FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

MATHEMATICS, MATHEMATICIANS AND NUMERICAL ANALYSIS: THE BRIDGE AND BRIDGEHEAD VIEW OF NIGERIA WITH MATHEMATICAL PRISM

By

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Professor of Applied Mathematics

INAUGURAL LECTURE SERIES 27

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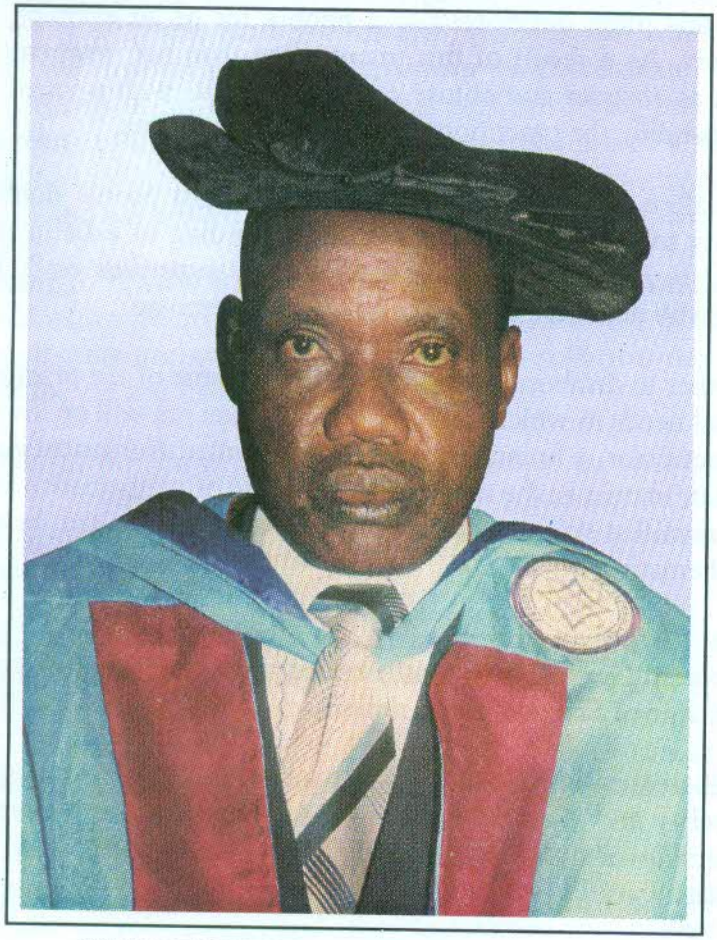

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1.0 Introduction

The motive force of a fixed idea is very great. Many people have this fixed notion or obsession or even complex about mathematics and this often develops into a phobia for or an aversion to the subject. As a result of this, more often than not, mathematics is seen as abstract and obtuse or even esoteric, with a lot of myths surrounding the practitioners – the mathematicians.

Therefore it is not difficult to see why most people doubt their ability to understand mathematics. According to a Latin proverb *"Qui in prdum catamine dubitat tendem superatus est"*. That is "He who doubts in a footrace is always overcome".

In other to disabuse the people of these, some of the practical and social needs to which mathematics has been put will be illustrated. In particular, a branch of mathematics called Numerical Analysis will be shown as the most applicable side of mathematics and will be manifest to all that it actually accentuates the beauty of mathematics.

2.0 Mathematics

According to Kuku, Mathematics is first and foremost the language of Science. Other definitions include:

Mathematics is the study of numbers, shapes, physical systems, patterns and their relationship. Mathematics is the Science of quantitative relations, which has very wide and useful applications.

In actual fact, Mathematics arose from the need for a system for counting and for calculating areas and volumes. Isaac Newton stated *"Numero pondere et Mensura Deus omnia condidit"* (God created things by number, size and weight)

Mathematics is not just about numbers it is also about general objects. It is a process of trying to verify how a statement made by A is related to that made by B. With the use of well-defined notations or symbols, Mathematics can reduce a vast amount of difficult information into a finite number of expressions which when properly understood, help a great deal in solving problems, which relate to the given set of information. The use of letters to represent an unknown quantity has made Mathematics a universal language and has proved to be a magnificent intellectual tool.

According to Francis Bacon, many parts of nature can neither be invented with sufficient subtlety, nor demonstrated with sufficient perspicuity, nor accommodated unto use, with sufficient dexterity without the aid and intervention of mathematics.

Albert Einstein, one of the greatest scientists of the 20^{th} century asked "how can it be that mathematics, a product of human thoughts independent of experience, is so admirably adapted to the object of reality?"

Robert Recorde stated that "Besides the mathematical arts, there is no infallible knowledge, except it be borrowed from them.

And to Leonardo Da Vinci, "No human enquiry can be called true science unless it proceeds through mathematical demonstration."

Ward and Hardgrove [1] defined mathematics by stating that "mathematics results from the discovery, the formulation, the systematic development, and the application of patterns of inductive thinking". In short, they stated that mathematics consists of patterns of related ideas and patterns of thought. And they elaborated by stating that; the development of simple convenient mathematical patterns is an important part of the evolution of the western culture.

Mathematics knows no language, political or ideological barriers to function. That is why Mathematics is even more encompassing than English; the most widely spoken language in the world. The Chinese, Russians and so on, do not speak English yet they practice Mathematics the same way as every other nation does. The complexity of every society, so different, one from another, is responsible for the generation of codes, norms, rules and values in direction of organizing, classifying, comparing and ordering the action of its individuals. Instances of these codes, norms, rules and values are instruments of analysis, of explanations and of action, such as, more or less, small and big, few or many, near and far, and in and out. These codes, norms, rules and values, for instance cardinality and ordinality, counting and comparing, take different forms according to the cultures in which they were generated, or organized and accepted.

According to Galileo "Philosophy is written in this grand book of the universe which continually opens to our gaze, it is written in the language of mathematics". So we can conveniently say that mathematics is the language of the Creator of the universe – God!

The discovery of the Higgs Boson is the latest reminder that the universe can be understood through mathematics. "It makes you feel good as a theorist that mathematics does provide a window of reality" – Brian Greene, Columbia University Physicist's comment on the discovery of the Higgs Boson (4th July 2012).

3.0 **Mathematics, Games, Logic and Patterns**

Mathematics is logic. It is the discovery and application of patterns in inductive and deductive thinking. It is also a game. According to Bertrand Russell [1], Mathematics is the class of all propositions of the form p implies q, where p and q are propositions containing one or more variables. Therefore,

mathematics is simply any assertion of truth or falsehood. In fact all pure mathematics consists of logical deductions. Bertrand believed that mathematics and logic are one and the same thing; so they are inseparable. The development of mathematical ideas actually implies the development of logical thinking.

Mathematics consists of patterns of related ideas and patterns of thought. We observe that these patterns appear in nature. For instance the blossoms of some flowers naturally arrange themselves in interlacing spiral curves. The arrangement of some seeds and fruits like the pineapple and the arrangement of leaves on trees, solar system and the galaxies, all depict specific patterns of arrangement.

In 1772, the astronomers, Johann Titius and Johann Bode [1] discovered that the distances from the sun to the planets, known at the time, showed an interesting numerical pattern. If we take the distance from the sun to Saturn to be 100 (Saturn was the farthest planet known at the time) then the distances of the planets are approximately:

Mercury	4
Venus	$4 + 2^0(3)$
Earth	$4 + 2^1(3)$
Mars	$4 + 2^2(3)$
Asteroid	$4 + 2^3(3)$
Jupiter	$4 + 2^4(3)$
Saturn	$4 + 2^5(3)$

Mercury does not fit the pattern exactly (it should be: $4 + 2^{-1}(3)$ to fit the pattern).

We observe that no planet fits $4 + 2^{3}(3)$ but Bode insisted that there must be a planet at that distance from the sun. In 1801, Giuseppe Piazzi found, not a planet, but a smaller body called asteroid at the distance of $4 + 2^{3}(3)$, and before long the celestial police (a group in Germany) found many more asteroids about the distance, showing that these were fragments of a planet that somehow got smashed into pieces. The discovery of the asteroid belt was a great success for Bode's law and this encouraged the search for planets beyond Saturn at distances following the progression: i.e. $4 + 2^{6}(3)$, $4 + 2^{7}(3)$, etc. Sure enough, Uranus turned up to be at a distance of $4 + 2^{6}(3)$! *Quod erat Faciendum* (i.e. that which was to be shown).

Mathematics is not only the language of the sciences; it is the essential nutrient for thought, logic, reasoning and therefore, progress, technology and indeed all human progress. Mathematics liberates the mind and not only gives individuals an assessment of their intellectual abilities, but points to the direction for improvement. Prof. Jibrin Aminu [1] said that "Mathematics is the gift of God to man and it is only those who are devoted to extolling the supremacy of God, who is the only Being that can explain to us the phenomena of infinity and the incongruity of the square root of -1". Of course according to Pascal; *"Tout ce qui est incomprehensible ne laisse pas, detre, le numbrebinfiniti un espace infini cealaufini"* [1] (What is incomprehensible exists; infinite number or infinite space equal to a finite one!).

4.0 Branches of Mathematics

Mathematics consists of at least two distinct subjects [2]: some call them Pure and Applied Mathematics but some refer to them as Mathology (Pure maths) and Mathophysics (Applied maths) respectively.

For the professional pure mathematician, mathematics is the logical dovetailing of a carefully selected sparse set of assumptions with their surprising conclusions via a conceptually elegant proof. Simplicity, intricacy and above all logical analysis are the hallmark of mathematics.

5.0 Applied Mathematics

When the procedures are turned to the analysis of physical and engineering problems and when the relations are examined by the methods developed in pure mathematics, the field is called Applied Mathematics or Mathematical Physics. The general trend now is that every branch of science and its mode of explanations depend more and more on mathematical formulations. There is no doubt that the fountainhead, the inspiration of mathematics is the physical and social universe. The ultimate goal of applied mathematics is "action" from the theory of convex sets, convexity has become the main tool in Linear programming, an indispensable part of modern economic and industrial practice. Functional analysis has become the main tool in quantum theory and particle physics. The Physicist regards applicability of Von Neumann algebra (a part of functional analysis) to elementary particles as the only justification of quantum theory.

Applied mathematics is not engineering; the applied Mathematician does not design airplanes or atomic bombs. Rather, it is a part of theoretical science concerned with the general principles behind what makes planes fly, bombs to