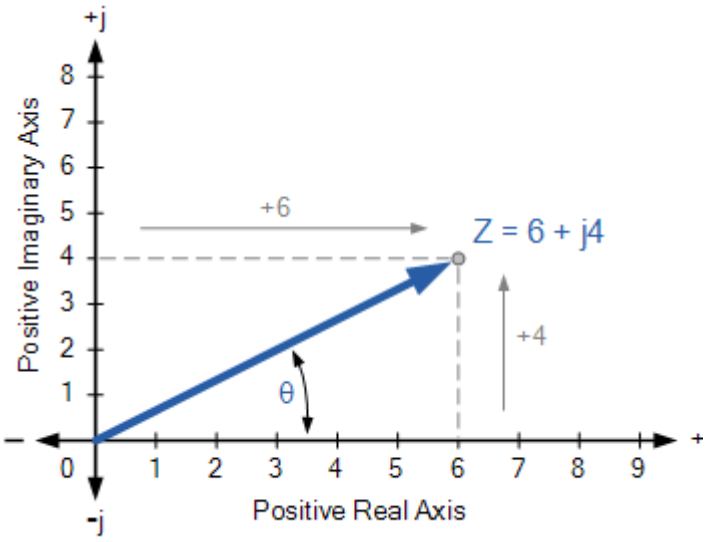
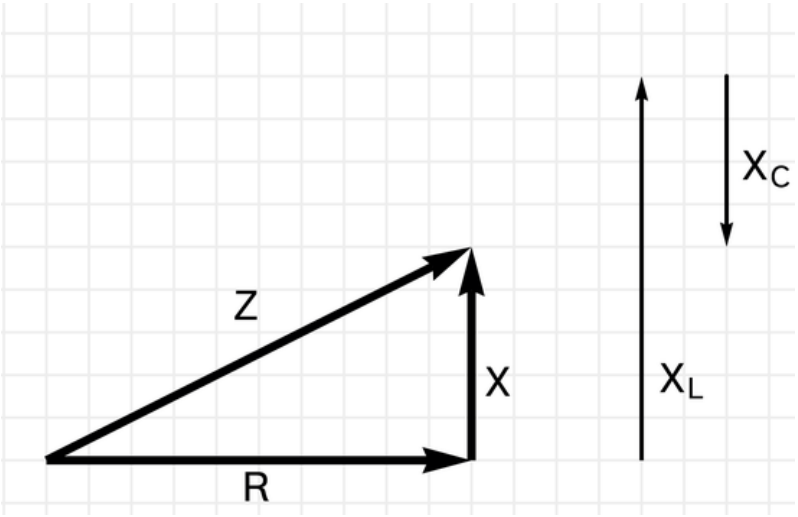
Co-ordinate Geometry

In order to explain and illustrate about the impedance triangle, concepts of coordinate geometry is extensively used. In the figure given below, it is clearly shown the usage of coordinate geometry to draw the phasor diagram representation. The impedance is shown in rectangular Cartesian form.



Vector analysis

The following figure demonstrates the phasor diagram representation of impedance and resistance parameters.



The above figure depicts the inductive and capacitive reactance which is explained by vector method. 'X' represents the reactance parameter.

Probability analysis

This type of analysis is essential for learning the distribution pattern in load flow studies of power system subject area. Also, it is highly beneficial to understand the switching pattern of the circuit.

The following figures depicted below incorporate the concept of probability.

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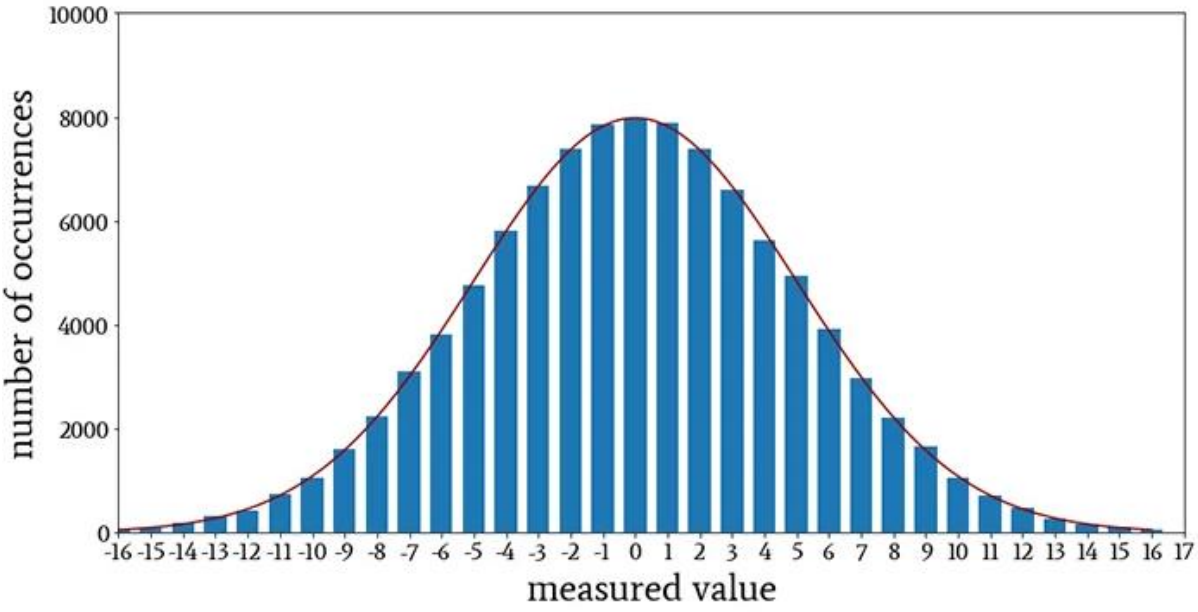

Fig: load duration curve patterns

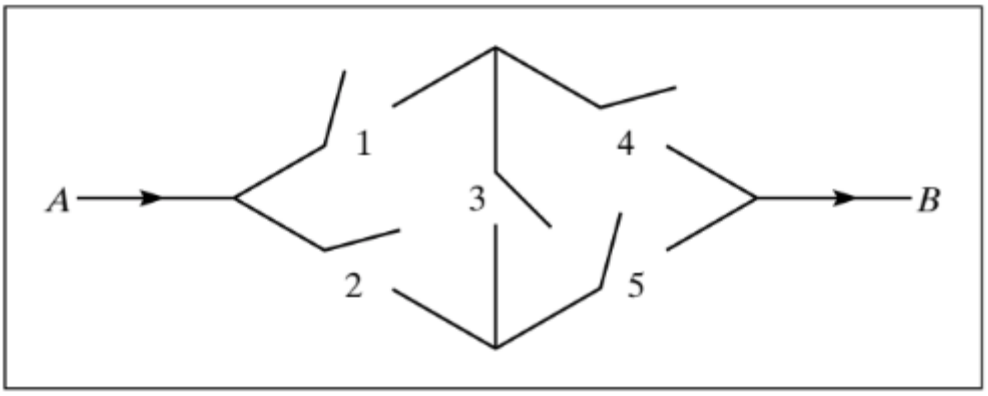

Fig: switch functionality operations

Complex variable analysis and embedding of Fourier Transform:

Especially in order to analyze the harmonic spectrum of waveform, Fourier analysis is predominantly utilized. The figure shown below, clearly explains about the harmonics (shown up to 5th harmonics).

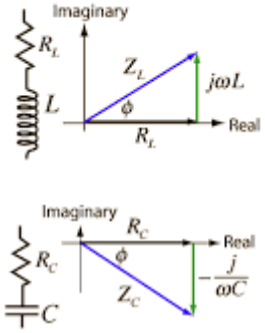

Fig: Inductance and capacitance complex variable analysis

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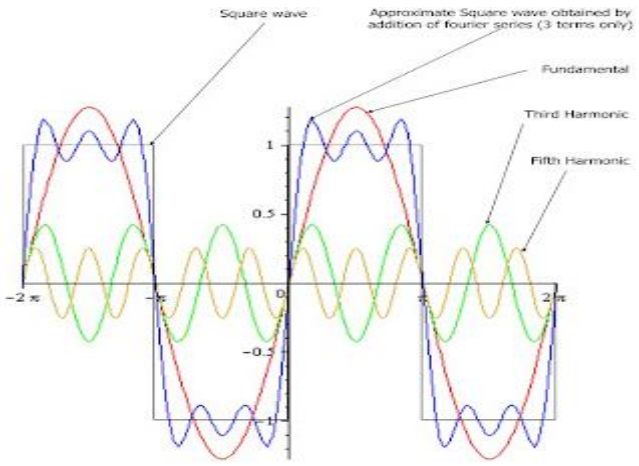

Fig: Figure representing the harmonic analysis

Transient analysis:

The figure depicted below is representing the transient behavior of RL circuit. Hence forth, without mathematical tool, it is very difficult to understand the behavior of RL circuit.

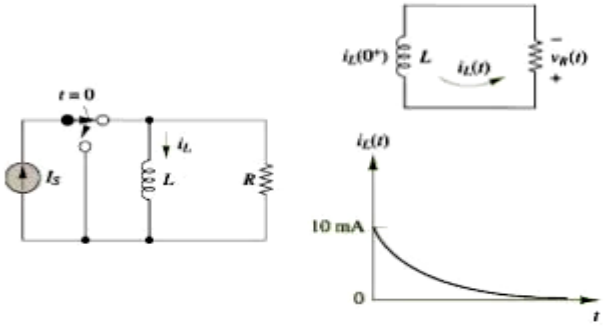

Fig: Transient analysis of RL circuit

Laplace transform:

This mathematical tool is widely used to generate various waveform patterns like triangular waveform, ramp waveform etc. The figure shown below shows the triangular wave signal.

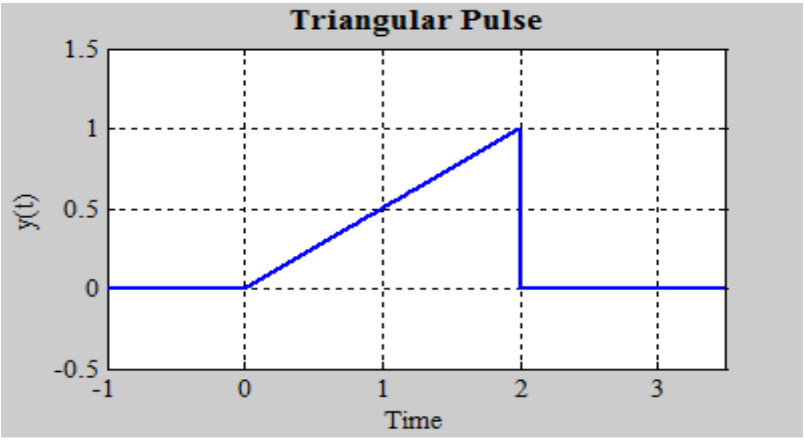

Fig: Application of Laplace transform

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Eigen values:

The following figure shows the application of Eigen values and Eigen vectors to draw the modes of the elements of amplitude parameter.

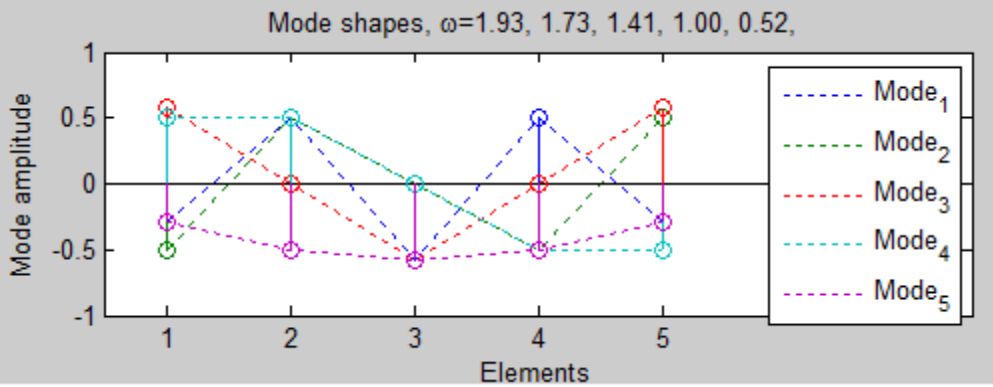

Fig: figure showing the modes of amplitude

3. Conclusion

In this research paper, major emphasis has been given on applying various kinds of diligences of mathematics in electrical as well as electronics engineering related field areas. Also, this work will reveal the advantages of applying the mathematical treatment to real time examples pertaining to electrical systems. By incorporating mathematical analysis, it shall become easier to understand the inherent behavior of circuits especially to analyze rhe transient and switching action of RL and RC based circuitry. It is also shown in this paper, the embedding of concepts of calculus, integration and differentiation, application of Fourier analysis methodology to solve the electrical related problems further making the solutions comparatively more compact and easier.

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