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PROCEEDINGS OF JOHOR INTERNATIONAL INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2024 (JIICaS 2024)



*“Flourish and Nurturing Sustainable
Innovation for a Prosperous Nation”*

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Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector



Assalamualaikum warahmatullahi Wabarakatuh,
Salam Sejahtera, Salam Malaysia MADANI and
Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most
Merciful.

It is a great honor to welcome you to the Johor
International Innovation, Invention, Competition, and
Symposium 2024 (JIICaS 2024). This event

connects various disciplines, focusing on education and engaging educators,
students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and
determination to turn those ideas into reality. The remarkable projects
showcased today highlight the dedication and spirit of all participants.
Initiatives like this not only explore new technologies but also cultivate skills
and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor
Branch, we are fully committed to fostering a dynamic culture of innovation,
promoting the commercialization of new products, and encouraging
meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all
sponsors, judges, the College of Computing, Informatics and Mathematics,
UiTM Pasir Gudang Campus as the event organizer, as well as to the
researchers and participants for their hard work in making this event a
success. Let us continue striving for innovation and excellence. May the
ideas presented today inspire us and lay the groundwork for future
achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
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(A-ST053) T.I. CALC: TOPOLOGICAL INDICES CALCULATOR APP

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ABSTRACT

Calculator apps are digital tools that can be used on mobile devices, tablets, or computers for performing mathematical calculations. MATLAB has become widely recognised as a powerful tool for developing calculator apps, utilising MATLAB App Designer's advanced capabilities. Topological indices are numbers that describe the topology of a graph and its properties. Over the last two decades, researchers have successfully correlated numerous topological indices with a variety of physical and physicochemical properties. The most significant types of topological indices of graphs are degree-based and distance-based topological indices. The degree-based topological indices studied in this research include the first general Zagreb index, the zeroth-order Randić index, and the reduced first Zagreb index. The distance-based topological indices include the Wiener index, the hyper-Wiener index, and the Harary index. In graph theory, a zero divisor graph is one in which the vertices are the zero divisors of a ring, and two vertices are adjacent if their product is zero. The set of vertices, the set of edges, and the degree of a vertex in the zero divisor graph for the integers modulo ring are determined in order to generate the programming code for the calculator app. This code is based on basic definitions and previous results in graph theory and ring theory. The development of this topological indices calculator app, which is named as T.I. CALC, uses MATLAB App Designer with user-friendly interfaces and features for computing the topological indices. This app has the capability of visualising and displaying the results.

Keywords: Topological Index, Zero Divisor Graph, Commutative Ring, MATLAB App Designer

1.0 INTRODUCTION

In the field of chemistry and materials science, topological indices are crucial in predicting the properties of molecules and materials. Topological index is a function that assigns a numeric value to a (molecular) graph that predicts its various physical and structural properties. This work can help the chemists and biologists to analyse the physical properties of the molecule in the simplest way without involving any laboratory work. The main difficulty in computing topological indices arises from the requirement for accurate and efficient mathematical techniques.

T.I. CALC, a topological indices calculator app, has been created to overcome these challenges by utilising the features of MATLAB App Designer. The app is intended to simplify and enhance the process of computing topological indices by

offering a user-friendly interface and robust computational capabilities. This app not only saves time but also enhances the accuracy and reliability of the results. This feature enhances the user's understanding and interpretation of the data, making T.I. CALC a valuable tool for both educational and research purposes.

The motivation behind developing T.I. CALC is to provide an accessible and efficient tool for computing these indices, particularly for degree-based and distance-based indices. The degree-based topological indices included in this study are the first general Zagreb index, the zeroth-order Randić index, and the reduced first Zagreb index. The distance-based topological indices consist of the Wiener index, the hyper-Wiener index, and the Harary index. It is specifically designed for computing topological indices of the zero divisor graph of integers modulo ring. The algorithms using MATLAB App Designer for T.I. CALC is based on fundamental definitions and existing results from graph theory and ring theory.

2.0 OBJECTIVES

The objectives in developing the T.I. CALC are stated as follows:

- i) To build new algorithms in T.I. CALC using MATLAB App Designer based on the general formulas of topological indices.
- ii) To design comprehensive and user-friendly interfaces, allowing users to easily interact with the calculator app.
- iii) To obtain and visualise the properties of the zero divisor graph for the ring and to calculate the topological indices of the graph.

3.0 METHODOLOGY

The methodology for developing T.I. CALC begins with determining the general formulas for some properties of the zero divisor graph for integers modulo ring, specifically the set of vertices, the set of edges, and the degree of a vertex. Subsequently, the general formulas for degree-based and distance-based topological indices are derived. Once these formulas are established, new algorithms are developed and implemented within the MATLAB environment using MATLAB App Designer. The user interface is designed to be clean and intuitive, allowing users to easily input data, perform calculations, and view the results. The design process utilizes drag-and-drop components and customizes their behaviour, incorporating features like custom input fields, advanced mathematical functions, and a user-friendly interface to enhance accessibility and ease of use. Thorough testing is conducted to ensure the app's accuracy and functionality, with results validated against known values from the literature or manual calculations. T.I. CALC ultimately provides a valuable tool for the rapid computation and analysis of topological indices, benefiting research in fields such as theoretical chemistry, network analysis, and other fields.

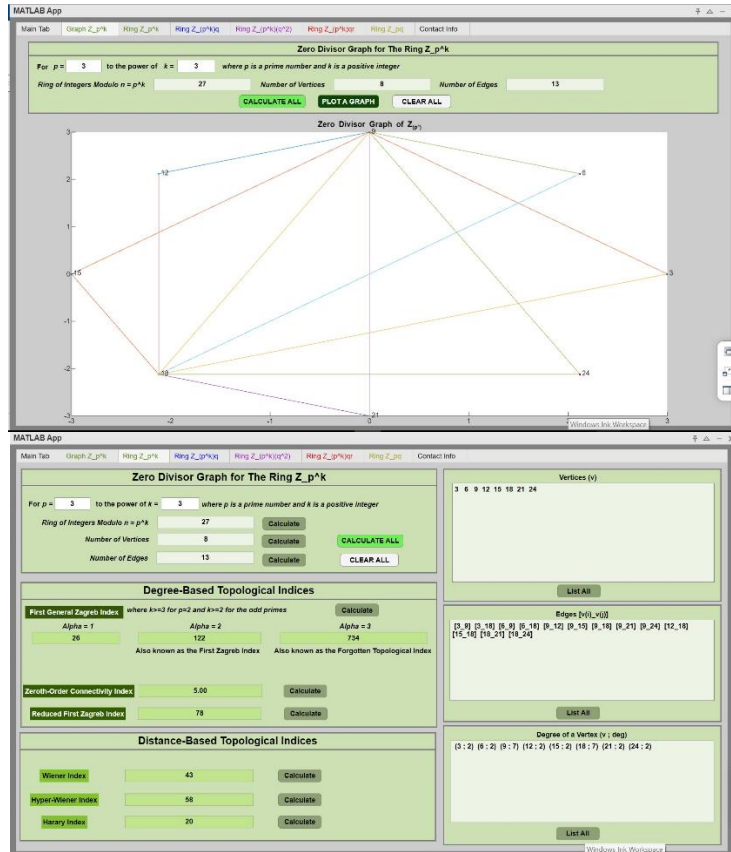


Figure 1: The user-friendly interface of T.I. CALC

4.0 RESULTS

Some advantages and novelty of T.I. CALC are included as follows:

- **Advantages**
 - i) **Efficient and Accurate Computation:** The algorithms of the calculator app are designed to efficiently compute topological indices, ensuring quick and accurate results.
 - ii) **Visualization Capabilities:** Its ability to provide visual representations of graph and the calculated topological indices.
- **Novelty**
 - i) T.I. CALC using MATLAB App Designer as the development base applies advanced concepts from graph theory and ring theory, particularly in calculating and visualisation tools of topological indices
 - ii) An amazing educational tool that can be used to explore and analyse graph features and encouraging future study in topological indices.

5.0 CONCLUSION

In conclusion, T.I. CALC is an innovative application that addresses the need for a specialized tool to compute and visualise topological indices of a graph. This calculator app is comprehensive and easy to use for researchers and students studying ring theory, graph theory and topological indices.