iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** III **Month of publication:** March 2025

DOI: https://doi.org/10.22214/ijraset.2025.67681

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue III Mar 2025- Available at www.ijraset.com

Recent Approaches in the Application of Ordinary Differential Equation

Amita Rawat[1], Shumaila Hashmi[2], Simran Chhabra[3]
Department of Basic Science, Bansal Institute of Science & Technology, Bhopal 462002, India

I. INTRODUCTION

This paper [1], which appeared in the International Journal of Engineering Science and Technologies, discusses the application of first-order differential equations. Ordinary, partial, linear, and non-linear differential equations are among the several differential equations that the author describe to introduce the subject. After that, they concentrate on using first-order differential equations to solve temperature and heat convection issues in fluids. The authors also go through how convective boundary conditions and Newton's law of cooling can be utilized to address real-world first-order ordinary differential equation issues. Examples and links to prior research in the field are included in the study. The outcome is that first-order differential equations can be used to describe real-world events like Newton's law of cooling and to determine orthogonal avenues, among multiple applications in mathematics and physics.

Having an emphasis on distinct kinds of differential equations and their uses, this article [2] addresses the applications of first-order ordinary differential equations to real-world systems. For police and detective security organizations to identify the cause of death, the study focuses on the time of death of a dead person found at midnight. The time of death can be estimated using Newton's Law of Cooling; however, it only functions when the ambient temperature of the body remains constant. Other uses of first-order differential equations, including the population growth model and radioactive decay of radioactive isotopes, are also considered in the study. The significance of developing mathematical models to address real-life occurrences using a set of differential equations is also covered in the article. Population growth and decay, drug distribution, carbon dating, wave in composite media, aerodynamics, casting of materials, electromagnetic analysis for bar radar detection, rocket launch trajectory analysis, space vehicle motion, heat transfer, and temperature problems that use Newton's law of cooling are only a few of the arenas in which differential equations are beneficial.

A core mathematical framework, ordinary differential equations (ODEs)[3] has been used in many fields, especially economic analysis and deep neural networks. By enabling dynamic structures, ODEs have modified training procedures, enhancing the capacity to recognize intricate patterns and adjust to evolving inputs. More reliable and effective AI systems have resulted from the application of this invention in computer vision, natural language processing, and reinforcement learning. ODEs make it easier to create dynamic systems in economic modeling that show how economic factors change over time. These models support economic stability and growth by helping economists in the analysis of intricate economic phenomena, forecasting, and the formulation of well-informed policy decisions. The study of ODEs emphasizes how important they are in forming the current economic and technological environment, emphasizing how interrelated they are and how crucial it is to comprehend natural processes and develop prediction models. Designing and optimizing complicated systems in engineering fields involving electrical circuits, mechanical systems, and control theory needs the use of ODEs.

The application of first-order ordinary differential equations (ODEs) to heat convection in fluids [4] is investigated in this research, which was created by Zahidullah Rehan. It describes the importance of differential equations in several fields of study, such as biology, physics, and engineering. The distinction between partial differential equations (PDEs) and ordinary differential equations (ODEs) is explored. The First-order linear homogeneous and non-homogeneous differential equations are explained in this section as well as solutions. Examples are provided for showing the solution method. The study utilizes the approaches that have been discussed to solve heat transfer problems with a special emphasis on heat convection in fluids. It models the heat transmission process with Newton's cooling law and illustrates its use with mathematical formulas and examples. The study concludes that heat transfer in fluids may be effectively modeled using first-order differential equations, both homogeneous and non-homogeneous. It shows how helpful these equations are for addressing real-world heat convection problems. The study emphasizes the value of first-order linear ODEs in the analysis of fluid heat convection and other heat transfer issues. It also covers how these equations can be categorized as homogeneous or non-homogeneous, and how the separation of variables approach can be used to resolve them.

The study teaches how mathematical ideas can be utilized and applied practically to real-world heat transport issues and offers an easy method for solving these problems using first-order ODEs.

The article [5]"Application of Differential Equations in Medical Field" discusses the significance of differential equations (DE) are to improving the knowledge, diagnosis, and treatment of a range of medical diseases. The author emphasizes the importance of DEs in several medical domains, covering pathology, cardiology, cancer treatment, and the dynamics of infections like dengue fever. Important considerations consist of when applied to medical scenarios, DE models including ordinary and partial differential equations have been shown to generate better results than classical models. Differential extraction can be used in pathology to model how they interact among fluids and elastic tissues. They aid in the analysis of cardiac tissue dynamics and the advancement of knowledge regarding heart function in cardiology. Through the dynamics of Reactive Oxygen Species (ROS), DEs are used in cancer therapy to model tumor-immune interactions and predict chemotherapy responses. The complex nature of analytical solutions and the need for collaboration between modeling, exploration, and clinical practice are two of the difficulties facing the application of DEs in the field of medicine. According to the article, using advanced computational models and merging machine learning and differential equation methods could improve biomedical understanding and treatments.

The application of ordinary differential equations (ODEs) in turning practical issues into mathematical frameworks is covered in the paper [6] "Applications of Ordinary Differential Equations in Mathematical Modeling."According to the paper, mathematical modeling is the process of applying mathematical language to the analysis of complicated phenomena. It aims to resolve real-world problems by providing mathematically explicable relationships. ODEs are highlighted as crucial instruments for simulating a wide range of applications in diverse fields. Through systematic mathematical methods, they make it easier to streamline real-world problems and advance solutions. The authors describe the process of generating ODE models, which consists of Making use of recognized theorems and laws (such as Newton's laws of motion, growth, and decay rates). Derivatives are used to quantify instantaneous rates of change that are pertinent to different research areas. The article gives instances of ODEs' consumption in mathematical modeling, including Forecasting the dynamics of a population.Utilizing growth rate modeling to analyze patterns in corruption. In population prediction, environmental tolerance factors are dealt with. According to the authors, ODEs are crucial for creating fresh mathematical models that tackle societal issues. They urge more studies to broaden the use of mathematical modeling and enhance current models for challenging problems. All things taken into account, this research underlines the value of ordinary differential equations in mathematical modeling and indicates how they may be used to connect theory to real-world applications in a variety of sectors.

The numerous applications of ordinary differential equations (ODE) in engineering are addressed in this study. It helps with a lot of engineering issues. It is used to calculate the motion of things such as pendulums and the flow of electricity. Understanding the principles of thermodynamics is also helpful. It can be useful for several physical phenomena. As a result, it has a lot of uses. The article [7] explores how the Ordinary Differential Equation (ODE) is used in engineering to explain thermodynamics thoughts, calculate electricity flow, and explain pendulum motion, amongst other natural phenomena.

Several significant subjects about the use of ordinary differential equations (ODEs) in engineering are covered in the paper [8]"Use of Ordinary Differential Equations Applied to Mechanical and Electrical Problems with First Order Linear Systems". The study demonstrates how first-order linear ODEs can be used to solve issues involving the motion of objects, like pendulums, and the movement or flow of electricity. This demonstrates the value of ODEs in the fields of electrical and mechanical engineering. It is being shown that ODEs are useful for elucidating ideas in thermodynamics and other physical phenomena. This illustrates their wide range of uses in several scientific and engineering domains. To evaluate and forecast the behaviors of systems in mechanical and electrical contexts, the study highlights the significance of creating mathematical models using ODEs.The importance of ordinary differential equations. Engineering applications are highlighted in the study, particularly for the modeling and resolution of issues about mechanical motion, electrical flows, and thermodynamic principles. It shows that ODEs are vital for both theoretical analysis and everyday life engineering jobs, hence improving their extensive usefulness in dealing with intricate phenomena in a variety of areas. In light of ODEs' crucial role in technological advancements; the paper encourages further research into its app in engineering problem-solving.

K. Jyothi's paper [9] "A Study on Differential Equations (Exactness)" paper provides an introductory review of differential equations, emphasizing their kinds, definitions, and solutions. It describes how differential equations, especially precise equations, can be solved. There is talk on how to use integrating factors to determine solutions and verify accuracy. The article [9] provides real-world examples that show how to use integrating factors to solve differential equations and evaluate for accuracy. It places heavily on methodical approaches to broad solutions.

In both theoretical and applied mathematics, differential equations are portrayed as powerful weapons that are necessary for comprehending and forecasting behavior in a wide range of scientific fields. The study underlines the basic role of differential equations in mathematics as well as its wide range of applications in resolving practical issues in an array of fields.

II. CONCLUSION

Applications of first-order ordinary differential equations (ODEs) to real-world systems, such as mathematical modeling, cardiac tissue dynamics, cancer treatment, and biological knowledge, are the main topic of the numerous publications that are provided. Utilizing Newton's law of cooling to estimate the time of death, population growth and decay analysis, drug distribution, carbon dating, wave propagation, aerodynamics, material casting, electromagnetic, rocket launch trajectory analysis, space vehicle motion, heat transfer, and temperature issues are just a few of the specific applications of ODEs. The papers stress how important it is to create mathematical models that use the differential equation framework to solve real-life situations. The intricacy of analytical solutions and the requirement for cooperation between modeling, exploration, and clinical practice are challenges to using ODEs in the medical field. Utilizing sophisticated computational models and combining machine learning and differential equation methodologies could increase our understanding of and abilities to treat biological conditions.

REFERENCES

[1] Mahata, G., Raut, D., Parida, C., Baral, S., & Mandangi, S. (2022). Application of first-order differential equations. International Journal of Engineering Science Technologies, 6(5), 23-33. https://doi.org/10.29121/ijoest.v6.i5.2022.402

[2] Shior, M., Agbata, B., Ezeafulukwe, A., Topman, N., Mathias,, A., & Ekwoba,, L. (2024). Applications of first-order ordinary differential equations to real-life systems. European Journal of Statistics and Probability, 12(2), 43-50. https://doi.org/10.37745/ejsp.2013/vol12n24350

[3] Zheng, B. (2023). Ordinary differential equation and its application. Highlights in Science, Engineering and Technology, 72, 645-651. https://doi.org/10.54097/rnnev212

[4] Rehan, Z. (2020). Application of first-order differential equation to heat convection in fluid. Journal of Applied Mathematics and Physics, 08(08), 1456-1462. https://doi.org/10.4236/jamp.2020.88111

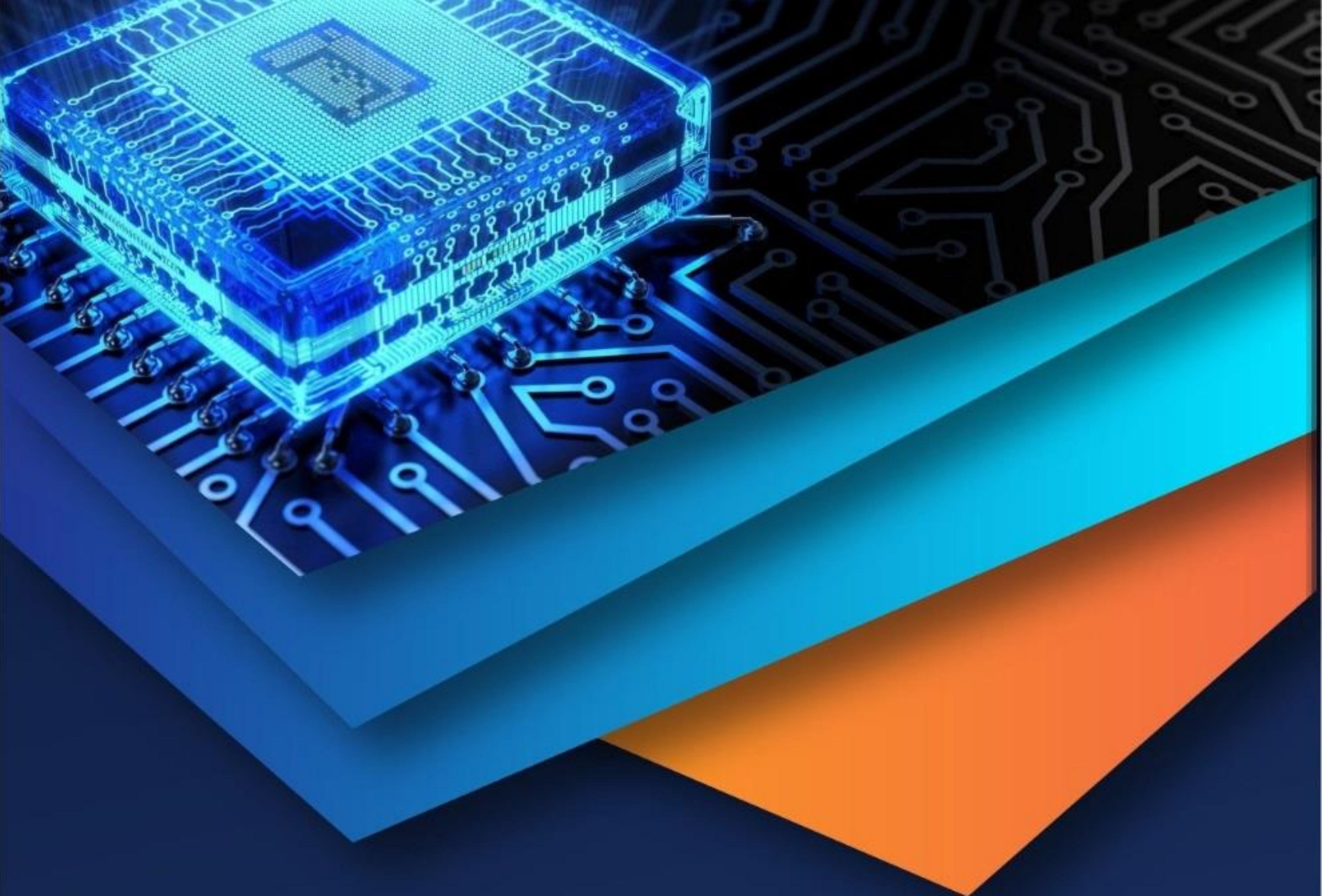
[5] Y. D Teja[2022] IJCRT | Volume 10.6084/m9.doi.one.IJCRT2212674, ISSN: 2320-2882

[6] Meng Liu(2020)Applications of Ordinary Differential Equations in Mathematical Modeling, International Journal of New Developments in Engineering and Society, ISSN 2522-3488 Vol. 4, Issue 2: 102-107, DOI: 10.25236/IJNDES.040220

[7] S.N.More, P. (2024). Application of ordinary differential equation. INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH IN ENGINEERING AND MANAGEMENT, 08(11), 1-5. https://doi.org/10.55041/ijsrem39291

[8] MARTHA XIMENA DÁVALOS VILLEGAS et al. (2023). Use of ordinary differential equations applied to mechanical and electrical problems with first-order linear systems. Russian Law Journal, 11(7s). https://doi.org/10.52783/rlj.v11i7s.1449

[9] K.Jyothi[2023] A Study on Differential Equations (Exactness) IJNRD, ISSN: 2456-4184 | IJNRD.ORG



10.22214/IJRASET

45.98

IMPACT FACTOR:
7.129

IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY