**MECHANICS AND MOTION**

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**IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE DEGREE IN MATHEMATICS.**

## DECLARATION

I hereby declare that this research was written by me and is a correct record of my own research. It has not been presented in any previous application for any degree of this or any other University. All citations and sources of information are clearly acknowledged by means of references.

#### AYOOLA TIJESUNI SAMUEL

#### Date:. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .

## CERTIFICATION

This is to certify that this research work entitled **Mechanics and Motion** is the outcome of the research work carried out by **Ayoola Tijesuni Samuel** (20183008) in the Department of Mathematics, Federal University of Agriculture, Abeokuta, Ogun State.

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## DEDICATION

This project work is dedicated to Almighty God, the creator of the universe and all mankind, who gave me this grace from the inception of this project work till its completion. And also to my wonderful family, starting from my beloved parents, Mr and Mrs Ayoola as well as my ever-supportive siblings and to everyone that has been supportive and helpful in my education life.

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## ABSTRACT

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# INTRODUCTION

## 1.1 Background to the Study

Think about a simple action like kicking a soccer ball or swinging on a swing. Have you ever wondered why things move the way they do? That's where the fascinating world of Mechanics and Motion comes into play.

Welcome to a journey where we'll explore the secrets of how things move. Mechanics is like the rulebook that our universe follows for any motion, from a car racing down the highway to a leaf falling from a tree. And the best part? You don't need to be a rocket scientist to understand it!

Imagine you're riding a bike. You push the pedals, and off you go. But what makes your bike move? Why don't you just stay still? We'll uncover the answers to these questions and more as we dive into the world of Mechanics

Mechanics and motion are foundational concepts that underpin our understanding of how objects move and interact in the physical world. From the graceful flight of a bird to the complex machinery of a car engine, mechanics governs the behavior of these systems, allowing us to predict and control their motions. The study of mechanics not only has practical applications in engineering and technology but also provides profound insights into the workings of the natural world.

In this project, we will embark on an exploration of mechanics and motion, unraveling the principles, theories, and applications that shape this fascinating discipline. By delving into the theoretical foundations and examining real-world examples, we aim to provide a comprehensive overview that will deepen your understanding of the mechanics behind motion.

To begin, let us set the stage with a brief historical context. Mechanics has a rich history, with notable contributions from pioneering scientists who laid the groundwork for our understanding of motion. Sir Isaac Newton, with his groundbreaking work in the 17th century, introduced the laws of motion that revolutionized the field of mechanics. Newton's laws, which describe the relationship between forces and motion, form the cornerstone of classical mechanics1. Their applications are vast and encompass everything from the motion of celestial bodies to the mechanics of everyday objects.

The theoretical framework of mechanics encompasses several key concepts. Kinematics, the study of motion without considering its causes, involves analyzing quantities such as displacement, velocity, and acceleration2. Dynamics, on the other hand, explores the relationship between motion and the forces acting upon an object, as described by Newton's laws1. By understanding these principles, we can predict and explain the behavior of objects in motion.

Mechanics and motion find practical applications in numerous fields. In engineering, mechanics is crucial for designing structures that withstand forces and move efficiently. In sports, an understanding of mechanics helps athletes optimize their performance and minimize the risk of injury. Even in fields as diverse as robotics, biomechanics, and astrophysics, mechanics plays a pivotal role.

Throughout this seminar report, we will explore various subtopics within mechanics and motion, including projectile motion, circular motion, conservation laws, oscillations, and more.

## 1.2 Motivation

Why study Mechanics and Motion? What drives our curiosity to explore this captivating field of science and its profound impact on our world? The motivation behind this study lies in the recognition of the pivotal role that mechanics plays in shaping our understanding of the physical universe and its practical applications. Let's delve into the motivations that drive our exploration of Mechanics and Motion.

* **Everyday Phenomena**

Mechanics governs the behavior of objects in our daily lives, from the motion of vehicles on the road to the swaying of trees in the wind. Understanding these phenomena through the lens of mechanics enhances our comprehension of the world around us.

* **Innovation and Design**

Mechanics is at the heart of innovation and design in engineering and technology. It enables the creation of safer vehicles, efficient machinery, and cutting-edge robotics. As we study Mechanics and Motion, we gain insights into how to design more advanced and sustainable solutions.

* **Performance Enhancement**

In sports and athletics, mechanics is the key to unlocking human potential. By optimizing the mechanics of an athlete's movements, we can enhance performance, reduce the risk of injury, and push the boundaries of achievement.

## 1.3 Objectives

In this project, we'll break down complex concepts into simple ideas. We'll learn about the forces that make things go faster or slower, the tricks behind acrobats' flips, and even the science behind superheroes' super jumps.

But Mechanics isn't just for superheroes or scientists in lab coats. It's for everyone who's curious about the everyday magic of movement. Whether you're a sports enthusiast looking to improve your game or just someone who enjoys the thrill of a rollercoaster ride, this seminar is for you.

So, join us as we embark on a journey through Mechanics and Motion. Together, we'll unlock the mysteries behind our world's most incredible movements. It's like learning the rules of a fascinating game – a game where you're the player, and Mechanics is your playbook. Get ready to be amazed by the simple yet extraordinary science of how things move!

## 1.4 Definition of Terms

Before we embark on our journey through the captivating world of Mechanics and Motion, let's establish some essential concepts and terminology to ensure that we're all on the same page. Whether you're new to this subject or a seasoned enthusiast, these definitions will serve as our guiding stars throughout our exploration.

* **Mechanics**

Mechanics is the branch of physics that deals with the behavior of objects under the influence of forces, including their motion and how they respond to different types of forces.

* **Motion**

Motion refers to the change in an object's position with respect to time. It encompasses a wide range of phenomena, from the slow crawl of a snail to the swift flight of a rocket.

* **Force**

Force is a vector quantity that causes an object to change its state of motion or rest. It has both magnitude and direction and is measured in units called Newtons (N).

* **Newton's Laws of Motion**

Newton's three laws of motion are fundamental principles that describe the relationship between the motion of an object and the forces acting on it. They were formulated by Sir Isaac Newton in the 17th century.

Newton's First Law (Law of Inertia): An object at rest tends to stay at rest, and an object in motion tends to stay in motion unless acted upon by an external force.

Newton's Second Law (F = ma): The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass.

Newton's Third Law (Action-Reaction): For every action, there is an equal and opposite reaction.

* **Velocity (v) and Speed (s)**

Velocity is a vector quantity that describes the rate of change of an object's position with respect to time and includes both magnitude and direction.

Speed, on the other hand, is a scalar quantity that only considers the magnitude of velocity. It is expressed in units like meters per second (m/s).

* **Acceleration (a)**

Acceleration is the rate of change of velocity with respect to time. It can be caused by changes in speed or direction and is measured in units like meters per second squared (m/s²).

* **Biomechanics**

Biomechanics is the study of the mechanical aspects of living organisms, including the analysis of movement, forces, and the structure and function of biological tissues.

* **Kinematics and Dynamics**

Kinematics is the branch of mechanics that deals with the description of motion, including the positions, velocities, and accelerations of objects without considering the forces causing the motion.Dynamics, on the other hand, is concerned with the forces and torques (rotational forces) that cause motion.

* **Equilibrium**

Equilibrium is a state in which the net force acting on an object is zero, resulting in a stable condition where the object remains at rest or moves with constant velocity.

* **Friction**

- Friction is a force that opposes the relative motion or tendency of such motion between two surfaces in contact. It plays a significant role in determining the behavior of objects in motion.

These preliminary definitions will provide a solid foundation for our exploration of Mechanics and Motion. As we venture further into the seminar, these terms and concepts will become the building blocks of our understanding, allowing us to unravel the mysteries of the dynamic world around us.

# 2.0 LITERATURE REVIEW

The study of mechanics and motion has a rich history and has been extensively explored by scientists and researchers over the years. In this literature review, we will examine key studies, theories, and advancements that have contributed to our understanding of mechanics and motion.

* One of the foundational works in mechanics is Sir Isaac Newton's "Philosophiæ Naturalis Principia Mathematica" (1687), which introduced his **three laws of motion**. Newton's laws provide a fundamental framework for analyzing the motion of objects and the forces acting upon them. They have stood the test of time and continue to be widely applied in various scientific fields.
* Advancements in mechanics continued with the works of other prominent scientists. In the 18th century, Leonhard Euler developed the principles of rigid body dynamics, which laid the groundwork for the study of rotational motion. His contributions to the field were instrumental in understanding the complex motion of objects in three dimensions.
* The 19th century witnessed significant progress in mechanics, with the development of analytical mechanics by William Rowan Hamilton and Joseph Louis Lagrange. Lagrange's formulation of mechanics, known as Lagrangian mechanics, provided a powerful mathematical framework for describing the motion of systems using generalized coordinates and the principle of least action. Hamilton's formulation, known as Hamiltonian mechanics, introduced a different approach using generalized momenta and Hamilton's equations. These formulations revolutionized the field of mechanics and allowed for more advanced analyses of complex systems.
* In the realm of fluid mechanics, Daniel Bernoulli's work on hydrodynamics in the 18th century has been foundational. Bernoulli's principle, derived from the conservation of energy, relates the pressure, velocity, and height of a fluid in motion. This principle has found extensive applications in fields such as aerodynamics and hydraulic engineering.
* The study of oscillations and waves has also been a significant area of research in mechanics. Jean-Baptiste Fourier's work on Fourier series in the early 19th century paved the way for understanding the decomposition of complex waveforms into simple sine and cosine functions. Fourier analysis is crucial for analyzing various wave phenomena, including sound waves, electromagnetic waves, and quantum mechanical wave functions.
* Furthermore, the integration of mechanics with other scientific disciplines has led to exciting interdisciplinary research. Biomechanics, for example, combines principles from mechanics with biology to understand the mechanics of biological systems, such as the human musculoskeletal system. Robotics and mechatronics also rely on principles of mechanics to design and control robotic systems for various applications.

Overall, the literature on mechanics and motion demonstrates a rich history of scientific inquiry and ongoing research. From the foundational works of Newton to the modern advancements in computational methods and interdisciplinary applications, the study of mechanics continues to expand our understanding of the physical world and enable innovative technological developments.

# 3.0 METHODOLOGY

# 5.0 CONCLUSION AND RECOMMENDATIONS

## 5.1 Conclusion

In the journey through the realm of Mechanics and Motion, we have explored the fundamental principles that govern the behavior of objects in motion, from the graceful arcs of a satellite in orbit to the intricate maneuvers of an athlete on the field. As we conclude this seminar, let us reflect on the insights and knowledge gained from our exploration.

**Key Takeaways**

* **Foundation of Understanding**: Mechanics is the bedrock of understanding how the physical world operates. It provides the tools to analyze and predict the behavior of objects in motion, from the macroscopic to the microscopic scale.
* **Interplay of Forces**: Our exploration revealed the interplay of forces, whether it's the centripetal force keeping a satellite in orbit or the fluid forces affecting the flight of a soccer ball. Forces are the driving factors behind motion.
* **Practical Applications**: Mechanics is not confined to textbooks and equations; it has practical applications across numerous fields. Whether it's designing efficient machines, optimizing athletic performance, or exploring outer space, the principles of mechanics are ever-present.
* **Curiosity and Wonder**: Mechanics invites us to be curious about the world around us. It inspires us to ask questions, seek answers, and marvel at the elegance of nature's laws.

## 5.2 Recommendation

As we conclude our seminar, we offer the following recommendations for further study and practical applications of Mechanics and Motion:

* **Continuous Learning**: Mechanics is a vast field, and there's always more to explore. We recommend a commitment to continuous learning, whether through further study in physics or engineering or by staying updated with the latest advancements in the field.
* **Interdisciplinary Applications**: Mechanics finds applications in various disciplines. Consider interdisciplinary collaborations to solve complex real-world problems. For instance, merging mechanics with biology can lead to breakthroughs in biomechanics and medical technologies.
* **Practical Problem Solving**: Mechanics is a powerful tool for practical problem-solving. Use your understanding of mechanics to contribute to innovative solutions in engineering, technology, and other fields.
* **Research and Innovation**: If you're involved in research, explore uncharted territories within mechanics. Investigate emerging areas such as nanomechanics, quantum mechanics, or applications in renewable energy technologies.

In conclusion, Mechanics and Motion are more than just scientific concepts; they are the underpinning of our understanding of the physical world. Our journey through this seminar has revealed the elegance of mechanics, and we encourage you to continue exploring, learning, and applying these principles to shape a better, more informed, and innovative future.

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