



NIGER DELTA UNIVERSITY
WILBERFORCE ISLAND, BAYELSA STATE.

61st Inaugural Lecture

Mathematics: The Structure of Life

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By

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NIGER DELTA UNIVERSITY
Wilberforce Island, Bayelsa State, Nigeria

Motto

Creativity, Excellence, Service

Vision

To be a centre of excellence defined by well articulated programme that will produce creative and innovative minds

Mission

To strive to maintain an international reputation for high quality scholarship, research and academic excellence for the promotion of the socio-cultural and economic well-being of mankind

**NIGER DELTA UNIVERSITY ANTHEM
(THE BRIGHTEST STAR)**

Like the brightest star we are, to lead the way
To good education that is all our due,
The dream of our fathers like the seed has grown;
Niger Delta University if here to stay.

In all that we do, let us bring to mind
Our duty as staff and students of N.D.U
Ev'rywhere to promote peace towards mankind.
Creativity, Excellence and Service

Let us build on this noble foundation
And with love, let our dedication increase,
To rise and uphold this noble vision
Ev'ry passing moment let our zeal never decrease.

CHORUS
Rejoice, great people old and new, rejoice
For the good fruit through us is shown;
Be glad in our worthy contribution
To the growth of humanity (x2)

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DEDICATION

I dedicate this Inaugural lecture to the one and only true God, in Him I live and have my being.

Protocol

Vice Chancellor

Deputy Vice Chancellor (Administration)

Deputy Vice Chancellor (Academic)

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Dean, Faculty of Science

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Distinguished Professors and Scholars

President and members of Nigeria Women in Mathematics

Bishops of the Dioceses of Northern Izon, Niger Delta West
and Ahoada

HRH, Sir Bokumo F. Orukari, Amananaowei of Sabagreia

Council of Knight

Obrikom Community

Kalama compound of Sabagreia

St Peter's Church (Yenagoa and Sabagreia)

Anglican Youth Fellowship (fellowship – in Christ)

Gentlemen of the Press

Ladies and Gentlemen

Preamble

It is with profound gratitude and humility that I stand before you today, to deliver my inaugural lecture at this esteemed university.

Vice Chancellor Sir, inaugural lecture is a significant academic tradition, offering Lecturers the opportunity to reflect on their scholarly journey, articulate their vision for the future, and outline their contributions to their field of specialization. Today, I embrace this platform to share my perspectives and aspirations as I step into this new phase of my academic career.

The steps of the righteous are ordered by the Lord. Psalm 37:23 God directed my choices and path to ensure it aligned with His.

My journey into Mathematics

My journey into Mathematics began with my admission into the Department of Mathematics, Faculty of Science, at the then Rivers State University of Science and Technology (RUST) in 1991, now Rivers State University (RSU). Interestingly, Mathematics was not my choice of study. I had applied to study Electrical Engineering, following the footsteps of my elder brothers, all of whom who pursued degrees in Civil, Mechanical, and Chem/Petrochem Engineering in the University. However, due to my JAMB score of 2 marks below the cut-off mark for Electrical Engineering, I was offered admission to study Mathematics instead.

Though disappointed at first, I had no option but to accept the offer and do a transfer in my second year. As a first-year student, I found myself doing tutorial MTH111 for students of other faculties. The same MTH111 was the course I failed and could not transfer out of my department. How and why, I failed that course I still can't explain.

During my Youth service, I was posted to Ilasa Community Secondary School in Ekiti State. From my very first lesson, the students responded enthusiastically, developing a keen interest in the subject. Their excitement further ignited my love for teaching Mathematics. The satisfactory expressions on the faces of my students as I try to explain mathematics to them was worth more than millions of naira to me. Inspired by this experience, I decided to pursue a career in teaching, rejecting all other juicy jobs that came my way.

This work is a product of that journey of unexpected beginnings, growing passion, and a lifelong commitment to the study and teaching of Mathematics.

Introduction

Vice Chancellor Sir, it is both an honour and a privilege to deliver this lecture titled "Mathematics: Structure of Life." Mathematics is the architecture of logic, a framework upon which life itself is structured.

Mathematics, often is perceived as an abstract and theoretical, extends far beyond numbers and equations. It serves as the foundation of human endeavour—shaping scientific discovery, technological advancement, artistic expression, and philosophical thought.

At its core, mathematics provides solutions to life's complexities, offering structure, clarity and it has been the invisible scaffolding supporting human progress. Its applications are boundless, its relevance universal, and its principles timeless. This lecture explores how mathematics serves as a vital structure of life—bridging science, technology, and the humanities—and how it continues to shape the world around us.

What is Mathematics?

Mathematics has been defined and interpreted differently by scholars and researchers across various eras, reflecting its evolving nature and diverse applications. The following structured summary presents key perspectives on mathematics, demonstrating its fundamental role in

shaping human knowledge, logical reasoning, and scientific discovery.

Aristotle (384–322 BCE) described mathematics as "*the science of quantity*," emphasizing its role in measuring and comparing numerical values.

Galileo Galilei (1564–1642) stated, "*The universe is written in the language of mathematics*," underscoring its role in explaining natural phenomena.

Carl Friedrich Gauss (1777–1855) referred to mathematics as the "*queen of the sciences*," signifying its structural importance across scientific disciplines.

Bertrand Russell (1872–1970) described mathematics as "*the subject in which we never know what we are talking about, nor whether what we are saying is true*," pointing to its abstract and logical nature.

John von Neumann (1903–1957) saw mathematics as "*a precise and structured language that models reality*," emphasizing its role in technological innovation, computing, and physics.

My Personal Definition of Mathematics

Mr. Vice-Chancellor, Sir, it is evident from the diverse perspectives and definitions of mathematics that this discipline transcends mere computation and numerical analysis.

Given its broad applications and interpretations, there is no doubt that mathematics is one of the most universally

applicable disciplines. While I acknowledge the depth and validity of the definitions presented, I, Professor Mercy A. Orukari, define Mathematics as:

"The systematic patterns of structures, and relationships through logical and symbolic representation, interpretation, and transform the complexities of the natural and abstract worlds into meaningful solutions."

This definition highlights the dual nature of mathematics—as both an intellectual pursuit and as a practical tool for advancing human knowledge and solving real-world problems. It emphasizes not only the study of abstract concepts but also their applications in meaningful ways across all domains of life.

Applications of Mathematics in Everyday Life

Mathematics is not just a theoretical discipline confined to classrooms and research papers; it is the underlying structure of modern life, and every aspect of daily existence. This lecture explores the diverse applications of mathematics in banking, engineering, transportation, medicine, and technology, emphasizing its role as the foundation of structured living.

Mathematics in Banking and Finance

The global financial system operates on mathematical principles, that ensures precision in transactions, investments, and economic policies (Hull, 2018).

Banking operations rely on arithmetic, algebra, and probability theory to calculate interest rates, loan repayments, and investment returns. The concept of compound interest demonstrates how minor financial contributions accumulate exponentially over time, reinforcing the importance of mathematical literacy in personal and corporate finance.

Mathematics in Engineering and Architecture

Mathematics forms the backbone of engineering and architectural design, ensuring structural stability and functionality (Glover, 2019). Geometry, trigonometry, and calculus are applied in constructing buildings, bridges, and road networks, where engineers calculate load distributions and stress tolerances (Timoshenko, 2018). Finite Element Analysis (FEA) uses differential equations to simulate structural behaviour under various forces, optimizing safety and durability. Parametric design enables architects to experiment with innovative geometries, leading to the creation of energy-efficient and structurally resilient buildings

Mathematics in Transportation and Urban Planning

Optimized transportation networks rely on mathematical models for traffic management, route planning, and logistics optimization. Graph theory and combinatorial optimization are used in Google Maps and GPS navigation.

Mathematics in Vehicle Routing and Logistics

Efficient supply chain operations depend on mathematical modeling to optimize delivery routes, reduce operational costs, and improve service efficiency (Dantzig & Ramser, 2019). The Vehicle Routing Problem (VRP) employs integer programming and heuristic algorithms to determine the most effective paths for freight trucks, ride-sharing services, and emergency response vehicles. Companies such as Amazon, FedEx, and UPS rely on AI-driven mathematical models to improve last-mile delivery efficiency and reduce environmental impact (Gendreau et al., 2019).

Mathematics in Biological Patterns and Genetic Studies

Mathematics explains biological patterns and genetic structures, helping scientists understand the organization of life. The Fibonacci sequence appears in plant growth, DNA helix structures, and animal body proportions, demonstrating the inherent order in nature (Stewart, 2020). Computational biology uses statistical modeling and machine learning to analyze DNA sequencing, gene mutations, and hereditary diseases, significantly advancing medical research (Lander et al., 2001).

Mathematics in Welding and Fabrication

Precision is crucial in welding and fabrication, where even minor miscalculations can result in structural failure. Geometry and trigonometry are used to determine angles, lengths, and material tolerances, ensuring the accuracy of joint connections and metal cutting (Hicks, 2018).

Mathematics in Internet and Mobile Communication

The internet and mobile communication networks rely on mathematical theories and computational algorithms to enable seamless global connectivity. Binary mathematics (0's and 1's) forms the foundation of data transmission, digital encoding, and computer processing (Knuth, 2018). Fourier analysis and wave equations are used in wireless communication and 5G technology to optimize signal processing and bandwidth efficiency (Tse & Viswanath, 2018).

Mathematics in Medicine and Healthcare

Medical practitioners use mathematical models and statistical analysis to diagnose diseases, predict patient outcomes, and optimize treatment plans. Epidemiological models, such as the SIR (Susceptible-Infected-Recovered) model, help track the spread of infectious diseases like COVID-19, enabling policy makers to implement effective containment strategies (Hethcote, 2000).

Mathematics in Agriculture

Agriculture, a cornerstone of human civilization, depends on mathematical techniques for crop management, resource optimization, and climate adaptation. The emergence of precision farming—which integrates GPS technology, machine learning, and statistical modeling—has revolutionized how farmers make data-driven decisions to improve yield and efficiency (Gebbers& Adamchuk, 2010).

In livestock management, mathematics aids in optimizing feeding ratios, animal breeding cycles, and disease control. Linear programming and statistical forecasting help modern dairy farms improve milk production efficiency while ensuring animal welfare (Bailey et al., 2014).

Mathematics in Sociology

Mathematics provides quantitative tools and analytical frameworks for studying human behaviour, social networks, and demographic patterns. Statistical analysis, probability theory, and computational modeling allow sociologists to interpret population growth, migration trends, and societal interactions.

Game theory, a mathematical concept applied in sociology, examines strategic decision-making in social interactions, negotiations, and group dynamics.

Mathematics in Climate Science and Epidemiology

Mathematics plays a crucial role in addressing global challenges such as climate change and disease control. Climate scientists use computational models and differential equations to simulate the effects of greenhouse gases, predict extreme weather events, and develop environmental policies.

During the COVID-19 pandemic, mathematical epidemiology became a critical tool for tracking virus transmission, assessing intervention strategies, and optimizing vaccine distribution. The SEIR (Susceptible-Exposed-Infected-Recovered) model provided governments with insights into infection rates, mortality risk, and the impact of lockdown measures

Mathematics in Tailoring and Fashion Design

The fashion industry relies on precise mathematical calculations to create garments that are pleasing and functionally accurate

- **Geometry and Trigonometry:** Used to calculate fabric draping, pleats, and stitching angles for a well-fitted structure (Tatham & Seaman, 2021).
- **Scaling and Proportions:** Pattern grading relies on ratio calculations and algebra to adjust clothing sizes while maintaining design integrity (Fan, Yu, & Hunter, 2020).

- Golden Ratio (1.618): This principle is applied in garment design and aesthetics to create visually appealing silhouettes (Livio, 2021).
- Computer-Aided Design (CAD): Uses algorithmic calculations and coordinate geometry to develop precise digital patterns and reduce fabric waste

Mathematics in Recreational Activities

Recreational activities, including board games, puzzles, and digital simulations, often incorporate probability, combinatorics, and mathematical logic to enhance gameplay strategy and problem-solving skills (Gardner, 2021).

Mathematical Applications in Recreational Activities:

- Chess and Strategy Games: Game theory, probability models, and decision algorithms are used to develop winning strategies
- Sudoku and Logical Puzzles: These rely on combinatorics, set theory, and matrix operations to identify patterns and solutions
-

Mathematics in Crowd Management

Effective crowd management is essential for large-scale events, urban planning, and emergency response systems. Mathematics provides the necessary tools to analyze crowd flow, optimize space utilization, and ensure public safety (Helbing, 2020).

Mathematical Models Used in Crowd Control:

- Queueing Theory: Predicts waiting times and optimizes crowd movement in places such as airports, stadiums, and public transportation hubs (Gross et al., 2018).
- Density Analysis and Spatial Statistics: Used to monitor crowd density and prevent overcrowding at concerts, protests, and festivals (Still, 2014).

Case Study: The 2022 FIFA World Cup in Qatar

The FIFA World Cup 2022 in Qatar demonstrated the role of mathematics in large-scale crowd control. Advanced machine learning algorithms and AI-driven analytics were used to:

- Predict crowd movement patterns in stadiums and surrounding areas.
- Optimize entry and exit strategies to reduce congestion.
- Enhance security measures through real-time surveillance and predictive modeling (FIFA, 2023).

Mathematics in Economics and Business

Mathematics is a cornerstone of economic modeling, financial forecasting, and business analytics. Economists and financial analysts rely on mathematical techniques such as differential equations, probability theory, and statistical modeling to analyze market trends, optimize

resource allocation, and evaluate economic policies (Varian, 2014).

Mathematics in Nature

Mathematics governs natural patterns, biological structures, and cosmic formations. The Fibonacci sequence, fractal geometry, and the Golden Ratio reveal the underlying order and symmetry in nature (Stewart, 2017).

Mathematical Phenomena in Nature:

- **Fibonacci Sequence in Biological Growth:** Appears in sunflower seed arrangements, pinecones, and the branching of trees (Livio, 2021).
- **Golden Ratio in Living Organisms:** Observed in shell spirals, DNA structures, and human facial proportions (Devlin, 2021).
- **Fractal Geometry in Natural Structures:** Self-replicating patterns seen in snowflakes, river networks, and lightning bolts.
- **Wave Mathematics in Environmental Science:** Fourier transforms and differential equations describe ocean tides, atmospheric currents, and sound waves (Tsonis, 2008).

Mathematics in Art and Music

Mathematics has long been a foundation for artistic design, musical harmony, and digital creativity.

Geometric symmetry, proportionality, and harmonic sequences govern both visual aesthetics and auditory compositions.

Mathematics in Visual Arts:

- **The Golden Ratio (1.618):** Used in painting, sculpture, and architectural proportions, as seen in Leonardo da Vinci's "Vitruvian Man" (Livio, 2021).
- **Perspective and Linear Algebra:** Applied in Renaissance art, photography, and 3D modeling.
- **Frequency Ratios and Harmonic Series:** Define chord progressions, musical scales, and rhythm structures
- **Pythagorean Tuning and Fibonacci Sequences:** Influence sound wave resonance and melody composition.
- **Fourier Analysis in Digital Audio Processing:** Used in auto-tuning, sound equalization, and music production software.

Mathematics as a Life Skill

Beyond its academic and professional applications, mathematics is a critical life skill that enhances problem-solving, financial literacy, and logical reasoning (Boaler, 2016).

- **Mathematical Thinking and Problem-Solving**
Mathematics fosters a structured approach to decision-making, helping individuals develop critical thinking and analytical reasoning. Studies suggest that students who engage in mathematical problem-solving exhibit improved cognitive flexibility and adaptability (Devlin, 2021).
- **Financial Literacy**
Understanding basic mathematical concepts such as compound interest, inflation, and risk diversification empowers individuals to make informed financial decisions.
- **Investment Strategies:** Financial literacy helps individuals plan for retirement, manage debts, and optimize savings (Lusardi & Mitchell, 2017).
- **Budgeting and Economic Planning:** Mathematical models assist in household budgeting and national economic policies (Varian, 2014).

A strong foundation in numerical literacy has been linked to greater financial independence and long-term economic security

- **Everyday Decision-Making**
From estimating travel times and calculating discounts to assessing probabilities in risk-taking scenarios, mathematical reasoning is embedded in

daily life. Developing mathematical fluency helps individuals navigate uncertainty, analyze data, and make logical choices (Steen, 1990).

The Role of Mathematics in Modern Society

Mathematics remains an indispensable tool for addressing contemporary challenges. During the COVID-19 pandemic, mathematical models played a crucial role in predicting virus spread and optimizing resource allocation (Baker et al., 2021).

Mathematics also drives economic and technological progress. The STEM (Science, Technology, Engineering, and Mathematics) paradigm is recognized as a key driver of 21st-century development, with major global economies investing heavily in mathematical research (OECD, 2021).

Life Lessons from Mathematics

Mathematics is not just a discipline confined to numbers, equations, and formulas—it is a *structural framework that mirrors the principles of life itself*. The logical reasoning, precision, and problem-solving skills ingrained in mathematics provide valuable insights into how we navigate challenges, make decisions, and structure our lives. Below are some profound life lessons derived from mathematics that illustrate its deep connection to everyday experiences.

Balance and Fairness – The Principle of Equilibrium

In algebra, maintaining balance on both sides of an equation is essential to finding solutions. This mirrors the importance of fairness, justice, and equilibrium in life. Just as an equation must remain balanced, relationships, work-life dynamics, and decision-making require fairness and stability to achieve harmony. Whether in personal interactions or global policies, maintaining balance ensures long-term sustainability and ethical integrity.

Growth and Lifelong Learning – The Concept of Infinity

The infinity symbol (∞) in mathematics represents something limitless and unending, much like human potential and lifelong learning. Mathematics teaches us that growth is continuous—each new concept builds on prior knowledge, just as in life, where personal and professional development is a never-ending journey. The pursuit of knowledge, adaptability, and perseverance is what allows individuals and societies to evolve.

Problem-Solving and Resilience – Overcoming Challenges

Mathematics requires patience, logic, and critical thinking to solve complex problems. In life, challenges arise unexpectedly, but a structured approach to problem-solving, much like in mathematics, helps us find solutions. Trial and error, persistence, and logical

analysis allow us to navigate difficulties, whether in business, relationships, or career advancement.

Precision and Accuracy – The Importance of Details

Fields such as engineering, architecture, and medicine depend on mathematical precision. A slight miscalculation can lead to structural failure or medical errors. Similarly, in life, attention to detail, discipline, and accuracy in decision-making prevent costly mistakes and lead to excellence in various fields.

Adaptability – The Role of Variables

In mathematics, variables represent unknowns that change depending on different factors. This concept teaches us to be adaptable and flexible in a world where circumstances constantly evolve. Just as equations adjust with new variables, individuals and organizations must be willing to recalculate, strategize, and embrace change to succeed.

Connectivity and Relationships – The Power of Networks

Mathematical models such as graph theory and network analysis demonstrate the importance of connections and relationships. In today's digital age, social networks, transportation systems, and supply chains rely on well-structured connections. This teaches us that building

strong networks—both personally and professionally—enhances opportunities and facilitates success.

The Framework of Mathematics

Over time, its scope has expanded to include numerous specialized fields, necessitating systematic classification. The division of mathematics into pure and applied branches provides a structured framework for understanding both abstract mathematical theories and their practical applications. This categorization is not rigid, as many mathematical concepts transcend boundaries, influencing multiple fields and adapting to emerging challenges.

1. Pure Mathematics: The Foundation of Abstract Reasoning

Pure mathematics is primarily concerned with theoretical exploration, focusing on mathematical structures, patterns, and relationships independent of direct real-world application (Hardy, 1940).

Key Branches of Pure Mathematics:

- Algebra which Studies structures, equations, abstract systems, fields such as cryptography and coding theory.
- Geometry and Topology which explore spatial properties and shapes, and its applications extends from theoretical physics to computer graphics.

- Number Theory: Investigates the properties of integers and prime numbers,
- Mathematical Logic and Set Theory: Establish the formal foundations of modern mathematics,

Thus, pure mathematics serves as the intellectual foundation for advancements across multiple domains.

2. Applied Mathematics: Bridging Theory and Real-World Solutions

While pure mathematics focuses on abstract principles, applied mathematics translates these principles into practical solutions for real-world challenges. It integrates mathematical models, computational techniques, and statistical methods to address problems in engineering, finance, medicine, and technology (Strang, 2016).

Some Key Fields of Applied Mathematics include

- Mathematical Modeling
- Optimization and Operations Research: Involves linear programming, game theory, and decision analysis
- Probability and Statistics: Essential for data science, risk assessment, and epidemiology
- Computational Mathematics and Numerical Analysis: Develops algorithms for scientific computing, artificial intelligence, and financial forecasting (Atkinson, 2013).
- Mathematical Physics: Applies mathematical frameworks to describe physical phenomena,

supporting advancements in quantum mechanics, relativity, and electromagnetism (Dirac, 1981).

The Uniqueness of Applied Mathematics: A Foundation for Scientific and Technological Progress

Applied mathematics is distinct from pure mathematics in its direct impact on solving practical problems. It employs mathematical models, algorithms, and computational techniques to tackle challenges in engineering, finance, medicine, and environmental science (Boyce & DiPrima, 2017).

It is the branch that bridges theoretical mathematics with practical applications, enabling advancements in science, engineering, economics, medicine, and technology. It provides the quantitative framework necessary for modeling natural phenomena.

This discussion explores the uniqueness of applied mathematics, its interdisciplinary nature, and its essential role in understanding the behaviour of fluids, which are fundamental to both natural and engineered systems. It is not limited to a single domain.

Fluids and Their Connection to Applied Mathematics What Are Fluids?

Fluids are substances that flow continuously under applied force, encompassing liquids, gases, and plasmas. Their behaviour is described by fluid mechanics, a branch of applied mathematics that examines motion, pressure,

and energy transfer in flowing substances (Batchelor, 2000).

Fluids are everywhere in our daily lives, playing critical roles in transportation, industry, healthcare, and environmental systems. Their study through applied mathematics helps solve complex problems in engineering, medicine, and environmental science.

Mathematical Models in Fluid Mechanics:

1. Navier-Stokes Equations: Describe the motion of fluids, essential in aerodynamics, weather forecasting, and marine engineering (Chorin & Marsden, 1993).
2. Bernoulli's Principle: Explains pressure variations in fluid flow, applied in aviation, hydraulic systems, and medical devices (Anderson, 2011).
3. Fourier Analysis in Heat and Fluid Transfer: Used in climate modeling, industrial cooling systems, and energy efficiency research (Tsonis, 2008).

Practical Applications of Fluid Mathematics:

- Transportation and Engineering:
 - Fuel flow dynamics in automobiles, aircraft, and rockets.
 - Hydraulics in construction, irrigation, and urban water systems.
 - Aerodynamics in high-speed trains, wind turbines, and space exploration.

- Environmental Science:
 - Ocean circulation models for climate change predictions.
 - Weather forecasting using fluid dynamics and atmospheric physics.
 - Pollution control through airflow and water contamination models.
- Biomedical Applications:
 - Blood flow modeling in cardiology and stroke prevention (Fung, 1997).
 - Lung fluid dynamics in respiratory medicine and anesthesiology.
 - Dialysis and intravenous drug delivery techniques.
- Everyday Life:
 - Cooking with fluids such as water, oil, and milk.
 - Air conditioning and refrigeration systems.
 - Sports physics in swimming, football, and cycling.

These applications demonstrate how fluid mathematics shapes the natural and engineered world, reinforcing the fundamental role of applied mathematics in modern life.

The Evolving Role of Applied Mathematics in Fluid Mechanics

Mathematical advancements have continuously refined our understanding of fluid behaviour, leading to breakthroughs in:

- Turbulence Modeling: Used in aviation safety, spacecraft engineering, and industrial mixing processes (Pope, 2000).
- Computational Fluid Dynamics (CFD): High-performance computing enables realistic simulations of airflow, ocean currents, and climate patterns (Versteeg & Malalasekera, 2007).
- Biomedical Fluid Mechanics: Improved diagnosis and treatment through blood circulation modeling, artificial heart valves, and respiratory fluid simulations (Quarteroni et al., 2016).

As technology advances, applied mathematics will continue to play a pivotal role in fluid mechanics, driving innovations in renewable energy, medical technology, and aerospace engineering.

Tissue blood flow is also obtained by a rearrangement of Darcy's law: $\mathbf{F}=\Delta\mathbf{P}/\mathbf{R}$, where flow now is the blood flow through a tissue and ΔP is the difference between arterial and venous blood pressure.

Darcy's law is an equation that describes the flow of a fluid through a porous medium and through a Hele-Shaw cell. The law was formulated by Henry Darcy based on

results of experiments on the flow of water through beds of sand, forming the basis of hydrology, a branch of earth sciences.

$$q = \frac{-K}{\mu} \nabla p$$

(1)

Where, q = instantaneous flow rate

K = Permeability

μ = Dynamic viscosity of the fluid

∇p = Pressure drop

A material can be described as porous if it contains spaces (pores, voids or holes); the pores usually contain fluid such as air, water, oil etc. And the material is permeable to various fluids.

In porous media, the point wise fluid velocity V is not a useful identity, since it is volume fluxes that are usually measure and are relevant.

The normalized porosity is defined by $k = kM$ where k is the permeability porosity and M is the ratio of the heat capacities.

A problem that consists of a channel that is porous with fluid layers that is bounded by two horizontal impermeable parallel planes of height $d < 0$, with the plane at $z' = -d/2$ and the temperature at $T = T_1$, concentration $C = C_1$, also, at $z' = d/2$ with temperature at $T = T_2$, concentration $C = C_2$. Heating the fluid layer from the bottom plane, we considered the flow to be electrically conducting, radiating, and incompressible. A magnetic field of strength B_0 is applied in a direction

perpendicular to the channel. The x' - axis is taken along the flow in the downstream direction and the z' -axis is taken normal to the planes in the direction of the applied magnetic field.

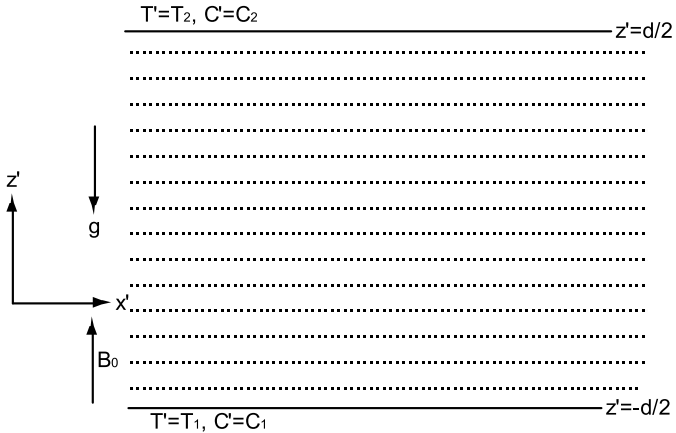


Fig 1: Depicts the Physical model of the system

Assuming that the porous medium in the channel obeys Oberbeck-Bousinesq approximation and that the flow is governed by Darcy's law. The fluid density is considered to be linearly dependent on the temperature T and concentration C as , Lombardo *et al*, (2013) and Hill (2015).

$$\rho = \rho_0[1 - \beta_T(T - T_0) + \beta_C(C - C_0)],$$

where ρ is the density of the fluid mixture at $T = T_0$ and C_0 . Also, T_0 and C_0 are reference temperature and concentration, respectively. β_T and β_C are the thermal expansions for temperature and solutal concentration, respectively. Under these conditions, the governing equation of flow, energy and solute transport taking into account the effects of radiative heat transfer and magnetic field. Nield and Bejan (2006); Orukari (2010) are

$$\text{Continuity Equation: } \nabla' \cdot \vec{V}' = 0$$

$$\text{Momentum Equation: } \frac{\mu}{k} \vec{V}' = -\nabla' P' - \rho g \vec{k} + J' \times B'$$

Energy Equation:

$$(\rho_0 C_p)_m \frac{\partial T'}{\partial t'} + (\rho_0 C_p)_f (\vec{V}' \cdot \nabla' T') = \kappa \nabla'^2 T' - \nabla' \cdot \vec{q}'$$

Specie Concentration transport:

$$\phi \frac{\partial C'}{\partial t'} + \vec{V}' \cdot \nabla' C' = D_m \nabla'^2 C'$$

$$\text{Radiative heat flux: } \nabla'^2 q_r - 3\alpha^2 q_r - 16\sigma\alpha T'^3 \nabla' T' = 0$$

$$\text{Electric density equation: } \nabla' \cdot \vec{J}' = 0, \quad \vec{J}' = \sigma_c [\vec{E} + \vec{V}' \times \vec{B}'],$$

where \vec{V}' is the Darcy velocity; T' is temperature; g is acceleration due to gravity; ρ_0 is density; C_p is specific heat capacity; q_r is radiative heat flux; k is permeability of the porous medium; κ is thermal conductivity; P' is pressure; D_m is mass diffusivity of species through the fluid saturated medium; \vec{J}' is electric current density; \vec{E}

is electric field; α is absorbing coefficient or penetration depth, and σ is Stefan-Boltzmann constant.

Mathematics, a structure of life has to do with the stability of everything about life. Stability in fluid in various medium has been my area of research, especially when the medium is porous. Stability as it affects fluid flow could be discussed in two phases that is, steady motion and time dependent flows. The fluid is considered in a basic state of steady motion.

LINEAR STABILITY ANALYSIS

The motionless solutions are the basic steady solutions, by the linear stability analysis, which when solved with boundary conditions corresponds with the static solution for temperature T_s , solute concentration C_s and pressure P_s . To access the stability of the steady state solutions, a perturbation is defined

When certain parameters are introduced, the onset of stationary instability is triggered off, these are Lewis number (Le), thermal Rayleigh number (Ra), solutal Rayleigh number (Rs), Magnetic parameter (Ha) and Radiation parameter (F). The variation of these parameters affected the onset of stationary instability.

The onset of the stationary instability with the limiting conditions, the Rayleigh number shows the threshold of

instability, which is in agreement with several other works.

Conclusion

Mathematics is far more than a collection of numbers, formulas, and equations—it is the very **structure of life**. As explored throughout this inaugural lecture, mathematics is the foundation upon which scientific discovery, technological advancement, economic growth, medical innovation, and artistic expression are built. It is the universal language that transcends disciplines, cultures, and generations, shaping the way we understand and navigate the world.

From the intricacies of pure mathematics, which fuel intellectual exploration, to the practical applications of applied mathematics that solve real-world problems, we have seen how mathematical principles influence engineering, medicine, agriculture, finance, cybersecurity, artificial intelligence, and climate science. The seamless integration of mathematics into every aspect of life reinforces the idea that mathematics is not just a subject—it is a way of thinking, a problem-solving tool, and a framework for innovation.

As we continue to face global challenges such as climate change, cybersecurity threats, public health crises, and technological disruptions, mathematics will remain an

indispensable guide in developing solutions that improve the quality of life. The logical reasoning, precision, adaptability, and analytical skills ingrained in mathematics empower individuals to think critically, innovate, and make informed decisions.

Furthermore, mathematics teaches us valuable life lessons—the importance of balance, resilience, accuracy, adaptability, and continuous learning. Just as an equation seeks equilibrium, so too must we strive for fairness and stability in our interactions. Just as the infinity symbol represents limitless potential, so too must we embrace a mindset of lifelong growth and exploration.

A Call to Action

As educators, researchers, and professionals, we must promote mathematical literacy and foster a culture of curiosity and innovation. We must continue to push the boundaries of mathematical knowledge, ensuring that future generations harness its power to solve emerging challenges. Governments, industries, and academic institutions must recognize that investment in mathematics is an investment in progress, as mathematical advancements drive scientific breakthroughs, economic development, and societal transformation.

In the words of **Eric T. Bell**, “Mathematics has rendered a great service to humanity. It has put common sense back where it belongs.” Indeed, mathematics is the pillar of logic, the bridge between theory and reality, and the key to unlocking the mysteries of the universe.

Let us embrace mathematics not just as a discipline, but as a mindset, a tool for progress, and a guiding force for a better future.

Mathematics is the structure of life—and together, let us continue to build upon it.

***“TELL ME WHAT YOU DO AND I WILL TELL YOU
THE MATHEMATICS IN IT”***

ACKNOWLEDGMENT

The journey that seemed impossible at the beginning, was achieved through the encouragement and support of several persons who, from the onset believed in me and my vision. Chiefly among those is the one who knew me before I was formed in my mother's womb, my creator and sustainer, the Lord God Almighty, unto whom I owe a lifetime of gratitude.

I am also filled with gratitude for the human agents God placed along my path to provide guidance and mentorship on every twist and turn. My parents Chief. Tobin Nwokezi and Mrs. Sabaina Nwokezi of blessed memory, were willing vessels on whose shoulders I rode as an infant and all through my teenage years with the warmth and love of the Nwokezi and Uzi families of Obrikom.

Also, at the very heart of my support system has been my children, Dr. Doubara Orukaria, Bar. Amaebi Orukaria and Ndukiye Orukaria, whom altogether constitutes my team, first audience and critics. Their criticism, suggestions and contributions helped in no small measure to prepare me for the biggest stage.

I cannot forget my able, passionate and hardworking supervisor – Prof Isreal Cookey of the Department of Physics, Rivers State University. Who worked tirelessly to smoothen the rough edges of my work into something worthy of attention today. It is to his credit that I completed my research work within three years. I am very privileged to be one of his proteges, as I am certain, that I could not have chosen a better supervisor and mentor.

It is as much my pleasure to express my very profound gratitude to Professor Promise Mebine, The DG of the National Mathematical Centre, Abuja. Who in his time as Head, Department of Mathematics in the Niger Delta University, gave me the needed support and encouragement to pursue my Post graduate studies. He contributed to many of the early career decisions I made in my journey in the academia. His support then and now, has been quite invaluable.

My professional colleague and research partner, Professor AlalaboNgiangia, of the University of Port Harcourt, also deserve to share in this gratitude. His contribution was selfless, as he took no offense for the countless nights I had woken him from sleep, just to share a thought or seek

his opinion on a nutty issue. He is indeed, a worthy research partner.

I also in the same wise, recognise the worthy role played by another professional colleague and partner, Dr. Zonaki Ongodiebi of the Department of Mathematics, Niger Delta University, Ammasoma. His support and contributions are greatly appreciated.

This acknowledgment cannot be complete without mentioning my one and only sister - Mrs Ndidi Joyce Oburu, who stood in for me, to care for my young family during my MSc. days. Her sacrifice in nursing my young children while I was far away in Ibadan, cannot be forgotten. Thank you, my sister, confidant and prayer partner.

I am equally profoundly grateful to my husband and soul mate, Hon Justice Amaebi Orukari (KSC), for his love and affection that provided the emotional stability, without which I would not have been able to function well to actualize my dreams. He saw my potential well before others did and spared no effort in giving me the necessary push. It is to his credit that I am who I am today. Thank you, my biggest fan.

And to the very many others who contributed in one way or the other in making this dream come true, I say your efforts did not go unnoticed. I will indeed, remain forever grateful.

NDU 61ST INAUGURAL LECTURER



Prof. Mercy Amaebi Orukari

B.Sc. (RSUST), M.Sc. (U.I), Ph.D. (RSUST) MNMS, MNWM

Professor of Applied Mathematics

Department of Mathematics, Faculty of Science,
Niger Delta University, Wilberforce Island

CITATION OF THE INAUGURAL LECTURER

Professor Mercy Ezima Amaebi Orukari (Nee Nwokezi) was born in Port Harcourt, Rivers State, into the family of Late Chief Tobin Eke Nwokezi of Umuezeali family and Mrs Sabiana Ada Nwokezi (Nee Uzi) both of Obrikom community in Ogba/Egbema Local Government Area of Rivers State.

Young Mercy began her academic journey when she first attended the Young Women Christian Association (YWCA) nursery school in 1976 for one year before moving to St Cyprian's Primary School, Port Harcourt (1976-1981), and Omoku Urban Girl Secondary School, Omoku (1982-1988) where she was the best student in Physics, Chemistry and Mathematics. She later attended Rivers State School of Basic Studies in 1989.

In furtherance of her pursuit of excellence she bagged a Bachelor of Science degree in Pure & Applied Mathematics from the now Rivers State University between 1991 and 1995), followed by a Master's degree in Applied Mathematics from the University of Ibadan between 2003 and 2005 and culminated in a Ph.D. in Applied Mathematics from Rivers State University 2006 to 2010.

In the same spirit, Professor Mercy Amaebi Orukari, a quintessential scientific scholar of international repute and a Professor of Mathematics at the Niger Delta University, has carved her own path of brilliance.

Professor Mercy began her professional journey during the National Youth Service Corps (NYSC) in 1996, serving as a Mathematics teacher at Eka Mefa Community Grammar School in Ilasa Ekiti, Ekiti State. She went on to teach at Light Secondary School in Borikiri, Port Harcourt between 1997 and 2000, and later served as an Education Officer II (mathematics teacher) at the Federal Government Girls' College, Abuloma, Rivers State from 2000 to 2002. Between 2002 and 2003, she worked as a Statistician II at the Bayelsa State Ministry of Finance.

In February 2003, she joined Niger Delta University as a Graduate Assistant in the Department of Mathematics/Computer Science.

Clearly, her growth within the institution was steady and meritorious, this is why, it is no surprise at all when she rose through the ranks as Assistant Lecturer, Lecturer II, Lecturer I, Senior Lecturer, Associate Professor and ultimately to the rank of a professor.

From 2014 to 2019, she served as Acting Head of the Department of Mathematics/Computer Science, and from 2019 to 2025, she held the position of Acting Director of the Information and Communication Technology (ICT) Centre, where she spearheaded key ICT initiatives across the university.

She also served on the institution's Governing Council (2017–2021), and continues to contribute actively as a member of several strategic committees such as the Departmental examination officer, Faculty of Science Welfare officer, Quality Assurance Committee, SSSC, Accreditation Committee, and Management Committee.

She has also participated in high-level selection processes, including the Registrar Selection Committee (2020) and Bursar Selection Committee (2021).

Notably, she served as Treasurer of the NDU Cooperative Society from 2018 to 2023, and subsequently emerged as the President in 2023 till date.

Her intellectual contributions are equally impressive. A prolific researcher, Prof. Orukari has authored and co-authored over 40 peer-reviewed articles across diverse areas of mathematics and applied physics, exploring

complex phenomena such as viscous dissipation in hydrodynamic flows, magneto-hydrodynamics in porous media, finite amplitude oscillations, and the mathematical modelling of fluid behaviour, stress waves, and instability mechanisms in various physical systems.

These studies, often interdisciplinary, reveal her deep analytical mind and a research orientation rooted in solving real-world problems through mathematics.

Prof. M.A. Orukari is a devote Christian of the Anglican communion and has served in several committees in the church. She is a principled and a no-nonsense woman. Beyond her academic and administrative engagements, Prof. Orukari is a mentor, a thought leader, and a beacon of inspiration to aspiring scholars and young women in STEM.

She brings to her profession not only technical brilliance but also an admirable sense of duty, integrity, and compassion.

Suffice to say, her skills in computer applications, programming languages such as Maple and Mathematica, and her fluency with software tools like LaTeX,

PowerPoint, Excel, and Word underscore her versatility and modern approach to teaching and research.

In sum, Professor. (Mrs.) Mercy Amaebi Orukari epitomizes the ideal of an academic who blends scholarliness, service, and leadership. Her journey from a humble classroom in Ilasa Ekiti to becoming a professor at Niger Delta University is both inspiring and instructive. She has carved a path marked by diligence, innovation, and excellence—a legacy that continues to grow and impact lives across Nigeria and beyond.

Beyond all contentious doubts, Professor (Mrs.) Mercy Amaebi Orukari exemplifies the fusion of scholarliness, service, and leadership.

Outside of her professional life, Prof. Orukari enjoys reading, cooking, and singing. She is married to Hon. Justice Amaebi Ibomo Orukari, and their union is blessed with three children. Dr. Doubara A. Orukaria, Barr. Amaebi Amaebi Orukaria and Ndukiye Amaebi Orukaria (the tech bro).

Her blend of academic excellence, research innovation, and leadership in ICT makes her a distinguished figure in

the landscape of mathematics and higher education in Nigeria.

Indeed; her journey is a glowing testament to what is possible when talent and determination meets opportunity, even as her personal achievement becomes a symbol of progress and possibility.

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