



2nd **International Conference on Nonlinear
Dynamics and Applications**
February 21- February 23, 2024

ABSTRACT BOOKLET

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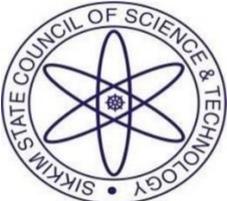
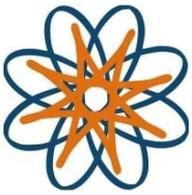
 <p>SMIT SIKKIM MANIPAL UNIVERSITY SIKKIM MANIPAL INSTITUTE OF TECHNOLOGY</p>	<p>Sikkim Manipal Institute of Technology (SMIT), Sikkim Manipal University (SMU)</p>
	<p>Science and Engineering Research Board (SERB)</p>
 <p>सीएसआईआर CSIR भारत का नवाचार इंजन <i>The Innovation Engine of India</i></p>	<p>Council for Scientific and Industrial Research (CSIR)</p>
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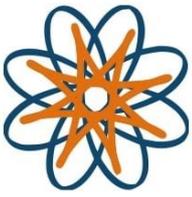
FOREWORD



The Department of Mathematics at Sikkim Manipal Institute of Technology (SMU) hosts the 2nd International Conference on Nonlinear Dynamics and Applications (ICNDA 2024) from February 21st to 23rd, 2024. The conference aims to inspire and provide significant exposure to researchers, both new and experienced, who are involved in different areas of nonlinear dynamics. This esteemed occasion includes keynote and invited speeches by renowned scientists, as well as oral presentations by research academics and attendees. The conference provides a vibrant venue for young researchers to interact with prominent academicians from across the world, presenting their innovative research efforts.

ICNDA 2024 covers diverse topics such as Dynamical Systems, Mathematical Modelling, Chaos, Complexity and Fractals, Plasma Dynamics and Applications, Space Plasmas, Bifurcation Analysis, Graphs and Applications, Cryptography and Networks, Communication and Applications, Financial Data and Applications, Semiconductor Devices and Materials and their Applications, Deep Learning and Machine Learning, Nonlinear Effects on Climate Change, Internet of Things and Smart Applications, Artificial Intelligence and Applications, Fluid Dynamics and Nonlinear Flows, Fractional Systems and Applications, Signal Processing and Signal Analysis, The Dynamics of Pandemics, Quantum Systems and Quantum Chaos, Chaos and Complexity in Social Structures, Genetic Algorithm and Optimization, Ecological, Biological and Biomedical Models and Applications.

The conference has had a large and diversified response, indicating its importance. It has attracted national and international attendees, including well-known scientists, technologists, young researchers, and academic faculties. We extend our heartfelt appreciation to all delegates who have travelled from all parts of the nation and abroad, contributing to the success of the event. The event has a total of 28 sessions, thoughtfully balanced between physical and virtual formats with a combined total of around 180 oral presentations. The event comprises 6 keynote lectures, 16 invited talks and 180 presentations. It has attracted the active participation of more than 216 research academics and scientists.



2nd International Conference on Nonlinear Dynamics and Applications 2024
(ICNDA 2024)

Organized by:

Department of Mathematics
Sikkim Manipal Institute of Technology, Sikkim, India
Date: February 21-23, 2024



I express my sincere gratitude to the Sikkim Manipal University administration for their invaluable financial assistance. The generous support from SERB, New Delhi, and CSIR, New Delhi, greatly facilitated the arrangement of lodging and boarding facilities for all participants. Moral support from Sikkim State Council of Science & Technology is appreciable. Additionally, junior, and senior scientists, as well as conference speakers, received financial support in the form of waived registration fees, complimentary accommodations, and travel allowances. It is my hope that this three-day event has opened new horizons and inspired innovative research ideas for young and senior scientists worldwide.

The Patrons, Co-Patrons, organising faculty members, members of the National and International Advisory Committee, National Organising Committee, and Local Organising Committee deserve special recognition for their steadfast support, direction, and help. Furthermore, sincere gratitude is sent to all members of the sub-committee, including volunteers, whose committed endeavours, both direct and indirect, have played a crucial role in guaranteeing the success of this nationwide undertaking.

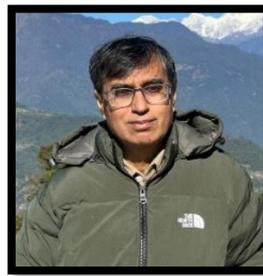


Dr. Asit Saha
Organizing Secretary

Dr. Asit Saha
Assistant Professor (SG)
Organizing Secretary, ICNDA 2024
Department of Mathematics,
Sikkim Manipal Institute of Technology
Sikkim Manipal University, East Sikkim 737136,
India



Message



I am glad to know that the Department of Mathematics, Sikkim Manipal Institute of Technology, SMU, Sikkim is organising the 2nd International Conference on Nonlinear Dynamics and Applications (ICNDA 2024) from 21-23 February 2023. This conference is the second one in the series of ICNDA conferences. It provides an excellent opportunity to the eminent scientists of the world working in the field of nonlinear dynamics. I welcome all the delegates to the beautiful campus of SMIT, which stands with excellence in academia and research as recognised by various national ranking institutes.

I congratulate the organiser of the ICNDA-2024 for grasping this opportunity to host the event biannually. I hope this three-day event will bring out new horizons in the area of nonlinear dynamics and its application. The critical scientific discussions with speakers will be helpful for young researchers to pursue productive and cutting-edge research in their careers.

I wish you all a memorable and productive conference experience at the beautiful campus of SMIT, Sikkim, India.

Prof. Anjan Raychaudhuri

Head, Department of Mathematics,

Sikkim Manipal Institute of Technology
Sikkim Manipal University, East Sikkim 737136,
India

Dr. A. Raychaudhuri
Prof. & Head
Department of Mathematics
SMIT, Majitar-737136

About Department of Mathematics, SMIT

SMIT is synonymous with excellence in quality technological education and research. It is one of the leading academic institutions and is a constituent college of SMU which is accredited with the prestigious grade of NAAC A+. Established in the year 1997, it is a home to more than 3000 students from India and its neighbouring countries, pursuing higher education in diverse fields of science and technology. An efficient team of more than 200 highly qualified faculty members and a large number of dedicated support staffs set an excellent platform for exchange of academic ideas and deliberations with students and scholars. Apart from classroom teaching and discussions, the faculty members are actively involved in research with more than ₹ 10 crore research funding from different funding agencies like the DRDO, DST, AICTE, CSIR, DeitY, and Manipal Pai Foundation.

The Department of Mathematics came into existence with the inception of the institute in 1997. It offers B.Sc., M.Sc. and PhD in Mathematics, apart from bridging the gap between Mathematicians and Engineers. It has a strength of 12 faculty members and 2 support staffs. Faculty members are actively involved in diverse fields of research such as Fluid Dynamics, Wavelet Analysis, Signal Processing, Natural Language Processing, Fuzzy Logic and Topology, Linear Algebra, Graph Theory, Complex Analysis, Stochastic Process, Nonlinear Dynamics, Plasma Dynamics, Bifurcation Analysis, Nonlinear Waves, etc. At present, 13 research scholars are pursuing PhD under the guidance of the faculty members of the department. Recently one post-Doctoral research fellow has joined the department to continue his research work in the field of nonlinear waves in plasma. Besides teaching and research, the department organizes various workshops, seminars and conferences regularly

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ICNDA 2024 SCHEDULE OF PHYSICAL MODE (LOCATION SMIT)

[Link 1](#) [Link 2](#) [Link 3](#) [Link 4](#)

Day I (21-02-2024)

10:00-11:00 Inaugural Session [Link 1]				
11:00-11:30 High Tea, Venue: Amphitheater				
11:30-12:30 Keynote Talk: "Nonlinear Dynamics of Coupled Spin Torque Nano Oscillators"				
12:30-13:00 Invited Talk: "A Spotlight on Global Warming of Future Earth"				
13:00-14:00 Lunch Break				
Paper Presentation [14:00-14:45] [10× 03]	Venue 1 Session 1 [Seminar Room]	Chair Person: Dr. Vignesh Dhakshinamoorthy, CMR University. [Link 1]	Venue 2 Session 1 [E-207]	Chair Person: Dr. Swarniv Chandra, Government General Degree College at Kushmandi
	Paper ID	042, 047, 118	Paper ID	156, 198, 254
14:45-15:30 Keynote Talk: "Hamiltonian dynamics and neutral delay equations in laser systems"				
15:30-16:00 Invited Talk: "Ion-acoustic Nonlinear Structures in Multicomponent Superthermal Plasma" Speaker: Prof. N. S. Saini, Department of Physics, Guru Nanak Dev University, India. Chair Person: Prof. Prasanta Chatterjee, Department of Mathematics, Visva Bharati University, India. [Link 1]				
16:00-16:15 Tea Break				
16:15-16:45 Invited Talk: "Mathematical Modelling: Development and Applications on Biological Systems" Speaker: Dr. Soumen Kundu, Department of Mathematics (SAS), VIT, India.				
Paper Presentation [16:45-18:00] [10× 07]	Venue 1 Session 2 [Seminar Room]	Chair Person: Dr. Rishi Raj Kairi, CoochBehar Panchanan Barma University. [Link 1]	Venue 2 Session 2 [E-207]	Chair Person: Dr. Swarniv Chandra, Government General Degree College at Kushmandi
	Paper ID	148, 052, 299, 068, 218, 298,	Paper ID	224, 008, 105, 121, 315, 246
19:00-20:30 Cultural Programme, Venue: Amphitheater				

ICNDA 2024 SCHEDULE OF PHYSICAL MODE (LOCATION SMIT)

Day II (22-02-2024)

9:00-09:45 Keynote Talk: "Finite size quantum multibarrier systems vs. boundary driven Zero Range models"				
09:45-10:15 Invited Talk: "Transport of microbes in non-Newtonian nanofluid flow influenced by Marangoni convection" Speaker: Dr. Rishi Raj Kairi, Cooch Behar Panchanan Barma University, India.				

Paper Presentation [10:15-11:00] [10× 03]	Venue 1 Session 3 [Seminar Room]	Chair Person: Dr. Rustam Ali, Sikkim Manipal Institute of Technology [Link 1]	Venue 2 Session 3 [E-207]	Chair Person: Dr. Soumen Kundu, Department of Mathematics (SAS), VIT, India. [Link 4]
	Paper ID	372, 284, 302	Paper ID	135, 065, 045, 257, 330 (Online)
11:00-11:15	Tea Break			
11:15-11:45	Invited Talk: "Mathematical modelling of combat" Speaker: Dr. Sharanjeet Dhawan, Department of Mathematics, CCS Haryana Agricultural University, India. Chair Person: Prof. N. S. Saini, Department of Physics, Guru Nanak Dev University, India. [Link 1]			
11:45-12:15	Invited Talk: "Role of mathematics and computer modelling on cardiovascular intervention"			
Paper Presentation [12:15-13:00] [10× 03]	Venue 1 Session 4 [Seminar Room]	Chair Person: Dr. Sharanjeet Dhawan, CCS Haryana Agricultural University [Link 1]	Venue 2 Session 4 [E-207]	Chair Person: Dr. Rajeeb Dey, National Institute of Technology Silchar. [Link 4]
	Paper ID	106, 108, 338	Paper ID	140, 095, 164, 174, 317, 082 (Online)
13:00-14:00	Lunch Break, Venue: Marena			
Paper Presentation [14:00-15:15] [10× 06]	Venue 1 Session 5 [Seminar Room]	Chair Person: Dr. Soumen Kundu, Department of Mathematics (SAS), VIT, India. [Link 1]	Venue 2 Session 5 [E-207]	Chair Person: Prof. Prasanta Chatterjee, Department of Mathematics, Visva Bharati University, India [Link 4]
	Paper ID	062, 215, 220, 300, 056, 074	Paper ID	213, 080, 350, 004, 011, 307, 137, 314 (Online)
15:15-16:00	Keynote Talk: "Fractional Dynamics and Applications"			
16:00-16:15	Tea Break			
16:15-16:45	Invited Talk: "Discretization and impact of Fractional order in Nonlinear Systems"			
		Chair Person:		

Paper Presentation [16:45-19:00] [10× 10]	Venue 1 Session 6 [Seminar Room]	Dr. A. Gowrisankar, Vellore Institute of Technology. [Link 1]	Venue 2 Session 6 [E-207]	Chair Person: Dr. R. Sivaraj, Dr. B R Ambedkar National Institute of Technology [Link 4]
	Paper ID	332, 232, 124, 264, 261, 203, 265, 144, 217, 326	Paper ID	081, 279, 061, 263, 255, 027, 142, 346, 357, 141, 097, 250 (Online)
20:00-21:30	Gala Dinner, Venue: Marena			
ICNDA 2024 SCHEDULE OF PHYSICAL MODE (LOCATION SMIT)				
Day III (23-02-2024)				
9:00-9:45	Keynote Talk: "Detecting dynamical transitions in observational time series data"			
9:45-10:30	Keynote Talk: "Solutions of Nonlinear Partial Differential Equations and applications"			
10:30-11:00	Invited Talk: "Heat transfer optimization using machine learning"			
11:00-11:15	Tea Break			
Paper Presentation [11:15-12:30] [10× 06]	Venue 1 Session 7 [Seminar Room]	Chair Person: Dr. Rishi Raj Kairi, Cooch Behar Panchanan Barma University. [Link 1]	Venue 2 Session 7 [E-207]	Chair Person: Dr. A. Gowrisankar, Vellore Institute of Technology, India
	Paper ID	322, 327, 337, 234, 111, 092	Paper ID	163, 354, 166, 370, 371, 113, 165, 380
12:30-13:00	Invited Talk: "Stability Assessment of interpersonal relationship among Indian urban dyads (couples) : System Theory Approach"			
13:00-15:00	Lunch Break, Venue: Marena			
15:00-	Valedictory Session			

ICNDA 2024 SCHEDULE OF ONLINE MODE				
Link 1	Link 2	Link 3		
Day II (22-02-2024)				
Time [IST]	Programme			
9:00-09:45	Keynote Talk: "Finite size quantum multibarrier systems vs. boundary driven Zero Range models" Speaker: Prof. Lamberto Rondoni, Department of Mathematical Sciences, Politecnico di Torino, Italy. Chair Person: Prof. M. Lakshmanan, Professor of Eminence and DST-SERB National Science Chair, Bharathidasan University, India. [Link 1]			
09:45-10:15 [Online]	Invited Talk: "Acoustic Modes Inside White Dwarfs" Speaker: Dr. Pralay Kumar Karmakar, Department of Physics, Tezpur University, India. Chair Person: Dr. Asit Saha, Sikkim Manipal Institute of Technology, India. [Link 2]			
Paper Presentation [10:15-11:00] [10× 03]	Channel 1 Session 3 [Link 2]	Chair Person: Dr. Avijit Panja, Sikkim Manipal Institute of Technology, India	Channel 2 Session 3 [Link 3]	Chair Person: Prof. Pankaj Chettri, Sikkim Manipal Institute of Technology, India
	Paper ID	021, 019, 043	Paper ID	174, 292, 054, 306, 118, 268, 121, 342, 013
11:00-11:15	Tea Break			
11:15-11:45 [Online]	Invited Talk: "Harmonizing Chaos: Unveiling the Power of Chaotic System Synchronization in the IoT Age" Speaker: Dr. Nur Aisyah Abdul Fataf, Cyber Security and Digital Industrial Revolution Centre, National Defence University of Malaysia (NDUM), Malaysia. Chair Person: Dr. M Sivabalan, Sri Ramakrishna Mission Vidyalaya College of Arts and Science, India. [Link 2]			
11:45-12:15	Invited Talk: "Role of mathematics and computer modelling on cardiovascular intervention" Speaker: Prof. Prashanta Kumar Mandal, Department of Mathematics, Visva-Bharati, India. Chair Person: Prof. N. S. Saini, Department of Physics, Guru Nanak Dev University, India. [Link 1]			
Paper Presentation [12:15-13:00] [10× 03]	Channel 1 Session 4 [Link 2]	Chair Person: Dr. Rustam Ali, Sikkim Manipal Institute of Technology, India	Channel 2 Session 4 [Link 3]	Chair Person: Dr. Avijit Panja, Sikkim Manipal Institute of Technology, India
	Paper ID	073, 063, 075, 320, 160	Paper ID	291, 069, 006, 039, 158, 353, 355
13:00-14:00	Lunch Break, Venue: Marena			
Paper Presentation [14:00-15:15] [10× 06]	Channel 1 Session 5 [Link 2]	Chair Person: Dr. Samarendra Nath Sur, Sikkim Manipal Institute of Technology, India	Channel 2 Session 5 [Link 3]	Chair Person: Dr. Uday Narayan Ghosh, Munger University, India.
	Paper ID	001, 029, 030, 031, 050, 192, 167, 154	Paper ID	303, 172, 227, 059, 016, 102, 308
15:15-16:00 [Online]	Keynote Talk: "Fractional Dynamics and Applications" Speaker: Prof. Juan J. Nieto, Mathematical Analysis and Optimization of the University of Santiago de Compostela, Spain Chair Person: Dr. Vignesh Dhakshinamoorthy, Department of Mathematics, CMR University, India. [Link 1]			
16:00-16:15	Tea Break			
16:15-16:45 [Online]	Invited Talk: "House prices power law distribution across cities" Speaker: Dr. Luca Sebastiano D'Acci, Inter university Department of Regional and Urban Studies and Planning, Politecnico di Torino, Italy Chair Person: Dr. Nahid Fatima, Prince Sultan University (PSU), Saudi Arabia [Link 2]			
16:45-17:15 [Online]	Invited Talk: "Quantum and chaotic dynamical systems for multimedia cybersecurity" Speaker: Dr. Ahmed A. Abd El-Latif, Department of Computer Science, Menoufia university, Egypt Chair Person: Dr. Nahid Fatima, Prince Sultan University (PSU), Saudi Arabia [Link 2]			
Paper Presentation [17:15-19:00] [10× 10]	Channel 1 Session 6 [Link 2]	Chair Person: Dr. Md. Golam Hafez, Chittagong University of Engineering and Technology, Bangladesh	Channel 2 Session 6 [Link 3]	Chair Person: Dr. Uday Narayan Ghosh, Munger University, India.
	Paper ID	015, 023, 038, 044, 055, 089, 162, 273, 281, 285	Paper ID	161, 049, 064, 247, 114, 243, 093, 094, 274, 202, 308
20:00-21:30	Gala Dinner, Venue: Marena			

ICNDA 2024 SCHEDULE OF ONLINE MODE

[Link 1](#)
[Link 2](#)
[Link 3](#)

Day III (23-02-2024)

9:00-9:45 [Online]	Keynote Talk: "Detecting dynamical transitions in observational time series data" Speaker: Prof. Michael Small, Mathematics and Statistics, The University of Western Australia, Australia Chair Person: Prof. Lamberto Rondoni, Department of Mathematical Sciences, Politecnico di Torino, Italy. [Link 1]			
9:45-10:30	Keynote Talk: "Solutions of Nonlinear Partial Differential Equations and applications" Speaker: Prof. Prasanta Chatterjee, Department of Mathematics, Visva Bharati University, India. Chair Person: Prof. Lamberto Rondoni, Department of Mathematical Sciences, Politecnico di Torino, Italy. [Link 1]			
10:30-11:00	Invited Talk: "Heat transfer optimization using machine learning" Speaker: Dr. R. Sivaraj, Department of Mathematics, Dr. B R Ambedkar National Institute of Technology, India. Chair Person: Dr. Sharanajeet Dhawan, Department of Mathematics, CCS Haryana Agricultural University, India. [Link 1]			
11:00-11:15	Tea Break			
Paper Presentation [11:15-12:30] [10× 06]	Channel 1 Session 7 [Link 2]	Chair Person: Dr. Md. Golam Hafez, Chittagong University of Engineering and Technology, Bangladesh.	Channel 2 Session 7 [Link 3]	Chair Person: Dr. Uday Narayan Ghosh, Munger University, India [Link 3]
	Paper ID	205, 348, 349, 088, 153, 331, 233, 241, 236, 252	Paper ID	007, 009, 018, 041, 097, 138, 033
12:30-13:00	Invited Talk: "Stability Assessment of interpersonal relationship among Indian urban dyads (couples) : System Theory Approach" Speaker: Dr. Rajeeb Dey, Department of Electrical Engineering, National Institute of Technology Silchar, India Chair Person: Dr. Sharanajeet Dhawan, Department of Mathematics, CCS Haryana Agricultural University, India. [Link 1]			
13:00-15:00	Lunch Break, Venue: Marena			
15:00-17:00	Valedictory Session			

ICNDA 2024 SCHEDULE OF ONLINE MODE

[Link 1](#)
[Link 2](#)
[Link 3](#)

Day I (21-02-2024)

Time [IST]	Programme			
10:00-11:00	Inaugural Session [Link 1]			
11:00-11:30	High Tea, Venue: Amphitheater			
11:30-12:30	Keynote Talk: "Nonlinear Dynamics of Coupled Spin Torque Nano Oscillators" Speaker: Prof. M. Lakshmanan, Professor of Eminence and DST-SERB National Science Chair, Bharathidasan University, India. Chair Person: Dr. Santo Banerjee, Department of Mathematical Sciences, Politecnico di Torino, Italy. [Link 1]			
12:30-13:00 [Online]	Invited Talk: "Acoustic solitary and shock waves around the super-critical values in unmagnetized plasmas" Speaker: Dr. Md. Golam Hafez, Professor of Mathematics, Chittagong University of Engineering and Technology, Bangladesh Chair Person: Dr. Asit Saha, Sikkim Manipal Institute of Technology, India. [Link 2]			
13:00-14:00	Lunch Break			
Paper Presentation [14:00-14:45] [10× 03]	Channel 1 Session 1 [Link 2]	Chair Person: Dr. Avijit Panja, Sikkim Manipal Institute of Technology, India	Channel 2 Session 1 [Link 3]	Chair Person: Prof. Pankaj Chettri, Sikkim Manipal Institute of Technology, India
	Paper ID	076, 143, 276	Paper ID	020, 014, 032, 352, 003
14:45-15:30 [Online]	Keynote Talk: "Hamiltonian dynamics and neutral delay equations in laser systems" Speaker: Prof. Antonio Politi, School of Natural and Computing Sciences, University of Aberdeen, UK. Chair Person: Prof. Lamberto Rondoni, Department of Mathematical Sciences, Politecnico di Torino, Italy. [Link 1]			
15:30-16:00 [Online]	Invited Talk: "AI Applications In Climate Change Data Analytics" Speaker: Dr. Devanjan Bhattacharya, The Bayes Centre, University of Edinburgh, United Kingdom Chair Person: Prof. Kajal Kumar Mondal, Cooch Behar Panchanan Barma University, India [Link 2]			
16:00-16:15	Tea Break			
16:15-16:45 [Online]	Invited Talk: "Non-equilibrium phase transitions in 3D billiards with a Maxwell demon" Speaker: Dr. Matteo Colangeli, Department of Information Engineering, Computer Science and Mathematics, University of L'Aquila, Italy. Chair Person: Prof. Kajal Kumar Mondal, Cooch Behar Panchanan Barma University, India [Link 2]			
Paper Presentation [16:45-18:00] [10× 07]	Channel 1 Session 2 [Link 2]	Chair Person: Dr. Moumi Pandit, Sikkim Manipal Institute of Technology, India	Channel 2 Session 2 [Link 3]	Chair Person: Dr. Nahid Fatima, Prince Sultan University (PSU), Saudi Arabia
	Paper ID	212, 230, 262, 096, 194, 340, 341	Paper ID	024, 036, 067, 084, 090, 115, 149
19:00-20:30	Cultural Programme, Venue: Amphitheater [Link 1]			

Keynote Talks

SL. No.	Title/Name/Affiliation
1.	<p>Nonlinear Dynamics of Coupled Spin Torque Nano Oscillators. Prof. M. Lakshmanan F.N.A., FTWAS, Professor of Eminence & DST-SERB National Session Chair Department of Nonlinear Dynamics, School of Physics, Bharathidasan University, Tiruchirapalli, India</p>
2.	<p>Finite size quantum multibarrier systems vs. boundary driven Zero Range models. Prof. Lamberto Rondoni Professor Department of Mathematical Sciences, Politecnico di Torino, Italy</p>
3.	<p>Solutions of Nonlinear Partial Differential Equations and Applications. Prof. Prasanta Chatterjee Professor Department of Mathematics, Visva-Bharati, Santiniketan, India</p>
4.	<p>Fractional Dynamics and Applications. Prof. Juan J. Nieto Professor Mathematical Analysis and Optimization of the University of Santiago de Compostela, Spain</p>
5.	<p>Hamiltonian dynamics and neutral delay equations in laser systems. Prof. Antonio Politi Emeritus Professor School of Natural and Computing Sciences, University of Aberdeen, United Kingdom</p>
6.	<p>Detecting dynamical transitions in observational time series data. Prof. Michael Small Professor Mathematics and Statistics, The University of Western Australia, Australia</p>

Invited Talks

SL. No.	Title/Name/Affiliation
1.	Role of mathematics and computer modelling on cardiovascular intervention Prof. Prashanta Kumar Mandal Professor Department of Mathematics, Visva-Bharati (a central university), West Bengal, India
2.	Ion-acoustic Nonlinear Structures in Multicomponent Superthermal Plasma Prof. N. S. Saini Professor Department of Physics, Guru Nanak Dev University, Amritsar, India
3.	ACOUSTIC MODES INSIDE WHITE DWARFS Prof. Pralay Kumar Karmakar Professor Department of Physics, Tezpur University, Assam, India
4.	Acoustic solitary and shock waves around the super-critical values in unmagnetized plasmas Prof. Md. Golam Hafez Professor Department of Mathematics, Chittagong University of Engineering and Technology, Chattogram-4349, Bangladesh.
5.	House prices power law distribution across cities Dr. Luca Sebastiano D'Acci Associate Professor Interuniversity Department of Regional and Urban Studies and Planning (DIST), Politecnico di Torino, Italy
6.	Quantum and chaotic dynamical systems for multimedia cybersecurity Dr. Ahmed A. Abd El-Latif Associate Professor Department of Computer Science, Menoufia university, Egypt
7.	Non-equilibrium phase transitions in 3D billiards with a Maxwell demon Dr. Matteo Colangeli Associate Professor Mathematical Physics, University of L'Aquila, Italy
8.	Heat transfer optimization using machine learning Dr. R. Sivaraj Associate Professor Department of Mathematics Dr. B R Ambedkar National Institute of Technology, Punjab, India

9.	Modelling & Stability of Dyadic Interpersonal Relationship Indian Urban Societal Perspective Dr. Rajeeb Dey Associate Professor Department of Electrical Engineering, National Institute of Technology Silchar, Assam, India
10.	Harmonizing Chaos: Unveiling the Power of Chaotic System Synchronization in the IoT Age Dr. Nur Aisyah Abdul Fataf Senior Lecturer Cyber Security and Digital Industrial Revolution Centre, National Defence University of Malaysia (NDUM), Malaysia
11.	A Spotlight on Global Warming of Future Earth! Dr. A. Gowrisankar Assistant Professor Senior Department of Mathematics, School of Advanced Sciences, Vellore Institute of Technology, Tamil Nadu, India
12.	Mathematical modelling of combat Dr. Sharanjeet Dhawan Assistant Professor Department of Mathematics, CCS Haryana Agricultural University, India
13.	Transport of microbes in non-Newtonian nanofluid flow influenced by Marangoni convection Dr. Rishi Raj Kairi Assistant Professor Department of Mathematics, Cooch Behar Panchanan Barma University, West Bengal, India
14.	Mathematical Modelling: Development and Applications on Biological Systems Dr. Soumen Kundu Assistant Professor Department of Mathematics (SAS), VIT AP University, Andhra Pradesh, India
15.	Discretization and impact of Fractional order in Nonlinear systems Dr. Vignesh Dhakshinamoorthy Assistant Professor Department of Mathematics, School of Engineering and Technology, CMR University, Karnataka, India
16.	AI APPLICATIONS IN CLIMATE CHANGE DATA ANALYTICS Dr. Devanjan Bhattacharya Teaching Fellow The Bayes Centre, University of Edinburgh, United Kingdom

Abstracts

A General Form of FO PI-PD Controllers for Some Stable Integer and Non-integer Order Plants with Transport Delay Paper ID: 001

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An increase in flexibility of the Fractional Order (FO) controllers introduced over the years attracting attention with adjustable tuning parameters having the potential of better control effort are made available in the literature. It is very troublesome as well as quite demanding to arrive at a control with its feedback loop closed of a high order oscillatory mass spring damper system with good performance. Now, in order to reach the desired control performance it has to be characterized by satisfying the pre-defined specifications in both the domain of frequency and time simultaneously not guaranteed with the $FO - PI^\lambda D^\mu$ controllers. A systematic design procedure is thus identified for a distinct cascaded FO PI and PD controller in terms of the required stability margins of the system to be controlled. Equating with the integer order (IO) controllers this controller will serve obvious benefits with the extra degree of freedom contributed by its non-integer orders achieving better servo tracking performance and loop robustness. Simple numerical examples with MATLAB simulations results illustrate its advantages while ensuring closed loop control stability of the system considered.

Keywords: Fractional Order (FO); high order oscillatory system; pre-defined specifications; stability margins; servo tracking performance; loop robustness

Frequency Analysis of Orthotropic Square Plates with Circular Thickness Variations in Two Dimensions Paper ID: 003

Neeraj Lather¹, Ankit Kumar², Vijil Kumar³, Tapas Sharma², Alka¹, Aabidaand⁴ and Amit Sharma¹

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This paper is concerned with vibrational frequency characteristics of orthotropic and non-homogeneous square plate having circular thickness variation in two dimensions along with linear density at clamped is carried out. A two-dimensional parabolic variation is assumed for the temperature distribution across the plate. Rayleigh-Ritz technique is employed to compute the frequency for the first four modes of vibration. Authors have performed the convergence study of modes of frequency for orthotropic square plate. The objective of the study is to present numerical data that demonstrate how the vibrational frequencies can be controlled by manipulating the plate parameters of the plate.

Keywords: Orthotropic, non homogeneous, circular thickness, linear density.

Deflection of a Smooth Cantilever Beam Caused by Fluid Pressure Gradient: A Numerical Investigation

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The central objective of this study revolved around a numerical exploration, aiming to comprehend the deflection patterns exhibited by elastic cantilever beam that is deformable in two dimensions with a smooth composition. This beam's distinctive features included sharp rectangular corners accompanied by rounded edges. The investigation was centered on the beam's reaction to a flowing fluid induced by a gradient in fluid pressure. To address this research question, Utilizing the Immersed Boundary (IB) technique as a computational tool, enabling an in-depth analysis of the phenomenon. A comprehensive sensitivity analysis was carried out, encompassing variations in parameters such as beam stiffness, height, and the pressure gradient within the flowing fluid. To provide context and insights, the outcomes of these simulations were juxtaposed with predictions from linear beam theory. Importantly, the findings obtained were corroborated through sound physical justifications.

Paper ID: 004

Keywords:

Fluid-Structure Interaction, Immersed Boundary Method, Euler Beam Theory, Newtonian Fluid, Poiseuille Flow.

Multifractal characterization of Weibull and Gamma probability distribution functions

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The intrinsic properties of probability distribution functions is important for its several applications especially atmospheric and climate studies. In this study, the multifractal strength of two probability distribution function - Weibull and Gamma distribution functions, in wide range of parameter space was investigated. Results obtained that the multifractal spectra of the two distribution functions are independent of the scale but dependent on the shape parameter. A mathematical model of the form $y = ce - kx$ was developed to characterize the relationship between multifractality and shape parameter of the distribution functions. The developed model was found to be a good fit with $r^2 \geq 0.98$ in the two probability distribution function.

Paper ID: 006

Keywords: probability distribution, multifractal spectrum, Weibull distribution, long range correlation.

Patient Health Monitoring System for Chronic Cardiac Attack using Machine Learning

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Cardiovascular disease is one of the prime principles of the demise globally. In nowadays usual contemporary life, demises on account of the cardiovascular disease had turn into one of crucial matters, that abruptly each individual lost his or her life every minute because of cardiovascular disorder. Forecasting the incidence of illness at early phases is a crucial threat these days. ML whenever executed in health protection is competent of rapid and precise identification of disorder. In this paper we provide a thorough analysis and development and implementation of a patient health monitoring system using Machine Learning techniques. The system is outlined to constantly observe and gather indispensable health data of patients in real-time, empowering healthcare providers to remotely detect and examine their health conditions. For implementing this monitoring system applying different ML algorithms, we have incorporated Logistic Regression, Naive Bayes, Support Vector Machines (SVM), K-Nearest Neighbors (KNN), and Random Forest. Among these algorithms, Random Forest offered the highest accuracy.

Paper ID: 008

Keywords: Health Monitoring, Machine Learning, Random Forest, Cardiac Attack.

Kinks-Antikinks Dynamics of Nonlinear DNA Molecules

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In this case, it is shown that the kinks created by the local opening of base pairs cause the double helix to curves more readily. Denaturation is the outcome of a quantum phase transition (QPT) brought on by a replenish, and the structural characteristics of DEOXYRIBONUCLEIC ACID may be mapped using the Heisenberg spin system when the temperature effect is taken into account during the replenish period. The replenish produces defects like kinks and antikinks, whose densities depend on temperature and replenish time, respectively, and causes the non-equilibrium effect in quantum phase transition. Additionally, local denaturation caused by replenish-induced quantum phase transition is shown to result in the creation of defects like kinks and antikinks, which represent dynamic curving of the elastic rod and correlate with axis curvess in the DEOXYRIBONUCLEIC ACID molecule. Application of this result to the DEOXYRIBONUCLEIC ACID rod-like-chain (RLC) model is suggested here to result in curves due to these defects. According to this, dynamic kink creation leads to curves development.

Paper ID: 009

Keywords: Kinks, DEOXYRIBONUCLEIC ACID, curves, Quantum phase transition.

A Brief Note on Zeroes of $f^n(z)f(z+b)f^{(k)}(z) - a$ and Normality Criteria

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The article comprises of two parts. For $a \neq 0$ being a complex constant and $b \in \mathbb{Z}^+$, firstly the zeros of the differential polynomial $F = f^n(z)f(z+b)f^{(k)}(z) - a$ generated by meromorphic function f is studied quantitatively in the light of Nevanlinna theory. As a consequence, normality criteria for the family of such functions is established in the second part.

Paper ID: 013

Keywords: differential polynomial, meromorphic function, Nevanlinna theory.

Conditions for Oscillation Onset and Flow Stagnation in Oscillating Heat Pipes

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Phase changes are believed to be the predominant mode of heat transfer in oscillating heat pipes (OHPs) which are partially filled with liquid and loop through the hot and cold zones of a heat exchanger. Evaporation takes place in the hot zone and condensation in the cold zone. The net effect of phase changes alone is accumulation of liquid slugs in the cold zone. In our previous work, we have demonstrated the mechanism for the onset of oscillations when there is a sufficient temperature gradient between the two zones. An explicit criterion was found through the examination of stability of an equilibrium corresponding to liquid slugs filling up the parts of OHP in the cold zone. However, due to the assumed symmetry of simultaneous heating in the evaporation zone and cooling in the condensing zone, that model cannot explain the experimental observations that certain OHPs cannot be driven into oscillations with large imposed input power into the evaporation zone. In this paper, we modify the evaporation model to reflect the fact that condensation in the cold zone is zero at thermodynamic equilibrium, and it starts only as a result of a pressure rise above the thermal dynamic equilibrium following the imposition of heat flux into the hot zone. With this modification, it is shown that with a higher heat flux to the hot zone, the mean pressure inside the heat pipes rises. Because of the pressure dependence of the stability criterion, the condition for the onset of oscillations is no longer met and oscillations cease. This is consistent with our previous result since the stability criterion is dependent on the mean pressure and higher pressure requires a larger temperature gradient for the onset of oscillations. Through numerical simulations that are based on the modified evaporation model, we show that motions in the OHP may become stagnant due to the build-up of the mean pressure in the OHP.

Paper ID: 014

Keywords: Self-excited oscillations, Oscillating heat pipes, Flow stagnation, OHP dry out.

Gardner solitons and double layers in self-gravito-electrostatic opposite polarity magnetized dusty plasmas

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The phenomenon of Gardner solitons (GSs) and double layers (DLs) in a self-gravitating dusty plasma, composed of negatively and positively charged dust grains in the presence of inertialess ions and electrons, is investigated utilizing the reductive perturbation method. The derivation of the Korteweg-de Vries (KdV) and modified KdV (mKdV) equations is performed. Numerical examinations have uncovered the occurrence of compaction or dilation Dust Acoustic (DA) solitons, contingent upon the parameters. The propagation of DA waves is described by the Gardner equation, whose GS and DL solutions are subject to numerical analysis. The existence of GSs and DLs regimes are determined. The impact of plasma parameters on compressive and rarefactive GSs and DLs is also explored in depth. The current findings are deemed to be valuable for comprehending the dynamic structures in various experimental setups and astrophysical environments, including the cometary tails, Earth's mesosphere, and Jupiter's magnetosphere.

Paper ID: 015

Keywords: reductive perturbation method, Korteweg-de Vries (KdV) equation, Dust Acoustic (DA) solitons.

Nonlinear Vibration Response and Dynamic Control of Piezolaminated Plates under Electromechanical Actuation Paper ID: 016

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Nonlinear vibration response with dynamic actuation of piezo-laminated composites under electro-mechanical actuation is evaluated and studied. Finite element modelling is employed and the piezoelectric actuation mechanism is established with coupled electro-mechanical loading to gain the response. Such smart composite laminates with cross ply orientation are studied for vibration response in the analysis. Responses of control are evaluated for piezoelectric condition of electro-mechanical actuation. Results are provided for actuation mechanism obtained in the analysis of depending upon modes of vibration. Dynamic response depending upon velocity control gain of feedback (G_v) on the NL vibrations of SS composites is achieved. Also the influence of variation of fibre orientation of the PVDF layers for damping control is also demonstrated.

Keywords:

Piezolaminated composites, damping, control, gain

Complex Invariants Corresponding Non-hermitian PT-Symmetric Hamiltonian

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In this work, we build exact dynamical invariants for complex Hamiltonian systems. Our aim is to extract a further understanding into the aspects of a dynamical system, we build here complex dynamical invariant. There could be systems which may concede complex invariants. To accomplish this we adopt rationalization formalism to analyse complex dynamical systems on the continued complex phase plane. Scope and purview of attained invariant is acuminated.

Paper ID: 018

Keywords: Continued complex phase space (CCPS), Complex Hamiltonian

Solving Population Balance Models via a Novel Semi-Analytical Method

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This article uses a novel semi-analytical method called the Daftardar- Jafari method (DJM) to solve the condensing coagulation model (CCM) and the Lifshitz-Slyozov model (LSM). Our study concentrates on two CCM test cases and one LSM test case. We compare numerical solutions for number density and moments in CCM to exact solutions for constant and product kernels with exponential initial conditions. Furthermore, the constant kernel with the exponential initial condition for LSM is considered. The numerical results are provided in tabular and graphical formats, allowing for a thorough examination of the models.

Paper ID: 019

Keywords: Integro-Partial Differential Equation; Condensing Coagulation Model; Lifshitz-Slyozov Model; Daftardar-Jafari Method; Series Solution.

Semi-Analytical Solution for Condensing Coagulation and Lifshitz-Slyozov Models: Variational Iteration Method

Paper ID: 020

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This article delineates a semi-analytical methodology for addressing the condensing coagulation and Lifshitz-Slyozov models. The work also delves into the convergence analysis of the variational iteration method, elucidating the approximated solutions for these equations. To assess the efficacy and precision of this approach, the study incorporates a range of test cases. Specifically, it compares the approximated number density and moments with their exact counterparts under conditions involving constant and product kernels, along with exponential initial conditions. The findings are systematically presented through numerical simulations, featuring tabular and graphical representations that underscore the scheme's accuracy.

Keywords: Population Balance Models, Aggregation-Breakage Processes, Oort-Hulst-Safronov Model, Inverse Coagulation Model, Series Solution, Convergence Analysis.

Semi-analytical Solutions for Breakage and Aggregation-breakage Equations via Daftardar-Jafari Method

Paper ID: 021

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The semi-analytical method obtains the solution for linear/ nonlinear ODEs and PDEs in series form. This article presents a novel semi-analytical approach named Daftardar-Jafari method (DJM) to solve integro-partial differential equation such as breakage and nonlinear aggregation-breakage equations (ABE). Four test cases for the breakage equation are used to acquire closed form series solutions. Further, numerical findings such as number density and moments are compared with the analytical solutions to show the efficiency and accuracy of the method. Moreover, the DJM is employed to solve the well-known ABE, and truncated solutions are presented for the two test cases. In addition, absolute errors over various time periods are depicted in the form of tables.

Keywords: Integro-partial differential equation, DJM, Series solution, Moments, Error.

Bifurcation analysis and the influence of (r, q) distribution on ion-acoustic kinetic Alfvén waves

Paper ID: 023

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Within this paper, we embark on a theoretical exploration of ion acoustic kinetic Alfvén (IAKA) solitary wave propagation within magnetized plasma, drawing on fundamental equations as our foundation. Notably, we consider the presence of two distinct temperature electron components. Employing the standard reductive perturbation method, we derive the Korteweg-de Vries (KdV) equation, a quintessential component of our analytical framework. Employing numerical techniques, we meticulously examine the interplay of diverse plasma parameters and their impact on the inherent characteristics of IAKA solitary waves. This inquiry extends further to the discovery that specific parameters hold the capacity to modulate the patterns and dynamics of kinetic Alfvén soliton energy, a pivotal insight into the behavior of these intricate waveforms.

Keywords: bifurcation analysis, the reductive perturbation method, KdV equation, magnetized plasma.

On a Numerical Investigation of MHD Flow of a Hybrid Nanofluid with Rotation and Thermal Buoyancy Force

Paper ID: 024

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Amagnetohydrodynamic flow of aluminum oxide, and copper nanoparticles in water based hybrid nanofluid with thermal radiation and rotation is investigated. The numerical solution of the model describing the flow is achieved through the implementation of the improved an overlapping spectral simple iteration method (O-SSIM). The accuracy is enhanced by the overlapping grid, which reduces the density of the coefficient matrix. The objective is to assess the efficiency of the O-SSIM on a system of nonlinear ordinary differential equations that describe the hybrid nanofluid flow. The O-SSIM algorithm is implemented in MATLAB and tested for its convergence and accuracy. The accuracy of the O-SSIM are proved using the residual error analysis. The results are compared with previously published findings that were obtained using the overlapping spectral local linearization method. The nonlinear differential equations are linearised using the simple iteration method. The study aims to examine how various fluid parameters influence the characteristics of the hybrid nanofluid. The results presented the influence the stretching ratio, rotation, magnetic, and heat generation and absorption parameters on the temperature profile. The skin friction coefficients and Nusselt number were calculated and analyzed. It is found among other results, that the heat transfer rate of the hybrid nanofluid increased with both the volume fraction of copper nanoparticles and heat generation parameters.

Keywords: Hybrid nanofluid, Overlapping grids, Spectral method, Simple iteration method.

Variable order R-L fractional calculus and its Applications

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This paper influences a brief study of variable order fractional calculus along with the Riemann – Liouville approach. We are considering the Mittag - Leffler function of one parameter as an order of Riemann – Liouville (FD)fractional derivative and (FI)fractional integration. We observed the changes for the different values of that parameter of the Mittag - Leffler(M - L) function further more applied this variable order fractional operator on the polynomial function of different degrees. For simplicity sake, we examine the Mittag - Leffler order R - L fractional calculus theoretically and graphically.

Paper ID: 027

Keywords: Fractional Calculus, Gamma Function, Mittag - Leffler Function.

New G -optimality criteria for multi-dimensional control problem with applications in artificial neural system

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In this article, we aim to study a class of multi-dimensional control problems with first-order PDE constraints and obtain its optimality by deriving generalized necessary and sufficient optimality conditions. For this, we propose the concept of a generalized convex multi-dimensional integral functional as so-called G -convex functional. Using the proposed definition, we extend the concept of the $G - KT$ point, state and prove the G -necessary optimality conditions for the problem mentioned earlier. After that, by imposing the hypothesis of G -convexity over-involved functionals, we derive the generalized sufficiency criteria of earlier established G -necessary optimality conditions, named G -sufficient optimality conditions. That ensures the optimality of a feasible solution to the problem under consideration. In addition, some applications are also constructed to demonstrate the utilization of primary results for the controlled behavior of an artificial neural system. Also, we provide an algorithm that illustrates the steps in addressing the control problem explored in this study.

Paper ID: 029

Keywords:

Multi-dimensional control problem, non-linear dynamical system, G -convex functional, $G - KT$ point, G -optimality conditions.

Analysis of surface texture and material removal rate during AISI 202 thermal-assisted turning using a carbide cutting tool

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To attain a superior surface quality and material removal rate, it is advisable to employ environmentally conscious machining techniques, often referred to as "green machining." Within the domain of conventional machining, the thermal-assisted turning method applied to the workpiece emerges as a commendable option, owing to its operational simplicity and the elimination of coolant requirements, thereby aligning with eco-friendly practices. This re-search is fundamentally oriented towards the optimization of machining performance for AISI 202 utilizing a carbide tool, with a specific emphasis on two pivotal output factors: material removal rate and surface roughness. The investigation leverages the Response Surface Methodology (RSM) to extrapolate predictions and optimize the machining process. The Box-Behnken design method is employed to systematically analyze variations in independent variables, which encompass workpiece temperature, cutting speed, and cut-depth (depth of cut). The empirical findings underscore that temperature exerts the most pronounced influence on surface roughness, followed by cut-depth and cutting speed. Similarly, concerning material removal rate, temperature emerges as the most influential factor, succeeded by cutting speed and cut-depth. This research helps us understand how different factors affect metal cutting and gives us ideas on how to make the process more sustainable and efficient.

Paper ID: 030

Keywords:

Green machining, Thermal-assisted turning, Box-Behnken design, Material removal rate, Surface roughness, AISI 202.

High cycle fatigue behavior of TIG welded joint at optimum parametric condition

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In this study, AISI 316L stainless steel plates are joined together in a square butt joint arrangement using a semiautomatic tungsten inert gas (TIG) welding process. The re-search project has two goals in mind. To create mathematical models based on the recorded data, a series of experiments are first carried out using the Box-Behnken design of response surface methodology (RSM). Next, desirability function analysis (DFA) is used to perform multi-objective optimisation for a subset of responses at once. Secondly, a set of another TIG welded joints are prepared at the obtained optimum parametric condition and then high cycle fatigue behaviour of the welded joints as well as base metals are investigated at room temperature with a stress ratio $R=0.1$. Furthermore, the fracture surfaces of the fatigued specimens are analysed by scanning electron microscopy (SEM). The result shows that welded joint depicts almost 8% higher fatigue limit compare to base metal.

Paper ID: 032

Keywords: Tungsten inert gas welding, Response surface methodology, Optimization, High cycle fatigue, Austenitic stainless steel.

Investigation of channel doping effects on high-frequency noise for Trench Double gate JLFETs

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In this paper first time the impacts of channel/drain doping on the highfrequency noise parameters are studied along with the analog device performances for trench double gate junctionless FETs. It is revealed that a higher channel doping of about $8 \times 10^{18} \text{ cm}^{-3}$ contributes to appreciable noise performance and an improvement in drain current, transconductance are also observed. Although doping concentration at the drain side is less significant for the betterment of drain current or transconductance, but it is one of the key performers in the reduction of noise and a large value of drain doping can degrade the noise parameters a lot.

Paper ID: 033

Keywords: JLFET, high-frequency noise, Input referred voltage noise, minimum noise power.

Bounds on the Phase Speed of Swirling flows

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In this study, we consider stability of inviscid, incompressible hydromagnetic swirling flows with an azimuthal magnetic field to axisymmetric disturbance. For this problem we obtained the range of complex phase speed that intersect with Sasakura semiellipse under certain condition. The result has been illustrated with three standard examples. When minimum Richardson no. equals to zero it reduces to corresponding result for homogeneous problem. Also, we obtained sharper estimate for the growth rate.

Paper ID: 036

Keywords: Hydromagnetic stability, Azimuthal magnetic field, Axisymmetric disturbances, Inviscid, Phase speed, Incompressible.

Dynamics of ion-acoustic waves in a magnetised plasma with two-temperature superthermal electrons

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An investigation on the dynamics of electrostatic waves in a magnetised super-thermal plasma constituting ions and two-temperature electrons has been presented in this paper. Employing the reductive perturbation method (RPM), we have derived the Zakharov-Kuznetsov (ZK) equation that describes the dynamical behaviour of such waves. The dimensionless model with a planar dynamical system exhibits the basic properties of the nonlinear waves in the system. Considering typical values of parameters, we have presented all possible phase plots for the dynamical systems. It is found that the existing physical parameters greatly influence the fundamental characteristics of ion-acoustic waves (IAWs). The outcome of the present work can be helpful in understanding nonlinear waves and their motion in the super-thermal magnetised plasma, where two distinct temperature electrons exist (e.g. Auroral zone plasma, Saturn's magnetosphere).

Paper ID: 038

Keywords: Ion-acoustic Wave, Superthermal Electron, Reductive Perturbation Method, ZK Equation, Dynamical System.

Study of Spin reorientation and dielectric phenomenon in $Sm_{3-x}Bi_xFe_5O_{12}$ ($x = 0.0 - 0.6$) samples

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This paper deals with the structural, magnetic and dielectric properties analysis for $Sm_{3-x}Bi_xFe_5O_{12}$ ($x = 0.0 - 0.6$) samples obtained from solid-state reaction method. The lattice parameter is obtained from the refined XRD data that comes out to be $12.5391(1) \text{ \AA}$ for $x = 0.0$ sample and it goes on increasing to the value of $12.5528(2) \text{ \AA}$ for $x = 0.6$ sample. The crystallite size also follows the same pattern and it has enhanced from 111 nm to 196 nm for $x = 0.6$ sample. Further, the magnetic characterization encompasses the spin reorientation transition at around 65 K which is almost independent of the doping concentration of Bi . Additionally, we have noticed a magnetic transition in the lower temperature region arising because of the ordering of rare earth ions. The saturation magnetization is dropped from 32.46 emu/g to 26.76 emu/g with the non-magnetic Bi substitution. Further, the dielectric constant is measured and it is obtained in the order of 10^3 at 100 Hz frequency for $x = 0.0$ sample and it falls sharply with the increase in frequency. Along with this, the parent sample holds magneto-electric coupling which is absent in rest of the samples. This multiferroicity leads to the applicability of these materials in microwave applications. Moreover, dielectric behaviour of our samples follows Universal Dielectric Response by having slope almost equal to -1 in the lower frequency regime.

Paper ID: 039

Keywords: Spin reorientation transition, Magneto-electric coupling, Multiferroicity, Universal Dielectric Response.

Basins of attraction in the photogravitational magnetic-binary problem with oblateness and dissipations

Paper ID: 041

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This study explores the effects of dissipation forces on the photogravitational magnetic-binary problem (PMBP). These forces include the Poynting- Robertson drag, and the nebular gas (Stokes) drag. In PMBP, the larger primary body emits radiation, whereas the smaller primary body is oblate in shape. We have developed the equations of motion for a charged particle (secondary body) in PMBP. The linear stability of equilibrium points and their existence and location have been demonstrated, along with the parametric evolution of these points. We have plotted the Newton-Raphson basins of attraction while accounting for Poynting-Robertson drag and nebular gas (Stokes) drag. Our numerical results reveal that the magnetic moment ratio λ influences the position and stability of the equilibrium points and Newton-Raphson basins of attraction. There exist nine or eleven equilibrium points depending on the mass parameter μ values and the ratio of magnetic moments λ values. All these equilibrium points are unstable, according to the Lyapunov criterion. Moreover, the basins of convergence associated with the collinear equilibrium points L_1 and L_3 have infinite extents in all cases. Our numerical analysis demonstrates that the evolution of the attractive regions in this dynamical system is quite intricate. The spacecraft deviates from equilibrium points over time owing to the instability of these locations, and the drift is most at the L_7 point.

Keywords:

Photogravitational magnetic-binary problem, Dissipative forces, Linear stability, Basins of attraction.

The perturbed potential Kadomtsev-Petviashvili equation: Bilinear form, multi shock, kinky-breather, resonant Y -type shock solutions

Paper ID: 042

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This article claims the integrability of the perturbed potential Kadomtsev-Petviashvili (pPKP) equation in (3+1)-dimensions through the bilinear Backlund transformation. Using the bilinear form of the aforementioned problem, new kinds of shock solutions are produced via careful selection of the auxiliary functions. On the basis of vector options in the solution space, the kinky breather solution is explored from a two-shock solution. The three-shock seed solution is used to offer an explanation of the interplay between the one-order kinky breather solution and the one-shock solution. The wave interaction of the shock with breathers and another shock is studied from the numerical understanding. Under certain compatibility conditions, the K-shock solutions are transformed into the resonant Y -type shock wave solution. Specific values of the related parameters in the current system are used to show the resulting solutions in various patterns.

Keywords: Potential Kadomtsev-Petviashvili equation, Bilinear method, Backlund transformation, Multi-shock solution, Kinky-breather solution, Y-type resonant shock solution.

Stability Analysis of Vaccinated and Non-Vaccinated Population of Covid'19 – A Study by Mathematical Modeling Paper ID: 043

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This work aims to study the mathematical model of the coronavirus disease, which affects human beings. A deterministic mathematical model for coronavirus disease among the population, including the vaccinated population, was developed and analyzed. Using the survey, statistical data of the vaccinated population were analyzed to reduce the COVID-19 affected count and loss of death using a mathematical model. A stability analysis was conducted to investigate the model described for the population, and the equilibrium points and interior equilibrium points of the system were derived. Positiveness and boundedness were also analyzed. The global stability analysis is expressed for the proposed model by constructing the Lyapunov function and also by the feedback controller mechanism. The results of this study were tested using simulations carried out in MATLAB. The applicability of the result was illustrated using numerical examples.

Keywords: Mathematical model, Lyapunov function, stability analysis, deterministic model, global stability, equilibrium Points.

Instabilities of ion sound wave due to density and temperature gradients in the presence of $\vec{F} \times \vec{B}$ drift wave turbulence Paper ID: 044

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This study focusses on nonlinear up-conversion mechanism in wave energy to predict ion-sound wave instability in an inhomogeneous plasma where density and temperature gradients are present. Plasma inhomogeneity supports drift waves due to the $\vec{F} \times \vec{B}$ drift of particles. F is the external force arising due to the gradients. Drift wave turbulence interacts with ion-sound waves through a wave energy up-conversion process. A modified Maxwellian distribution function is used to describe the wave interaction, which involves gradient parameters of inhomogeneous plasma. The wave interaction process is characterized by the Vlasov-Poisson system of equations. Prediction of ion-sound instabilities is done after estimating the growth rate from the nonlinear dispersion of ion-sound waves in the presence of drift wave turbulence.

Keywords: Ion-sound wave, Drift wave turbulence, Density and temperature gradients, Nonlinear wave-particle interaction.

Investigation of dielectric studies of $(Nd_{1-x}Gdx)_2FeCrO_6$ ($x = 0.0-0.3$) Double Perovskite

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In this article, we have done a comprehensive study of the $(Nd_{1-x}Gdx)_2FeCrO_6$ ($x = 0.0-0.3$) (NGFCO) series. Our study comprises an in-depth analysis of structural properties, dielectric behavior, impedance characteristics, and conductivity analysis of the NGFCO series. Solid-state reaction technique was employed to prepare the samples. Single-phase configuration is confirmed, by analyzing the XRD patterns of all the samples with Rietveld refinement. All of them exhibit the orthorhombic structure with the Pbnm space group. In the frequency-dependent impedance studies, the contribution of space charge polarization is discussed, and the temperature-dependent study reveals the negative temperature coefficient behavior of resistance in the samples. The presence of relaxation behavior that is not of the ideal Debye type is revealed from the Nyquist plots of all the samples. Using the Jonscher Power Law, the frequency-dependent conductivity data are analyzed, leading to the conclusion that both the small and large Polaron tunneling models effectively describe the conduction mechanism in our samples.

Paper ID: 045

Keywords: Double perovskite, space charge polarization, Nyquist plot, dielectric relaxation, Jonscher power law.

Strong Landau Damping of electron plasma waves and vortical analysis of the formed electron holes

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In this study, the vortical nature of electron phase-space holes formed due to nonlinear Landau damping of electron plasma waves is explored and established using the recently developed fluid-analogue model of particle phase-space. Kinetic Vlasov simulation is performed and the phase-space of the system is analysed. Velocity and vorticity fields of the electron phase-space are traced and rotational flow of the phase-space element is observed. The phase-space vortex identification parameter L is used to locate regions with vortical flow in the electron phase-space. This study describes the applicability of the phase-space fluid model to the study of electron phase-space holes formed due to strong Landau damping phenomena.

Paper ID: 047

Keywords: Phase-space fluid model, Phase-space holes, B.G.K. modes.

Impact of Hall current on chemically reactive Darcy Forchheimer flow of hybrid nanofluid over moving slender needle

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A numerical investigation of steady chemically reactive MHD hybrid nanofluid flow over a moving slender needle is presented in this study. The flow is considered in a porous medium incorporating inertial effects. The hybrid nanofluid comprises of Al_2O_3 and Cu nanoparticles with H_2O as base fluid. The flow is governed by conservation of mass, energy and momentum as well as the concentration equation which are reconstructed using suitable similarity transformation. The Keller Box finite difference scheme, which is implicit, is employed to perform the numerical computations. The effects of various physical parameters, such as the Forchheimer number, Hall current, chemical reaction on velocity, concentration, and temperature profiles are illustrated graphically. The outcomes of this study are beneficial for enhanced understanding of flow over slender needle configuration. The findings are compared with existing literature to validate the numerical scheme.

Paper ID: 049

Keywords: Boundary layer flow, Nonlinear boundary, Magnetic field, Keller Box, Chemical reaction.

Performance Analysis of Accurate and Approximate Compressors at Nanometer Regime

Paper ID: 050

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In digital signal processing, mainly in image and video processing, approximate devices have acquired a unique place. Approximate computing is an alluring creation that brought a revolution in terms of minimizing essential parameters like power, delay, and area to improve performance. Whereas beyond CMOS devices enhanced this whole work to the next level leveraging them to perform approximate computing. In this paper different research made on approximate compressors is discussed, accompanied by its working, and the use of spin devices to make computation devices is also discussed. The use of beyond CMOS devices brought a lot of improvement in compressors in terms of speed and accuracy. The error rate for spin-based devices is less as research is done forward in time, for some of the work on 4-2 compressors it turns out to be approximately 0.25 percent.

Keywords: Spin- CMOS, Approximate computing, Low-power, MTJ, Approximate compressors.

Implicit numerical schemes based on the lower incomplete gamma function for solving a class of nonlinear fractional-ordinary differential equation problems arising from a stochastic process

Paper ID: 052

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In this manuscript, we developed novel implicit numerical schemes based on the incomplete gamma function for a class of nonlinear fractional-order compartmental models arising from a stochastic process. Unlike conventional fractional order compartmental models, where fractional derivatives are on the left-hand side of the systems, in these nonlinear integro-differential equation model's fractional derivatives are in the right-hand side of the systems with order $1 - \alpha$, where $0 < \alpha < 1$. Convergence analysis of the proposed numerical schemes suggested that the rates of convergence of these implicit schemes are $O(h^{2+\alpha})$, and $O(h^{1+\alpha})$, respectively, where h is the time step size. Several numerical examples are presented that illustrate the effectiveness of these two implicit methods and confirm our theoretical claims.

Keywords: Nonlinear fractional-ordinary differential equation; Lower incomplete gamma function; Implicit method; Rectangle formula; Convergence.

On the Investigation of Interacting Fault Movement in a Viscoelastic Structure

Paper ID: 054

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The present paper investigates the ground deformation due to interaction between an infinite and finite fault. The nature of the faults are inclined, surface-breaking, strike-slip and situated in a viscoelastic half-space of Maxwell medium. The fault movement across the infinite fault is creeping and after a sudden movement across the finite fault it stops to move. The analytical solution of displacement, stress-strain components are deduced for absence of fault movement and due to interaction between the faults by inducing appropriate boundary conditions. A closed form of displacement, stress-strain components are determined by employing Mittag-Leffler function, Integral transform, and Green's function technique. The efficacy of different affecting parameters such as inclinations, velocity of the fault movement, distance between the faults, depth of the faults from the free surface and fractional order are portrayed graphically which may help us to study earthquake prediction programs.

Keywords: Interacting faults, Surface breaking, Fractional order Maxwell model, Mittag-Leffler functions, Green's function technique.

Stronger Self-focusing of Gaussian laser beam in collisionless plasma based Exponential density profile Paper ID: 055

K. Y. Khandale¹, A. T. Valkunde², S. S. Patil³, P. T. Takale⁴, R. T. Patil⁵, A. R. Patil⁶, S. D. Patil⁷ and M. V. Takale⁸

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Long-range forces rather than collective actions dominate the collisionless plasma dynamics, and coupling between particles because of collisions is often insignificant, with long-range collective interactions binding the particles together. Naturally, the ponderomotive force is primarily responsible for the collisionless plasma's nonlinear dielectric function. The nonlinear features of intense Gaussian laser beams traversing through collisionless plasma along with tangent upward density ramp as well as exponential density profile have been investigated in the current paper. The differential equations for the beam width parameter (BWP) f has been constructed and numerically solved using Akhmanov's parabolic wave equation approach via Wentzel-Kramers-Brillouin (WKB) and paraxial approximations. By utilizing the fourth order Runge – Kutta method the numerical computation is completed. The noteworthy impact of exponential density profile on propagation dynamics of a Gaussian laser beams is precisely explored and correlated with tangent upward density ramp profile. It is revealed that an exponential density ramp, rather than a tangent upward density ramp, leads laser beam to become highly focus.

Keywords: Exponential density ramp, tangent upward density ramp, Self-focusing, Collisionless plasma, Gaussian.

Local Nonsimilarity Solution for Nonlinear Convection of Casson Fluid Flow with Nonuniform Heat Source/Sink

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The present investigation emphasizes the nonlinear mixed convective heat transport phenomena of non-Newtonian fluid from a horizontal plate in presence of non-uniform heat source/sink. To represent the non-Newtonian features of the fluid, Casson fluid model is adopted for the analysis. It is also assumed that the density of Casson fluid varies nonlinearly with temperature. A thorough boundary layer analysis is carried out by incorporating suitable group of non-dimensional variables. However, local similarity and non-similarity methods are considered for solving the transformed nonlinear PDEs as the dimensionless variables do not permit a similarity solution. Hence, the obtained ODEs are solved by Runge-Kutta technique. The control of relevant parameters on flow, temperature distributions, and on the quantities of physical interest namely, Nusselt number and skin friction coefficient is explored through graphs and tabular evidence. An advance understanding about the outcome of these parameters on heat transfer rate and surface shear in boundary layers can be extremely helpful in the perspective of engineering applications.

Paper ID: 056

Keywords: Mixed convection, Heat source/sink, Non-linear Boussinesq approximation, Nusselt number, Skin friction, Casson fluid.

Dynamics on new wave shapes of the Landau-Ginzburg-Higgs equation using a new extended hyperbolic function method

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In this study, we aim to explore the nonlinear Landau-Ginzburg-Higgs equation for coherent ion-cyclotron waves, which also accounts for superconductivity and drift cyclotron waves in radially inhomogeneous plasma [1]. The search for new soliton solutions of this equation using a new extended hyperbolic function approach is the topic of attention. This technique yields a wide range of new exact solutions that may be useful in plasma physics, nonlinear optics, and fluid dynamics. Some of the acquired solutions under suitable conditions are shown via 2D and 3D plots to aid physical comprehension and realize our developed solutions better.

Paper ID: 059

Keywords: Landau-Ginzburg-Higgs equation, Soliton solutions, New extended hyperbolic function method.

Non-autonomous for Modified Fifth-order Korteweg-de Vries equation with variable coefficients, Breather, and soliton

Paper ID: 061

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In this paper, an investigation of a damped variable-coefficient fifth-order modified Korteweg–de Vries equation by using Hirota bilinear approach for N-soliton solution and breather. The characteristic line method is used to examine the propagation and collision of soliton. With variable coefficients (t) , (t) and (t) are the dispersive, dissipative and line-damping coefficients, respectively, and discussed the effect of a variable coefficient in graphically and analytically. The amplitude of soliton is affected by $\gamma(t)$. In breather $\alpha(t)$ and $\beta(t)$ affect the central path. The soliton's amplitude is inverse variation to line damping. For breather, the amplitude of solitons decreases as the positive coefficient of the (t) increases. The $\alpha(t)$ and $\beta(t)$ are not only influenced by the position of the breather but also the period of the breather.

Keywords: Hirota bilinear approach, KdV equation, N-soliton, Breather.

Bilinear forms, N-soliton solution for Extended Fifth-order Korteweg-de Vries (eKdV), Breather

Paper ID: 062

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This paper investigates extended Korteweg-de Vries (eKdV) equations in shallow water with nonlinear and dispersive terms of the second order. With the Hirota method's and symbolic computation's help, the bilinear forms, N-soliton solutions, and graphs for the eKdV equations' Breather are constructed. Asymptotic analysis demonstrates that the collisions for the profile are elastic. We can control collision types (head-on or taking lead collisions) by adjusting the sign of the velocity v . During collisions, the speeds of solitons are proportional to a_4 and α . In addition, there is a proportional relationship between the velocity v and amplitude a . When it comes to breather solutions, α affects the central trajectories of the solutions, whereas $\gamma(t)$ affects the amplitudes of the solitons. The amplitude of solitons will experience a decrease whenever there is an in-crease in the positive coefficient of the line-damping term $\gamma(t)$. Breather and soliton are discussed and plotted graphically.

Keywords: Hirota Bilinear, Soliton, Nonlinear equation, KdV.

On a variable-order fractional parabolic problems

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In this article, we have investigated the existence and uniqueness of a weak solution to a parabolic problem involving the variable-order fractional p-Laplacian. We have demonstrated that this solution exists and is unique under certain assumptions on the second member. The problem studied is a parabolic case of the one examined in reference [5] by M. Hsini et al., with the replacement of the fractional Laplacian operator with variable exponent by the variable-order fractional operator. The functional framework involves spaces of variable-order fractional Sobolev spaces.

Paper ID: 063

Keywords: Existence and uniqueness of weak solution, variable-order fractional p-Laplacian, Rothe's time-discretisation method.

A numerical analysis on heat and mass transport process in porous medium on MHD Williamson nanofluid through a permeable extending surface

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The key intension of this study is to probe into the process of heat and mass transport initiated by the motion of hydromagnetic Williamson nanofluid over a permeable stretching surface in porous medium. Joule heating, thermal radiation, sloped magnetic field and chemical reaction are important effects incorporated in the present investigation. The fundamental equations of flow, heat and mass transfer are made dimensionless with the help of similarity transformations. Bvp4c Matlab solver has been employed to obtain the solutions in graphical form. The results reveal that radiation parameter accelerates the heat transmission rate but slows the mass transmission rate while Joule heating and chemical reaction effects show opposite behaviour to that of radiation parameter. The precision of the numerical solution is also validated by making comparison with formerly published result.

Paper ID: 064

Keywords: Radiation, thermophoresis, Brownian motion, chemical reaction, bvp4c.

A Simple but Accurate Method of Estimation of Far Field Pattern of Single-mode Triangular Index Fiber

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Chebyshev power series expression for fundamental mode of triangular index fiber is used for formulating expression of far field pattern associated with it. The prescribed simple formalism can be executed easily using little computation. Here, two triangular index fibers having V numbers 3.5 and 4.0 have been used. Our results have been shown to be in excellent agreement with the exact numerical results. Accordingly, our formalism will prove useful in predicting different relevant parameters related to the far field of triangular index fiber. Further, the knowledge of far field is effective for evaluating normalized frequency (V number), radius of the core and as such the numerical aperture. The expression for far field also gives expression for the near modal field as well. Thus, our formalism will benefit the scientists and engineers in the domain of fiber optical devices.

Paper ID: 065

Keywords: Mono-mode triangular index fiber, Chebyshev method, far field, numerical aperture, normalized frequency.

Asymptotic Analysis of a Class of Singularly Perturbed Nonlinear Electromechanical Dynamic Models

Paper ID: 068

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The paper deals with a mathematical model of a cart coupled to a DC motor via a scotch yoke mechanism in the case of a small electrical inductance. The studied model presents a singularly perturbed system. For this system, conditions of Tikhonov's theorem on limit passage of solutions of a perturbed initial value problem to a solution of the degenerate one under a small parameter tending to zero are valid. For slow variables, this passage takes place for argument values from the closed interval and for the fast variable only for the interval without the initial point. The degenerate system corresponds to eliminating the inductive term from the electrical equation. For the first time, using the boundary functions method by A. B. Vasil'eva, any order uniform asymptotic solution is constructed for the considered initial value problem. A numerical example is given. The presented graphs illustrate the good approximation near the starting point of the ex-act solution by the constructed first order asymptotic solution.

Keywords: Cart with a DC Motor, Small Electrical Inductance, Boundary Functions Method, Asymptotic Solution.

Dynamical Analysis of a Three-Species Diseased Food Web Model with Different Functional Responses

Paper ID: 069

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This paper presents a three-species diseased food web dynamical model that relies on interactions between species of susceptible (healthy) prey, infectious (diseased) prey, and predators. It is suggested that in the absence of predator species, the prey population grows logistically. Predators are assumed to consume their prey in the form of Beddington-DeAngelis and Crowley-Martin response function. In addition, diseased prey is hypothesized to consume healthy prey using the Holling type II functional response. This dynamical model is examined in terms of positivity, boundedness, and positivity invariance. Furthermore, we explored every biologically feasible equilibrium point in the system. Also, the local stability of non-negative equilibria and the global stability are evaluated by suitable Lyapunov functions. Moreover, the Hopf bifurcation has undergone analysis at the infection rate. Finally, numerical solutions are investigated in accordance with our findings.

Keywords: infectious prey, stability, equilibrium point, Hopf-bifurcation.

Mapping the Spatial Dynamics of COVID-19 Clusters in Nueva Vizcaya, Philippines
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As the COVID-19 pandemic unfolded globally, understanding the localized patterns of disease transmission became essential. This study investigates the spatial dynamics of COVID-19 clusters in Nueva Vizcaya, Philippines, utilizing advanced spatiotemporal analysis techniques. Examining the data from the first quarter of 2020 to the second quarter of 2022, the research identifies notable clusters of COVID-19 cases, particularly along the national highway, with a focus on Bambang, Bayombong, and Solano municipalities. Notably, the third quarter of 2021 saw peak incidence rates in Bayombong and Bambang, while Solano experienced a peak in the fourth quarter of the same year. These areas, serving as major transportation and commercial hubs, emerged as significant hotspots. The findings provide a comprehensive understanding of the spatiotemporal dynamics of COVID-19 clustering, offering insights for informed policy decisions, targeted interventions, and a nuanced comprehension of the interplay between mobility, commerce, and disease transmission.

Paper ID: 073

Keywords: COVID-19 spatiotemporal analysis, clustering, disease transmission.

Thermo-Solutal Marangoni Convection in Maxwell Nanofluid Flow Through Darcy-Forchheimer Porous Medium

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This paper investigates Marangoni flow of Maxwell nanofluid in a Darcy-Forchheimer porous medium under an inclined magnetic field. The nanofluid, with variable thermal conductivity and Arrhenius activation energy, is modeled using Buongiorno's nanofluid model. Nonlinear PDEs governing the flow are transformed into coupled ODEs via similarity transformations. The Runge-Kutta Fehlberg method is employed for numerical solutions, considering various parameters. Graphical illustrations depict the impact of these parameters on velocity, concentration, and temperature profiles. The study also analyzes local Nusselt and Sherwood numbers, revealing significant effects on heat and mass transport due to variations in the Maxwell fluid and Marangoni convection parameters, as well as the variable conductivity of nanofluid.

Paper ID: 074

Keywords: Magnetic field, Stratification, Shooting technique, Activation energy, Mathematical physics, variable conductivity, Darcy-Forchheimer.

Symmetry Analysis and Solutions of Fractional Simplified Kawahara Equation

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In recent work, traveling wave solutions of the time fractional simple modified Kawahara equation are obtained using the F/G -expansion method. The wave transformation is acquired by Lie symmetry analysis with Conformal fractional derivatives. The NLPDE is transformed into an ODE of fractional order, making use of wave transformation. Also, the series solution of reduced ODE is attained. Some graphs of acquired solutions are drawn using Maple.

Paper ID: 075

Keywords: Simple modified Kawahara equation, Symmetry Analysis, Traveling wave solutions, Series Solutions.

A Structural Model of Mathematics Performance as Influenced by Students' Engagement with Technology to Students' Motivation

Paper ID: 076

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Researches in mathematics always reveal that performance of students in Mathematics can be influenced by some factors like attitudes including some demographic profiles. This study then investigated student's motivation and their engagement with technology in learning mathematics could influence their performance. It sought to describe the level of motivation and level of students' engagement with technology in learning mathematics. Through Structural Equation Modeling (SEM), this study determines the model that describes students' engagement with technology to students' motivation and its direct and indirect influence to performance in mathematics. It consisted of 348 grade 10 students from 18 public secondary schools of the Department of Education Northern Nueva Vizcaya, Philippines. The instruments consisted of two adapted research survey questionnaires which include Students' Engagement with Technology and Mathematics Motivation Scale. Results revealed that students had high level of motivation in learning mathematics in the aspects of self efficacy, intrinsic, extrinsic, and utility. However, students only attained high level of engagement in learning mathematics in the aspects of cognitive domain-problem solving, behavioral domain-interest, evaluation domain-feedback and social domain. Through SEM, an obtained model demonstrated an acceptable fit where the CMIN/DF, is less than the threshold value of 3. Two dimensions of student engagement with technology: the social and cognitive domains have direct influence on performance in mathematics. Three dimensions of motivation: intrinsic, utility, and extrinsic motivations had direct influence to performance in mathematics. Evaluative domain had an indirect influence to performance through the mediating effects of intrinsic and extrinsic motivation.

Keywords: Structural Equation Modeling, cognitive domain-problem solving, behavioral domain-interest.

Stability Analysis of Diffusive Predator-Prey Model Involving Intra-Specific Coefficients with the Concept of Difference Equation

Paper ID: 080

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The discussion delves into a prey-predator model encompassing three species, incorporating intra-specific coefficients alongside interval biological parameters, utilizing the concept of a difference equation. Analysis of equilibrium points and stability conditions was conducted employing Lyapunov theory. The application of the backstepping feedback method aimed to achieve global asymptotical stabilization and explore qualitative properties.

Keywords: Predator, Prey, Lyapunov, Bifurcation, Difference Equation.

Ion Bernstein Mode Instability in Presence of Ion Cyclotron Turbulence With Particle Heating

Paper ID: 081

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This study aims to investigate the ion Bernstein mode instability through nonlinear resonant interaction process of particles with ion cyclotron turbulence and subsequent transfer of accelerated particle energy for the onset of Bernstein mode instability. We consider a particle distribution function for non-uniform plasma involving density gradient parameter. The ion cyclotron wave turbulence is considered to be present in the system and the fluctuating parts of this quasi-steady plasma state corresponding to this turbulence is evaluated on the basis of weak turbulence theory. In this quasi-steady state of plasma, we have considered the ion Bernstein mode wave as perturbation to the system. Non-linear interaction of ion Bernstein mode with turbulence field is described by Vlasov-Poisson system of equations and the various linear and non-linear fluctuating parts of distribution functions are evaluated. The nonlinear dispersion relation of ion Bernstein mode is obtained by Poisson's equation with the involvement of ion cyclotron turbulent energy. An expression of growth rate of Bernstein mode is obtained from the influence of turbulent energy as well as the gradient parameters which can be analysed for the onset of instability . . .

Keywords: weak turbulence theory, quasi-steady, non-uniform plasma, non-linear interactions, Vlasov-Poisson equations.

Analyzing Electrocardiogram Signal Complexity with Weighted Entropy Here

Paper ID: 082

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In the present study, the complexity of ECG signals in normal individuals and those with cardiac disorders is analyzed. This analysis is conducted by utilizing a weighted entropy measure computed from the probability distribution of shortest path lengths in the Recurrence network (RN) domain. The results demonstrate distinct statistical complexity between normal and cardiac disorder ECG signals, with higher average weighted entropy in the latter, signifying increased complexity. Weighted entropy shows significant variability within the same category of ECG signals, attributed to individual variations. Furthermore, ECG signals with additional cardiac abnormalities are analyzed, and our analysis revealed that high complexity is observed in those signals.

Keywords: ECG Signals, Complex networks, Shannon entropy, Recurrence network, Distribution of shortest path lengths.

Study on atmospheric internal waves phenomenon model by variational iteration transform method

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The primary objective of this research is to investigate internal waves within the atmosphere that manifest within the fluid itself rather than on its surface. The study employs a mathematical model grounded in the shallow fluid hypothesis, resulting in a coupled nonlinear system of partial differential equations. In this shallow flow model, a key assumption is that the vertical dimensions are considerably smaller than the horizontal dimensions. This assumption is particularly valuable as it allows the model to faithfully replicate atmospheric internal waves, which tend to disperse over a vast horizontal expanse. A semi-analytical technique known as the variational iteration transform method is successfully implemented. Notably, this method yields an approximate analytical solution in the form of a convergent series without resorting to linearization, perturbation, or unnecessary term calculations. To test the effectiveness and accuracy of the proposed method, obtained results are compared with another method.

Paper ID: 084

Keywords: Shehu Transform, Variational Iteration Method, Nonlinear Partial Differential Equation.

Propagation of nonlinear dust acoustic solitons in an inhomogeneous magnetized plasma

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In this paper, we have presented our investigations on the propagation of nonlinear dust acoustic solitons in the environment where non-extensive electrons are present. We have also included effect of the magnetic field in our proposed problem. Assuming the standard dust density profile and its gradient, we have studied the effects of density variations on dust acoustic solitons during their propagation through the inhomogeneous plasma system. We have considered the governing equations of plasma and used the reduction perturbation technique (RPT) to derive the Zakharov-Kuznetsov (ZK) equation. The solution of the ZK equation indicates the nonlinear propagation of dust-acoustic solitons and their variations of structures in inhomogeneous magnetized plasmas.

Paper ID: 088

Keywords: Dust Acoustic Solitons, ZK-Equation, Inhomogeneous Magnetized Plasma.

Nonextensive Effect on the Lump Soliton Structures in Dusty Plasma

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We examine the lump structures of the Kadomtsev-Petviashvili (KP) equation in a collisionless magnetised plasma system consisting of ions, nonextensive electrons, and dust grains using a well-known technique known as the Hirota Bilinear Method (HBM). Soliton theory is a useful tool for illustrating the qualitative behaviours of nonlinearity, which has applications in several fields across the globe. Hence, lump solitons are highly relevant and captivating. We have seen that the linked properties of the plasma system cause differences in lump formations. Furthermore, it is discovered that the lump features are significantly altered by the nonextensive parameter.

Paper ID: 089

Keywords: Hydrodynamical model, KP equation, Hirota Bilinear Method, Nonlinear structures.

On the Decay Process of Temperature Field in a General Type of Turbulent Flow

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The dynamical equations, governing the decay process of a general type of turbulence visualized by superimposing temperature field on an incompressible velocity field, are obtained in a straight forward manner. The inherent non-linearity of the problem has been tackled with the help of Millionshtchikov's hypothesis. According to this hypothesis all fourth order moments are related to the second order moments as in a normal distribution. Further, it is shown that in the case when turbulence is simplified to homogeneous isotropic turbulence, two dynamical equations governing the decay of $F(k, t)$ and $E_{\theta\theta}(k, t)$, respectively the kinetic and thermal energy spectrum functions form a closed system. Finally, when viscosity effects are negligible i.e., when $\nu \approx 0$, the results for the final period decay of homogeneous and isotropic turbulence are recovered.

Paper ID: 090

Keywords:

Millionshtchikov's hypothesis, homogeneous isotropic turbulence, kinetic energy spectrum function, thermal energy spectrum function.

On Graphs Attaining Upper Bound of k-Rainbow Total Domination Number

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Let G be a simple graph with vertex set $V(G)$ and edge set $E(G)$. A function $f : V(G) \rightarrow 2^{[k]}$ is a k -rainbow dominating function of G if for every vertex v in G for which $f(v) = \phi$, $\bigcup_{u \in N(v)} f(u) = [k]$ and its weight is given by $\|f\| = \sum_{v \in V(G)} |f(v)|$. The k -rainbow domination number $\gamma_{rk}(G)$ of G is the minimum over the weights of k -rainbow dominating functions of G . A k -rainbow dominating function f is said to be a k -rainbow total dominating function if the image of a vertex v under f is a singleton set then its entry should belong to the image of at least one vertex from the neighbourhood of v . The k -rainbow total domination number denoted by $\gamma_{krt}(G)$ of G is the minimum over the weights of k -rainbow total dominating functions of G . In this article we explore the concept of k -rainbow total domination number in caterpillar trees and various other class of graphs. We also identified some class of graphs for which $\gamma_{krt}(G) = k\gamma(G)$, uncovering connection between these graph parameters.

Paper ID: 092

Keywords: Domination, k -Rainbow Total Domination, Total Domination.

Study of Cylindrical Magneto-hydrodynamic Shock Waves in Non-Ideal Gas: Similarity Solution Perspective

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This study endeavors to establish a similarity solution for symmetric, cylindrically converging MHD shock waves propagating into a plasma medium governed by the Mie-Gruneisen equation of state (EOS). We employ the Eulerian form of the governing equations, which consider total energy and constant specific heats. Through similarity transformations, these equations are transformed into a system of Poincare-type differential equations. Subsequently, we reduce the transformed system to a finite difference set of equations, which we solve numerically using MATLAB. The research encompasses the exploration of non-ideal Royce EOS of Mie-Gruneisen type, characterized by its material constants. We evaluate the similarity exponent, α , and its dependence on the measure of shock strength, β . Notably, we observe that the shock front is influenced by the measure of shock strength, β , while also presenting the impact of non-idealness parameters and magnetic field strength on the flow variables.

Paper ID: 093

Keywords: Compressible flow, Mie-Gruneisen equation of state, Rankine-Hugoniot conditions, Finite difference methods.

QSPR Analysis of Anti-Asthma Drugs using some recent Neighbourhood Degree-based Topological Descriptors Paper ID: 096

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Asthma is one of the predominant diseases across the World. Several medications have been discovered to treat asthma but still, it cannot be cured completely due to its changing behaviour. Numerous research articles are available in the literature that deal with asthma medications. In this article, we make a QSPR analysis using regression models on nineteen anti-asthma drugs to study the correlation between six physicochemical attributes such as Boiling Point, Enthalpy, Flash Point, log P, Molar Volume, Molar Refractivity of those chosen drugs and fourteen different neighbourhood-degree based topological descriptors that have been developed recently.

Keywords:

Neighbourhood degree, Neighbourhood Zagreb indices, Neighbourhood hyper Zagreb indices, Neighbourhood Geometric Arithmetic index, Antiasthma drugs, QSPR analysis.

Dynamic Analysis of a New Chaotic System with Multistability, Amplitude and Offset Boosting Control, Its Adaptive Synchronization Paper ID: 097

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In the present work, a new 3D chaotic system is reported. The proposed system is constructed using five nonlinear terms and four parameters. The novelties of the new system are it can exhibit initial condition-oriented multiple coexisting attractors, amplitude control, and offset boosting control. Firstly, the basic behaviors of the system such as stability, and Lyapunov exponents are analyzed in detail. Then, the dynamical behavior of the system is analyzed using bifurcation diagrams and the Lyapunov spectrum. It is shown that the system experiences periodic and chaotic attractors by varying the system parameters in a particular region. It is also shown that the system can present multiple coexisting attractors by plotting the bifurcation diagram for different initial conditions. The amplitude and offset boosting control of the system are verified with the help of bifurcation plot and Lyapunov exponent plot. Rich chaotic dynamics are found for various system parameters. Finally, the nonlinear feedback adaptive controller is designed to synchronize the proposed system. The numerical simulations are performed to show the effectiveness of the designed control scheme.

Keywords:

chaotic system, dynamic analysis, multistability, amplitude and offset boosting control, adaptive synchronization.

A study on hybrid solutions and their interactions in the extended nonlinear Schrödinger equation

Paper ID: 102

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In this paper, we examine the properties of hybrid solutions of the extended nonlinear Schrödinger equation. To begin with, we construct higher order positon/degenerate soliton solutions on the zero-intensity background by employing the generalized Darboux transformation method and investigate the interactions between smooth positons and multi-soliton solutions. We then construct another class of hybrid solutions with plane wave seed solution and investigate their dynamic interactions. More specifically, we scrutinize the interaction scenarios involving (i) one soliton with second order positon, (ii) two soliton with second order positon, (iii) one soliton with third order positon, (iv) second-order breather positon with breathers, and (v) third-order breather positon with breathers in the considered equation. By varying the nonlinear parameters that are present in the equation, we bring out a diverse range of intriguing behaviours in soliton-positon and breather-breather positon wave profiles.

Keywords: Soliton, Positon, Breather, Darboux transformation.

Combination Therapy for Chronic Hepatitis B Using Capsid Recycling Inhibitor

Paper ID: 106

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In this paper, we investigate the dynamics of hepatitis B virus infection taking into account the implementation of combination therapy through mathematical modeling. This model is established considering the interplay between uninfected cells, infected cells, capsids, and viruses. Three drugs are considered for specific roles: (i) pegylated interferon (PEG-IFN) for immune modulation, (ii) lamivudine (LMV) as a reverse-transcriptase inhibitor, and (iii) entecavir (ETV) to block capsid recycling. Using these drugs, three combination therapies are introduced, specifically CT: PEG-IFN+LMV, CT: PEG-IFN+ETV, and CT: PEGIFN+ LMV+ETV. As a result, when LMV is used in combination therapy with PEG-IFN and ETV, the impacts of ETV become insignificant. In conclusion, if the appropriate drug effectively inhibits reverse-transcription, there's no need for an additional inhibitor to block capsid recycling.

Keywords: HBV infection, Mathematical modeling, Interferon, Lamivudine, Entecavir, Numerical simulation.

Role of diffusivity of lactate on its accumulation in tumor necrotic core

Paper ID: 108

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Tumors are heterogeneous composition of cells having different diffusivity. The necrotic core is commonly seen even in small tumors. It has different material properties compared to other components of the tumor. The necrotic core poses a challenge for diffusion. Due to glycolysis metabolic process, tumor cells in hypoxic region generate lactate in greater amount. In this study, using a mathematical model, we explore the effects of diffusivity hindering the property of the necrotic core in the tumor on lactate accumulation over the tumor region. Our results are consistent with experimental observations.

Keywords: lactate, necrotic core, diffusivity.

On maximal μ^* -open set, minimal μ^* -closed set and mean μ^* -open set

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The main aim of this article is to introduce the weak form of open set known as maximal μ^* -open set in generalized topology in presence of topology and discuss some of its properties and it is shown that this concept is independent from the existing concept of maximal open set and maximal μ -open set. The relation between μ^* -interior and μ^* -closure of maximal μ^* -open set are obtained. Also for a proper nonnull μ^* -open set P be in a space $(X, \mu X, \tau)$ such that $(X - P)$ is finite then \exists maximal μ^* -open set Q such that $P \subseteq Q$. These concepts can be used as a tool in other branch of mathematics like graph theory to compare different class of edge sets as generalized topology can be formed from the edge set of maximal path of directed graph and also to characterize maximal invariant set of non linear discrete time control dynamical systems.

Paper ID: 111

Keywords: Maximal μ^* -open, Minimal μ^* -closed, μ^* -closure, μ^* -interior

The Investigation of Squeezing Flow Through a Porous Medium Between Parallel Plates Using the Homotopy Perturbation Method

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We have conducted an analysis of fluid flow between two rectangular parallel plates filled with a porous medium, with both plates symmetrically approaching or receding from each other. The governing Darcy-Brinkman equations were transformed into an ordinary differential equation through a similarity transformation. Subsequently, we employed the homotopy perturbation method to solve the resulting equations. For the problem at hand, we obtained numerical solutions while varying the following parameters: Reynolds number in the range of 1 to 10 and Darcy number from 0.05 to 1.0. We derived expressions for the velocity profiles and provided graphical representations for both the axial and normal velocity components. Additionally, we calculated the skin friction coefficient at the wall and presented it graphically for a comprehensive understanding of the results.

Paper ID: 114

Keywords: Porous media, Darcy-Brinkman equation, homotopy perturbation method, Reynolds number.

Turbulence features in a wall-wake flow downstream of two horizontal cylinders – a numerical approach

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This study presents experimental and numerical studies of flow past two horizontal cylinders. The study was performed using the experimental data that was recorded over a rough bed with bluff bodies. First, general features have been specified at various downstream distances from cylinders, including streamwise velocity, Reynolds shear stress, and turbulence intensity profiles. Eventually one numerical model has been implemented to replicate the experimental scenario and to perform simulation. Information regarding general turbulence properties along with dissipation rate have been extracted from simulation software and compared with that of experimental data measured at different locations, which are found to be fairly consistent.

Paper ID: 115

Keywords: Open channel flow, Bluff body hydrodynamics, ANSYS, Reynolds Stress Transport Model.

Fractal Structures in some Non-linear Partial Differential Equations Here

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Fractal-type solutions of the non-linear partial differential equation are obtained by using the Riccati projection method. The calculations are done by symbolic computation. The separation of variable method is also used. The arbitrariness of the functions in the solution causes several fractal structures. The ordinary and random fractal structures of the solution are plotted. It is significant to note that the structures are self-similar at different scales. Repeating patterns are observed when the frame is in magnification.

Paper ID: 117

Keywords: Riccati projection, Symbolic computation, Fractal structures.

Hydrodynamic Dispersion of Volatile Contaminant in an Open Channel Flow Using a Fitted Operator Approach

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This research work focuses on hydrodynamics and its role in free surface channel flow, specifically in relation to the transport of volatile contaminants. In such scenarios, the convection-diffusion equation is commonly employed to model the dispersion of these contaminants. Specifically, we investigate the ongoing release of tracer particles from a point source situated at an elevated position, and subsequently analyze the emission of volatile contaminants from the exposed surface. Simple examples of open channel flow include rivers and canals, where the convection-diffusion problem is predominantly dominated by convection. A special numerical method is adopted to solve the concentration equation. This scheme is based on a fitted operator approach on a uniform mesh over the channel. The observation indicates that the concentration of contaminants decreases below the injection point as more solute particles are transported towards the free surface through the process of volatilization. Furthermore, concentrations in both the longitudinal and transverse directions rise as the parameter for volatile contamination intensifies. The results of this research may have significant implications for managing the spread of air pollution originating from various types of water bodies. This knowledge can contribute to more effective pollution control measures and protect the health and well-being of communities near water bodies.

Paper ID: 118

Keywords: Free surface channel, volatile contamination, fitted operator.

Study of upper hybrid waves instability in collisional magneto Gallium Antimonide (GaSb) semiconducting plasma system

Paper ID: 124

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The effect of electron-phonon and hole-phonon collisions on upper hybrid waves (UHWs) instability instigated by an external electron beam in a magneto GaSb semiconducting plasma system has been studied. Quantum hydrodynamic (QHD) model has been used to derive the dispersion relation considering collision term and various quantum corrections like Bohmian force, quantum statistical pressure and exchange correlation potential. The influence of collisions on growth rate has been studied and it has been found that growth rate decreases non-linearly with the inclusion of collision term. The influence of propagation angle and beam streaming speed on the growth rate and phase speed of UHWs has also been studied.

Keywords:

Semiconductor plasma, quantum plasma, upper hybrid waves, collision, instability.

Chemical Significance of Some Neighborhood Degree-based Molecular Descriptors

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Molecular graphs encrypt the structure of a chemical compound and their topological indices provide an insight into its physical and chemical properties and activities. In this article, the chemical applicability of some neighborhood-degree based topological indices like the neighborhood modified first Zagreb index (${}^mNM_1(G)$), neighborhood inverse degree index ($NID(G)$), neighborhood zeroth order index ($NZ(G)$) and the fifth geometric-arithmetic index (GA_5) has been explored. Furthermore, considering four cases in terms of number of rows and number of hexagons per row in the honeycomb-lattice of graphene, explicit expressions for aforesaid indices as well as the neighborhood versions of the sum-connectivity index and the Randic index like the general fifth M_1 -Zagreb index ($M_1^a G_5(G)$) and general fifth M_2 -Zagreb index ($M_2^a G_5(G)$) have been determined. Also, a graphical comparison of the four indices ${}^mNM_1(G)$, $NID(G)$, $NZ(G)$ and GA_5 is made for graphene.

Paper ID: 133

Keywords:

molecular graph, molecular descriptor, neighborhood degree.

The Time Fractional Navier-Stokes-Damped Equations with Slip Boundary Conditions

Paper ID: 135

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In this paper, an initial boundary value problem for the time fractional Navier-Stokes-Damped equations with a Navier-type slip boundary condition is considered. The existence, uniqueness and regularity of the solutions to the time fractional Navier-Stokes-Damped equations with slip boundary conditions are investigated. Firstly, the existence of weak solutions for $\beta \geq 1$ is established using the Galerkin approximation. Secondly, it is demonstrated that for $\beta \geq 4$, the weak solution becomes unique. Lastly, the regularity of the solution for $\beta \geq 1 + 2\alpha$ is proven.

Keywords: Caputo fractional derivative, Navier-Stokes-Damped equation, Weak solutions, Existence and uniqueness, Navier slip condition.

Role of Combined Nonlinear Harvesting in a Prey-predator model

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In this research article, we have developed and analyzed a prey-predator model with the combined effect of nonlinear harvesting with Holling I functional response. Due to the impact of Nonlinear harvesting, multiple predator-free and interior equilibrium points in the dynamical system appeared. We have studied the local stability analysis of all the equilibrium points. Besides these, various bifurcations, such as backward, saddle-node, Hopf and Bogdanov-Takens (BT) bifurcations, are also observed in this study. Furthermore, exciting phenomena like bi-stability and tri-stability occur in our model between the different equilibrium points. Also, we have derived different threshold values of predator harvesting parameters from these bifurcations to obtain the different harvesting strategies for both species. We have observed that the extinction of predator species may not happen due to backward bifurcation, although a stable predator-free equilibrium (PFE) exists.

Paper ID: 137

Keywords: Prey-predator model, Nonlinear harvesting, Bifurcation, Stability analysis

Exact Traveling Solutions of the Fractional type Kuramoto-Sivashinsky (KS-Equation) equation by $\frac{G'}{G}$ -Expansion Method

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In this work, we find the traveling wave solutions of nonlinear fractional Kuramoto-Sivashinsky equation by employ G'/G -expansion method. Some new exact traveling wave solutions with arbitrary parameters of nonlinear fractional Kuramoto-Sivashinsky equation are successfully obtained these are presented in terms of hyperbolic function, trigonometric function, and rational function.

Paper ID: 140

Keywords: Fractional Kuramoto-Sivashinsky equation, Conformable derivatives, $G_0 G$ -Expansion method, Exact traveling wave solutions.

Solute transport phenomena in a stratified fluid through a porous media with boundary reactions

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The paper analyzes the dispersion of solute on stratified, viscous, incompressible fluid flowing through a porous media between two parallel plates with reaction at the boundaries. The governing advection-diffusion equation is solved using Aris's method of moments with the aid of a finite difference technique. The coefficient of transport and the axial mean concentration distribution are obtained using the first four central moments. The impact of Darcy number, stratification factor and reaction parameter on the transport process of tracer are analyzed.

Paper ID: 141

Keywords: Dispersion, Method of moments, Stratified fluid, Porous media, Absorption, Mean concentration distribution.

Soliton dynamics in metamaterial with higher order nonlinear phenomena

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The soliton is produced in a metamaterial that has higher-order nonlinearity, self-steepening, and Raman scattering. The propagation of solitons is studied under higher-order effects. The system is governed by a nonlinear Schrödinger equation and solved using both analytical and numerical approaches. The Lagrangian variational method is used for analytical analysis, while the RK-45 and split-step Fourier method (SSFM) is used for numerical analysis. The investigation explores the effects of quintic nonlinearity, self-steepening, and Raman scattering on soliton propagation and on the interaction of solitons. The study can be used to make devices to control light and make optical switching devices.

Paper ID: 142

Keywords: soliton, quintic nonlinearity, self-steepening, Raman scattering.

Does anything beat a GARCH(1,1)? Evidence from Crypto Markets

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We leverage the emerging cryptocurrency markets as an independent testing ground to evaluate the hypothesis that the GARCH(1,1) model serves as an effective and generalizable volatility model due to its simplicity and parsimony. Our investigation extends to five variations of the standard GARCH model across six cryptocurrency markets: Bitcoin (BTC), Ethereum (ETH), Litecoin (LTC), Binance Coin (BNB), Ripple (XRP), and Chainlink (LNK). Consistent with findings from conventional financial markets, our analysis endorses the GARCH(1,1) model as a suitable prior for cryptocurrency volatility modeling, demonstrating superior performance in four out of the six markets examined. Specifically for Bitcoin, incorporating an E-GARCH model to account for asymmetric volatility responses to positive and negative market movements offers significant modeling advantages, despite the increased complexity and associated model risk.

Paper ID: 143

Keywords: GARCH modeling, cryptocurrencies, risk assets.

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As a serious worldwide health concern, lung cancer requires novel methods for early detection. This study investigates the potential of Sn-doped hexagonal boron nitride (hBN) as a sensing material, with a focus on its use in the detection of volatile organic compounds (VOCs) such as isoprene (C₅H₈), benzene (C₆H₆), and acetone (C₃H₆O) that are associated with lung cancer. The study uses the Cambridge Sequential Total Energy Package (CASTEP) based on Density Functional Theory (DFT) for computation study. Subsequently, we introduced tin (Sn) atoms into these vacancies to evaluate their stability and reactivity. The investigation of critical parameters that are crucial for reliable sensing, such as bandgap, density of states, adsorption energy, and binding energy, reveals promising properties of Sn-doped hBN for the effective detection of VOCs linked to lung cancer. Moreover, the analysis of adsorption energies reveals strong bonding relationships between the target VOCs and Sn-doped hBN. Compared to Sn-doped N vacancy hBN (-1.03 eV), the Sn-doped B vacancy hBN has a binding energy of -5.14 eV, showing higher stability. The adsorption energies on Sn-doped hBN for C₃H₆O, C₆H₆ and C₅H₈ are determined to be -0.18 eV, -1.6 eV, and -1.5 eV, respectively. Based on these results, Sn-doped hBN is a promising choice for sensing applications. With implications for the early identification and treatment of lung cancer, this study is a significant advancement in the search for non-invasive diagnostic tools in the rapidly developing field of nanotechnology.

Keywords: : Lung cancer, Sn-doped hBN, DFT, VOC.

Mixing of a solute in a micropolar blood flow model through a capillary tube with an absorptive wall Paper ID: 148

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This study dives into the secrets of how solutes navigate in the dynamic flow of blood. Here, we investigate the process by which solute mixes with blood in capillaries in a time-independent flow with a first-order absorption parameter at the tube wall. The micropolar fluid model is considered to investigate the dispersion mechanism of the solute. To analyze the transport process, a generalized dispersion model is utilized. At large times, different transport coefficients are asymptotically evaluated. The dependences of the exchange, convection, and dispersion coefficients are assessed with respect to the wall absorption parameter. Variations of both axial fluid velocity and micro-rotational velocity of blood are discussed for different values of the micropolar parameter and coupling number. For different values of these parameters, it is observed that there is a significant change in the convection and dispersion coefficients concerning the absorption parameter. This work may have relevance in comprehending the mechanism of drug dispersion within the blood flow in capillaries.

Keywords: Blood flow, micropolar fluid, boundary absorption, microvessels.

Casson Fluid Flow in a Duct with Iso-thermal Walls under the Local Thermal Non-Equilibrium Framework: Temperature Distribution Paper ID: 149

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The current study explores the ramifications of Casson fluid flow within a duct filled with porous material, characterized by isothermal boundaries and incorporating viscous dissipation while adhering to local thermal non-equilibrium (LTNE) conditions. Our investigation delves into the quantifiable effects of various parameters, including the Hartmann number (Mh), Casson fluid parameter (β), thermal conductivity ratio (ν), Brinkman number (Brh), and Biot number (Bih), on the augmentation of heat transfer. We derive analytical solutions for the governing equations and present velocity profiles as well as temperature distribution profiles for both the solid and fluid phases. This model demonstrates that the magnetic field significantly influences the temperature field at all stages. Furthermore, for the iso-flux boundaries, our findings reveal that irrespective of the Hartman number and Casson fluid parameter, the solid phase consistently maintains a lower temperature than the fluid phase, substantiating the existence of LTNE.

Keywords: Casson fluid, Hartmann number, Brinkman number, LTNE model.

Dust-acoustic Multi-solitons and shock in a Polarized Space Dusty Plasma using Darboux transformation Paper ID: 153

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The properties of dust acoustic waves (DAWs) in a dusty plasma containing Cairns-Tsallis (C-T) distributed ions, Boltzmann distributed electrons, and negatively charged dust particles in the presence of a polarization force are investigated. The Burger equation is derived from the fluids equation of the plasma system with the help of the reductive perturbation technique (RPT). The Lax-pair of the evolution equation is obtained and the characteristic of the DAWs are investigated by employing the Darboux transformation. Some new waves are observed (one soliton, two soliton-shock etc.) as the Darboux transformation is used through the Lax pair. It is also shown that the propagation of nonlinear waves are significantly affected by the physical plasma parameters.

Keywords: Dust acoustic waves, Darboux transformation, Lax-pair, Burgers' equation.

Exploring Business Management Practices of Milk Tea Houses in Selected Urban Towns of Nueva Vizcaya Paper ID: 154

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This study aimed to analyze the business management practices of milk tea houses in three urban towns in a province, with a focus on the implications of the COVID-19 pandemic. The study sought to elucidate the business profiles of these establishments, analyze their management practices regarding product marketing, operational procedures, and human resource management, and consider the unique challenges posed by the pandemic. The business management practices were delineated across various dimensions, including marketing strategies such as the procurement of beverage materials and the marketing of products, operational aspects such as beverage preparation and ensuring food safety, and the management of the human resource group. The study also considered the adaptations and innovations implemented by milk tea houses in response to the challenges brought about by the COVID-19 pandemic. Further analysis revealed significant correlations between demographic profiles (age, sex) and related training with marketing practices. The position of personnel and the NC acquired exhibited significant differences in operational practices, specifically in the types of beverage services and the preparation of milk tea. Age and personnel position were also found to significantly impact human resource management practices, particularly in personnel qualities and attitude, observation tours, and skills and competencies, with considerations for the changing dynamics introduced by the pandemic. In line with these findings, a business scheme has been formulated to enhance the overall operation of milk tea businesses, considering the persistent influence of the COVID-19 pandemic on the industry. This research provides valuable insights for practitioners and stakeholders navigating the evolving landscape of the milk tea business amid global challenges.

Keywords: COVID-19 pandemic, business scheme, marketing strategies.

Solitons and resonance in fractional Sawada–Kotera equation using Hirota bilinear method Paper ID: 156

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The resonance of non-linear waves are studied in the fractional Sawada- Kotera (FSK) equation using Hirota bilinear method. All the mathematical calculations are done using symbolic computation. The effects of fractional order parameter (α) are shown graphically on one-soliton and two-soliton solutions. In one-soliton solution the change of phase is prominent with the enhancement of α . It is significant to note that, when the phase shift parameter (β_{12}) tends to zero or infinity, two-soliton solution exhibits the behavior of resonance. At resonant state, a soliton splits into two-soliton or two-soliton fuses and is transmuted into singular soliton.

Keywords:

Sawada-Kotera (SK) equation, Fractional derivative, Hirota bilinear method, Resonance, Symbolic computation.

Drift and Annihilation of a Counter-rotating Spiral Pair in Belousov-Zhabotinsky Reaction Under a DC Electric Field Paper ID: 158

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We present a numerical study of the dynamics of the counter-rotating spiral pair in the presence of a DC electric field using the Oregonator model of the Belousov-Zhabotinsky (BZ) reaction. The dynamics of the counter-rotating pair is investigated by changing the strength and direction of the electric field. The dynamics can change from meander to drift with increasing field strength. The drift velocity increases with the field strength, and its direction depends on the direction of the field. Finally, the spiral pair is annihilated when the applied field is above a threshold value. With further increase in field strength, the annihilation is followed by generation of a new counter-rotating pair oriented opposite to the initial pair.

Keywords:

Excitable Medium, Belousov-Zhabotinsky Reaction, Oregonator Model, Spiral Wave, Drift, Meandering, Annihilation.

Nonlinear wave features of the fractional Gardner equation using Darboux transformation Paper ID: 160

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The focus of this article is to explore a class of multi-soliton nonlinear wave features of the time fractional Gardner (TFG) equation employing Darboux transformation with the aid of Lax pair. In the framework of this technique, first we set a transformation so that the TFG equation is converted into the standard Gardner equation and simultaneously the Lax pair of the foregoing equation can be achieved by employing Ablowitz-Kaup-Newell-Segur (AKNS) method. By determining Darboux transformation, multi-soliton nonlinear wave features of the TFG equation are considered which allows us to encounter with new type of wave structures, like multi-kink type solitons, bell type soliton, compressive lump type soliton, breather-type soliton, etc. For better understanding two-dimensional and three-dimensional graphs are plotted of these nonlinear wave structures. Finally we will see by the effects of the fractional parameter how one structure is converted into another form.

Keywords: Gardner equation, time fractional Gardner equation, Lax pair, multi-soliton nonlinear wave features, Darboux transformation method.

Impacts of Hall and Ion Slip on a Casson Nanofluid of a MHD with Radiation Absorption Paper ID: 161

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This study investigates the multifaceted impacts of Hall and ion slip effects on the flow and heat transfer characteristics of a Casson nanofluid subjected to Magnetohydrodynamics (MHD) and radiation absorption. The influence of electromagnetic forces through MHD, along with hall and ion slip effects, plays a vital role in shaping the flow of fluid and heat transfer within the system. The mathematical model governing the flow is built on the conservation equations of mass, momentum, energy, and species incorporating the Casson rheological model for non-Newtonian behavior. The findings from this research contribute valuable insights into the intricate interplay of Hall and ion slip effects on the blood flow and thermal characteristics of a Casson nanofluid under the influence of MHD and radiation absorption. Using the perturbation approach, the dimensionless governing equations have logical solutions. The significant results are displayed graphically.

Keywords: Heat transfer, rotation, porous medium, mixed convection and chemical reaction.

Excitation of pinned solitons by moving charge debris in a plasma with kappa-distributed electrons Paper ID: 162

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We study the excitation of pinned solitons by a moving charge debris object in an ion-acoustic plasma with kappa(κ)-distributed electrons. Sagdeev pseudo-potential analysis shows that amplitudes and steepness of the pinned soliton solutions decrease with an increase in the κ value. The pinned solitons can access higher Mach numbers for higher values of κ with very large amplitudes. Peak modulations in pulse-like solitons are found at a lower source velocity $M \ll 1$ for decreasing κ , unlike Maxwellian electrons where modulation in the peaks are found only at $M > 1$. The numerical simulation for the evolution of the plasma also supports the theoretical results. This study may have relevance in the study of nonlinear propagation ion-acoustic waves in space plasmas and potential near-earth plasma applications.

Keywords: solitons, charge debris, kappa distribution, plasma simulation.

Bifurcation of small amplitude dust-acoustic waves in two-temperature ions dissipative plasmas

Paper ID: 163

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A study of small amplitude dust-acoustic waves is considered in a dissipative plasma system that is composed of mobile dust particles, q -nonextensive distributed cold and hot ions, and immobile electrons. The study is considered under the framework of the nonlinear evolution equation, the Burgers equation and the modified Burgers equation derived using the reductive perturbation technique. Using the wave transformation, the Burgers equation and the modified Burgers equation are transformed into the corresponding dynamical systems. Through the concept of planar dynamical systems, the bifurcation of dust-acoustic waves is studied using the phase plane analysis. By varying the q -nonextensive distribution parameter and the coefficient of viscosity, the changes in the shock waves and periodic waves are examined using numerical simulation. This study may be applicable to understand the dynamics of the dust-acoustic shock and periodic waves in q -nonextensive distributed cold and hot ions that may occur in dissipative plasmas.

Keywords: Phase plane analysis, Small-amplitudewaves, Reductive perturbation technique, Non-extensive plasma

Multidimensional Extensions of Basic (or q -)Analogues of Certain Erdelyi Type Integrals

Paper ID: 164

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A number of Erdelyi type integrals involving and representing certain hypergeometric functions and their multidimensional extensions have been studied in the literature. The basic (or q -) analogues of certain Erdelyi type integrals have also been analyzed but the multidimensional extensions of basic (or q -) analogues of the Erdelyi type integrals have not appeared so far. The aim of this work is to provide the development of such multidimensional extensions of certain Erdelyi type q -integrals. The motivation behind this work stems from the recognition that basic (or q -) series and basic (or q -) polynomials, with a specific focus on basic (or q -) gamma and q -hypergeometric functions, q -hypergeometric polynomials along with q -integrals containing and representing q -hypergeometric functions, hold significant relevance across various domains. Notably, their applications extend to diverse fields such as Number Theory, the Theory of Partitions, Combinatorial Analysis, Physics, and the exploration of q -deformed systems in the Nonlinear Dynamics.

Keywords: Multidimensional extensions, Erdelyi type q -integrals, q -hypergeometric functions, q -integrals.

2-path signed graph of signed Smith graphs

Paper ID: 165

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The 2-path signed graph of a signed graph $\Sigma = (G, \sigma)$ has G^2 as the underlying graph, in which the sign of an edge u, v is -1 if, in each $u - v$ path of length 2 in Σ , the sign of all the edges is -1 ; otherwise, it is $+1$ [1]. Smith graphs are defined as graphs having the highest eigenvalue of 2. There are six connected classes of such graphs [2]. In this article, the balance and canonical consistency of 2-path graphs of signed Smith graphs have been investigated.

Keywords: Signed graphs, Smith graphs, 2-path signed graphs, balance, canonical consistency

Multi-soliton solution and periodic solution of the fractional Lax equation using by Darboux transformation

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Through this paper we derived the exact solution of the fractional order Lax equation. We consider the fractional Lax equation which is the generalization version of the Lax equation by replacing the modified Riemann-Liouville fractional derivative from classical derivative. Some important definition and result of modified Riemann-Liouville fractional derivative are discussed. The Darboux transformation and fractional complex transformation are used to compute some exact solution such as single solitary wave solution, two solitary wave solution, singular solitary wave solution, singular periodic solution, etc. Also the dynamical behavior of the solution by changing the fractional parameter ρ are illustrated.

Paper ID: 166

Keywords: Fractional Lax equation, modified Riemann-Liouville fractional derivative, fractional complex transformation, Darboux transformation, soliton solution, periodic solution.

Non-equilibrium Cytokine Dynamics For Possible Therapeutic Intervention

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Cytokines and T-cells interaction plays an important key role in complex immune system dynamics. However, we need to monitor crucial way of cytokines and T-cells cross-talk in our immune system, the failure of which may result in dire consequences. We present a minimal basic model of this interaction and study the evolution of the cytokine dynamics in their interaction with T-cells using stochastic formalism. Our results indicate that the stochastic fluctuations drive the system at near equilibrium steady state (NESS) which is a non-equilibrium state. The production rate of cytokines via T-cells can manipulate the steady state to NESS, thereby activating the system. Time delay is also able to drive the system to various immunological states, namely, NESS, oscillating state, dissipating non-equilibrium state, etc. by manipulating the steady state. These states could be useful for therapeutic intervention of various immunological disorders.

Paper ID: 167

Keywords: Stochastic Simulation; Cytokine, T-cells; Delay Reaction, Non-delay reaction.

Analyzing the Impact of COVID-19 pandemic and Ukraine-Russia war in WTI-Brent Spread: A MFXDFA Approach

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This study investigates the dynamic interplay between WTI and Brent crude oil benchmarks during critical periods marked by COVID-19 and the Ukraine-Russia conflict. Utilizing the MFXDFA by means of Hurst exponent dynamics, we investigate both futures and spot crude oil prices, particularly focusing on WTI-Brent and WTI-DatedBrent spreads. The investigation encompasses four distinct periods: P_0 (February 2019 to February 2020, predating the two significant events), P_1 (February 2020 to February 2021, during the initial phase of the COVID-19 pandemic), P_2 (February 2021 to February 2022, covering the pandemic and antecedent to the conflict), and P_3 (February 2022 to February 2023, post-pandemic and amidst the Ukraine-Russia conflict). Our findings reveal strong evidence of persistence increase during COVID-19 periods (P_1 and P_2), with P_2 exhibiting the highest $H(q)$ levels, signifying heightened persistence following the initial pandemic impact. However, persistence diminishes in P_3 without returning to previous levels seen in P_0 .

Paper ID: 172

Keywords: crude oil, commodities, price dynamics, Russia-Ukraine conflict, Covid-19

An Efficient Hybrid Sequence of Retargeting Operators to Minimize Structural Deformities in Image

Paper ID: 192

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Researchers have proposed several techniques to alter image aspect ratios in order to preserve visual information while retargeting. However, researchers discovered that no single retargeting approach consistently produces the optimum outcomes. As a result, several retargeting operators are combined to form a hybrid sequence that takes use of the current algorithms. In this paper a hybrid set of image retargeting operators is proposed that combines five different retargeting operators. The addition of a switching point among these operators is an attempt to maximize the benefits of each algorithm via the retargeting operation. In addition, an image morphological procedure is used to minimize abnormalities in crucial image regions and increase the effectiveness of the suggested approach. To identify prominent parts in the image, an importance map is created by integrating a saliency map, gradient map, edge map, skin map, shadow map, and object map. These maps are generated using MATLAB's built-in functions and libraries. The suggested technique's effectiveness is tested using a structural similarity index measure (SSIM) that is based on three parameters: luminance comparison, contrast comparison, and structure comparison. The suggested hybrid sequence's superiority is compared with single image retargeting operators using the generated SSIM index. The SSIM index results show that the suggested technique achieves 86.51% similarity between the original and retargeted images.

Keywords: Seam carving, Multi-operator, Image retargeting, Energy map, Saliency detection, Scaling, Warping.

Image acquisition and electric field application in the Belousov-Zhabotinsky reaction using LabVIEW

Paper ID: 194

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This paper introduces LabVIEW-based software and hardware designed to simultaneously record and control chemical wave activity in the Belousov-Zhabotinsky (BZ) reaction. The chemical waves in the BZ reaction can be controlled by DC and polarized electrical stimuli. Our software can be used to study the interaction of DC or different types of polarized electric fields with chemical waves. The software allows the user to capture and save images for further analysis.

Keywords: Chemical waves, Triggering, DC electric field, Polarised electric field, Data acquisition.

The effect of self-defocusing nonlinearity on the eigenmodes of PT-symmetric single system with k-wavenumber Scarf II barrier potential

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The studies on the linear and nonlinear systems with confining refractive index distribution and gain/loss effects are of great interest as it leads to the formation of localised stable modes in the PT-symmetric phase. The fundamental and higher eigenstates are analysed in the self-defocusing nonlinear single system with PT-symmetric k-wavenumber Scarf II barrier potential. The PT phase transition and the effect of the real component of the barrier potential on the field intensity of the stationary modes have been analysed in the linear regime. The effect of the self-defocusing nonlinearity, on the formation of eigenmodes with central dips in the PT-symmetric phase is studied. Also, the variation in the nonlinear modes with the width of the barrier potential is analysed. The linear stability analysis has been carried out to analyse the stability condition of the stationary modes under small perturbation. The existence and dynamics of bright and dark soliton-like PT-symmetric modes due to the interplay between the defocusing nonlinearity and Scarf II barrier potential find applications in the lossless communication processes.

Paper ID: 202

Keywords: dark and bright soliton, nonlinear modes, linear stability analysis, PT phase transition.

Theoretical Investigation to Analyze the Effect of Core Size of InAs/GaAs Core-shell Nanostructure

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Core-shell quantum dots (CSQD), are an appealing class of nanostructured semiconductor materials, recognised for their exceptional electronic and optical properties. They consist of a core material enclosed by a surrounding shell, hence earning them the name 'core-shell' quantum dots. An interesting property of CSQDs is the self-induced strain produced due to the difference in bandgap and lattice parameters of the respective materials, which is in turn related to the size of the core or shell layer. In our work, we have opted for III-V materials, InAs core coated with a GaAs shell layer to replicate a CSQD nanostructure, to theoretically study the effect of varying the InAs core size on the internal strain produced in the nanostructure. Variation in the InAs core layer size from 0.3-9 nm was seen to have an effect on the hydrostatic strain produced at the junction of the nanostructure, which led to an alteration in the band edge position of both the internal InAs core and the enclosing GaAs shell. This alteration in the position of band edges has a direct effect on the band gap of the respective nanomaterial, which in turn is a determining factor in tailoring or understanding the electrical and optical properties of these nanostructures.

Paper ID: 203

Keywords: Core-Shell QD, Band Edge, Band Gap, III-V semiconductor, Strain.

Inhomogeneity effects on Energy and Instability of Ion-Acoustic Solitary Waves in Quantum Magnetized Plasma

Paper ID: 205

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Theoretical research has been done on inhomogeneous multi-component magnetized plasmas that contain inertial ions, nonthermal electrons, and Boltzmannian positrons. Variable coefficients Zakharov Kuznetsov (VZK) equation have been derived. The solitary wave structures are dependent on the inhomogeneity effects of ion density $n_{i0}(x)$, velocity, u_{i0} , the density gradient scale length specifically associated with the ions, α_i , and the scale length of the density through x/L . The soliton's electric field and energy are also derived and investigated, which were found to be enhanced as n_{i0} and u_{i0} increase. The instability growth rate is also derived by using the small-k perturbation expansion method. It decreases as n_{i0} and u_{i0} increase. Also, the instability is affected by α_i , x/L , electron, and positron temperatures. A comparison of the energy and instability growth rate behavior against system parameters is carried out. Large energy and small instability growth rate occur at large values of ion density and velocity or large electron temperatures. Our research may be used to better understand the dynamics of e-p-i plasma in high-intensity laser-solid matter interactions, semiconductor plasma, magnetic white dwarfs, and magnetar corona.

Keywords: Instability, quantum plasma, e-p-i plasma, wave energy.

Estimating Soil Temperature at Various Depths in Bangladesh: A Comparative Analysis of Advanced Machine Learning Tree-Based Models

Paper ID: 212

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Soil temperature at various depths is vital for hydrology, ecology, agriculture, and engineering, influenced by weather conditions and physical factors. This research utilizes machine learning models with historical data and temporal windowing to predict soil temperature at different depths, effectively addressing nonlinear complexities in environmental studies and meteorology. Utilizing evaluation criteria such as the Root Mean Square Error, Nash-Sutcliffe coefficient, and Pearson Correlation coefficient, it is advisable to employ all four data-based models (Decision Trees, Random Forest, Gradient Boosting Trees, and a hybrid DT-GBT) for accurate soil temperature estimation. The findings reveal that the RF model performed better than others in accurately estimating soil temperature at depths of 10cm, 20cm, and 30 cm. Notably, the RF model, followed by the hybrid DT-GBT, GBT, and DT methods, consistently demonstrated accurate predictions across various depths. Overall, the RF model exhibited slightly better performance with significantly faster computation speed compared to other models, making it highly recommended for accurate soil temperature estimation across different depths. These models provide cost-effective alternatives to on-site measurements, delivering valuable benefits to advantages to agriculture. Their accuracy and reliability enhance decision-making processes, thereby improving overall agricultural practices.

Keywords: soil temperature, meteorological parameters, tree-based models, Bangladesh.

Spatiotemporal Dynamics in Trade-off Prey Predator Model With Doomed Function Response Paper ID: 213

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In ecological scenario, predators often risk their lives pursuing dangerous prey, potentially reducing their chances of survival due to injuries. Prey, on the other hand, try to strike a balance between reproduction rates and safety. In our study, we introduce a two-dimensional prey-predator model inspired by Walter Tostowaryk's work, specifically focusing on the domed-shaped functional response observed in interactions between pentatomid predators and neo-diprionid sawfly larvae. To account for the varying effectiveness of larval group defense, we incorporate a new component cx^2 into the response equation. Our investigation delves into predator trade-off dynamics by adjusting the predator's mortality rate to reflect losses incurred during encounters with dangerous prey and preys' trade off between safety and reproduction rate incorporating this domed-shaped functional response. Our model demonstrates bistability and undergoes various bifurcations, including transcritical, saddle node, Hopf, Bogdanov-Takens, and Homoclinic bifurcations. Critical parameters impact both predator and prey populations, potentially leading to predator extinction if losses due to dangerous prey encounters become excessive, highlighting the risks predators face for their survival. Furthermore, the efficacy of group defense mechanisms can further endanger predators. Expanding our analysis to a spatially extended model under different perturbations, we explore Turing instability to explain the relationship between diffusion and encounter parameters through both stationary and dynamic pattern formation. Sensitivity to initial conditions uncovers spatiotemporal chaos. These findings provide valuable insights into comprehending the intricate dynamics of prey-predator interactions within ecological systems.

Keywords:

domed-shaped functional response, predator's mortality rate, bifurcation, spatiotemporal chaos.

Dynamics in the parameter planes of a tri-trophic food chain model with immigration and emigration Paper ID: 215

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Migration is a natural behavior and an integral part of many species' life cycles. Although most commonly found in many species of mammals and birds, it also occurs in several other species such as fish, insects, etc. Animals migrate in response to the spatial and temporal variability of environmental factors, such as food availability, habitat safety, climate, and mating opportunities. The present study investigates the role of middle predator's migration (immigration and emigration) in the dynamics of a well-known tri-trophic food chain model. We perform extensive numerical simulations of this model system with simultaneous variation of migration and another system parameter related to the half-saturation constant of the middle predator, and present a collection of high-resolution isospike and Lyapunov exponent diagrams drawn in the biparametric space illustrating the intricate nature of the system dynamics. We mainly find that a moderate amount of migration (both immigration and emigration) promotes regularity in the dynamics of the system. High migration rates, however, lead to the extinction of one or more species from the system. The isospike diagrams uncover several periodic windows of different periodicity inside the chaotic region, some of them crossing one another. We demonstrate with the aid of phase portraits and basins of attraction that these overlappings induce bistability between coexisting attractors. We notice that these basins have a self-similar nature. Additionally, the system exhibits shrimp-shaped periodic structures, spike-bubbling route to chaos, and multiple-times stability switching.

Keywords:

tri-trophic food chain model, Lyapunov exponent, isospike diagrams, phase portrait.

Dissipative Force on an External Quark in AdS Gauss-Bonnet Gravity with String Cloud Paper ID: 217

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In this work, we have studied the dissipative force experienced by an external quark in AdS Gauss-Bonnet gravity with an attached string cloud. The dissipative force is computed using gauge/gravity duality with the consideration of the AdS Gauss-Bonnet with string cloud as dual bulk. The drag force has been studied with respect to the temperature (T) of the black hole, Gauss-Bonnet coupling constant (α) and the string cloud density (α).

Keywords: Black Holes, Gauss-Bonnet, Dissipative Force, AdS/CFT

Periodic structures, multistability, and Wada basin boundaries in a predator–prey model with additional food for predators Paper ID: 218

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Provision of additional food is widely recognized as one of the most effective means of conserving species and controlling pests in biological control programs. Providing additional food to predators can assist in deterring overconsumption of prey (short-term) or increasing predation rates (long-term). In the present article, we consider a predator–prey model in a discrete-time setup with Holling type-II functional response by incorporating additional food for the predator species. Here, we explore the overall dynamics of the underlying system as well as the effect of additional food on prey growth. We analyze the intricate dynamics of the system by varying two parameters, viz, the biomass of additional food and the intrinsic growth rate of prey species, simultaneously with the help of Lyapunov exponent and isoperiodic diagrams. We notice the presence of infinite families of different organized periodic structures, like Arnold tongues, shrimp-shaped domains, a new kind of ‘double fishhook’ structures, etc., in the quasiperiodic and chaotic zones of the parameter planes. We find the presence of bistability and tristability in several different sets of attractors. The most fascinating finding in this study is coexistence of quadruple attractors, one of the rarest phenomena in ecological systems. The basins of attraction of all these coexisting double, triple, and quadruple attractors are of a very complex nature, they are either fractal basin boundaries or Wada basin boundaries.

Keywords: predator–prey model, Lyapunov exponent, isoperiodic diagrams, quasiperiodic.

Complex dynamical behaviors of a discrete-time eco-epidemiological system in parametric planes

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The environmental characteristics of a biological system are imbedded in some particular parameters of that system. Significant changes in any system parameter exert influence on the system dynamics as well as the persistence of interacting species. In this article, we explore the rich and tangled dynamics of a discrete-time eco-epidemiological system. We analyze the model theoretically by performing stability analysis of the biologically feasible fixed points and studying some local bifurcations. We focus on exploring the model system's dynamics in different parametric planes of the system. In the parameter planes, we find a variety of complex and subtle properties of the system. We observe the presence of a variety of intricate regular structures like Arnold tongues, shrimps, connected shrimp, etc. within the quasiperiodic and chaotic regions of the parametric planes. The appearance of such regular patterns within irregular regimes is of great importance in population biology. Fascinatingly, we observe a new kind of 'eye'-shaped structure in a parameter plane. The structure contains numerous periodic Arnold tongues, and chaos is observed at some portions in the upward direction of it. At the center of this 'eye'-shaped pattern, a number of periodic rings have formed. Finding the appearance of this peculiar structure in the parameter plane is one of the striking results of this study. Analyzing different parametric planes of this eco-epidemiological system, we find many fascinating and complex properties underlying the system that are impossible to find through one-parameter analysis.

Paper ID: 220

Keywords: stability analysis, bifurcation, quasiperiodic, chaotic region.

A Numerical Analysis of MHD Micropolar Hybrid Nanofluid Flow over a Porous Stretching/Shrinking Sheet

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This study investigates the behaviour of a two-dimensional, time-in-dependent, and incompressible magnetohydrodynamic (MHD) flow of a hybrid nanofluid made of water and single-walled carbon nanotubes (SWCNT) and multi-walled carbon nanotubes (MWCNT). The research centers on analyzing a sheet undergoing stretching or shrinking within a porous medium subject to suction and a no-slip condition. It examines the influences of thermal radiation, heat generation, viscous dissipation, and Joule heating on the system. Through a suitable similarity transformation, nonlinear ordinary differential equations are derived from the governing equations, and the Keller-box numerical method is utilized to solve them. Our analysis includes graphical representations of the velocity profile, angular velocity profile, and temperature profile. Our findings indicate that the hybrid nanofluid consisting of SWCNTs and MWCNTs in water yields better results than other hybrid nanofluids, as well as single nanoparticle nanofluids. This study also offers a comprehensive comparison with previously published works. The research fills a gap in the current understanding of the behaviour of hybrid nanofluids in MHD flows, and has important implications for practical engineering problems.

Paper ID: 224

Keywords: magnetohydrodynamics, thermal radiation, viscous dissipation, Joule heating, hybrid nanofluid, Stretching/shrinking sheet.

Synchronisation scenario and emergence of spatial chimeras in 2D lattice

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This work analyses the emergence of spatial chimeras due to the interplay of electromagnetic, nonlinear, distance dependent and cross coupling in a network of Hindmarsh-Rose neurons. The neurons are arranged to form a square lattice. The electromagnetic induction produced by the flow of ions is represented using the memristor. The chemical coupling is inherently nonlinear. The distance between the neurons in the terms of lattice parameter ensures that the contribution decreases with increase in distance. The cross coupling is a non conventional method of coupling which enables the network to exhibit different interesting behaviours. The statistical factor of synchronisation is calculated to quantify the amount of synchrony in the network for different coordination numbers of the coupling neurons. The spatiotemporal analysis reveals that the spatial chimeras possess travelling nature. The Hamiltonian energy of the system derived using the Helmholtz theorem suggests that significant energy is utilised to maintain the membrane potential at high values regardless of polarity, while energy consumption is lower when the membrane potential approaches zero.

Paper ID: 227

Keywords: 2D lattice, cross coupling, non local coupling, spatial chimeras, travelling chimeras, energy analysis.

BlossomNet: A Deep Learning Framework for Accurate Flower Identification

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This study focuses on the vital task of classifying floral photographs, essential for applications in botany, agriculture, and environmental protection. Utilizing deep learning, we propose an efficient system employing a Convolutional Neural Network (CNN) to automatically extract discriminative features from floral images. Our approach involves training and evaluating the model with a substantial dataset of labeled flower photos from diverse species. To optimize performance, we employ supervised learning techniques, including data augmentation, fine-tuning, and transfer learning, during image preprocessing for quality enhancement and data normalization. The CNN model effectively identifies and distinguishes various flower species based on visual features like color, texture, and form. Experimental results showcase the system's proficiency in accurately categorizing floral photos, with excellent accuracy on both training and testing datasets, highlighting robustness and generalization capabilities. Comparative analysis underscores the superior classification accuracy and effectiveness of our proposed strategy. The developed technique holds significant potential for real-world applications, aiding botanists, scientists, and enthusiasts in easily identifying diverse flower species. This advancement contributes to plant biodiversity study and preservation, automating tasks related to ecological assessments, species monitoring, and floral inventories. The study presents a reliable and effective deep learning-based method for floral image categorization, providing a valuable resource for various sectors requiring precise flower detection and identification.

Paper ID: 230

Keywords: Deep learning; transfer learning; convolutional neural network; image processing; flower prediction

Nonlinear Evolutionary Stages of a Dispersive Kappa Distributed Magnetized Plasma

Paper ID: 232

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We have examined a magnetized plasma, where the electron distribution follows a kappa distribution. Our focus is on studying the propagation of ion acoustic modes. Employing the reductive perturbation method, we derived an evolutionary equation, revealing a 3-D Zakharov-Kuznetsov (ZK) equation. Utilizing the Runge-Kutta (RK4) technique, we numerically solved the equation, varying parameters for comprehensive analysis. Subsequently, we conducted a phase plane analysis by transforming our evolutionary equation into a pair of ordinary differential equations (ODEs). Through this dynamical system analysis, we extracted substantial data concerning the stability of stationary structures represented by the ZK equation.

Keywords: Ion acoustic waves, Kappa distribution, perturbation method, Runge Kutta method, Dynamical System, Phase Plane Analysis.

Modulational instability of magnetosonic waves in self-gravitating, rotating magnetohydrodynamic plasmas

Paper ID: 233

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We study the amplitude modulation of magnetohydrodynamic (MHD) waves in gaseous plasma with the effects of external magnetic field, Coriolis force due to Earth's rotation and self-gravitating force. Standard multiple-scale perturbation technique is applied to derive one-dimensional nonlinear Schrödinger (NLS) equation, which governs the dynamics of the modulated MHD wave packets. The effects of Coriolis force and self-gravitating force on the modulational stability are examined. It is found that the parameters significantly affect the nonlinear instability domain of the wave vector. It is noticed that when Coriolis force dominates over self-gravitating force, the wave packet shows stability and when self-gravitating force dominates Coriolis force, the wave packet exhibits instability. The numerical analysis predicts the formation of dark envelope soliton in the stable region. The findings of this investigation should be useful for understanding the formation of different structures in space as well as laboratory plasmas.

Keywords: magnetohydrodynamic (MHD) waves, nonlinear Schrödinger (NLS) equation, modulational stability, Coriolis force.

Photonic Crystal Fiber as a Nonlinear Optical Coupler

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The importance of fiber optic communication is increasing at very fast pace in today's world. Optical fiber communication systems are extensively used all over the world for telecommunication, video and data transmission purposes. This is due to the large information carrying capacity of the fiber. Coupling and switching operations are very important in information processing in optical networks. The recent trend is to design all optical network elements in optical signal processing which eliminate the use of high speed costly electronic elements. In this regard, new materials are also widely explored. One among them is photonic crystal fibers (PCF) which could explosively change the telecommunication industry. In this work, we explore the coupling operations of a PCF under the influence of nonlinear effects.

Paper ID: 234

Keywords: optical network, optical signal processing, photonic crystal fiber.

A brief review on TGL vortices in the lid-driven cavity

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TGL vortices are one of the most important features in the lid-driven cavity. From the past few decades, the formation of TGL vortices and their various properties have been an interesting research problem in the arena of computational fluid dynamics. In this work, we provide a rigorous review on the occurrence and importance of TGL vortices. We further explore some of the important features of TGL vortices in the lid-driven cavity. The asymmetry of TGL vortices, the relation between TGL vortices with U-shaped and mushroom-shaped vortices are also discussed in this work.

Paper ID: 236

Keywords: Lid-driven Cavity; TGL Vortices; U-shaped Vortices; Mushroom-shaped Vortices.

Derivation of Korteweg-de Vries (KdV) equation for ion-acoustic waves in plasmas and solving it using various techniques

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This study focuses on ion-acoustic waves in plasmas, employing a fluid approach. Linear waves are studied by linearizing fluid equations around an equilibrium point, and the dispersion relation is analyzed to identify distinct wave modes in the plasma environment. A reductive perturbation technique is applied for the nonlinear evolution equation, resulting in the derivation of the Korteweg-de Vries (KdV) equation. The study then delves into solving the KdV equation using various methods, such as the Direct method, Tanh method, Tanh-Coth method, G'/G expansion method, and Hirota bilinear method.

Paper ID: 241

Keywords: ion-acoustic waves, dispersion relation, reductive perturbation technique, Korteweg-de Vries (KdV) equation.

Numerical exploration of tracer behavior in porous channels with couple stress and magnetic fields Paper ID: 243

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The solution for tracer dispersion in a couple stress fluid flow through a porous channel subject to the transverse magnetic field is obtained by means of finite difference technique with special attention on non-uniform grid. A transformation entitled artanh is adopted to resolve the problem of boundary condition at infinity. A two-point forward and a three-point central differencing scheme are employed to discretize the convection and diffusion terms, respectively. The present result for the limiting case of some parameters is verified with well-established experimental research at four downstream locations and received nice agreement. It is noticed that movement of the solute concentration diminishes with the enhancement of couple stress parameter and Hartmann number. However, tracer molecule dispersed more throughout the channel as Darcy number increases. The investigation has several applications in polymer extrusion, liquid crystallization, and animal blood flow.

Keywords: Mass transfer, Couple stress effect, Shishkin mesh, Hartmann number, Darcy number.

Classification of Consumers on Usage Intentions: Multi-Layer Perception Approach

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Paper ID: 246

Fintech has changed a lot about how financial services are offered and how people use them. The intention to adopt Fintech is an individual's desire or willingness to use and adopt Fintech innovations. The objective of this study is to confirm the UTAUT model in the context of acceptance of Fintech in Northeast India by predicting the usage intention on the basis of scores of Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC), and Social Influence (SI). Analysis of 454 responses has been done using the multi-layer perception of the neural network approach. Results have shown that the prediction is 79.6% correct which provides a basis to identify individuals with high or low usage intention. The results validate the UTAUT Model on technology usage.

Keywords: Classification, Multi-Layer Perception, Fintech, Northeast India, UTAUT Model.

Thermal Energy Transport in Carbon Nanotubes-Water Nanofluid Flow on an Inclined Surface: Fractional and Classical Perspective

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Theoretical modelling of single/multi wall Carbon nanotubes dispersed in water past an inclined plate is deemed to scrutinize the heat energy together with variable temperature condition. The analytical solutions of the partial differential equations governed by the fractional model are acquired using transform technique via Prabhakar's derivative. The flow characteristics such as velocity, temperature, viscous drag and heat transfer are comprehended graphically. Also, the current results are correlated competently with the antecedent solutions.

Paper ID: 247

Keywords: Mittag-Leffler function, Prabhakar's derivative, variable temperature, permeable surface.

Flow-induced vibrations of a freely vibrating bidirectional square cylinder in the presence of a stationary square cylinder at a low Reynolds number

Paper ID: 250

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Undamped flow-induced bidirectional (In-line and transverse direction) vibrations of two square cylinders in tandem arrangement were explored numerically by a two-dimensional stabilized space-time solver. Two scenarios examined: (i) downstream cylinder oscillates while up- stream remains stationary and (ii) upstream cylinder oscillates while downstream is stationary. The center-to-center distance of the two cylinders is 5D. The non-dimensional mass ratio, m^* is taken as 10 for the flexibly mounted cylinder. Computations were performed at a fixed Reynolds number of 100 across a reduced velocity (U^*) range of 1-10. The current exploration aims primarily at understanding the behaviour of oscillator response and fluid forcing in these contrasting cases. Strong interaction occurs between the wake of the upstream cylinder and the downstream cylinder. Vibration response, lock-in branch and wake structures are emphasized. The in-line and transverse direction trajectories of flexibly mounted cylinder greatly influence the response and formation of vortex shedding due to the impingement of the vortices from the upstream cylinder.

Keywords:

Fluid-Structures Interactions, FEM, Vortex interactions, CFD, tandem arrangement.

Nonlinear Ferroconvection in a Porous Medium Saturated with a Couple-Stress Magnetic Fluid

Paper ID: 252

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Linear and nonlinear analyses of Rayleigh-Bénard convection in a porous medium saturated with a Boussinesq-ferromagnetic fluid in the presence of couple stresses are performed. As for the linear approach, the conditions for stationary and oscillatory modes of instabilities are obtained using the normal mode technique. The nonlinear analysis is based on a minimal representation of double Fourier series. The autonomous system of differential equations representing the generalized Lorenz model of convective process arising in the nonlinear study is solved numerically. In the case of linear analysis, the principle of exchange of stabilities is shown to be valid. In the case of nonlinear analysis, it is found that there is an increased heat transport due to increasing magnetic forces. The transient behaviour concerning the Nusselt number variation with time has been examined. The streamline plots are used to explain the effect of the involved physical mechanisms on the cell size at the onset of ferroconvection. The effect of magnetic and non-magnetic parameters on the nonlinear evolution of ferroconvection is analyzed by considering the time-series plots. The findings of the problem may come in handy for heat transfer applications concerning ferromagnetic fluids.

Keywords:

Rayleigh-Bénard convection, Boussinesq-ferromagnetic fluid, Lorenz model, ferroconvection.

$1/f^\alpha$ noise in an extremal model of self-organized criticality

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We consider a one-dimensional SOC model with extremal dynamics describing the evolution of low temperature creep. Our interest is in the time evolution of the state variable (force or energy noise). To understand the temporal correlations, we compute power spectra of the local force fluctuations and apply finite-size scaling to get scaling functions and critical exponents. We find the $1/f^\alpha$ noise for the local force with a nontrivial value of the spectral exponent $0 < \alpha < 2$. We also examine temporal fluctuations in the position of the extremal site and a local activity signal. We present results for different local interaction rules of the model.

Paper ID: 255

Keywords: time evolution, spectral exponent, local activity signal.

Dynamical Analysis for the Prey-Predator Model in Beddington De-Angelis type Functional Response with Prey Refuge

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Analysing the prey-predator model is the purpose of this paper. In Beddington De-Angelitype interactions, the predator consumes its prey. For the model, first we analyse some mathematical results like the positivity of solutions and the boundedness of solutions. Next, we examine whether any possible non-negative equilibrium points exist and local stability. Additionally, we examine the suggested model using the prey refuge's Hopf-bifurcation and global stability analysis. To emphasise our key analytical conclusions, we show some numerical simulation results at the end.

Paper ID: 257

Keywords: Equilibrium points, Prey refuge, Stability, Global stability, Hopf-bifurcation.

Spin-orbit coupled rotating spin-1 Bose-Einstein condensates under the influence of external magnetic field Paper ID: 261

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We investigate the topological excitations in the ground state of a spinorbit (SO) coupled rotating spin-1 ferromagnetic Bose-Einstein condensate (BEC) under the influence of externally applied magnetic field. We numerically solve the Gross-Pitaevskii equation to study the ground state of these cases of SO coupled BEC with and without rotation considering different choices of magnetic fields to depict the competition between interatomic interaction, Rashba SO coupling, rotation and magnetic field. For a non-rotating spin-1 BEC without magnetic field, we observe a state with (0,+1,+2) type vortex at the centre, where the number in the parenthesis represents the vortex charge. For the rotating case, we observe that the vortices are arranged in exotic vortex structures owing to the choice of magnetic field applied - (a) along z -direction, (b) in $x - y$ plane. These exotic structures include vortex-lattices, vortex-pair, vortex dipole, ghost vortices owing to different cases.

Keywords: spinor $F = 1$ condensate, axial magnetic field, in-plane magnetic field, trap rotation, SU(2) SO-coupling, Gross-Pitaevskii equation, topological excitation, exotic vortex lattices, ghost vortex.

Multiscale Permutation Entropy Analysis of EEG-Based Seizure Classification: A Machine Learning Approach Paper ID: 262

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Epilepsy is a disorder of the central nervous system characterized by the excessive synchronous firing of cortical neurons. Electroencephalogram (EEG) is a diagnostic tool for tracking neuronal populations to identify the underlying brain dynamics responsible for seizures. Neurologists have to continuously evaluate EEG recordings during the preoperative stage to identify seizures from background activity, which is tedious and susceptible to errors. Hence, automatic identification of seizure and seizure-free EEG signals is crucial for diagnosis and treatment. Entropy-based techniques are effective for detecting seizures due to the non-linear, non-stationary, and chaotic nature of EEG signals. The present study explores the efficacy of Multiscale Permutation Entropy (MSPE), a recently introduced entropy feature, for quantifying and classifying various EEG signals utilizing two public datasets. MSPE is assessed in each EEG epoch from healthy subjects and epileptic subjects; thereby, fifteen relevant features are chosen for training the two machine learning algorithms, namely the K-nearest neighbor (KNN) and Support Vector Machine (SVM). Results show that MSPE features combined with the KNN classifier can effectively discriminate seizure EEG signals from the healthy subjects and seizure-free signals with 100% respectively. Therefore, the MSPE method is a potential feature extraction technique for detecting seizures from the EEG signals, which can assist neurologists in correctly diagnosing epilepsy.

Keywords: Epilepsy, Seizure, Electroencephalogram, Multiscale permutation entropy, Machine learning, K-nearest neighbor, Support Vector Machine.

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In India, the persistent societal preference for male offspring has fostered a detrimental practice of illegal prenatal gender determination and subsequent termination of female fetuses. This entrenched issue exacerbates gender imbalances and poses significant threats to the well-being of women. To address this pressing need, we propose an innovative and compassionate solution aimed at revolutionizing prenatal care. Our groundbreaking approach centers on leveraging state-of-the-art technology, including biometric scanning, to monitor and enhance prenatal care practices. The integration of Machine Learning Operations (MLOps) streamlines the entire process of fraud prediction, encompassing model development, deployment, monitoring, and maintenance. Ensemble learning algorithms, such as Random Forest and Gradient Boosting Machines (GBM), are employed for fraud anticipation, demonstrating exceptional capability in handling skewed datasets and detecting complex patterns in transactional data. The significance of this proposal lies in its potential to transform the landscape of antenatal care in India. By providing secure access to medical records through biometric scanning and sending appointment reminders to expecting mothers, our system ensures timely and personalized healthcare delivery. Furthermore, it actively monitors missed prenatal care visits, enabling timely interventions to address potential health concerns and promote a consistent continuum of care. The societal impact of our solution is profound, aiming to mitigate the deeply ingrained gender bias prevalent in prenatal care. By visualizing gender ratios at birth and actively deterring the illegal practice of sex determination and selective abortion, our technology not only fosters awareness but also contributes to dismantling systemic gender discrimination. Empowering women with access to comprehensive prenatal care not only improves maternal and fetal health outcomes but also lays the foundation for a more inclusive and just society. Our innovative approach to prenatal care, integrating biometric scanning, MLOps, and ensemble learning algorithms, offers a transformative solution to the pervasive issue of gender-biased prenatal practices in India. Through its implementation, we aim to ensure healthier pregnancies, empower women with timely and personalized healthcare, and actively contribute to the eradication of systemic gender discrimination, fostering a society where equality is nurtured from the very beginning of life.

Keywords: Prenatal care, gender equality, data processing, data visualization, case studies, social impact.

Effect of vacancy defect on the free vibration of some noncarbon nanomaterials: A molecular static study Paper ID: 264

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The presence of vacancy defect has significant effect on the fracture behavior of the nanomaterials, hence it is important to study the effect of these defects on the mechanical and other properties of the nanostructure. The present study is carried out using molecular static simulation with modified Tersoff-Brenner type interatomic potential. The effect of mono-atom, di-atom, tri-atom and quad-atom vacancy on the free vibration characteristics of the different nanomaterials is investigated. The effect of clamped-clamped (CC) and clamped-free (CF) boundary conditions, geometric parameters i.e., length and diameter is studied. Furthermore, the effect of vacancy atom position on the fundamental frequency is also investigated.

Keywords: Molecular static (MS) simulation, Free vibration, Noncarbon nano-tubes, Tersoff-Brenner potential, vacancy defect.

UV-visible, FTIR and Electrochemical Properties of rGO and ZnO/rGO Nanocomposite Produced via Green Synthesis Process Paper ID: 265

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In this study, we explored the synthesis of reduced graphene oxide (rGO) and rGO/zinc oxide (rGO/ZnO) nanocomposites derived from graphene oxide (GO) in an eco-friendly approach. Using Hummers method, we successfully synthesized GO, which was subsequently reduced to rGO using *Tinospora Cordifolia* plant extract. Furthermore, a novel one-pot synthesis method employing the plant extract was employed to fabricate rGO/ZnO nanocomposites. Optical study using UV-visible spectroscopy, vibrational analysis using Fourier Transform Infrared Spectroscopy (FTIR), and electrochemical evaluation using cyclic voltammetry (CV) were among the extensive characterizations performed on the synthesised materials. The characterization results unequivocally confirmed the formation of GO, its reduction to rGO, and the successful synthesis of rGO/ZnO nanocomposites. This study not only demonstrates the viability of green reducing agents in the fabrication of advanced nanomaterials but also underscores the importance of sustainable practices in contemporary materials research. The findings presented herein not only contribute to the expanding knowledge of green synthesis methodologies but also offer a promising pathway for future environmentally conscious research and technological advancements.

Keywords: Reduced Graphene oxide, Zinc Oxide, Graphene oxide, Green Synthesis.

A gesture based turing test for mitigation of DDoS attacks in cloud

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The attractive features of cloud computing has lead to its widespread adoption in various sectors like healthcare, ecommerce, banking, power, education etc. However, attacks can put the availability of services of such crucial sectors in danger. One of the security concerns is due to Distributed Denial of Service (DDoS) which is one of the deadliest attacks from past years. This paper proposes a novel approach to mitigate DDoS attacks using a Turing test based on gesture verification. By challenging clients with gesture-based captchas, the system aims to differentiate between legitimate users and attacking IoT devices or bots. The performance evaluation of proposed method has been done by considering Yo-Yo attack with synthetically generated traffic. The findings show that the suggested approach demonstrates superior speed and cost-effectiveness compared to other existing state-of-the-art methods, offering a promising solution for safeguarding cloud services.

Paper ID: 268

Keywords: Cloud Computing ; DDoS ; IoT ; Captcha; Yo-Yo attack; IoT security

Solitary and shock structures in two temperature magnetized plasma

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In this investigation, we have explored the dynamics of dust ion-acoustic (DIA) shock and solitary waves in a magnetized three-component plasma system containing inertial ion fluid, negatively charged immobile dust grains, and two-temperature Cairns-Tsallis (CT) distributed electrons. The Korteweg de Vries-Burgers (KdVB) equation has been derived to obtain the shock wave solution. Furthermore, we have also obtained the solitary solution in the absence of viscosity. The analysis encompasses a thorough examination of various plasma parameters on the characteristics of DIA shock structures. These findings hold significance for the understanding of electrostatic waves in the magnetosphere of Saturn, particularly in scenarios where two distinct temperatures of electrons coexist.

Paper ID: 273

Keywords: KdV Burgers equation, two temperature electrons, CT distribution.

An effective numerical approach based on collocation method for the generalized Rosenau-RLW-Burgers equation

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This article related with the numerical study for the generalized Rosenau- RLW- Burgers (G-RRB) equation procured by coupling Rosenau-RLW equation and Rosenau-Burgers equation. To reach this goal, collocation method and septic B-spline basis functions have been employed as a polynomial approximation to the solution. It is proved by applying von-Neumann stability analysis that the numerical method is unconditionally stable. A test problem is successfully solved by calculating L_2 and L_∞ error norms for illustrate the adequacy and efficiency of the method. It is made an inference that the numerical results match well with the analytical solutions, which indicates that the current B-spline collocation algorithm is an attractive and powerful algorithm. The obtained results have been presented both in tables and graphically. As can be seen from the tables and graphs that the proposed method is computationally attractive, effective, reliable, and robust for solving various physical models in science and engineering.

Paper ID: 274

Keywords: Generalized Rosenau-RLW- Burgers, stability analysis, finite element method, septic B-spline, soliton.

Modeling the Dynamic Effects of Parathyroid Hormone Therapy on Bone Remodeling

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A mathematical model examines the temporal effects of plasma parathyroid hormone (PTH) and external dosages on bone remodeling. Sex steroids, especially estrogen, crucially maintain bone equilibrium. Daily PTH injections, with dual anabolic or catabolic action, are prominent for severe osteoporosis. The study predicts osteogenic responses to PTH, considering factors like $TGF-\beta$ (Transforming Growth Factor- β), RANKL (RANK Ligand), bisphosphonates, PTH's influence on the gland, and regulatory roles of $Runx2$ (Runt-related transcription factor 2), PCREB (Phosphorylation of cAMP response element-binding protein), and $BCL2$ (B-cell lymphoma 2). Utilizing methods such as numerical simulations and sensitivity analysis, it comprehends how PTH therapy impacts bone volume, enhancing its therapeutic relevance.

Paper ID: 276

Keywords: Bone, Parathyroid hormone, Mathematical modelling , Sensitivity analysis

Ion acoustic cnoidal waves in an ion-beam multispecies plasma

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In this study, the morphology of ion-acoustic cnoidal waves in unmagnetized plasma consisting of positive and negative ion fluids, a positive ion beam, and superthermal electrons is presented. The Korteweg-de Vries (KdV) equation, which characterizes nonlinear periodic waves, is derived using the reductive perturbation technique, and the solution for an IA cnoidal wave is determined. The influence of the ion beam, the superthermality of electrons, and other relevant plasma parameters on the properties of ion-acoustic cnoidal waves are examined. The results of this study may contribute to our understanding of the key characteristics of fully nonlinear ion-acoustic waves in laboratory plasmas.

Paper ID: 279

Keywords: Ion acoustic, ion beam, Cnoidal waves

Bifurcation of ion-acoustic waves in Venus' upper ionosphere

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Bifurcation of ion-acoustic waves (IAWs) is studied for the upper ionosphere of Venus. The nonlinear wave solutions in a five-component plasma consisting of H^+ and O^+ ions, solar wind (SW) protons with Maxwellian distributed electrons are studied. Reductive perturbation technique (RPT) is applied to obtain the Korteweg-de Vries (KdV) equation. Planar dynamical system is formed for the KdV equation using the travelling wave transformation. Phase portrait is drawn and the corresponding nonlinear waves are analyzed. The effects of the physical parameters $\alpha = n_{e0}/n_{O0}$, $\gamma = n_{H0}/n_{O0}$, $\beta = n_{se0}/nn_{O0}$, $\delta = n_{sp0}/n_{O0}$ which are the unperturbed number density ratio for H^+ ions, O^+ ions and SW protons, $\sigma_{se} = T_{se}/T_e$, the temperature ratio of SW electrons to ionospheric electrons and V , the travelling wave speed are shown on the nonlinear waves.

Paper ID: 284

Keywords: Solar Wind, Reductive perturbation technique, Venus Express, Pioneer Venus Orbiter.

Bifurcation Study of Nonlinear Spherical Structure for Degenerate Electron-Positron Quantum Plasma Paper ID: 285

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In this study, we have explored the existence of electrostatic periodic (cnoidal) and solitary wave structures in a weak relativistic quantum electron-positron-ion plasma within a spherical geometry. By employing the perturbation technique, we derived a spherical Kadomtsev-Petviashvili equation (SKP), and through a suitable variable transformation, we proposed an exact solution for this equation. Furthermore, we utilized bifurcation theory to demonstrate the possibility of compressive structures in the form of electrostatic solitary waves and periodic traveling waves in such plasmas. Analytical and numerical results were obtained using the Sagdeev potential approach. We investigated the effects of electron number density and the positron to electron density ratio on the nonlinear electrostatic traveling and solitary waves. The cnoidal wave structure always lies within the separatrix, according to the phase plane portraiture of these nonlinear wave structures. We discovered through numerical analysis that the amplitude and phase of the cnoidal wave both decrease as the positron to electron density ratio rises. Additionally, an increase in positron density resulted in a decrease in the amplitude of the soliton and an increase in its width. These findings are of interest in studying nonlinear electrostatic traveling waves in dense quantum e-p plasmas, which may exist in dense stellar objects such as massive white dwarfs.

Keywords:

Electron-positron plasma, the quantum hydrodynamic model, Bifurcation theory, the nonlinear spherical Structure

Modeling the Impact of Behavioral Changes on Disease Dynamics in Prey-Predator Eco-Epidemic Systems Paper ID: 291

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This study elucidates the impact of infectious diseases on both predator and prey populations and how the dynamics of these species, in turn, affect disease transmission. A focal point is the SIS eco-epidemiological model, focusing on disease transmission from susceptible prey to predators. Infected prey and predator's exhibit reduced reproduction and consistent resource depletion. Survival of susceptible predators depends on infected prey, potentially leading to their infection. Despite unaffected predation ability, infected predators face elevated mortality rates. Additionally, an ecological-epidemiological model is introduced, focusing on prey populations afflicted by disease and its transmission to predator species. This study bridges a significant gap in understanding the complex interactions between diseases, predator-prey systems, and ecological dynamics. Novelty lies in the comprehensive analysis of diverse eco-epidemiological models, including those accounting for migration, density-dependent mortality, and competitiveness among infected prey. The study investigates how different factors influence disease persistence leading to population declines. This work contributes to a deeper understanding of eco-epidemiology and its practical applications in ecological conservation and disease management. It sheds light on the critical role of the infection-age distribution among initial infectives, which can significantly impact population dynamics. The research offers a unique perspective on the interplay of diseases in predator-prey systems and their broader ecological implications. . . .

Keywords:

disease transmission, susceptible prey, density-dependent mortality, infection-age, species extinction.

Experimental and Parametric study of friction stir welding in similar and dissimilar metals Paper ID: 292

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Friction Stir Welding (FSW) is a solid-state metals joining method used to weld similar or dissimilar materials. Compared to the conventional fusion welding methods, this FSW can produce joints with excellent mechanical, metallurgical and corrosion resistance properties with minimum heat-affected zone (HAZ). In this welding technique, a tool is rotated between the parts to be welded. Sufficient heat is generated by the friction created by the rotation of the tool to achieve the plastic state of the parts to be welded. A linear feed motion is imparted to either the workpiece or the tool to achieve a continuous weld. The quality of the weld depends on several process parameters, such as the profile of the tool, the rotational speed of the tool, the feed rate, etc. In present study, both homogeneous (aluminium alloy to aluminium alloy) and heterogeneous (aluminium alloy to MS) welding to be performed through Friction Stir Welding (FSW). Several welding parameters such as – Tensile strength, Toughness, Hardness, welding Temperature to be noted to understand the properties of weld at different variations of welding parameters.

Keywords: friction stir welding, heat-affected zone (HAZ), tool profile, rotational speed, feed rate, homogeneous welding, heterogeneous welding, tensile strength, toughness, hardness etc.

Modelling transdermal drug delivery and its binding in tissue using microneedles

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A dynamic mathematical model is developed for the distribution of drug transdermally employing microneedles (MNs) in a monolayer skin along with compartments for blood and tissue. The drug diffuses throughout the viable skin and is absorbed in the blood compartment after being released from the MN tip. It then binds to the specific receptors after being absorbed in the tissue compartment. The model under consideration is appropriately formulated by a partial differential equation and a set of linear, non-homogeneous ordinary differential equations. The model equations along with appropriate initial and boundary conditions are solved analytically. The effect of metabolism on viable skin can not be ruled out in the present investigation. The effect of various factors, like, the MN length and the area of the skin-blood interface, etc. along with various transport properties of drug-using MNs should be accurately predicted to optimise the design of the MN array. Our results are in excellent agreement with the existing results available in the literature.

Paper ID: 298

Keywords: drug transdermally, microneedles, boundary conditions.

Analyzing Crude Oil Price Fluctuations: A Fractal Perspective

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This research article provides a comprehensive examination of crude oil price fluctuations using a novel approach that integrates fractal regression functions and fractal dimension analysis. The fractal regression analysis is currently elaborated method for time series analysis that has been effectively employed in various real-world applications. This approach involves creating a specialized fractal function for a given dataset, enabling the calculation of directional coefficients (indicating tenacity) and fractal coefficients (indicating fluctuations). By leveraging these coefficients, this paper proposed the reconstruction of West Texas Intermediate of crude oil prices in Fractal Regression Function model. Based on the scaling factor, this paper studies the fluctuation characteristics of the crude oil West Texas Intermediate prices. This paper demonstrates that crude oil prices possess fractal characteristics by fractal dimension of fractal regression function analyses on the basis of the monthly yield series.

Paper ID: 299

Keywords: Iterated Function System, Fractal Regression Function, Scaling Coefficients, Hurst Exponent, Fractal Dimension.

Propagation of two-soliton in a compressible hyperelastic rod

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The research delves into investigating the propagation of two-soliton in a compressible hyperelastic rods in the framework of the KdV equation. Using suitable transformation, the KdV equation is transformed to the standard KdV equation. By utilizing the Hirota bilinear method, the two-soliton solution of the KdV equation is obtained. Time evaluation of the propagation of two-soliton are plotted. Effect of various parameters on the two soliton solution are also investigated. Phase shift and their variation for different parameter values are also presented.

Paper ID: 300

Keywords: KdV Equation, Hirota Bilinear Method, Bilinier form, Phase Shift.

Generation of lump solitons structures in complex plasma media with superthermal electrons

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Lump soliton structures in a magnetized dusty plasma with electrons featuring superthermal distribution have been investigated. Canonical Kadomstev-Petviashvili (KP) equations have been derived from the uid hydrodynamical model equations by employing the reductive perturbation technique (RPT). Using Hirota bilinear method, we have derived lump soliton solutions by constructing appropriate bilinear form due to KP equations. Three sets of lump soliton solutions have been obtained. It has been shown that the lump solitons structures as well as in the one-dimensional form of lump soliton are varied with associated parameters of the plasma system. During the analysis of the features of the lump solitons, it is found that the superthermal parameter plays a crucial role in the lump solitons structures. The superthermal spectral index (κ) directly alters the amplitude of lump solitons. Destruction in oceanography, nonlinear optical fibers, plasmas, ferrite magnetic material, uid dynamics and atmosphere, microwave oscillation, and

Paper ID: 302

Keywords: Lump solitons; Nonlinear structures; KP equation; Superthermal electrons; Dusty Plasma.

nancial systems can be controlled by amplifying signals with the help of lump solitons solutions.

Null controllability results for fractional dynamical systems

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In this paper, we investigate the null controllability of fractional dynamical systems in finite dimensional framework. The fractional derivative used in the equations are in the Caputo sense with order $0 < \beta < 1$. The controllability results are proved using Gramian matrices and the controllability of the corresponding linear system. Two examples are provided to illustrate the theoretical findings.

Paper ID: 303

Keywords: null controllability, fractional dynamical system, Gramian matrix, Mittag-Leffler function

Wave Solutions of Nonlinear Landau-Ginsburg-Higgs Equation by using $(\frac{G'}{G})$ Method

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In this paper, the exact solution of nonlinear Landau-Ginsburg-Higgs (LGH) equation is studied by using $(\frac{G'}{G})$ -expansion method. When the corresponding second-order nonlinear ordinary differential equation (ODE) is transformed into a solved first-order nonlinear ODE by the nonlinear partial differential, new exact travelling wave solutions are identified. The nature of the solutions of LGH equation is hyperbolic and trigonometrically which satisfies the equation. All the calculations have been performed by using the Maple software.

Paper ID: 306

Keywords: Landau-Ginsburg-Higgs Equations, Traveling Wave Solutions, $(\frac{G'}{G})$ -expansion Method, Partial Differential Equation.

SNR Estimation for Hypercubic Signals in Rayleigh Channels

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This paper examines unbiased Non-Data-Aided (NDA) Signal- to-Noise Ratio (SNR) estimation for hyper-cubic modulated signals in Additive White Rayleigh Noise (AWRN) channels. We investigate the Cramér-Rao Lower Bound (CRLB) derivation, noting sensitivity to hyper-cubic constellation dimensions at low SNR. At higher SNR, we identify a unified behavior between multi-order square-QAM and hyper-cubic constellations, yielding a closed-form CRLB expression. Higher dimensions in hyper-cubic constellations increase the CRLB, mitigated by augmenting observations for improved precision. This study offers insights into optimizing SNR estimation precision across signal environments.

Paper ID: 307

Keywords: SNR estimation, Hypercubic signals, Rayleigh channels, Non-Data- Aided (NDA), Cramér-Rao Lower Bound (CRLB), Constellation dimensions, Additive White Rayleigh Noise (AWRN), Multi-order square-QAM, Estimation precision, Signal environments

Vehicle Detection with Number Plate Recognition

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The Vehicle Detection and Number Plate Recognition System (VDNPRS) emerges as a ground-breaking technological integration, seamlessly amalgamating computer vision, Artificial Intelligence (AI), and transportation management. Positioned as a solution to the escalating challenges presented by surging traffic congestion, VDNPRS not only optimizes traffic management but also significantly enhances road safety and security. This paper provides a detailed exploration of VDNPRS, delving into its core functionalities, ethical considerations, and real-world impact, with a particular emphasis on its substantial contribution to the continual evolution of road safety and security in our dynamic society. The technological underpinnings of VDNPRS, driven by computer vision algorithms and AI, are thoroughly examined to unravel its role in alleviating traffic congestion challenges. Ethical dimensions, including privacy concerns and responsible usage, take center stage, reflecting a commitment to aligning VDNPRS with societal values. Real-world applications are scrutinized through specific instances and case studies, highlighting the system’s practical contributions to road safety, traffic flow optimization, and law enforcement support. As technology evolves, the report anticipates the continued impact of VDNPRS in shaping the future landscape of transportation and security.

Keywords: VDNPRS, Vehicle Detection, Optical Character Recognition (OCR), Classification.

Time Domain analysis of vibration isolator using Newmark method along with Newton Raphson method

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The vibration isolator plays a very crucial role in the mitigation of vibration and is used in a wide range of applications. In the present work, the sandwich circular panel along with the spring is considered as a vibration isolator. The sandwich circular panel comprises metal and viscoelastic material. The sandwich circular panel introduces passive damping in the system. The viscoelastic material used in the sandwich panel is modelled by the four-parameter fractional order derivative (FOD) material model. The non-linear FE model is developed to characterize the dynamic behaviour of the isolator based on the (FOD) constitutive relation. The non-linear FE model is coupled with the Newmark time integration method and then, solved by the Newton-Raphson method. In the present FE model, the tangent stiffness matrix includes the effect of anelastic strain history. The dynamic response of the vibration isolator is studied under the external harmonic force excitation. Also, the effect of varying thickness of the viscoelastic core on the performance of the isolator is analysed.

Keywords: Four-parameter fractional order derivative model, Newmark method, vibration isolator, passive damping.

Performance Analysis of Discrete Wavelet Transforms for Acoustic Scene Classification with DCASE Dataset Paper ID: 315

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To control the chaos during an acoustic scene, it is crucial to recognize each particular sound class in the surrounding. This paper discusses the development of a model for acoustic scene classification, incorporating Fast Dynamic Time Warping (DTW) and reference audio. The main goal of the model is to correctly classify various sounds that are produced in environments, including airport, metro stations, parks, public square, bus etc. The model successfully identifies similarities across the extensive dataset of 23035 audio samples gathered from the Detection and Classification of Acoustic Scenes and Events (DCASE) 2021 Challenge Task 1 by employing the Fast DTW approach. In light of the significance of handling extensive audio data, the integration of reference audio diminishes processing complexity. Additionally, the suggested model investigates the effectiveness of features from several Discrete Wavelet Transforms, including Meyer, Symlets, and Daubechies, to improve classification accuracy. The acquired results, which demonstrate the model's efficacy and breakthroughs in acoustic scene classification, are compared with the DCASE 2021 baseline model and other technical papers presented in the same year. With the Meyer wavelet characteristic of audio data, the suggested model attains an accuracy of 79.92%.

Keywords: Daubechies, Symlets, Meyer, Fast Dynamic Time Warping, Alignment Cost, Reference audio.

Exploring Nonlinear Dynamics and Support Vector Machines in Real World Problems Paper ID: 317

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This research paper delves into the synergy between nonlinear dynamics and Support Vector Machines (SVM) in the realm of machine learning. Nonlinear dynamics, characterized by complex, non-linear relationships within data, poses challenges for traditional linear models. SVM, known for its versatility in handling high-dimensional data, emerges as a promising solution to tackle the intricacies of nonlinear dynamics.

Keywords: Keywords here

Generative models as out-of-equilibrium particle systems: training of Energy-Based Models using Non-Equilibrium Thermodynamics Paper ID: 320

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Energy-based models (EBMs) are generative models rooted in principles from statistical physics that find diverse applications in unsupervised learning. The evaluation of their performance often hinges on the cross-entropy (CE), which gauges the model distribution's fidelity to the underlying data distribution. However, training EBMs using CE as the objective poses challenges due to the need to compute its gradient with respect to the model parameters, a task demanding sampling from the model distribution at each optimization step. By incorporating tools from sequential Monte-Carlo sampling, we achieved efficient computation of the gradient of CE, thereby circumventing the uncontrolled approximations present in standard contrastive divergence algorithms. Numerical experiments conducted on Gaussian mixture distributions, as well as the MNIST and CIFAR-10 datasets, provided empirical support for our theoretical findings. In this proceeding, we present and emphasize our recent results, drawing particular attention on the physical interpretation of the proposed methodology.

Keywords: Generative models, Non-Equilibrium Thermodynamics, Sequential Monte-Carlo, Jarzynski Identity, Unsupervised machine learning.

Efficacy of an encouraged arrival M/M/1 queueing system with differentiated dual vacation, balking, and feedback customers Paper ID: 322

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The efficacy of an encouraged arrival M/M/1 queueing system with differentiated dual vacation, balking, and feedback is analyzed in this study. Both service times and vacations are exponentially distributed with various mean rates. The steady-state solution is obtained by utilizing the recursive- technique. System performance metrics of the queueing model are derived. The impact of encouraged arrival in a cost-profit model is developed. Further, we show the efficacy of encouraged arrival through the simulation results.

Keywords: Encouraged arrival, recursive method, different vacations, Steady-state.

An adaptable single-server encouraged arrival, balking, and symmetric stochastic Markovian queuing system with threshold policy

Paper ID: 326

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This study examines an adaptable single-server encouraged arrival, balking, and symmetric stochastic Markovian queuing system. We have first time introduced encouraged arrival and balking for this model. By employing a technique that allows the service to be a symmetric stochastic Markovian queuing system, based on a threshold level of "D," either single or in batch, the server may adjust to the system size. The server serves one consumer at a time if there are fewer than 'D' consumers in the system. A group of 'D' consumers receives service from the server if the total amount of consumers in the process exceeds or is exactly equal to 'D'. The service periods are exponential, and there are different service levels for both individual and batch service operations. Whether providing services to a single or a collection of consumers, the server will break down during the repair phase. The breakdowns occur after an encouraged arrival, and the breakdown collection for single and batch services is distinct. In addition, both single-service and batch-service instances have variable repair frequencies and exponential repair periods. The steady-state probabilities for system size are derived using the probability-generating function.

Keywords: Stochastic Markovian queue, adaptable server, encouraged arrival, balking, break down.

Optimizing Performance Measures in a Finite Markovian Heterogeneous Queueing Model with Encouraged Arrival

Paper ID: 327

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In this paper, We maximize the system-size and minimize the waitingtime in a heterogeneous M/M/2/K queueing model with encouraged arrival, reversebalking and reverse reneging. The iterative method is used to obtain the stationary system-size probabilities. The average rate of reverse reneging, reverse-balking and the performance measures are obtained. Finally, we provide numerical examples and simulation results to illustrate, how the parameters of the queueing model impact the system behaviour.

Keywords: Iterative method, Heterogeneous service, Encouraged arrival, Reversebalking, Reverse reneging.

Analytical Study of the Vibration Effects Due to Nonlinear Unbalanced Magnetic Pull in Electrical Machines under Static Eccentricity

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Electrical machines find extensive applications across domestic, commercial, and particularly industrial settings, including their use in Electric Vehicles (EVs). In industrial operations or EVs, these machines often operate under heavy load conditions. During their operation, various factors can lead to an un-even air gap between the rotor and stator assembly, resulting in eccentricity-related faults in induction machines. However, the Unbalanced Magnetic Pull (UMP) induced due to this asymmetric air gap has numerous adverse effects on the rotor. These effects increase vibration and noise levels within the system. Therefore, it is imperative to conduct a thorough analysis of the impact of UMP on the rotor system to comprehend the characteristics of electrical systems under such conditions. This paper focuses on investigating the influence of nonlinear UMP on the rotor in electrical systems with more than three pole pairs with axially constant static eccentricity. The analytical model is then coupled with the mechanical two degrees of freedom equation of motion to formulate and analyze the Multiphysics problem at hand. The paper also highlights the nonlinear effects of UMP by considering various system parameters and different contributing nonlinear terms. Where it is found that the UMP reduces the natural frequency of the system by introducing negative stiffness in the system. If the nonlinearity in UMP is considered it bends the response of the system towards the leftward by showing the softening characteristics which also again reduces the natural frequency of the system. The integration of nonlinear effects and the exploration of diverse system parameters contribute to a comprehensive understanding of this Multiphysics problem.

Paper ID: 330

Keywords: Eccentricity, Nonlinear Vibrations, Rotordynamics, Multiphysics, Negative Stiffness, etc.

Investigation of dust ion acoustic shock and solitary waves in a magnetised multicomponent plasma with superthermal electrons

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A significant amount of research has been directed towards the nonlinear wave propagation in dusty plasmas over the last several decades owing to the relevance it has in the interpretation of certain astrophysical phenomena. Compared to the propagation of waves in conventional plasmas, the wave propagation in dust-particle plasmas is anticipated to be drastically different. Acoustic waves may propagate in dusty plasmas in a variety of different ways, depending on the time scales at which they travel. There was an investigation of the propagation of DIA waves in a system consisting of dusty plasma with several components. The Burgers equation for the plasma system is established by the use of the Reduced perturbation approach. What is the significance of the superthermal parameter (κ), the speed of the travelling wave, and the temperature ratio in relation to the structures of dust-acoustic periodic waves and shock waves. The theoretical work that has been provided is helpful in gaining a comprehensive knowledge of the perturbations of the electrostatic field in dusty plasmas in space.

Paper ID: 331

Keywords: Burgers Equation, Kink & anti-Kink; Dusty Plasma, Reductive perturbation method.

KBM approach to the study of dust acoustic solitary waves in an electron-positron plasma with viscous dust Paper ID: 332

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The hydrodynamics of collision-less, unmagnetized viscous dusty plasma are studied with weakly relativistic electrons and positrons forming a charge-neutral background. The electrons and positrons are considered to follow the density distribution proposed by S Chandrasekhar. A KdV-Burgers equation has been derived using the Krylov-Bogoliubov-Mitropolsky perturbation technique. The solitary wave profile and the linear and nonlinear coefficients are analyzed numerically. abstract here

Keywords: SolitaryWaves, KdV-Burgers equation, dusty plasma, KBM method

Cost and Durability Optimization of Metal- Sandwich Panels for Bullet Proof Armours via Explicit Dynamic Analysis Paper ID: 333

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The research paper utilizes ANSYS (Explicit Dynamics) software to conduct dynamic analysis and simulate the fracture behaviour of a low-cost armour plate under high-speed bullet impact. The study also focuses on cost optimization in the creation of the armour. Armor protection technology is vital for safeguarding individuals, vehicles, and structures from various threats and hazards. Over the years, advancements in materials, designs, and manufacturing processes have significantly enhanced the effectiveness and reliability of armour systems. The paper investigates the dynamic fracture behaviour of the armour plate and emphasizes the importance of cost optimization in its development. It leverages ANSYS (Explicit Dynamics) software for the dynamic analysis and simulation of the armour's response to high-speed bullet impact. The research underlines the crucial role of armour protection technology in enhancing safety and security against diverse threats and hazards. The application of low-cost armor technology extends beyond traditional security realms to encompass infrastructure protection and homeland security. Critical infrastructure assets, such as power plants, transportation hubs, and government buildings, are vulnerable to potential terrorist attacks and acts of sabotage. Blast-resistant barriers, vehicle checkpoints, and blast-resistant shelters utilize low-cost armor technology to mitigate the impact of explosive blasts and ballistic threats on infrastructure components. Similarly, homeland security initiatives leverage affordable armor solutions to safeguard public spaces, high-profile events, and sensitive installations against security threats. Additionally, it highlights the continuous advancements in materials, designs, and manufacturing processes that have contributed to the improved effectiveness and reliability of armour systems.

Keywords: Ansys-Explicit Dynamics, Cost Optimisation, Bullet-proof Armour, Dynamic Analysis

Physics Informed Neural Network for solution of Duffing oscillators

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Physics Informed Neural Networks (PINNs) have shown promising results for solving forward and inverse problems of dynamical systems represented as partial differential equations. Their elegant formulation enables excellent solution approximation for forward dynamics along with simultaneous system parameter identification for inverse dynamic problems. The present paper discusses the performance of PINNs to find the approximate solution of systems governed by non-linear duffing oscillators under different forcing conditions. The use of periodic and non-periodic activation functions for the neural network has been studied and compared, and it was seen that periodic activation functions had good convergence and accuracy. The PINN approach was seen to have a very good performance in approximating the solution of non linear duffing oscillators, but are limited by the spectral bias a common problem encountered by neural networks, where the high frequency components are learned much slowly than the low frequency components.

Paper ID: 337

Keywords: PINN, Nonlinear dynamics, Duffing oscillator, Spectral Bias.

Parameters optimization of a hydraulically intercon-nected suspension in a stretcher using Genetic Algorithm

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Changes in acceleration and manoeuvring during ambulance operations can lead to the stretcher becoming unstable. Furthermore, the patient's condition can be worsened by the vibration created by uneven roadways, which can lead to nausea. Therefore, this research attempts to control the ambulance stretcher vertical vibration, roll and pitch acceleration by Pitch Roll Intercon-nected Hydraulic Suspension (PRIHS) system. To evaluate the effectiveness of a PRIHS system, a 14 Degree of Freedom (DOF) ambulance vehicle with an anti-roll bar and a 3 DOF ambulance stretcher were used. Additionally, a Genetic Algorithm (GA) based optimization was attempted to find the optimal settings for a PRIHS system. The AMEsim platform was used to build and test an ambulance vehicle model equipped with a stretcher. The model was tested on ISO 8608 D class road roughness to assess its pitch resistance, roll resistance, and ride comfort level of the ambulance stretcher. From the simulation results, the PRIHS has significantly improved the stretcher's ride comfort, roll stability, and pitch stability compared to the standalone system. The GA-optimized PRIHS system enhanced the stretcher's ride comfort, roll stability, and pitch stability by 36.86%, 33.65%, and 10.44%, respectively, compared to the PRIHS.

Paper ID: 338

Keywords: Hydraulically interconnected suspension, ambulance stretcher, D class road roughness, roll-resistant, pitch-resistant and ride comfort.

Wavelet Scattering Operators for Multiscale Processes: the Case Study of Marine Mammal Vocalizations

Paper ID: 340

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Marine mammals vocalization pose challenges in understanding animal communication due to signal diversity and environmental factors. Researchers leverage machine learning (ML) to characterize vocalizations, monitor movements, and enhance comprehension of vocalizations. The Watkins Marine Mammal Sound Database, a crucial resource, spans decades but poses challenges for ML classification. Addressing interpretability issues in deep learning, we employ the Wavelet Scattering Transform (WST), offering invariance and stability. WST's application to this dataset contributes to understanding complex natural sounds. Our study presents a statistical analysis using WST, emphasizing class dispersion, demonstrating high accuracy compared to existing pre-processing methods.

Keywords: Signal Processing, Machine Learning, Invariant Representation Operators, Mammals Vocalization

Outer Heliosphere and Interstellar Medium: investigation on the signal fluctuations collected by Voyager probes

Paper ID: 341

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The following article analyses deep-space data recorded by the Voyager 1 and Voyager 2 probes, covering the period between January 1, 2016, and December 31, 2020. Based on the available data, the investigation aims to contribute to predicting the future trends, with the goal of identifying the positions of the probes within the Interstellar Medium. The project begins by examining the current state of the probes, including their positions and the paths they have reached. The data are contextualized through estimates of different regions of the Interstellar Medium found in the literature, based on energy conservation law calculations. Two methods of analysis are employed: the Fluctuation Theory, which examines the oscillations of variables over time, and a simple Fourier interpolation, which allows for the Fourier Transform of the signal into a function of frequency and thus, the power of the signal.

Keywords: Deep-space, nonequilibrium Fluctuations, Probability.

Propagation of ion acoustic solitons around the critical values in weakly relativistic unmagnetized plasmas having nonthermal distributed electrons and positrons

Paper ID: 348

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In this article, an unmagnetized relativistic plasma consisting of relativistic warm ion fluids and nonthermal electrons as well as positrons is considered to report the nonlinear propagation characteristics of ion acoustic solitons (IASs) around the critical values (CVs) of a specific plasma parameter. To do so, the modified Korteweg-de Vries equation (mKdVE) involving electrostatic potential along with the existence of CVs is derived. With the consideration of parametric values of the plasma parameters within the proper ranges, the effects of parameters on the nonlinear electrostatic soliton propagation around CVs are reported.

Keywords:

Electron-positron-ion plasmas, Soliton, Critical Values, Weakly relativistic effect.

Comparative study of small amplitude dust ion acoustic Korteweg-de Vries and modified Korteweg-de Vries solitons in a dusty plasma with weak relativistic electrons

Paper ID: 349

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In the present theoretical investigation of a multicomponent dusty plasma consisting of non-thermal ions, weakly relativistic electrons and mobile dust particles, reductive perturbation technique is adopted to derive Korteweg-de Vries (KdV) equation and modified Korteweg-de Vries (mKdV) equation of cubic nonlinearity. Initial streaming of various plasma species (ions, weakly relativistic electrons, dust particles) in the formation of compressive and rarefactive relativistic DIA-KdV solitons and compressive relativistic DIA-mKdV solitons are found to play crucial role. Amplitudes of compressive relativistic DIA-mKdV solitons are found to be smaller than that of compressive and rarefactive relativistic DIA-KdV solitons for the same set of parameters, which is a salient feature of this investigation. Non-existence region of compressive relativistic DIA-mKdV solitons for some initial streaming of ions as well as weakly relativistic electrons are found to exist. mobile dusts, solitary waves, compressive and rarefactive solitons

Keywords:

mobile dusts, solitary waves, compressive and rarefactive solitons.

A Study on Coarse Deg-centric Graphs of Graphs

Paper ID: 350

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The coarse deg-centric graph of a simple, connected graph G , denoted by G_{cd} , is a graph constructed from G such that $V(G_{cd}) = V(G)$ and $E(G_{cd}) = v_i v_j : d_G(v_i, v_j) > deg_G(v_i)$. In this paper, the concepts of coarse degcentric graphs and iterated coarse deg-centrication of a graph are introduced and discussed. Also presents the properties and structural characteristics of coarse deg-centric graphs of some graph families.

Keywords:

Distance, eccentricity, deg-centric graphs, coarse deg-centric graphs, coarse deg-centrication process.

Nonlinear propagation of ion acoustic soliton in a magnetized three component relativistic plasma

Paper ID: 352

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This work investigates the nonlinear obliquely propagating ion-acoustic solitons (IASs) by proposing a magnetized rotating relativistic plasma environment having relativistic ion fluids and non-extensive electrons as well as positrons. The Korteweg-de Vries equation (KdVE) involving potential function is derived by using the conventional reductive perturbation method for analyzing such wave phenomena. The effect of plasma parameters on the amplitude and width of IASs has been discussed with the consideration of relativistic Lorentz factor (RLF) up to eleven terms for the first time. It is observed that the RLF up to eleven terms and obliqueness are significantly modified the propagation characteristics of IASs in the considered plasma environment.

Keywords:

Electron-positron-ion magnetized plasmas, Soliton, Relativistic effect, Korteweg-de Vries equation.

PDEs for anomalous transport and applications

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Anomalous diffusion is ubiquitous in nature and relevant for a wide range of applications, especially in bio- and nano-technologies. Numerous approaches have been developed to describe it from a microscopic point of view and, recently, it has been framed within universality classes, characterized by the behaviour of the moments and auto-correlation functions of the transported quantities. It is important to investigate whether such universality applies to macroscopic models. In this talk, the spectrum of the moments of the solutions of the transport equations is investigated for three continuous PDE models featuring anomalous diffusion. In particular, we consider the transport described by: (i) a generalized diffusion equation with time-dependent diffusion coefficient; (ii) the Porous Medium Equation and (iii) the Telegrapher Equation. Equivalence of the asymptotic behaviour of the corresponding transport is confirmed within the realm of weak anomalous diffusion. Finally, an application of the aforementioned models to a nanotechnology problem is presented.

Paper ID: 353

Keywords:

Anomalous diffusion, transport equations, Telegrapher Equation.

Superperiodic and periodic waves in a magnetized electron-positron-ion quantum plasma under the KP and the mKP equation

Paper ID: 354

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The Kadomtsev-Petviashvili (KP) equation and modified Kadomtsev-Petviashvili (mKP) equation is pivotal in analyzing nonlinear wave phenomena, particularly in plasma physics. Dubinov et al. [1] revealed the existence of super-nonlinear waves, distinguished by unique phase plot topologies and significantly larger amplitudes. Research has increasingly employed the quantum hydrodynamic (QHD) model to study wave propagation in quantum plasma mediums. Correctly adjusting the Bohm potential within the QHD model is crucial, as discussed by Moldabekov et al. [2, 3]. This work investigates nonlinear and super-nonlinear waves in electron-positron-ion quantum plasma under the KP and mKP equations using the latest prefactor of Bohm potential in the QHD model, aiming to advance our understanding of plasma physics and quantum plasmas.

Keywords:

Reductive perturbation technique, Planar dynamical system, Bifurcation theory.

Non-linear velocity effects on the flow of Newtonian/non-Newtonian basefluids with magnetic/non-magnetic nanoparticles over a stretching sheet embedded in a porous medium

Paper ID: 357

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This article introduces a numerical approach aimed at simulating the influence of nonlinear velocity on the flow of Newtonian/non-Newtonian fluids containing magnetic/non-magnetic nanoparticles. The flow is driven by a stretching sheet placed in a porous medium. Specifically, we examine the behavior of magnetite and aluminium oxide nanoparticles, categorized as magnetic and non-magnetic respectively, suspended in two types of base fluids: Water and Sodium Alginate. To ensure physical relevance, we investigate non-Newtonian profiles using the Casson model separately. Initially, the proposed model is transformed into dimensionless form using similarity transformation and then solved using the fourth-order Runge-Kutta method with a shooting iteration technique. Through graphical representations, we elucidate the dynamic effects of various parameters on velocity and temperature distributions. The results indicate that the velocity profile increases with the shape parameter, and the porosity parameter enhances the temperature profile. Moreover, skin friction is higher for non-magnetic nanoparticles with a Newtonian base fluid, while the rate of heat transfer is greater for non-magnetic nanoparticles with a non-Newtonian base fluid.

Keywords: Non-linear velocity, Newtonian, non-Newtonian, magnetic, non-magnetic, porous medium