

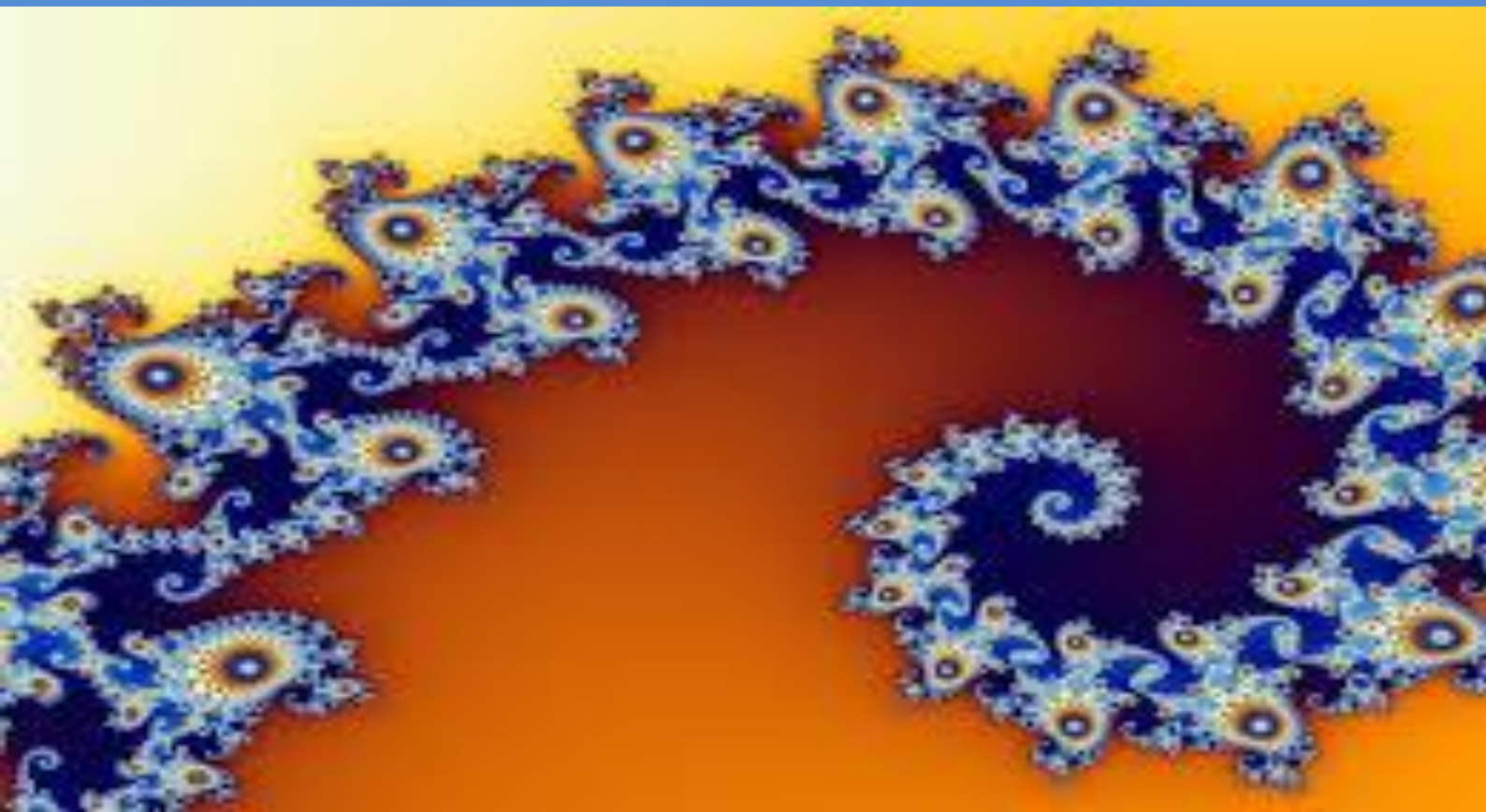


**National Conference**

**MATHEMATICS IN 21<sup>ST</sup> CENTURY:  
THEORY AND APPLICATIONS**

**April 26-27, 2024**

**BOOK OF ABSTRACTS**



**Organized by**

**DEPARTMENT OF MATHEMATICS**

**CENTRAL UNIVERSITY OF ODISHA**

National Conference

**“Mathematics in 21<sup>st</sup> Century: Theory and Applications”**

April 26-27, 2024

**Editorial Board**

**Dr. Ashok Kumar Sahoo**

**Dr. Jyotiska Datta**

**Dr. Sarbeswar Barik**

**Mr. Shubham Padhi**



Organized by

**Department of Mathematics**  
**CENTRAL UNIVERSITY OF ODISHA**



**Prof. Chakradhar Tripathi**  
Vice-Chancellor  
Central University of Odisha  
Koraput - 763004

April 24, 2024

### MESSAGE

I am glad to know that the Department of Mathematics, Central University of Odisha is organizing a Two-Day National Conference on “Mathematics in 21st Century: Theory and Applications” during 26th and 27th of April, 2024. India has an abundant history of talented Mathematicians starting from Aryabhat to Ramanujam. All have excellently contributed their knowledge to the world. The ongoing Conference aims to inspire interdisciplinary research and create a platform to use Mathematical tools of 21st Century. The testimonial and highly spectacular effects of conference will be the presence of notably eminent scholars and researchers of our country. The conference would definitely contribute to the ongoing research activities among the participants and also support the idea of “Vocal for Local” as an intellectual boost which is the present need of our nation.

I convey my warm wishes to the Department of Mathematics for arranging such a significant event with a theme that would foster invention and innovation.

I wish the National Conference a great success.

Vice- Chancellor



**Prof. Narasingha Charan Panda**  
**Registrar (I/c)**  
**Central University of Odisha**  
**Koraput - 763004**

**April 24, 2024**

### **MESSAGE**

Out of all modern subjects, taught in various Schools, Colleges, Universities, etc., Mathematics is one of the oldest as well as prominent subjects from time immemorial. Our four Vedas have recorded a large number of conceptualized Mathematics. In general, Vedic Mathematics is very popular in India, as it is known to us since last 5000 years. In particular, the Attharva veda has recorded various fundamental facts of Mathematics. Never ever hear, any epics of any other civilization has stored this much of wisdom, which has capacity to guide the present modern world.

I am really happy to know that the Department of Mathematics, Central University of Odisha is organizing a Two-Day National Conference on "Mathematics in 21st Century: Theory and Applications". I would like to convey my heartiest thanks to all the delegates and participants from across the country. This Conference will bring researchers of various topics of Mathematics into a common platform, so that one can intervene into the idea of other. Due to this, a hope of new Mathematical Applications will take birth.

I extend my heartiest good-will to the organizing committee and the Department of Mathematics for organizing such a significant conference on a topic which is a need-of-the day.

My best wishes for the grand success of the conference.

**Registrar**



**Dr. Ashok Kumar Sahoo**  
Associate Professor and HoD  
Department of Mathematics  
Central University of Odisha  
Koraput - 763004

April 24, 2024

**FROM THE DESK OF THE CHAIRMAN**

Mathematics has always been a life line of science and technology. Idea may take birth in any subject area of consideration, but if it wants to grow and justify itself, that it has something better to give for the society then it has to convert itself into a model with the help of Mathematics. Consistency of the above model and stability of its solution, will predict the fruitfulness of the idea. So, conceptualization of fundamental mechanism through Mathematics at its background is highly essential to transfer information to knowledge then to wisdom. Exchange of perception, which is stored in the minds of great scholars, will help the conceptualization process. An expectation, of exchange of idea is fulfilled through conglomeration of sages.

The main objective of this Two-Day National Conference on “Mathematics in 21st Century: Theory and Applications” during the 26th and 27th April 2024 is to provide forum for the researchers, academicians, students to exchange ideas, to collect and collaborate their research works.

We are grateful to our Hon’ble Vice Chancellor for inspiring and motivating for organising different conference and seminar of national and international excellence. Hope, the conference will be fruitful and flourish greatly.

A handwritten signature in black ink, appearing to read 'A. Sahoo'.

(Dr. Ashok Kumar Sahoo)



**Dr. Jyotiska Datta**  
Assistant Professor  
Department of Mathematics  
Central University of Odisha  
Koraput - 763004

April 24, 2024

**FROM THE DESK OF THE CONVENER**

I feel honoured to organize the Two-Day National Conference on “Mathematics in the 21st Century: Theory and Applications” during the 26th and 27th April 2024. The conference would enable participants to explore possible avenues to foster academic and student exchange, as well as scientific activities within India. The conference will give an opportunity to both academicians and research scientists to communicate and discuss mathematical problems and their applications in the industrial sector.

I express profound thanks to all the Guest of Honors, invited speakers, delegates, and participants across the country for their efforts to attend the conference. I am thankful to all the members of the Steering Committee, Organizing Committee and staff of the Department and University for their invaluable assistance in making this conference a reality.

We are grateful to our Hon’ble Vice-Chancellor, Prof. Chakradhar Tripathi for his constant support, guidance, and blessings to conduct such an event.

I wish the conference will be a great success.

  
(Dr. Jyotiska Datta)



**Sh. Shubham Padhi**  
Assistant Professor  
Department of Mathematics  
Central University of Odisha  
Koraput - 763004

April 24, 2024

**FROM THE DESK OF THE CO-CONVENER**

Opportunity always will not come itself, sometimes it is needed to create it, but I am lucky to be a member of the organizing committee of the Two-Day National Conference on “**Mathematics in 21st Century: Theory and Applications**” during the 26th and 27th April 2024. This opportunity is a great beginning of my life. Although many means are there to learn, acquire, and assess but still, the most influentially attractive learning, sharing, and inspirational way, is to come together and discuss. So Conference is an essential means of knowledge sharing.

Mathematics in India is not merely a subject to be taught, but it is an integral part of our culture. From our childhood, we have experienced, that if someone elder comes to our home, he usually asks some Mathematics question to assess our learning standard. I am quite thankful to our Vice-Chancellor Prof. Chakradhar Tripathi, Registrar Prof. Narasingha Charan Panda and all other respected persons, for inspiring us to organize such a conference, and highly obliged to all my colleagues to be a member of the organizing committee.

I overwhelmingly hope and pray for the grand success of the ongoing conference.

*Shubham Padhi*  
(Sh. Shubham Padhi)



**Dr. Sarbeswar Barik**  
Assistant Professor  
Department of Mathematics  
Central University of Odisha  
Koraput - 763004

April 24, 2024

**FROM THE DESK OF THE ORGANIZING SECRETARY**

I am highly happy to get responsibility for organizing such a novel thing like Two-Day National Conference on “Mathematics in 21st Century: Theory and Applications” on the 26th and 27th April 2024. I convey my regards to Vice Chancellor Prof. Chakradhar Tripathi, Registrar Prof. Narasingha Charan Panda all members of the Department of Mathematics for their cordial help to make the conference a grand success.

The conference will give an opportunity to conglomerate various ideas, exposure to the latest research and developments in the field of Mathematics and related areas. And also give the chance to: network with other scholars or delegates and make professional connections, present one's own research and receive feedback, hear talks by leading experts in the field to learn about new techniques and methodologies. Publish their research work.

I hope the conference will be a great success.

  
(Dr. Sarbeswar Barik)



Two-Day National Conference  
on  
“**Mathematics in 21st Century: Theory and Applications**”  
April 26-27, 2024  
Organised by  
Department of Mathematics,  
Central University of Odisha

<b>PROGRAMME SCHEDULE</b> <b>Day 1: 26.04.2024</b>	
8.00 AM – 9.00 AM	<b>Breakfast</b>
9.00 AM-12.00 Noon	<b>Registration</b>
9.00 AM-10:30 AM	<b>INAUGURAL CEREMONY</b>
9.00 AM	Welcome of dignitaries to the dais
9:05 AM	Lighting of Lamp
9:10 AM	Offering of Bouquet
9:15 AM	Welcome Address by <b>Dr. Ashok Ku Sahoo</b> , HoD
9:25 AM	Release of Book of Abstracts
9: 30 AM	Address by <b>Prof. Avanish Kumar</b> , Professor, Department of Mathematical Science and Computer Applications, Buldelkhand University, Jhansi, UP <b>Guest of Honour</b>
9.40 AM	Address by <b>Prof. A. K. Mishra</b> , Former Director, Institute of Mathematics & Applications, Bhubaneswar, Odisha <b>Guest of Honour</b>
9:50 AM	Address by <b>Prof. Mukut Mani Tripathi</b> , Senior Professor and Head, Department of Mathematics, Banaras Hindu University, Varnasi, UP <b>Chief Guest</b>
10.05 AM	Address by <b>Prof N.C. Panda</b> , Dean, School of Language, Registrar(I/c) and Finance Officer (I/c), CUO
10:20 AM	Vote of Thanks by <b>Dr. Sarbeswar Barik</b> Organising Secretary
10:25 AM	National Anthem
10:30 AM	Tea Break
<b>PLENARY SESSION - 1 (10.45 AM – 12.15 PM)</b>	
Invited Lecture - 1 10:45 AM-11:15 AM	<b>Prof. Bhawani Sankar Panda</b> Professor, Department of Mathematics, IIT Delhi, New Delhi
Invited Lecture - 2 11:15 AM-11:45 AM	<b>Prof. G.S. Khadekar</b> Professor, Department of Mathematics, RTM Nagpur University, Nagpur
Invited Lecture - 3 11:45 AM-12:15 PM	<b>Prof. Prasanta Chatterjee</b> Professor, Department of Mathematics Siksha Bhavana (Institute of Science), Visva Bharati, West Bengal
<b>TECHNICAL SESSION - 1 (12.15 PM - 1.05 PM)</b>	
<b>Chair: Prof. J.K. Prajapat</b> , Professor, Department of Mathematics, Central University of Rajasthan, Rajasthan	

<b>Co- Chair: Dr. A.K. Jha</b> Controller of Examinations, Ranchi University	
12.15 PM – 12.25 PM	Dr. Laxmipriya Parida, GIET University
12.25 PM – 12.35 PM	Ms. Bijayalaxmi Mandal, Veer Surendra Sai University of Technology
12.35 PM -12.45 PM	Mr. Anil Kumar Pandey, Veer Surendra Sai University of Technology
12.45 PM – 12.55 PM	Dr. Tumbhanath Samantara, Centurion University of Technology and Management
12.55 PM – 01.05 PM	Ms. Kuntima Miniaka, KISS (Deemed to be University)
<b>LUNCH (1.15 PM-3.00 PM)</b>	
<b>TECHNICAL SESSION - 2 (3.00 PM – 4.10 PM)</b>	
<b>Chair: Prof. Prasanta Chatterjee</b> Professor, Department of Mathematics Siksha Bhavana (Institute of Science), Visva Bharati, West Bengal	
<b>Co-Chair: Prof. G.S. Khadekar</b> Professor, Department of Mathematics, RTM Nagpur University, Nagpur	
3.00 PM – 3.10 PM	Mr. Pradeep Vishwakarma, IIT Bhilai
3.10 PM – 3.20 PM	Ms. Manisha Dhillon, IIT Bhilai
3.20 PM – 3.30PM	Mr. Prakash Paraseth, CUO
3.30 PM – 3.40 PM	Mr. Pramod Kumar Bindhani, CUO
3.40 PM – 3.50 PM	Ms. G Jayanti Reddy, CUO
3.50 PM – 4.00 PM	Mr. Santanu Dash, BITS Hyderabad Campus
4.00 PM – 4.10 PM	Mr. Rabindra Panda, BPUT
<b>PLENARY SESSION - 2 (4.15 PM – 5.15 PM)</b>	
Invited Lecture - 4 4.15 PM - 4.45 PM	<b>Prof. J.K. Prajapat</b> Professor, Department of Mathematics, Central University of Rajasthan, Rajasthan
Invited Lecture - 5 4.45 PM - 5.15 PM	<b>Dr. A.K. Jha</b> Controller of Examinations, Ranchi University
<b>TEA BREAK (5.15 PM - 5.30 PM)</b>	
<b>CULCURAL PROGRAM (6:00 PM - 8.30 PM)</b>	
<b>DINNER (8.30 PM - 9.30 PM)</b>	

<b>PROGRAMME SCHEDULE</b>	
<b>Day 2: 27.04.2024</b>	
<b>PLENARY SESSION - 3 (9.00 AM-11.00 AM)</b>	
Invited Lecture - 6 9.00 AM-9.30 AM	<b>Prof. Mukut Mani Tripathi,</b> Senior Professor and Head, Department of Mathematics, Banaras Hindu University, Varnasi, UP
Invited Lecture - 7 9.30 AM-10.00 AM	<b>Prof. A.K. Mishra,</b> Former Director, Institute of Mathematics & Applications, Bhubaneswar, Odisha
Invited Lecture – 8 10.00 AM-10.30 AM	<b>Prof. Avanish Kumar,</b> Professor, Department of Mathematical Science and Computer Applications, Buldelkhand University, Jhansi, UP
Invited Lecture – 9 10.30 AM-11.00 AM	<b>Prof. Ranjit Kumar Upadhyay,</b> Professor and Head, Department of Mathematics & Computing, IIT (ISM) Dhanbad

<b>TEA BREAK (11.00 AM - 11.15 AM)</b>	
<b>TECHNICAL SESSION - 3 (11.15 AM - 12.15 PM)</b>	
<b>Chair: Prof. Bhawani Sankar Panda,</b> Professor, Department of Mathematics, IIT Delhi, New Delhi	
<b>Co-Chair: Prof. Ranjit Kumar Upadhyay,</b> Professor and Head, Department of Mathematics & Computing, IIT (ISM) Dhanbad	
11.15 PM -11.25 PM	Mr. Saroj Sahoo, Government College of Engineering, Kalahandi
11.25 PM – 11.35 PM	Mr. Atish Kumar Sethy, CUO
11.35 PM – 11.45 PM	Mr. Rabindra Panda, BPUT
11.45 PM – 11.55 PM	Mr. Rajendra Dhal, JNV Kenjhor
11.55 PM – 12.05 PM	Mr. Satyabrat Kar, Driems University
12.05 PM – 12.15 PM	Dr. Partha Pratim Das, CUO
<b>LUNCH (1.15 PM - 3.00 PM)</b>	
3.00 PM – 5.00 PM	Valedictory

## **Objective of the Conference**

The aim of this conference is to bring together learned mathematicians, scientists, engineers, researchers from industry and research scholars working in the different areas of mathematics at a common platform. The Conference provides an excellent opportunity to researchers, practitioners and educators to present and discuss the recent innovations in mathematics for potential implementation in sciences and engineering. It focuses on strengthening the existing results along with identifying the practical challenges encountered with respect to various solutions adopted in the fields of mathematics and its applications. Moreover, it will provide an opportunity to enhance collaboration among researchers not only from the various parts of the country but also with those from abroad. The scientific program will consist of Keynote/Plenary/Invited lectures and parallel sessions for contributed presentations. The main emphasis will be on the vibrant implicational aspects of pure and applied mathematics for cultivating contemporary and advanced findings in multidimensional sphere of engineering and sciences. The invited lectures and refereed contributed papers will be published in the proceedings after due reviewing process by the committee of experts in various disciplines.

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## **Kulkarni-Nomizu Tensor Fields and Their Applications**

Professor Mukut Mani Tripathi  
Departemnt of Mathematics  
Institute of Science  
Banaras Hindu University  
Varanasi 221005

### **Abstract**

Motivated by the terminology of Kulkarni-Nomizu product, the phrases "Kulkarni-Nomizu tensor" and "Kulkarni-Nomizu tensor field" are introduced. The talk is organized as follows. First, we collect some basic material about Riemann curvature tensor field and Riemann-Christoffel curvature tensor field. Next, we revisit Kulkarni-Nomizu product and give some related basic results. Then the phrase "Kulkarni-Nomizu tensor" is introduced. Some of its basic properties are presented. Next, the phrase "Kulkarni-Nomizu tensor field" is introduced. Some of its examples and properties are presented. The Schur's theorem for proper Kulkarni-Nomizu tensor fields is given. In the last, some applications are pointed out.

## **Performance analysis of distributed computing system**

Professor Avanish Kumar

Department of Mathematical sciences and Computer Applications

Bundelkhand university, Jhansi-284128 UP (INDIA)

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### **Abstract**

Distributed Computing System refers to the solution of a problem by distributed systems of heterogeneous computers that is used in communication, networking, and workstation. Distributed computing is a computing technology that allows multiple computers to solve the same problem. Here problem-solving is achieved by communicating and executing the tasks in distributed environment. Distributed Computing helps in performing computational tasks much faster than single computers. In many real-life application domains, (e.g. meteorology, cryptography, signal processing, solar and radar surveillance, simulation of VLSI circuits, image processing, space science, military science and engineering systems, astronomy, genetic engineering, and Industrial process monitoring etc.), in which increased complexity and scale has led to the need for more powerful computation resources; distributed have emerged as a powerful platform for addressing such complex problems. Distributed Computing System consists of a set of cooperating nodes (either homogeneous or heterogeneous or autonomous) communicating over the communication links. Distributed Real Time Computing Systems provides enormous platform for large number of research problems. To discuss the performance of distributed computing system, several studies have been devoted to the distribution of tasks with the main concern on the performance measures such as minimizing the execution and communication costs / reliability, minimizing the application turnaround parameter as well maximizing the total throughput of the distributed computing system. The present study shall also include various algorithms that have been discussed for variety of different cases.



# SUBORDINATION AND RELATED INEQUALITIES ON A $C^*$ -ALGEBRA

A. K. MISHRA<sup>1</sup>

ABSTRACT. Let  $X$  be a  $C^*$ - algebra and  $x \in X$ . For a complex valued function  $f$ , which is analytic in a domain  $\mathbb{D}$  containing  $\sigma(x)$  the spectrum of  $x$ , let  $f(x)$  be defined by the following integral:

$$f(x) = \int_{\Gamma} f(\lambda)(\lambda e - x)^{-1} d\lambda.$$

where  $\Gamma$  is a positively oriented rectifiable simple closed contour containing  $\sigma(x)$ , the spectrum of  $x$ , in its interior domain  $\Omega$  and satisfying the condition  $\Gamma \cup \Omega \subset \mathbb{D}$ .

As we usually do in geometric function theory, let us restrict our selves to complex valued analytic functions  $f$  on the open unit disc  $\mathbb{U}$  of the complex plane:

$$\mathbb{U} := \{\lambda \in \mathbb{C} : |\lambda| < 1\}.$$

Let

$$\mathcal{B}(0, 1) := \{x \in X : \|x\| < 1\}$$

be the open unit ball of  $X$ . Observe that  $f(x)$  is well defined for  $x \in \mathcal{B}(0, 1)$ . Consider the range set

$$f(\mathcal{B}(0, 1)) = \{f(x) : x \in \mathcal{B}(0, 1)\} \subset X.$$

It is reasonable to expect that the set

$$f(\mathcal{B}(0, 1))$$

in  $X$  inherits some properties of the set

$$f(\mathbb{U}) = \{f(\lambda) : \lambda \in \mathbb{U}\} \subset \mathbb{C}.$$

Our focus shall be on such inherited properties.

In this lecture we shall discuss generalization of certain results on analytic functions of operators on a Hilbert space to the setting of a  $C^*$ -algebra. The results to be discussed include Schwarz's lemma, Harnack's inequalities, Pick's theorem and principles of subordination. Sharpened versions of Schwarz's lemma and Harnack's inequalities shall be discussed as further applications the principle of subordination.

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## **Modeling the detrimental effects of Obesity-Induced Pro-inflammatory microglia on Alzheimer's disease and its Intervention Strategies**

Professor Ranjit Kumar Upadhyay  
Department of Mathematics & Computing  
Indian Institute of Technology (ISM) Dhanbad  
Jharkhand, INDIA  
E-mail: ranjit.chaos@gmail.com

### **Abstract**

Evidence suggests that obesity, diabetes, and aging notably increase susceptibility to dementia-related conditions such as Alzheimer's disease (AD). In this talk, I will explore the correlations between obesity, diabetes, and AD. It introduces a diffusion-driven model encompassing variables like glucose dynamics, insulin levels, beta cells, microglia, cytokines, amyloid- $\beta$  plaques, neurofibrillary tangles ( $\tau$  plaques), neurodegeneration, and cognitive decline. In this presentation, I will include the stability analysis, examining boundedness, long-term behaviour and global attractor for reaction-diffusion system. A global sensitivity analysis, utilizing the Partial Rank Correlation Coefficient (PRCC), identifies factors sensitively impacting  $A\beta$  plaque growth,  $\tau$  plaques, and neurodegeneration. Deterministic model time series illustrate spatiotemporal dynamics revealing a link between obesity and Alzheimer's, characterized by distinct patchy patterns. While Alzheimer's has no cure, employing optimal control techniques can help alleviate its effects and enhance affected individuals' quality of life. An optimal control problem for AD management is developed, optimizing multiple aspects of disease management. This talk highlights the efficacy of long-term healthy lifestyle practices and customized anti-amyloid therapy in significantly delaying obesity-induced AD progression. This research sheds light on the connection between obesity and Alzheimer's, underscoring the negative impact of pro-inflammatory microglia on cognitive decline while proposing control strategies.

**Keywords: Alzheimer's, Global Attractor, PRCC, Reaction-diffusion, Optimal Control**

## General Theory of Relativity and Wormhole

Professor G S Khadekar  
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Dean Faculty of Science and Technology,  
RTM Nagpur University, Nagpur  
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### Abstract

We initially shed light on the fundamental ideas of Einstein's General Theory of Relativity in this talk. Subsequently, we explain a basic relativistic idea that forms the basis of the universe's wormhole representations. Wormholes are hypothetical gaps in space-time that might allow for lengthy interstellar travel to be shortened. Imagine it as a tunnel with two ends, located at different places in space-time. Although wormholes are predicted by Einstein's general theory of relativity, it is still unclear if they are real.

### References:

1. DeBenedictis, Andrew & Das, A. (2001). "On a General Class of Wormhole Geometries". *Classical and Quantum Gravity*. 18 (7): 1187–1204.
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## **Geometric Properties of Bessel Functions and their Generalizations**

Professor J.K Prajapat  
Department of Mathematics  
Central University of Rajasthan

### **Abstract**

In this talk, we shall discuss the Geometric properties of Bessel functions and their generalization. Specifically, we focus on the certain improved geometric properties of Struve functions, and Bessel functions of arbitrary order and degree. We will highlight our recent results on starlikeness, convexity, close-to-convexity, and convexity in one direction for these functions.

## An Efficient Method to obtain basic feasible solution of Transportation problem

Dr. Ashish Kumar Jha  
University Department Of Mathematics  
Ranchi University, Ranchi

### Abstract

The Transportation problem has been widely studied in Computer Science and Operation Research, it is a rational approach in Mathematics for decision making and problem solving, which is useful in businesses, Trade and transport government organization and society. To obtain best possible profit in a business, organization, society, it's not only a matter of profit of maximization but also cost should be minimize in realistic sense. It is one of the fundamental problem of network flow, which is used to minimize the transportation cost for industry with number of source and number of destination, while satisfying the limit and demand requirement of each mode. The Transportation problem is a linear programming approach used to reduce the total transportation cost between source and destination. We provide a study of new approach to solve transportation problem for minimizing the transportation costs, we have establish and improved techniques to obtaining an initial basis feasible solution (IBFS) for a transportation problem, which is optimal or too closed to optimal solution as compare to existing one namely NWCM, RMM, CMM, LCEM, VAM etc. The approach is more efficient and authentic as compare to Vogel's approximation method of determining initial basic feasible solution for a transportation problem and easy to understand for end users.

The mathematical representation of the transportation problem is as follows:

$$\text{Min. } Z = \sum_{r=1}^n \sum_{s=1}^n a_{rs} x_{rs}$$

Where  $a_{rs}$  and  $x_{rs}$  are the per unit cost and allocation respectively.

$$\sum_{s=1}^n x_{rs} \leq S_r; r = 1, 2, \dots, m$$

$$\sum_{s=1}^n x_{rs} \leq D_s; r = 1, 2, \dots, n$$

Where  $S_r$  and  $D_s$  are sources and destinations respectively.

**Keywords:** Initial basic feasible solution, Optimal solution, Penalty, Vogel's approximation method, Transportation cost.

## On Time-Changed Linear Birth-Death Processes with Immigration

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### Abstract

In this work, we introduce and study a time-changed version of the linear birth-death process under two types of immigration effects. Here, the time is changed via an inverse stable subordinator. It is shown that the systems of fractional differential equations govern the state probabilities of these immigration models. First, we consider a time-changed version of the linear birth-death process with immigration only when the population size reduces to zero. We establish a subordinate relationship that connects a time-changed process with its non-fractional counterpart via a random process whose density function is the folded solution of a time-fractional diffusion equation. Time-changed versions of two particular cases of this process are studied. Also, we consider a time-changed linear birth-death-immigration process where the effect of immigration is considered in all states. The explicit forms of the state probabilities are obtained in three different cases of birth, death, and immigration rates.

## On the Superposition and Thinning of Generalized Counting Processes

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### Abstract

The generalized counting process (GCP) is among the generalizations of Poisson process which was first introduced and studied by Di Crescenzo et al. (2016). It can perform  $k$  kinds of jumps of amplitude  $1, 2, \dots, k$  with some positive rates. It is well known that merging two independent Poisson processes is again a Poisson process whose arrival rate is equal to the sum of the arrival rates of merging components. Also, in the thinning of the Poisson process, the split components turn out to be Poisson processes with some decreased arrival rates.

In our work, we first study the merging of a finite number of independent GCPs and then extend the results to the countably infinite case. The merged process is observed to be a GCP with increased arrival rates. Some distributional properties of the merged process are obtained. The jump probabilities originating from a merging component are obtained. Moreover, we also study the thinning of a GCP in two different ways. In the first type of splitting, we study the splitting of jumps of GCP, where simultaneous jumps in the split components are not allowed. In the second type, there can be simultaneous jumps in the split components. In the first type of splitting, we show that the split components are independent GCPs with certain decreased jump rates. In the second type of splitting, we establish that the split components are GCPs but not necessarily independent.

## **Soret effect of MHD Nanofluid flow over an inclined stretching sheet with Darcy dissipation and heat source**

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### **Abstract**

An analysis has been made to illuminate the unsteady MHD slip flow of Nano fluid over an inclined stretching sheet. The heat transfer has been analysed incorporating Darcy dissipation and heat source. The presence of Soret effect makes the study more interesting. Using Similarity transformation technique, the governing partial differential equations are converted into a system of ordinary differential equations. The reduced system is dealt with 4th order Runge-Kutta method with shooting technique. The comparison with earlier results gives a reliability of present outcomes.



## Certain Subclass of Univalent Functions with Real Coefficients

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### Abstract

In this paper we have taken a subclass  $U+(A,B)$  of  $A$  of normalized analytic function on  $U = \{z \in \mathbb{C} : |z| \leq 1\}$  with the normalized condition as  $f(0) = 0$  and  $f'(0) = 1$ . Sharp estimates of the initial coefficients, logarithmic coefficients, second and third Hankel determinant for the function  $f \in U+(A,B)$  and its inverse are determined. For the conjecture due to Zalcman for the member of  $U+(A,B)$  is established.

## **An Inventory Model for Deteriorating Items Using GMIR Method followed by Defuzzification**

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### **Abstract**

In the present work, we have taken items which have deteriorating characters as our inventory, which in general produced by any natural or industrial process. The system was transferred from Crisp environment to Fuzzy environment, due to uncertainty characteristics of holding cost, set-up cost, deterioration cost, deterioration rate, demand rate, production rate, etc. For accuracy we have used heptagonal fuzzy numbers, which in later stage defuzzified by Graded Mean Integration Representation (GMIR). Numerical example is used to investigate the theoretical results thoroughly and ensure comprehension. Sensitivity analysis with diverse parameters is performed to illustrate the effective ness and behavior of the model.

## CESARO SEQUENCE SPACE OF NON-ABSOLUTE TYPE AND ITS PROPERTIES

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### Abstract

The study of sequence spaces has been of great interest recently. Furthermore, the sequence space has been widely applied in numerous domains. One of the sequence spaces that has lately been studied is the non-absolute type Cesaro sequence space. In this article, we provide the proof of a non-absolute type Cesaro sequence space, where the norm is defined as  $\|x\|_p = (\sum_{n=1}^{\infty} |1/n \sum_{k=1}^n x_k|^p)^{1/p}$  for any real number  $p$  satisfying  $1 \leq p < \infty$  and  $\|x\|_{\infty} = \sup\{|1/n \sum_{k=1}^n x_k|; n \in \mathbb{N}\}$  being a Banach Space. Also, we have proved some other properties of Cesaro sequence space of non-absolute type.

**Keywords:** Cesaro sequence space of non-absolute type, Cesaro sequence space, Banach space

## Geometry in Visual Art and Architecture

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### Abstract

When learning about visual art and viewing it in an exhibition gallery or a museum hall, you may wonder, what is a geometric shape in art and how is it significant to the creation of drawings, sculpture, paintings and architecture? Geometry – a branch of mathematics that deals with the measurement, properties, and relationships of points, lines, angles, surfaces, and solids. The geometric shape definition in art is characterized by a reliance on mathematical shapes such as triangles, squares, circles, and lines to organize space. Artists can use geometry to develop a theme, for example, Cubism uses cubes and Fractal Art uses statistical constants to develop a design. The use of geometric shapes in art also allows artists to isolate and display emotion in their work. Geometric shapes were used from very ancient times in creating various art forms, more frequently in the 20th century, developing out of the previous artistic period of figurative painting and landscapes, which in its final phase was beginning to experiment with cylinders, spheres, and cones.

Geometric patterns provide a sense of visual harmony and order. The symmetrical and repetitive nature of these patterns is aesthetically pleasing to the human eye, and it plays a very important role in visual art and architecture and helps to develop the country. This inherent sense of balance and proportion can be found in various visual elements, from art to architecture, drawing to painting, sculpture to ceramics, textiles to interior decor, and even in website layouts.

Keywords: Geometry, Visual Art.

## Initial coefficients and Fekete-Szego inequalities for functions related to Van Der Pol numbers

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### Abstract

By using subordination we have designed a function generated by Van Der Pol numbers a subclass of univalent functions  $M_R(\gamma, \nu, \lambda, \alpha)$  of class  $A$  in the unit disk. This subclass generalizes some other sub-classes. Fekete-Szego problem for the above class is completely solved and bounds of coefficients  $a_2, a_3$  are derived finally the third Hankel determinant of logarithmic coefficients of the above subclass is determined

**Effect of Changeable velocity, heat and mass transport on unsteady MHD free convective flow past infinite vertical plate.**

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**Abstract**

In this paper, the Effect of Changeable velocity, heat and mass transport on unsteady MHD free convective flow past infinite vertical plate has been studied. The dimensionless governing equations are solved analytically using Laplace transfer of concentration and temperature apart from the velocity as the function of  $y$  and  $t$ . The temperature and species concentration near the plate are assumed to be accelerate by exponential parameters. The influences of the various parameters on the flow field mass concentration field and Temperature field are extensively discussed from graphs.

## **Dynamical Behaviour of Harvesting Predators Over Modified Lotka-Volterra Model Using Holling Type IV Functional Response**

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### **Abstract**

This paper looks at a class of predator models that include cooperative predation in specialised carnivore populations. The functional response was parameterised, and numerical simulations supported the corresponding analytical analysis of the pattern formation possibilities. The fundamental conclusion of this work is that permanent Turing patterns like spots can develop when predators are less diffuse than their prey. Parameter values outside the Turing range are also produced and are the subject of extensive research, including spatiotemporal chaos. Since predation cooperation among predators can enable successful predation, specialised assemblages of predators supporting prey dispersal support the establishment of roost patches.

## A Mutation-based Single Candidate Optimizer for higher dimension optimization problems

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### Abstract

Single candidate optimizer (SCO) is a new member of metaheuristic (MH) algorithm based on a single candidate solution throughout the whole optimization scheme. To balance between two major factor of MH algorithm i.e., diversification and intensification, SCO utilized a unique set of solutions which helps effectively in updating the position of the individual solution. Like other MH algorithms, it faces difficulties to handle good trade-off between exploration and exploitation. In this study, an effective updated version of the SCO algorithm (In short M-SCO) is proposed by utilising the mutualism phase from the symbiotic organism search (SOS) method is to overcome the drawbacks of classical SCO algorithm. Twenty classical benchmark problems of 500 and 1000 dimensions were solved using the M-SCO technique to validate it. Seven well-known MH algorithms are compared. The Friedman rank test is used to check the algorithm's statistical performance. Finally, two constrained real-world engineering design problems are solved to check the problem-solving ability of M-SCO algorithm. Moreover, the experimental findings revealed that the proposed M-SCO algorithm achieves more than 90% superior results as compared to other optimization algorithms.

**Keywords:** *Single candidate optimizer, Symbiotic organism Search; Friedman rank test; Engineering design problems*



## **Application of Boundary Element Method in Mathematical Modeling of Wave-Structure Interaction Problems**

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### **Abstract**

Protection of marine structures from high-amplitude incident waves has been a major concern in recent years. In this context, the present work demonstrates the mathematical modelling of water wave interaction by a pair of inverted semicircular surface-piercing porous wave barriers that are placed over a stepped seabed. To handle the aforementioned physical problem the boundary element method has been considered. Additionally, to analyze the hydrodynamic behaviour of the water wave scattering phenomena by the pair of porous barriers, the influence of porosity and various geometrical configurations has been considered. Further, the energy identity has been derived to quantify the wave energy dissipated due to the pair of porous wave barriers. The study emphasizes the applicability of adopting a porous barrier in the coastal region over the permanent bulky rubble mound breakwaters by considering the parameter Keulegan Carpenter number, which reveals that the energy dissipation is higher in the case of porous structure, ensuring the long-term durability of the structure.

## **Combined Effects of Electrification and Transverse Force on Two Phase Flow over a Linear Stretching Sheet.**

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### **Abstract**

This research presents a numerical investigation of the flow and heat transfer of a steady two phase flow over a linear horizontal stretching sheet. Combined effects of electrification and transverse force have been taken into account. The flow problem's formulation comprises of highly nonlinear PDEs that have been transformed into systems of ODEs by using similarity transformation. Then the ODEs has been solved numerically by using Shooting technique followed by Runge Kutta 4th order method that is incorporated in BVP4C tool of the MATLAB software. The effects various flow parameters, such as the Prandtl number, Eckert number and transverse force on the flow geometry has been investigated. The overall findings are displayed in graphs and tables, and it is observed that the transverse force reduces the velocity of the particle phase in the flow where as electrification of particles raises the temperature of particle phase in the flow. The computations carried out with tolerance of order less than  $O(10^{-6})$ .

**Key Words:** Heat transfer, Electrification, Transverse force, Shooting technique

## Application of Assignment model in fuzzy environment

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### Abstract

Assignment models are used to tackle real-world challenges in Engineering and Management Science. In real-world problems, we may not have precise facts or information. In this work, the cost of allocating the  $i$ th individual to the  $j$ th job is calculated using a trapezoidal fuzzy number, which is more realistic and practical. The trapezoidal fuzzy number is defuzzified using Maleki's proposed linear ranking algorithm.

**Keywords:** Tr fuzzy number, Linear ranking function, Fuzzy number Assignment problems.

## **Application of Cutting Plan Method for Solving Fuzzy Number Linear Programming Problems in Fuzzy Environment**

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### **Abstract**

Linear programming is one of the most popular decision-making strategies for tackling real-world situations. Real-world circumstances are marked by imprecision rather than exactness. In this study, the traditional cutting plan method is extended to tackle a fuzzy number linear programming problem with integer solutions. The trapezoidal fuzzy integers are defuzzified using Maleki's proposed linear ranking approach. This strategy is simple to apply. This strategy is demonstrated using acceptable numerical examples.

**Keywords:** Fuzzy linear programming problem, Trapezoidal fuzzy number, Ranking method.

## Geometric modelling of phytoplankton as blue carbon sink in coastal Odisha, India

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### Abstract

Phytoplankton is considered to be the base of marine and estuarine ecosystems, whose composition and biomass are indicators of aquatic health. The present study has been undertaken in 05 stations of the Brahmani-Baitarani estuary of Odisha with the aim to understand the variation of cell volume and carbon. Cell volume is a unique indicator of variation in physio-chemical parameters of water and cell carbon is critical for understanding the plankton dynamics with respect to climate change. We reported 49 phytoplankton species constituting of diatoms, dinoflagellates, green algae and blue-green algae which are direct store house of carbon, absorbing CO<sub>2</sub> from atmosphere and releasing 50-60% of O<sub>2</sub> both to aquatic and atmospheric mediums. The cell volume has been calculated using 13 geometric models (values ranging 116.22-281346.45 μm<sup>3</sup>) and cell carbon has been calculated using standard logarithmic equations (values ranging 1.143-3.709 μg/l). Among 49 recorded species during October 2022 to September 2023, 15 species were found to be dominant. A significant positive relationship was observed with respect to cell carbon and cell volume, pH and salinity (p<0.01; p<0.05), which clearly speaks for the effect of aquatic alkalinity/acidity of ocean water and dilution from adjacent riverine systems on the growth and distribution of phytoplankton in the study area. A significant negative relationship (p<0.01) was observed between cell carbon and nutrients (nitrate, phosphate and silicate) which clearly depicts that the nutrients have been absorbed from the aquatic medium by the phytoplankton for increasing its cell size and biomass. A significant negative relationship with temperature (p<0.01) reveals that increased temperature has an adverse effect on

photosynthesis of phytoplankton, thereby causing death and decay of the species. Our results suggest that phytoplankton cell carbon as well as cell volume can act as indicators of ocean acidification effects in the changing era of climate.

**Keywords:** *Cell carbon, Cell volume, Climate change, Geometric models, Phytoplankton*

**Prediction model for *Shorea robusta* Gaertn.: An Economic Sustainability study for the Tribals of Odisha, India**

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**Abstract**

Non-Timber Forest Produces (NTFPs) gathered from the various parts of the Sal tree (*Shorea robusta* Gaertn.) plays a vital and significant role in economic sustainability of forest dwellers of Odisha. The present study investigates the current and future distribution of Sal forests impact on daily life and earnings of tribal communities reside at Odisha. Sal tree was found as dominant with having the highest importance value index (IVI) of 36.77 among the 96 tree species recorded. The Species Distribution Modelling (SDM) has been developed using six predictive variables on considering two representative concentration pathways (RCP4.5 and RCP8.5) for the year 2023, 2050, 2070 and 2080 respectively using MaxEnt algorithm. The study area bear a total area of 69096.78 km<sup>2</sup> out of which the suitability trend as high suitable (HS) [30030.22 km<sup>2</sup>] > low suitable (LS) [15109.64 km<sup>2</sup>] > moderate suitable (MD) [12257.95 km<sup>2</sup>] in both RCP4.5 and RCP8.5 in 2023. In 2080, the suitability trend as HS (25353.18 km<sup>2</sup>) > MS (15950.16 km<sup>2</sup>) > LS (13764.64 km<sup>2</sup>) and LS (24433.42 km<sup>2</sup>) > MS (14884.12 km<sup>2</sup>) > HS (11185.82 km<sup>2</sup>) for RCP4.5 and RCP8.5 respectively. The developed model also revealed that by the end of 21<sup>st</sup> century, 9.98% of suitable area will become unsuitable for Sal forests which will ruin the tribal's livelihood. The developed model validated as best fitting model with an area under curve (AUC) value of 0.86±0.017. The study recommends that the pinned unsuitable landscapes should be given with special attention by the forest departments, local stake holders and other associated authorities to conserve and manage Sal forests to ensure livelihood opportunity to the forest dwellers.

**Keywords:** Economic sustainability, IVI, MaxEnt, RCPs, SDM, *Shorea robusta* Gaertn., Tribals

## Modeling and Forecasting of Climatic Variables in South-Western Himalayas using ARIMA model

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### Abstract

One of the most fragile ecosystems: the Himalayan region is highly susceptible to current and potential climate change impacts like floods, droughts and landslides leading to the loss of biodiversity. Sundernagar, Shimla, Bhuntar and Kalpa were the four locations that were considered in the current study. From the study, it has been observed that, in the Himalayas the pre-monsoon minimum temperature is set to decrease during the late 20<sup>th</sup> century. The rate of decrease of minimum temperature is three times that of the rate of decrease of maximum temperature. Out of the four-point locations, Bhuntar and Kalpa being the nearest to the mountainous region of the Himalayas, showed the lowest mean annual temperatures of 10.1 °C and 9.2 °C respectively followed by Shimla (13.6 °C) and Sundernagar (18.8 °C). Autoregressive Integrated Moving Average (ARIMA) model was considered for the forecast of the climatic variables. In the model, it is clearly seen that all four locations have shown the cooling effect in the order Sundernagar (-0.005 °C) < Bhuntar (-0.07 °C) < Kalpa (-0.16 °C) < Shimla (-1.59 °C) respectively. In the forecast, the highest increase in rainfall was seen in Shimla (534 mm) followed by Kalpa (244 mm), Bhuntar (220 mm) and Sundernagar respectively. The forecast suggests Shimla will see an increase of 34.08 cm of snowfall by the year 2029, whereas in case of Kalpa the increase will be even more (188 cm). The aspects like ecotourism can also be an important aspect for the tourism and forestry departments of local governments keeping in view the future



extremes of climate in order to maintain and generate better revenue from the heavenly landscape of Himalayas.

**Keywords:** Climate change, Himalaya, ARIMA model, Ecotourism



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