PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON ADVANCEMENTS IN APPLIED MATHEMATICS (ICAAM'24)

25TH OCTOBER 2024

Organized by

DEPARTMENT OF MATHEMATICS

S.I.V.E.T. COLLEGE

(Affiliated to University of Madras)

Gowrivakkam, Chennai-600073 Tamil Nadu, India

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Dr. R. Ezhilarasi, M.Sc., M.Phil., Ph.D.,

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ICAAM'24

in honour of

Dr. K. THIRUSANGU, M.Sc., M.Phil., Ph.D.,

Former Principal, Head-Department of Mathematics

Dean-Research and Development Cell

S.I.V.E.T. COLLEGE

INVITED SPEAKERS

Prof.S.Sanjeewa Perera
Prof. & Head, Department of Mathematics
University of Colombo
Srilanka.

Dr. Prabhath Liyanage
Senior Lecturer,
Department of Mathematics
University of Colombo
Srilanka

Dr. B. J. Balamurugan,
Associate Professor,
School of Advanced Sciences/Mathematics
Vellore Institute of Technology
Chennai

DATES TO REMEMBER

Submission of the abstract	: 17-08-2024
Acceptance Notification	: 20-08-2024
Last date for Registration	: 18-10-2024
Submission of full Paper	: 05-09-2024
Conference Date	: 25-10-2024

REGISTRATION FEE

For paper Presentation	**: Rs.750/-**
For Participation	
Faculty / Academicians / Industrialists	**: Rs.500/-**
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INTERNATIONAL CONFERENCE ON ADVANCEMENTS IN APPLIED MATHEMATICS

ICAAM'24

25th October 2024

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S.I.V.E.T. COLLEGE
GOWRIVAKKAM
Chennai-600073, Tamil Nadu, INDIA

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ABOUT THE COLLEGE

S.I.V.E.T. College came into existence with a site of 28 acres assigned to the Trust by the Government of Tamil Nadu at Gowrivakkam in July 1966 situated in a semi-urban rural environment with a modesty constructed. The college affiliated to University of Madras offers 8 UG courses in History, Economics, Mathematics, Commerce, Physics, Chemistry, Zoology, Corporate Secretary ship and 2 PG courses in Mathematics and Commerce in shift I. In addition to, Shift-II [Self-Financed Stream] also has Thirteen U.G. programs and three P.G. programs.

The college offers full time and part time Ph.D., programs in Mathematics and Commerce as well as part time Ph.D., Programs in History, Economics and Tamil. At present, S.I.V.E.T. College has nearly 4000 students including both boys and girls on its rolls.

Thiru C.Ramakrishnan is the President of the S.I.V.E.Trust, Thiru.C.Madasamy, B.Sc.,F.C.A., the Secretary of the S.I.V.E.Trust and Thiru. D.Balakrishnan, the Treasurer of S.I.V.E.Trust. The college is ably administered by the College committee with Thiru.S.P.Kuppusamy, B.Com.,M.B.A., President of the college and is steered towards excellence by Mr.P.Sundara Raman, M.B.A., Secretary of the College.

ABOUT THE DEPARTMENT

Mathematics was introduced as a subject in the college at the Pre-University level in the year 1966. B.Sc., Mathematics degree course was introduced in the year 1971 and M.Sc., Mathematics degree course was started in the year 1986. M.Phil., degree course (Full-Time) in Mathematics was started in the year 2013 with a sanctioned strength of 8 students each year. The department has been recognized to conduct Ph.D., (Part-Time) programme and Ph.D., full time programme under University of Madras, since 2002 and 2022 respectively. The department conducts research activities in the areas of Geometric Function Theory and Graph Theory.

The department is on a relentless march towards academic excellence. With the team of dedicated faculty, the department strives to equip the students with a strong foundation in basic Mathematical concepts and their applications which will aid them to find jobs and also create interest for pursuing research. Our department students have secured University ranks at both UG and PG level. Some of our students have qualified in SLET/CSIR UGC NET examinations and are employed as teachers in Government/Aided/Private Colleges.

ABOUT THE CONFERENCE

This Conference aims to provide a forum to interact and share the knowledge of the academicians and research scholars of various research institutions and colleges among them. The experts in the field of applied Mathematics will deliver talks on current developments and applications in their subjects so that the participants will be motivated to enhance research in their area of study.

LINK FOR REGISTRATION
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CALL FOR PAPERS

Prospective authors are invited to submit Extended Abstract of their original and unpublished research work for oral presentation in the conference in the areas, but not limited to the following:

1. **Algebra & Analysis**
2. **Computational Mathematics**
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4. **Fuzzy sets & Applications**
5. **Graphtheory**
6. **Mathematical modeling & Simulation**
7. **Mechanics**
8. **Fluid Dynamics**
9. **Numerical Analysis**
10. **Operations Research**
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12. **Topology**

SUBMISSION OF PAPERS

The Abstract in MS Word format, Times New Roman, Font 12 with 1.5 line spacing, not exceeding 1000 words, restricted to A4 size including title of the paper, name, affiliation, postal address, and email address for each author should be sent to sivetmathsicaam@gmail.com . All papers presented in ICAAM 2024 will be published in the Conference Proceedings with ISBN number. The reviewed selected papers will be published in Journals which are in UGC CARE List.

Registration is compulsory for all the participants.
Payment to be made Online and the bank details are:

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Cordially invite you to the Inauguration of

International Conference on Advancements in Applied Mathematics (ICAAM'24)

at 9.00 a.m. on Friday 25th October 2024 in the PTR Auditorium, Main Block.

Dr. R. Saravanan, M.C.S., Ph.D.,
Principal i/c,
S.I.V.E.T. College Presides

Thiru. S. P. Kuppuswamy, B.Com., M.B.A.,
President, S.I.V.E.T. College
will deliver the Special Address

Thiru. P. Sundara Raman, M.B.A.,
Secretary, S.I.V.E.T. College
will deliver the Keynote Address

Chief Guest
Prof. Sanjeewa Perera,
Professor and Head
Centre for Mathematical Modeling
Department of Mathematics, University of Colombo
Sri Lanka.
will deliver the Inaugural address

Thiru. P. Sundara Raman, *M.B.A.,*
Secretary, S.I.V.E.T.College

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Principal i/c, S.I.V.E.T.College

Dr. R. Ezhilarasi, *M.Sc., M.Phil., Ph.D.,*
Associate Professor & Head
Department of Mathematics
S.I.V.E.T.College.

PROGRAMME

SESSION -I		
8.30 a.m - 9.00 a.m	***REGISTRATION***	
9.00 a.m - 10.00 a.m	***INAUGURATION*** *Welcome Address* : **Dr. R. Ezhilarasi** *Vision of the conference* : **Dr. E. Esakkiammal** *Presidential address* : **Dr. R. Saravanan** *Special address* : **Thiru. S.P. Kuppusamy** *Keynote address* : **Thiru. P. Sundara Raman**	
10.00 a.m-11.00 a.m	*Inaugural address & Invited Lecture -I*	**Prof. Sanjeewa Perera,** Professor and Head, Centre for Mathematical Modeling, Department of Mathematics, University of Colombo, Sri Lanka.
11 a.m - 11.15 a.m	*TEA BREAK*	
SESSION – II		
11.15 a.m – 12.15 p.m	*Invited Lecture -II*	**Dr. Prabhath Liyanage** Senior Lecturer, Centre for Mathematical Modeling, Department of Mathematics, University of Colombo, Sri Lanka.
12.15 p.m – 1.15 p.m	*Paper Presentation (Parallel sessions)*	
1.15 p.m - 2.00 p.m	*LUNCH BREAK*	
SESSION -III		
2.00 p.m - 3.00 p.m	*Invited Lecture-III*	**Dr. B. J. Balamurugan** Associate Professor, Senior, Department of Mathematics, School of Advanced Studies, VIT University, Chennai-127
3.00 p.m - 3.15 p.m	*TEA BREAK*	
SESSION - IV		
3.30 p.m	***VALEDICTORY FUNCTION*** *Chief Guest* : **Dr. S. Narayanamoorthy** Associate Professor, Bharathiar University, Coimbatore - 641046 *Felicitation* : **Dr. R. Panneer Selvam** Director, S.I.V.E.T. College *Vote of thanks* : **Dr. D. Nithya** Assistant Professor & Head (SF) Department of Mathematics, S.I.V.E.T. College.	

Paper Presentation Schedule on 25-10-2024

Parallel Session -I : **12.15p.m - 1.15 p.m**

Chair Person : **Dr. S. Sunil Varma**

Co-Chair Person : **Ms. J. Gomathi**

Title of the papers with authors name

1. ICAAM'24-P02: Certain Subclasses of k-uniformly Janowski starlike and the k-Janowski convex functions related to Pascal distribution series.
   S. Karthikeyan and V. K. Balaji

2. ICAAM'24-P03: Estimation of coefficient and second Hankel determinant for certain class of bi-univalent function defined on Leaf-like domain.
   P. Kavitha and V.K. Balaji

3. ICAAM'24-P04: Subclass of functions analytic with respect to symmetric and conjugate points associated with Leaf-like domain.
   Thomas Rosy and Sharon Ancy Josh

4. ICAAM'24-A05: Applications of (P,Q)- Gegenbauer polynomials on a family of bi-univalent function associated with the Hohlov operator.
   D. Balaji and V.K. Balaji

5. ICAAM'24-P12: Hermitian Toeplitz Determinants for a Certain Class of Close-to-Star Functions defined by Subordination.
   S. Kalaiselvan, K. Suchithra, T. Thulasiram and T. V. Sudharsan

6. ICAAM'24-A16: Coefficient bounds for certain subclasses of quasi-convex functions associated with Carlson-Shaffer operator.
   R. Sathish Srinivasan, R. Ezhilarasi and T.V. Sudharsan

7. ICAAM'24-P19: A study of harmonic starlike functions with respect to symmetric points using Mathieu-type series.
   E. Rajathi, R. Ezhilarasi and T.V. Sudharsan

8. ICAAM'24-A23: Toeplitz determinants for a certain subclass of analytic functions in a Limacon domain.
   Mehdha, R. Ezhilarasi and T.V. Sudharsan

Paper Presentation Schedule on 25-10-2024

Parallel Session –II : **12.15 p.m - 1.15 p.m**

Chair Person : **Dr. S. Hemalatha**

Co-Chair Person : **Mrs. P. Gayathri Priya**

Title of the papers with authors name

1. ICAAM'24-P09: Some Similarity Measures of fuzzy quadrigeminal sets based on normalized Euclidean distance and their application in determining the level of intellectual deficiency based on IQ range.
   G. Albert Asirvatham and R. Alagar

2. ICAAM'24-A17: New form of separation axioms in fuzzy soft sequential topological space.
   K. Japhia Tino Mercy and K. Bageerathi

3. ICAAM'24-A18: Network Topology - S. Kruthika

4. ICAAM'24-A20: Stability of a Ramanujan type additive functional equation in random Banach space.
   M. Arunkumar, E. Sathya and T. Namachivayam

5. ICAAM'24-A21: Approximations of a quadratic functional equation in quasi beta Banach space.
   M. Arunkumar, V. Chandiran and E. Sathya

6. ICAAM'24-A22: System of additive functional equations in Modular space.
   M. Arunkumar, T. Velmurugan and E. Sathya

7. ICAAM'24-P24: Fuzzy stability of a alternate cubic functional equation.
   M. Arunkumar, V. Alexpandiyan and E. Sathya

8. ICAAM'24-A31: Mathematical modeling for economic variables: A key for decision making.
   D. Bharathi and V. Nalini

Paper Presentation Schedule on 25-10-2024

Parallel Session -III : **12.15 p.m - 1.15 p.m**

Chair Person : **Dr. G. Uthra**

Co-Chair Person : **Ms. L. Preethi**

Google Meet Link : **https://meet.google.com/hsi-foov-ehb**

Title of the papers with authors name

1. ICAAM'24-A11: A sustainable three-level production inventory of cement works under Weibull distribution in Trapezoidal fuzzy numbers.
   P. Saranyaa and C. Sugapriya

2. ICAAM'24-A13: An Efficient Economic Order Quantity Model to obtain the optimal policy for the Retailers in an Online Platform
   C. Sugapriya and A. Fariya Azleena

3. ICAAM'24-A25: A Multi Criteria Decision Making Model using Hybrid AHP-WASPAS Technique under Fermatean Fuzzy Set.
   Ijaz Babu and Samayan Narayanamoorthy

4. ICAAM'24-A26: A unified entropy-Codas approach under cubic bipolar fuzzy environment to solve a multi criteria decision making problem.
   Kannusamy Aarthi and Samayan Narayanamoorthy

5. ICAAM'24-A27: An integrated entropy-Vikor method under normal Wigglyhesitant Pythagorean fuzzy set to solve a MCDM Problem.
   Antony Samy Christina and Samayan Narayanamoorthy

6. ICAAM'24-A28: A hybrid critic-spotis approach in optimal decision making frame work under bipolar picture Fuzzy environment.
   Navaneethakrishnan Suganthi Keerthana Devi and Samayan Narayanamoorthy

7. ICAAM'24-A29: An enhanced fuzzy-rough model for selecting optimal drilling techniques in Geothermal reservoirs.
   Michael Sandra, Samayan Narayanamoorthy and Krishnan Suvitha

8. ICAAM'24-A30: Evaluation of municipal solid waste for energy generation through a fuzzy decision approach.
   Chakkarapani Sumathi Thilagasree, Krishnan Suvitha and Thippan Jayakuma

Paper Presentation Schedule on 25-10-2024

Parallel Session -IV : **12.15 p.m - 1.15 p.m**

Chair Person : **Dr. Baby Smitha K.M.**

Co-Chair Person : **Mrs. S. Kavitha**

Title of the papers with authors name

1. ICAAM'24-P01: (S, d) Magic Labeling of non-unicyclic graphs- Paper II.

   P. Sumathi and P. Mala

2. ICAAM'24-A06: Total Chromatic Number of Extended Duplicate Graphs.

   K. Thirusangu, M. Vimala Bai and Balachandra Pattanaik

3. ICAAM'24-P10: Odd Graceful Labeling in the context of super subdivision of Cycle-related graphs.

   D. Devakirubanithi and J. Jeba Jesintha

4. ICAAM'24-A14: Developing Dengue Risk Index: Data from Western Province Sri Lanka.

   Chamila Niroshanie , Hasitha Erandi, Sanjeewa Perera and Yashika Jayathunga

5. ICAAM'24-A07: Total Chromatic Number of Comb Product of Bi-Graph with new graphs

   K. Thirusangu, M. Vimala Bai and P.Vijayakumar.

6. ICAAM'24-P15: Identifying Dengue Hot-spots in Sri Lanka: An Agent-based Models.

   Yasuri Wickramasinghe, Hasitha Erandi, Pushpi Paranamana and Sanjeewa Perera

7. ICAAM'24-A08: Total Chromatic Number of Comb Product of Diamond graph with some various graphs.

   K. Thirusangu, M. Vimala Bai and H. R. Bhapkar

Invited Talk I

NATURAL DISASTER MODELING: DROUGHT SEVERITY

Sanjeewa Perera

Professor of Mathematics (Chair)

Director | Centre for Mathematical Modeling, Head | Department of Mathematics, University of Colombo, Colombo 03, Sri Lanka.

Drought is an escalating global concern that is becoming more severe as a result of ongoing climate change. Accurately identifying drought conditions requires an in-depth analysis of meteorological factors and their changing patterns. In this study, we aim to improve upon the commonly used Standardized Precipitation Index (SPI) by incorporating additional data, specifically ground temperature measurements, alongside advanced statistical techniques like copulas. This combination allows for the development of a more comprehensive and nuanced metric to evaluate the severity of droughts.

The use of copulas in this context enables us to model the dependency between precipitation and temperature, effectively capturing the joint behavior of these two variables under drought conditions. By accounting for both precipitation deficits and temperature increases, our enhanced metric provides a more accurate representation of drought severity. This dual assessment evaluates both the intensity and duration of drought episodes, offering a deeper understanding of how prolonged periods of low rainfall and high temperatures interact to exacerbate droughts.

This new metric is applied to the main paddy cultivation region in Sri Lanka, where paddy crops are particularly vulnerable to water shortages and high temperatures. By doing so, we aim to offer clearer insights into the drought conditions that negatively impact agricultural productivity. Moreover, the refined metric is calibrated against historical drought records to ensure its accuracy and reliability in real-world applications.

Finally, comparison made between the results obtained from our enhanced metric with those produced by the traditional SPI, showcasing the benefits of using copula-based methodologies. This comparison highlights potential improvements in assessing drought severity, which can be critical for agricultural planning, resource management, and mitigating the adverse effects of future drought events.

Keywords: Drought, Model, Copulas, SPI

Invited Talk II

RECENT ADVANCEMENTS OF ARTIFICIAL INTELLIGENCE IN MEDICAL DIAGNOSIS

Uditha Prabhath Liyanage

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In general, medical diagnostics is simply a process of evaluating medical conditions or diseases by analyzing symptoms, medical history, and medical examination results. The major objective of the medical diagnosis is to rectify the cause of a medical illness and, thereby, carry out proper and effective treatments to cure the patient. The medical diagnosis is processed by observing symptoms, and additional diagnostics tests such as blood tests, biopsy procedures, or imaging tests, e.g. MRI, CT scans, and X-rays. Often, these tests are performed by qualified medical professionals, and the diagnostic process is done by a qualified medical doctor or a panel of doctors. Further, a sequence of medical tests and the associated diagnostics may be performed to monitor the patient concerning any side effects or complications of the treatment procedure. As early detection of some diseases (cancer, diabetes, heart problems) or as prevention measures of diseases, medical tests and diagnosis are conducted.

With the advancement of Artificial Intelligence (AI), the AI assists in the medical diagnostic process, by improving the prediction accuracy, speed, and efficiency. At present, AI is intensively used in medical image analysis in oncology, respiratory disorder recognition, virology, and heart disease recognition. AI algorithms use large amounts of patient data including medical images, bio-signals, patient symptoms, demographic information, laboratory test results, and medical history, leading to a better accuracy in decision making.

In this context, we have introduced an AI-aided procedure in pneumonia severity stage recognition of COVID-19 patients' respiratory disorders. Patients' lung CT-Scan images were analyzed using deep learning algorithms towards the severity stage determination. The analysis led to over 90% accuracy based on the obtained image datasets. Further, in the field of oncology, ovarian cancer diagnosis, and pelvis cancer diagnosis, we developed AI procedures with over 85% accuracy using histopathological images. However, AI is there only to assist medical and healthcare professionals in their judgments instead of making decisions by AI procedure on its own.

Invited Talk III

EXPLORING TOPOLOGICAL DESCRIPTORS IN ISOMORPHIC MOLECULAR GRAPHS

Dr. B. J. Balamurugan

Associate Professor Senior, Department of Mathematics, School of Advanced Sciences, Vellore Institute of Technology, Chennai Campus
Chennai-600 127, India.

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Chemical graph theory is a branch of mathematics that merges graph theory with chemistry, using graphs to model chemical molecules and provide insights into their physicochemical and pharmacokinetic properties. Let M represent a chemical molecule. The corresponding isomorphic molecular graph of M is G(V, E), where V denotes the set of atoms (vertices), and E represents the bonds (edges) between the atoms. These bonds may be single, double, or triple, corresponding to single, double, or triple edges, respectively. An emerging subfield of chemical graph theory, known as cheminformatics, focuses on quantitative structure-activity relationships (QSAR) and quantitative structure-property relationships (QSPR) of chemical compounds. A key tool in this field is the topological graph index, or topological descriptor, which is a numerical value derived from the structure of a molecular graph G = (V, E). These indices are crucial for performing QSAR and QSPR analyses.

Numerous topological indices have been developed [1,2], classified based on the structural properties of the graphs used. For instance, the Hosoya index counts non-incident edges, the Estrada index is based on the graph's spectrum, and indices such as the Randić connectivity and Zagreb indices are computed using vertex degrees. One of the most widely recognized topological indices is the Wiener index, introduced in 1947 by Harold Wiener[3], which measures the topological distance between vertices and was originally used to compare the boiling points of alkane isomers. Today, over 3,000 topological indices are documented in chemical databases, making this area a significant research focus for both mathematicians and chemists. Molecular topological indices are now of great multidisciplinary interest due to their wide range of applications. With rapid technological advances, especially in chemistry and pharmaceuticals, numerous new nanomaterials, crystalline materials, and drugs are synthesized annually. Testing the chemical properties of these new compounds requires numerous experiments, which can be labor-intensive. However, research has revealed

a strong correlation between molecular topology and properties such as melting point, boiling point, and drug toxicity.

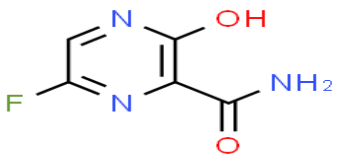
Topological indices have proven useful in QSPR/QSAR studies, helping to correlate physicochemical properties with biological activity. These indices are classified into major categories: count-based, degree-based, and distance-based. Direct computation of topological indices from molecular graphs can be complex, but algebraic polynomials, such as the M-polynomial[4] and NM-polynomial[5], simplify the process. Degree-based topological indices, in particular, are important in chemical graph theory for evaluating chemical compounds and drugs, especially in pharmaceutical engineering. The study of these indices provides a theoretical foundation for the development of new drugs and chemical materials. Recently, many researchers have explored topological indices for antiviral, anticancer, COVID-19, antituberculosis, Zika virus, and asthma drugs to develop QSPR models using linear, quadratic, and cubic regression analyses. These models establish relationships between the physicochemical properties of drugs and their corresponding topological indices.

Kirmani et al. [6] performed QSPR and QSAR analyses using multiple linear regression to investigate the correlation between degree-based topological indices and the physicochemical properties of several COVID-19 drugs. Similarly, M. C. Shanmukha et al. [7] conducted QSPR analysis using a linear regression model for anticancer drugs. Havare [8] designed a QSPR model based on degree-based, Mostar-type, and distance-based topological indices for drugs used in the treatment of COVID-19, employing a curvilinear regression method. In another study [9], a QSPR model was developed using degree-based and neighborhood degree-based topological indices for novel cancer treatments, also utilizing the curvilinear regression approach.

Furthermore, a QSPR analysis of drugs used in the treatment of breast cancer, based on well-known degree-based topological indices, revealed that certain indices showed a high correlation with the physicochemical properties of the drugs [10]. Zhong et al. [11] investigated the QSPR analysis of valency-based topological indices for COVID-19 drugs and found these indices to be effective predictors in QSPR studies. Recently, degree-based topological indices and Revan indices were used to design QSPR models for the ADMET properties of anti-COVID drugs targeting the Omicron variant, as well as Zika virus drugs [12,13]. Thus, topological indices play a significant role in mathematical chemistry, particularly in QSPR/QSAR studies.

Example:

Chemical structure and Isomorphic molecular graph of Favipiravir (COVID-19 drug)



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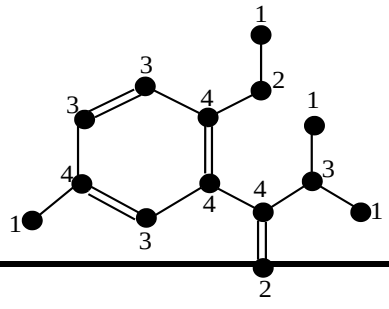

Computation from direct formula:

The first Zagreb index of the Molecular graph of Favipiravir is

$$M_1(G) = \sum_{v_i \in V(G)} d_i^2$$

= 1+4+16+16+16+4+9+1+1+9+9+9+16+1
= 112

Computation from M-polynomial:

The first Zagreb index is $M_1(G) = \left(D_x + D_y\right)(f(x,y))|_{x=y=1}$

Definition of M-Polynomial:

$M(G;x,y) = f(x,y) = \sum_{\delta \le i \le j \le \Delta} e_{i,j} x^i y^j$ where $e_{i,j}$, $i,j \geq 1$, is the number of edges $uv \in E$(G) and $(d_u, d_v) = (i,j)$, d_u and d_v represent the degree of the vertices u and v respectively and $(\delta, \Delta) = (\min d_v , \max d_v)$ where $u, v \in V$(G).

where, $D_x = x\left(\frac{\partial(f(x,y))}{\partial x}\right)$, $D_y = y\left(\frac{\partial(f(x,y))}{\partial y}\right)$

Table 2.1. Edge partition of the molecular graph of Favipiravir.

(d_u, d_v)	Number of edges $(e_{i,j})$
(1,2)	1
(1,3)	2
(1,4)	1
(2,4)	3
(3,3)	2
(3,4)	6
(4,4)	3
Total number of edges	18

$M(G;x,y) = f(x,y) = x\,y^2 + 2x\,y^3 + x\,y^4 + 3x^2y^4 + 2x^3y^3 + 6x^3y^4 + 3x^4y^4$

$D_x\left(f(x,y)\right) = x\,y^2 + 2x\,y^3 + x\,y^4 + 6x^2y^4 + 6x^3y^3 + 18x^3y^4 + 12x^4y^4$

$D_y\left(f(x,y)\right) = 2x\,y^2 + 6x\,y^3 + 4x\,y^4 + 12x^2y^4 + 6x^3y^3 + 24x^3y^4 + 12x^4y^4$

$M_1(G) = \left(D_x + D_y\right)(f(x,y))|_{x=y=1} = 112$

References:

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(S, d) MAGIC LABELING OF NON- UNICYCLIC GRAPHS PAPER –II

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Let G (p, q) be a connected, undirected, simple and non-trivial graph with p vertices and q edges. Let f be an injective function f: V(G) $\rightarrow \{s, s+d, s+2d \ldots s+(q+1)d\}$ and g be an injective function g: E(G) $\rightarrow \{d, 2d, 3d \ldots . 2(q-1)d\}$.Then the function f is said to be (s, d) magic labeling if $f(u)+g(uv)+f(v)$ is a constant, for all $u, v \in V(G)$ and $uv \in E(G)$. A graph G is called (s, d) magic graph if it admits (s, d) magic labeling.

In this study, a (s, d) Magic Labeling has been discovered for a few graphs. Future research will examine the (s, d) Magic labeling of additional graphs and some graph families.

Keywords: Shell graph, Jelly fish graph, Shell butterfly graph and Jahangir graph.

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CERTAIN SUBCLASSES OF K-UNIFORMLY JANOWSKI STARLIKE AND THE K- JANOWSKI CONVEX FUNCTIONS RELATED TO PASCAL DISTRIBUTION SERIES

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The purpose of the present paper is to find a necessary and sufficient conditions and inclusion relations of the function defined by

$$Q_q^m(z) = z + \sum_{n=2}^{\infty} \binom{n+m-2}{m-1} q^{n-1}(1-q)^m z^n$$

to be in some subclasses of analytic univalent functions of k-uniformly Janowski starlike and the k-Janowski convex functions in the open unit disk U. Further, we consider an integral operator related to the Pascal distribution series and several corollaries of the main results are also considered.

SUBCLASS OF FUNCTIONS ANALYTIC WITH RESPECT TO SYMMETRIC AND CONJUGATE POINTS ASSOCIATED WITH LEAF LIKE DOMAIN

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In this research article, by making use of the principle of subordination between analytic functions of a class with respect to symmetric and conjugate points associated with a leaf like domain in the unit disc is considered. We derive the coefficient estimates, the Fekete- Szego inequality, Hankel determinant and the estimates of Toeplitz Determinant with respect to the defined class. As a special consequence of our result, we mention certain interesting results through corollaries.

ESTIMATION OF COEFFICIENT AND SECOND HANKEL DETERMINANT FOR CERTAIN CLASS OF BI-UNIVALENT FUNCTION DEFINED ON LEAF-LIKE DOMAIN

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In this paper we have studied the class $\mathcal{BS}(s,t,\ell_d)$ of analytic bi-univalent function of class $\mathfrak{B}$ defined on leaf -like domain in the open unit disk D.

A function $f \in \mathfrak{B}$ is a member of class $\mathcal{BS}(s,t,\ell_d)$ if it satisfies the subordination condition

$$\frac{(s-t)zf'(z)}{f(sz)-f(tz)} \prec \ell_d(z), \quad z \in D$$

$$\frac{(s-t)wF'(w)}{F(sw)-F(tw)} \prec \ell_d(w)$$

where the function $\ell_d(\mathrm{z}) = \mathrm{z} + \sqrt[3]{(1+z^3)}$, which maps the unit disc onto analytic and univalent region which has the shape of leaf-like and has symmetry with respect to real axis. Also, real part of this function is positive with conditions $\ell_d(0) = 1 = \ell_d'(0)$.

We have estimated the coefficients a_2, a_3, a_4 and its second Hankel determinant.

APPLICATIONS OF (P,Q)- GEGENBAUER POLYNOMIALS ON A FAMILY OF BI-UNIVALENT FUNCTION ASSOCIATED WITH THE HOHLOV OPERATOR

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The (p,q) - gegenbauer polynomials, which are connected to the Hohlov operator, are introduced and studied in this study for a family of analytic and bi-univalent functions defined in the open unit disc. We discover estimates for the coefficients for the new subclass's functions. A corollary was provided to demonstrate certain outcomes of a particular subclass of our new class.

TOTAL CHROMATIC NUMBER OF EXTENDED DUPLICATE GRAPHS

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The total chromatic number of a graph G is defined as the minimum number of colors required to color both the vertices and edges of G such that no two adjacent vertices, no two adjacent edges, and no incident vertex and edge share the same color. This paper, investigates the total chromatic number of various graphs, such as Extended duplicate graph of tadpole graph, Middle graph of Extended duplicate graph of tadpole graph, Total graph of Extended duplicate graph of tadpole graph, Extended duplicate graph of fan graph, Middle graph of Extended duplicate graph of fan graph, Total graph of Extended duplicate graph of fan graph, Extended duplicate graph of subdivided shell graph, Extended duplicate graph of Dutch windmill graph, Extended duplicate graph of umbrella graph, Extended duplicate graph fish graph and the Extended duplicate graph of Bi-subdivided shell graph.

TOTAL CHROMATIC NUMBER OF COMB PRODUCT OF BISTAR GRAPH WITH NEW GRAPHS

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In this paper we investigate the total chromatic number of comb products involving various graph families. The comb product between G and H, denoted by (G ▷H), is obtained by taking graph G and |V(G)| copies of H and grafting the i-th copy of H at the vertex to the i-th vertex of G. The total chromatic number of a graph G, denoted $\chi_{tc}(G)$ is defined as the minimum number of colors needed to color the vertices and edges of a graph in such a way that no two adjacent vertices, no two adjacent edges and no incident vertex and edge are given the same color.

This paper explore the total chromatic number of comb product of new graphs namely, Bi-star with star, Bi-star with cycle, Bi-fan with path, Bi-fan with cycle, Bi-fan with star, Bi-fan with fan , Bi-cycle with path, Bi-cycle with star, Bi-cycle with cycle, Bi-fish with path, Bi-fish with star, Bi-fish with cycle, Bi-fish with fan, Bi-fish with complete graph, Bi-gear with path, Bi-gear with star, Bi-gear with cycle, Bi- subdivided shell with path, Bi- subdivided shell with star, and Bi-subdivided shell with cycle graphs.

NETWORK TOPOLOGY

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Network topologies is various components of network link nodes, link, peripherals are arranged. The way of connecting the computers is called as the topology.so depending on the manner of connecting the computers we can have different network topologies. Network topology is links and nodes of a network are arranged to each other. They describe the physical and logical arrangement of network nodes. The way in which different system and node are connect and communicate with each other is determined by topology of the network. In recent days for computing, distributed computer systems are playing a vital role and popular issue. In the present paper a detailed study and analysis on network topologies is presented.

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STABILITY OF A RAMANUJAN TYPE ADDITIVE FUNCTIONAL EQUATION IN RANDOM BANACH SPACE

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In this paper, the authors trigger the generalized Ulam-Hyers stability of a Ramanujan type additive functional equation

$$R(\alpha^3 x + \beta^3 y) = \alpha^3 R(x) + \beta^3 R(y)$$

in Random Banach Space.

TOTAL CHROMATIC NUMBER OF COMB PRODUCT OF DIAMOND GRAPH WITH SPECIAL GRAPHS

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This paper investigates the total chromatic number of comb products involving various graph families. The comb product between G and H, denoted by (G ▷H), is obtained by taking graph G and |V(G)| copies of H and grafting the i-th copy of H at the vertex to the i-th vertex of G. The total chromatic number of a graph G, denoted $\chi_{tc}(G)$ is defined as the minimum number of colors needed to color the vertices and edges of a graph in such a way that no two adjacent vertices, no two adjacent edges and no incident vertex and edge are given the same color.

This paper explore the total chromatic number of comb product of new graphs namely, diamond graph with fan graph, diamond graph with wheel graph, diamond graph with comb graph, diamond graph with friendship graph, diamond graph with twig graph, diamond graph with arrow graph, diamond graph with gear graph, diamond graph with (n,1) tadpole graph, diamond graph with book graph, diamond graph with sunlet graph ,diamond graph with jewel graph, diamond graph with flower graph, diamond graph with umbrella graph ,diamond graph with complete graph and diamond graph with bowknot graph.

SOME SIMILARITY MEASURES OF FUZZY QUADRIGEMINAL SETS BASED ON NORMALIZED EUCLIDEAN DISTANCE AND THEIR APPLICATION IN DETERMINING THE LEVEL OF INTELLECTUAL DEFICIENCY BASED ON IQ RANGE.

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This paper introduces a new concept "Quadrigeminal Sets", a new approach on assigning degree values to elements of a set. Set operations are defined over Quadrigeminal Sets which are very useful while attempting to solve real life problems. The concept of assigning 'degree of indeterminacy' value to an element of a set, introduced in Neutrosophic sets, is by passed in Quadrigeminal sets. Quadrigeminal sets help to reduce risk while attempting a solution on a uncertaint situation. The concept of viability of a Quadrigeminal sets is introduced for the purpose of finding which Quadrigeminal set has high percentage of optimal solution and which has low percentage of optimal solution. A real life application is explained for the purpose of understanding viability.

Keywords: Fuzzy Set, Intuitionistic Fuzzy Set, Neutrosophic Set, Quadrigeminal Set, Viability

ODD GRACEFUL LABELING IN THE CONTEXT OF SUPER SUBDIVISION OF CYCLE-RELATED GRAPHS

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An extension of the traditional idea of graceful labeling, odd graceful labeling is a specialized type of vertex labeling for graphs. This idea has consequences for network architecture and coding theory in addition to improving our understanding of graceful labelings and helping to solve several graph theory challenges. Odd graceful labeling is to inject $f:V(G) \to \{0,1,2,..,(2q-1)\}$ whenever the edgexy is identified the label$|f(x)-f(y)|$, so that the resulting edge labels are $\{1,3,5,..,(2q-1)\}$ distinct.In this paper, we prove Odd graceful labeling of the super subdivision of the Cycle, Crown, and Circular ladder graph.

Keywords: Odd graceful labeling, Super subdivision, Cycle, crown, circular ladder graph.

2010 Mathematics Subject Classification: 05C78

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HERMITIAN TOEPLITZ DETERMINANTS FOR A CERTAIN CLASS OF CLOSE-TO -STAR FUNCTIONS DEFINED BY SUBORDINATION

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In this paper a new class of close-to-star functions $\mathbf{CST}_{\varphi}$ defined by subordination, is introduced. Coefficient bounds, estimates on the second and third order Hermitian Toeplitz determinants for the class $\mathbf{CST}_{\varphi}$ are determined. Further, Hermitian Toeplitz determinants for special cases of $\varphi(z)$ are also discussed.

AMS Subject Classification: 30C45, 30C50**.**

Keywords: Analytic functions, close-to-star functions, Subordination, Hermitian Toeplitz determinants.

A SUSTAINABLE THREE-LEVEL PRODUCTION INVENTORY OF CEMENT WORKS UNDER WEIBULL DISTRIBUTION IN TRAPEZOIDAL FUZZY NUMBERS

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In manufacturing and production units, an EPQ model is crucial. Here represent the three levels of economic production inventory model in cement work industry for decadence of goods in the concern of making mistake, damage in the inspection, return of sale for the inspection goods are considered in this paper. It takes into account three distinct production levels and uses two parameters of Weibull distribution is determined for the rate of decadence. A low production rate at first avoids having a large amount of inventory of manufactured goods at the beginning, which lowers holding costs. However, the total cost of production depends on the rate of production, the rate of demand, and the rate of decadence items. There is a possibility to switch from starting at one rate to another rate after a certain amount of time. Where also in the manufacturing plant, the cement work goods need to be a complete one which make the emission is taken in the sense. The cost elements are considered in trapezoidal fuzzy number to minimise the total cost. A means of achieving customer satisfaction and possibly making a profit is offered by the variance in production level. Finding the ideal production time solution will minimise the cycle's overall costs, which is the paper's main goal. Lastly, to validate the outcomes of the suggested inventory system, sensitivity analyses and numerical examples are made for the parameters.

Keywords: defuzzification, inspection, Weibull distribution decadence, cement works.

AN EFFICIENT ECONOMIC ORDER QUANTITY MODEL TO OBTAIN THE OPTIMAL POLICY FOR THE RETAILERS IN AN ONLINE PLATFORM

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With the development of online sales, the practice of online shopping has risen in recognition, and as a consequence, clients now routinely confront a problem of exchanges. On the other hand the retailers ultimate aim is to maximize the profit. In this paper the optimal order size of the retailer is determined from which the retailers would gain maximum profit. Thus an effective Economic Order Quantity Model is developed for obtaining the optimal profit for the retailers. In addition, the problem of returns is also focused and the clients are given a full refund policy. This paper answers to the question in which amidst giving the clients a refund, how the retailer could maximize their profit. This paper is built in a fuzzy sense by considering the amount of defective items as a triangular fuzzy number. Sensitivity studies based on analytical results and numerical examples are provided. Findings reveal that by giving the clients refund the retailers profit is greatly increased.

Keywords: Economic Order Quantity, Online Sales, Triangular Fuzzy number.

DEVELOPING DENGUE RISK INDEX: DATA FROM WESTERN PROVINCE SRI LANKA

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Dengue is a mosquito-borne viral disease that impacts several countries including Sri Lanka. Western province is the most densely populated province in the country and the most affected region by dengue disease. It consists of the Colombo, Gampaha and Kalutara districts. To mitigate the impact of dengue, identifying the dengue risk in the early stage is crucial. This study aimed to develop a dengue risk index by assessing the combined effect of significant climatic factors on dengue transmission in distinct three districts in the western province. Due to the interconnected nature of climatic factors, we investigated the combined influence of climate conditions on dengue in each region using the Gaussian copula method. The results indicated that rainfall and temperature are the primary climatic factors affecting dengue in the three districts. The periodicity of dengue cases was identified using Fast Fourier in each district and then the Gaussian copula was used based on the identified periods. To assess the effectiveness of the designed risk, risk level validation was carried out.

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COEFFICIENT BOUNDS FOR CERTAIN SUBCLASSES OF QUASI-CONVEX FUNCTIONS ASSOCIATED WITH CARLSON-SHAFFER OPERATOR

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Let $\mathcal{A}$ denote the class of functions $f(z)$ of the form $f(z) = z + \sum_{n=2}^{\infty} a_n z^n$, which are analytic in the open unit disk $\Delta = \{z \in \mathbb{C}: |z| < 1\}$. In this paper, we consider two new subclasses of quasi-convex functions involving Carlson-Shaffer operator and obtain the coefficient bounds for functions in these classes.

Keywords: Analytic function, quasi-convex, close-to-convex, close-to-star, Janowski function, coefficient estimates, Carlson-Shaffer operator.

AMS 2010 Mathematics subject Classification: Primary: 30C45; Secondary:30C50

IDENTIFYING DENGUE HOT-SPOTS IN SRI LANKA: AN AGENT-BASED MODELS

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Over the past few decades, tropical and subtropical countries have experienced a dramatic increase in dengue incidences, leading to a major public health issue in the world. As the main prevention method is controlling dengue vectors, early prediction and hotspot analysis are vital for the control of the outbreaks. Several mathematical and statistical models have been developed to predict dengue transmission, and most of them are focused on the macro-level behaviour of humans.

In this study, we focus on the micro-level behaviors of humans and the environmental impact on dengue transmission using an agent-based model. In order to capture the environmental impact, we consider climate factors such as temperature and rainfall. Simulations are then conducted to identify dengue hotspots in Sri Lanka. The results show that the micro-level behaviour of human mobility is one of the most significant factors in the transmission of dengue.

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NEW FORM OF SEPARATION AXIOMS IN FUZZY SOFT SEQUENTIAL TOPOLOGICAL SPACE

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The separation axioms in topological space aims to distinguish disjoint sets and distinct points. In 2002, Bose and Indrajitgave the concept of separation axioms in sequential topological spaces. In 2018**,** Mahanta and Das introduced fuzzy soft point and studied separation axioms in fuzzy soft topological spaces. Khedr et al introduced fuzzy soft separation axioms in terms of the modified definitions of the fuzzy soft point and study some of the properties in the year 2019.By the way of above concepts, we introduce the separation axioms in a new way in fuzzy soft sequential topology. We define fuzzy soft sequential T_i axioms $(i = 0,1,2)$ using the concept of fuzzy soft sequential quasi-coincident relation betweenfuzzy soft sequential set and fuzzy soft sequential point and discuss some properties of these spaces with proper examples in detail.

A STUDY OF HARMONIC STARLIKE FUNCTIONS WITH RESPECT TO SYMMETRIC POINTS USING MATHIEU TYPE SERIES

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In this paper, we introduce a new class $\mathcal{S}^*_{\mathcal{STH}}(\alpha, n, r)$, $n \in \mathbb{N}$, $r > 0$ of harmonic starlike functions of order $\alpha, 0 \leq \alpha < 1$, with respect to symmetric points related to the convolution operator and obtain coefficient characterization, distortion bounds along with other properties for functions in this new class.

Keywords: Harmonic function, starlike, symmetric points, Mathieu-type series

AMS 2010 Mathematics subject Classification: Primary: 30C45; Secondary:30C50

APPROXIMATIONS OF A QUADRATIC FUNCTIONAL EQUATIONIN QUASI BETA BANACH SPACE

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In this paper, the authors examine the Gavruta – Rassias stability of a quadratic functional equation involving mean sum of the functions of consecutive variables of the form

$$\sum_{a=1}^{m} q\left(\frac{1}{a}\sum_{b=1}^{a}\kappa_b\right) = \sum_{a=1}^{m}\left\{\sum_{b=a}^{m}\left(\frac{1}{b^2}\right)q(\kappa_a)\right\} + \frac{1}{2}\sum_{a=2}^{m}\left\{\sum_{b=a}^{m}\frac{1}{b^2}\left\{\sum_{b=1}^{a-1}\{q(\kappa_b+\kappa_a)-q(\kappa_b-\kappa_a)\}\right\}\right\}$$

in quasi beta Banach spaces.

A HYBRID CRITIC-SPOTIS APPROACH IN OPTIMAL DECISION MAKING FRAMEWORK UNDER BIPOLAR PICTURE FUZZY ENVIRONMENT

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The novel hybrid BPFS addresses bipolarity in terms of neutrality, non-belongingness, and belongingness when quantifying the uncertainty that appears when turning a real-world issue into a mathematical model. The BPFS set is used for the analysis of FWT. The CRITIC technique is used to objectively evaluate the relevance of each criterion in FWT selection. The SPOTIS technique is used to effectively rank the alternatives based on the criteria. The proposed approach is rank reversal-free, i.e., the rank of the alternatives remains constant even when an alternative is added or removed. Furthermore, in order to verify the proposed result and ensure the accuracy and dependability of the suggested framework, comparison and sensitivity studies are carried out.

Keywords: Bipolar Fuzzy Set; Picture Fuzzy Set; Bipolar Picture Fuzzy Set; CRITIC; SPOTIS.

AN INTEGRATED ENTROPY-VIKOR METHOD UNDER NORMAL WIGGLY HESITANT PYTHAGOREAN FUZZY SET TO SOLVE A MCDM PROBLEM

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A Normal Wiggly Hesitant Pythagorean Fuzzy Set (NWHPFS) is constructed as an extension of Hesitant Fuzzy set and is applied to tackle the problem of choosing the best anti-aging treatment selection. The Normal Wiggly Hesitant Pythagorean-VlseKriterijumska Optimizacija I Kompromisno Resenje (NWHPF-VIKOR) technique is employed for assessing alternatives using MCDM approaches, and the entropy approach is utilized for determining weight values. Sensitivity and comparison analyses were carried out to make sure that the proposed method is reliable and robust. Decision Makers (DM) would surely benefit from the wise decision-making procedure and the MCDM method will help people understand the medicine.

Keywords: Hesitant Fuzzy set; Normal Wiggly Hesitant Pythagorean Fuzzy Set; Multi-Criteria Decision Making; Entropy; VIKOR

TOEPLITZ DETERMINANTS FOR A CERTAIN SUBCLASS OF ANALYTIC FUNCTIONS IN A LIMACON DOMAIN

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In this paper, we introduce a new class $\mathcal{T}\mathbb{L}_s(\alpha)$ of analytic normalized functions $f(z)$ defined in the open unit disc $\mathbb{D} = \{z \in \mathbb{C}: |z| < 1\}$satisfying the condition

$$\frac{2\left(\alpha z^2 f''(z) + z f'(z)\right)}{\alpha z[f(z) - f(-z)]' + (1-\alpha)[f(z) - f(-z)]} \prec \mathbb{L}_s(z)\,,$$

where $0 \leq \alpha \leq 1, z \in \mathbb{D}$ and $\mathbb{L}_s(z)$, $0 < s \leq \frac{1}{\sqrt{2}}$ is a Limacon function defined in $\mathbb{D}$. We obtain the sharp bounds of coefficients and Fekete-Szego inequality for the class $\mathcal{T}\mathbb{L}_s(\alpha)$. Also sharp bounds of second order and upper bounds of third order Toeplitz determinants are obtained .

Keywords: Toeplitz determinant, analytic function, Limacon function, subordination.

AMS 2010 Mathematics subject Classification: Primary: 30C45; Secondary:30C50

EVALUATION OF MUNICIPAL SOLID WASTE FOR ENERGY GENERATION THROUGH A FUZZY DECISION APPROACH

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The increasing volume of municipal solid waste due to industrialization and population growth is a major cause of global environmental deterioration. Decision makers face challenges in managing limited land resources and waste. Anaerobic digestion, gasification, pyrolysis, and incineration are methods used to convert waste into energy, reducing landfill burden and combating environmental pollution. This article proposes optimal municipal waste using fuzzy multiple criteria decision making, a tool popular in energy extraction. This approach allows decision makers to make judgments considering all criteria and objectives simultaneously.

Keywords: MCDM; Fermatean fuzzy; CRiteria Importance Through Inter-criteria Correlation; Municipal solid waste; Fuzzy logic

A MULTI CRITERIA DECISION MAKING MODEL USING HYBRID AHP-WASPAS TECHNIQUE UNDER FERMATEAN FUZZY SET

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Municipal solid waste (MSW) generation has suddenly increased as a result of increased product consumption brought on by population and industrial growth. The amount of municipal inorganic solid waste (ISW) has skyrocketed due to a lack of resources devoted to waste management, placing a heavy burden on the environment and human health. Sustainable waste management techniques must be used to lessen their negative effects on the environment and increase the effectiveness of waste collection and disposal. The Multi-Criteria Decision-Making (MCDM) to analyze and determine the best methods for getting rid of ISW in India. Using a range of conflicting and interacting criteria, this method involves choosing the best option. A decision model named the AHP-WASPAS based on the fermatean fuzzy set was developed.

Keywords: Municipal solid waste management; Fermatean fuzzy set; Multi Criteria Decision making methods; AHP; WASPAS method.

A UNIFIED ENTROPY - CODAS APPROACH UNDER CUBIC BIPOLAR FUZZY ENVIRONMENT TO SOLVE A MULTI CRITERIA DECISION MAKING PROBLEM

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Wind energy is one of the clean renewable energy source that doesn't include fuel combustion or emission of harmful gases into the atmosphere. Wind energy production includes onshore and offshore. Compared to onshore, offshore wind energy can generate more electricity since the wind is stronger and more consistent offshore. Multi-criteria decision-making plays a major role in the selection process of offshore wind turbine's structure, of which the crucial part is the selection of the foundation system, as this bears the entire wind turbine. Thus, in this study, we proposed a cubic bipolar fuzzy set-based integrated decision-making model and utilized it in the selection of offshore wind turbine foundation system. The entropy method has been employed to determine the weights of the criteria, and the combinative distance-based assessment method has been used to rank the alternatives. Comparative and sensitive analyses were performed to check the consistency and stability, respectively, of the proposed method.

Keywords: Foundation system; Entropy; Combinative distance-based assessment; Cubic bipolar fuzzy set; Decision making

AN ENHANCED FUZZY-ROUGH MODEL FOR SELECTING OPTIMAL DRILLING TECHNIQUES IN GEOTHERMAL RESERVOIRS

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Geothermal energy represents an exceptional renewable resource for power generation, offering reliable electricity without issues of intermittency. Despite its advantages, high costs remain a barrier to wider adoption. This study seeks to identify the most effective drilling methods for heat extraction from geothermal reservoirs, thereby enhancing project viability and heat recovery rates. Traditional evaluation methods often fall short due to inherent uncertainties. To address this challenge, we introduce a novel T-Spherical Hesitant Fuzzy Rough approach, which utilizes the geometric mean for criteria removal and integrates hybrid Multiple Criteria Decision-Making techniques for ranking alternatives. Our findings demonstrate that reservoir characteristics play a critical role in selecting sustainable drilling methods, with directional drilling identified as the most promising technique, followed by slim hole drilling. The robustness and credibility of our results are validated through sensitivity analyses and Spearman's rank correlation coefficient, indicating a strong positive correlation. This research provides stakeholders with essential insights to enhance the efficiency and sustainability of geothermal energy projects.

Keywords: Decision making; Fuzzy rough sets; Drilling techniques; Geothermal energy; Ranking alternatives with weights of criterion

MATHEMATICAL MODELING FOR ECONOMIC VARIABLES: A KEY FOR DECISION MAKING

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Mathematical economics is a distinct branch of economics which uses mathematical symbols in the statement of the problem and mathematical theorems are used in reasoning. Mathematical economics uses mathematical techniques like simple geometry, mathematical Algebra, differential and integral calculus etc. Mathematics underlies the analysis of many of the issues that business decision makers, public policy makers and economists address. Mathematical tools are widely used by economists to study the crux of the problem that exists in actual world. Application of mathematics in economics gains scope mainly because of the stochastic term or disturbance term 'u'. Normal equation is given by C=a+bY which can be solved to find the values of any variable, given the values of other variables. But when disturbance or error term 'u' is included the study becomes more valuable as they affect only the dependent variable and not the independent variable.

The purpose of this study is to explain the latest mathematical modeling in Sustainable development goals (SDGs). SDGs are 17 shortlisted by UN General Assembly in 2016 to achieve growth among economies by integrating environment and development. Sustainability concept initially coined in forestry, which means do not harvest what exceed the yield of the forests in a new growth (Kuhlman and Farrington 2010). It is said to be a "development that meet the present without compromising the ability of future generations to meet their needs" (Brundtland et al. 1987). A linear programming framework was used incorporating multi-criteria modeling approach for the analysis of SDGs in India by Gupta et al. (2018). Goal programming with satisfaction function has been used to analyzed SDGs (Ali et al. 2021). The concept of Fuzzy programming incorporating analytic hierarchy process in SDGs modeling and analysis has been recently studied (Modibbo et al. 2021; AlArjani et al. 2021). The concept of linear programming (LP) used to allocate resources that are competing and conflicting in nature (Muhammad et al. 2015). Sustainable Development Goals play paramount importance in addressing energy-related challenges,

Keywords: Mathematical modeling, SDGs, Error term, linear programming, Fuzzy Programming.

FUZZY STABILITY OF A ALTERNATE CUBIC FUNCTIONAL EQUATION

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In this paper, the authors confer the generalized Hyers - Ulam stability of an alternate cubic functional equation

$$C(4s_4+3s_3+2s_2+s_1)+C(4s_4-3s_3+2s_2+s_1)$$
$$+C(4s_4+3s_3-2s_2+s_1)+C(4s_4+3s_3+2s_2-s_1)$$
$$+C(4s_4-3s_3-2s_2+s_1)+C(4s_4-3s_3+2s_2-s_1)$$
$$+C(4s_4+3s_3-2s_2-s_1)+C(4s_4-3s_3-2s_2-s_1)$$
$$=16\{C(s_1+s_4)+C(s_4-s_1)\}+64\{C(s_2+s_4)+C(s_4-s_2)\}$$
$$+114\{C(s_3+s_4)+C(s_4-s_3)\}+124C(s_4)$$

in fuzzy Banach spaces via direct and fixed point methods.

SYSTEM OF ADDITIVE FUNCTIONAL EQUATIONS IN MODULAR SPACE

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In this paper, the authors establish the generalized Ulam – Hyers – Rassias stability of system of additive functional equations

$$C_1(v_{10}+v_{11}+v_{12}+v_{13}+v_{14})=C_1(v_{10})+C_1(v_{11})+C_1(v_{12})+C_1(v_{13})+C_1(v_{14})$$

$$C_2(v_{20}+v_{21}+v_{22}+v_{23}-v_{24})=C_2(v_{20})+C_2(v_{21})+C_2(v_{22})+C_2(v_{23})-C_2(v_{24})$$

$$C_3(v_{30}+v_{31}+v_{32}-v_{33}+v_{34})=C_3(v_{30})+C_3(v_{31})+C_3(v_{32})-C_3(v_{33})+C_3(v_{34})$$

$$C_4(v_{40}-v_{41}+v_{42}+v_{43}-v_{44})=C_4(v_{40})-C_4(v_{41})+C_4(v_{42})+C_4(v_{43})-C_4(v_{44})$$

in Modular space. An application of the above functional equations are also given.

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