POPULAR SCIENCE TALK SERIES – I
A Report

The Centre for Excellence in Mathematical Biology (CEMB) at Sri Sathya Sai Institute of Higher Learning (SSSIHL) organized a series of online talks titled "Popular Talk Series – I in Mathematical Biology" from June 2024 to January 2025. These sessions were held on the first Friday of each month from 3:00 PM to 4:00 PM IST, focusing on topics such as Mathematical Ecology, Epidemiology, AI/ML in Healthcare, and Bioinformatics.

Structure and Schedule

The series was coordinated by Dr. Darshan Gera from the Department of Mathematics & Computer Science and Dr. K. N. Naresh from the Department of Biosciences at SSSIHL. This initiative aligned with CEMB's mission to enhance national capacity in Infectious Disease Modeling and Mathematical Biology, aiming to leverage mathematical innovation for societal benefit, particularly in developing advanced solutions for public health.

By equipping participants with essential skills and knowledge, it aimed to foster confidence and competence in these cutting-edge domains of Mathematical Biology. The program was structured and focused on a specific theme, gradually building participants' knowledge and skills.

Event: Popular Talk Series – I in Mathematical Biology

Organizer: The Centre for Excellence in Mathematical Biology (CEMB), Sri Sathya Sai Institute of Higher Learning (SSSIHL)

Time: 3:00 PM – 4:00 PM IST

Mode: Online

Speaker: Dr. Mohit Kumar Jolly, Centre for BioSystems Science and Engineering (BSSE), IISc Bangalore

Date: June 7, 2024

Speaker Bio

Dr. Mohit Kumar Jolly is an Associate Professor in Bioengineering at IISc Bangalore. He holds a Bachelors and Masters in Bioengineering from IIT Kanpur and a PhD from Rice University, Texas, USA. Before joining IISc in 2018, he conducted extensive research in computational models of cancer progression. His work in the physics of cancer has received global recognition. He has been honored with prestigious awards, including:

- ICTP Prize 2023 (International Center for Theoretical Physics)
- IIT Kanpur Young Alumni Award (2022)
- Rice University Outstanding Young Alumni Award (2024)

Dr. Jolly also serves as the Editor-in-Chief of NPJ Systems Biology and Applications and continues to lead research that bridges mathematical modeling and cancer biology.

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Talk Title: "What does not kill cancer can make it stronger: Investigating cancer as a complex system"

Abstract

Despite significant advancements in cancer research over the past few decades, cancer remains a major global health challenge, causing millions of deaths annually. Dr. Mohit Kumar Jolly's talk focused on two critical processes that contribute to the difficulty in treating cancer:

- The ability of cancer cells to metastasize (spread from one organ to another)
- The ability of cancer cells to adapt when exposed to various therapies

These processes are driven by a complex network of molecular interactions within a cell and between tumor cells and their surrounding environment. Dr. Jolly discussed how quantitative mathematical models, when integrated with experimental and clinical data, can help decipher the underlying mechanisms of these processes. His research emphasizes how metastasis and treatment resistance can mutually reinforce each other, potentially worsening the disease over time.

Dr. Jolly also introduced the concept of creating 'digital twins' of cancer progression. These computational models aim to simulate and predict cancer behavior, enabling the identification of novel treatment strategies that could improve patient outcomes. The interdisciplinary approach of combining mathematical modeling with biological and clinical insights is crucial for advancing the fight against cancer.

Conclusion

Dr. Jolly's talk provided valuable insights into how mathematical models can be leveraged to better understand cancer progression and treatment resistance. His research underscores the importance of interdisciplinary collaboration in developing innovative strategies for cancer therapy. The session was well-received, engaging attendees in discussions about the future of mathematical biology in healthcare.

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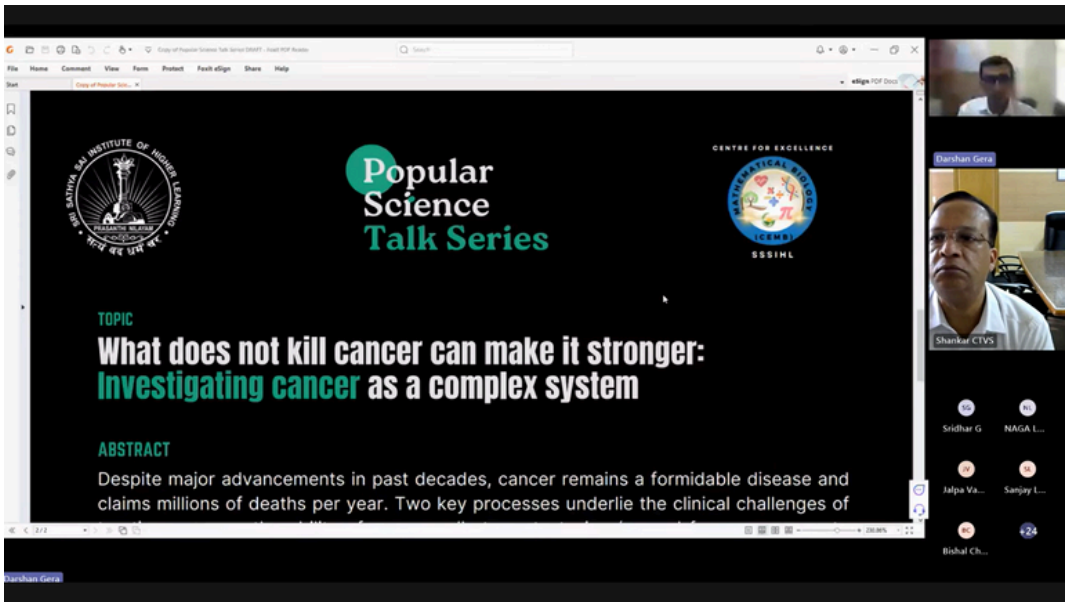

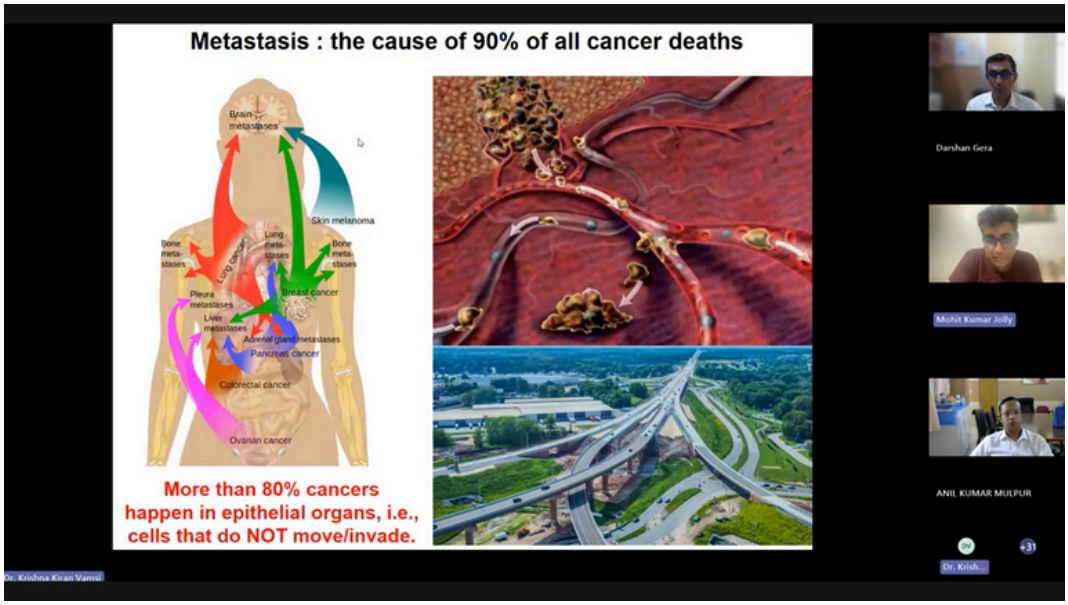

POPULAR SCIENCE TALK SERIES – I
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Speaker: Dr. Ananth Vedururu Srinivas, LSU Health, New Orleans, USA

Date: July 5, 2024

Speaker Bio

Dr. Ananth Vedururu Srinivas is a Postdoctoral Fellow working in Computational Neuroscience at LSU Health Sciences Center, New Orleans, USA. He earned his bachelor's, master's, and Ph.D. from SSSIHL. Since moving to the US in 2022, he has been working with Dr. Carmen C. Canavier on theoretical and computational modeling of neurons in the medial Entorhinal cortex, collaborating with experimentalists from Boston University.

During his Ph.D., he worked on prey-predator dynamics and optimal control problems. He was also involved with optimal control aspects of COVID-19 within host models studied by the mathematical modeling group at SSSIHL. Notably, he is the first graduate from the Mathematical Modeling group at SSSIHL, which laid the foundation for CEMB today.

Dr. Srinivas has received multiple accolades, including the academic gold medal and the Sathya Sai All-rounder gold medal during his bachelor's. He was also awarded the CSIR Direct Senior Research Fellowship during his research at SSSIHL.

Talk Title: "Bifurcations in the Brain: Exploring Neurons as Dynamical Systems"

Abstract

The brain is one of the most complex organs in the human body. Despite significant advancements in neuroscience, many aspects of its function and structure remain poorly understood. Researchers continue to uncover new insights, but the intricate nature of neural networks and brain activity presents ongoing challenges.

Neurons, the fundamental units of the brain, are excitable cells that exhibit complex electrical activities, which can be modeled and understood through the principles of dynamical systems. In this talk, Dr. Srinivas provided an overview of how the field of computational neuroscience evolved from the pioneering neuron model by Hodgkin and Huxley to the modeling of realistic neurons as dynamical systems. Using specific examples from his lab's work on neurons in the hippocampal formation, he demonstrated how different experimentally observed spiking activities can be explained through bifurcations in dynamical systems theory.

Understanding the mechanisms of neurons in a healthy brain is crucial for developing interventions for neurological disorders characterized by abnormal firing patterns. Computational models play a vital role in shedding light on potential causes of irregular firing patterns in such disorders.

Conclusion

Dr. Srinivas's talk provided valuable insights into how dynamical systems theory can be applied to understanding neuronal activity. The session sparked engaging discussions on the role of computational models in neuroscience and their potential applications in treating neurological disorders.

POPULAR SCIENCE TALK SERIES – I
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Speaker: Dr. Jai Prakash Tripathi, Central University of Rajasthan, India

Date: August 2, 2024

Speaker Bio

Dr. Jai Prakash Tripathi is an Assistant Professor in the Department of Mathematics at the Central University of Rajasthan. He completed his Ph.D. in Mathematical Ecology from IIT Mandi in 2015. With expertise in Mathematical Ecology, Disease Modeling, and Nonlinear Dynamics, he has more than a decade of teaching and research experience.

Dr. Tripathi has published over 50 research papers in prestigious journals such as the Journal of Mathematical Biology, Chaos, Bulletin of Mathematical Biology, and Nonlinear Dynamics. He has presented his research at international conferences in Italy, South Korea, Greece, Russia, Turkey, and Kathmandu. He has also received international travel support from SMB USA, SERB India, IIT Mandi, and CURAJ.

Dr. Tripathi has been awarded three research projects, including grants from UGC (Rs. 10 Lacs), SERB ECRA (Rs. 18 Lacs), and SERB MATRICS (Rs. 6 Lacs). He has mentored multiple Ph.D. and postgraduate students, many of whom are pursuing higher studies in prestigious institutions worldwide. He is also a life member of recognized academic bodies such as the Society of Mathematical Biology (USA), the Indian Science Congress Association, the Indian Mathematical Society, and the Society of Industrial and Applied Mathematics (USA).

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Talk Title: "Understanding of Nondimensionalization via a Bacterial Growth Model: Why, How and When"

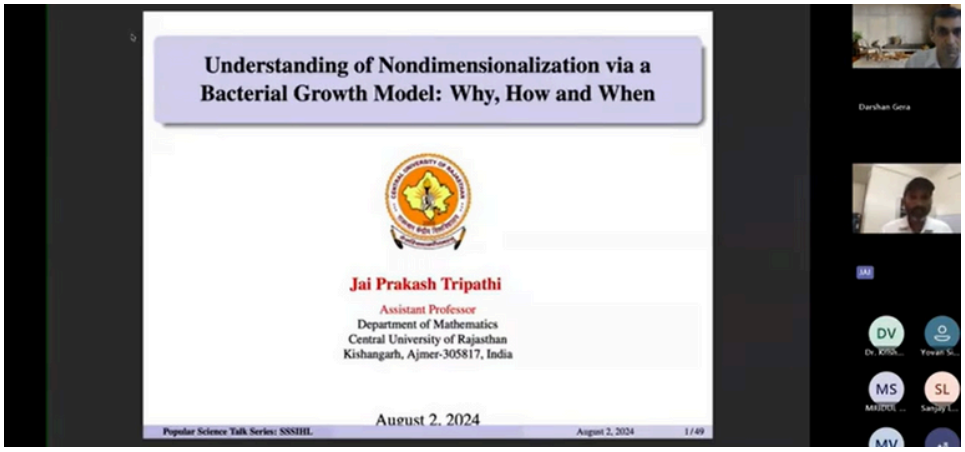
Abstract

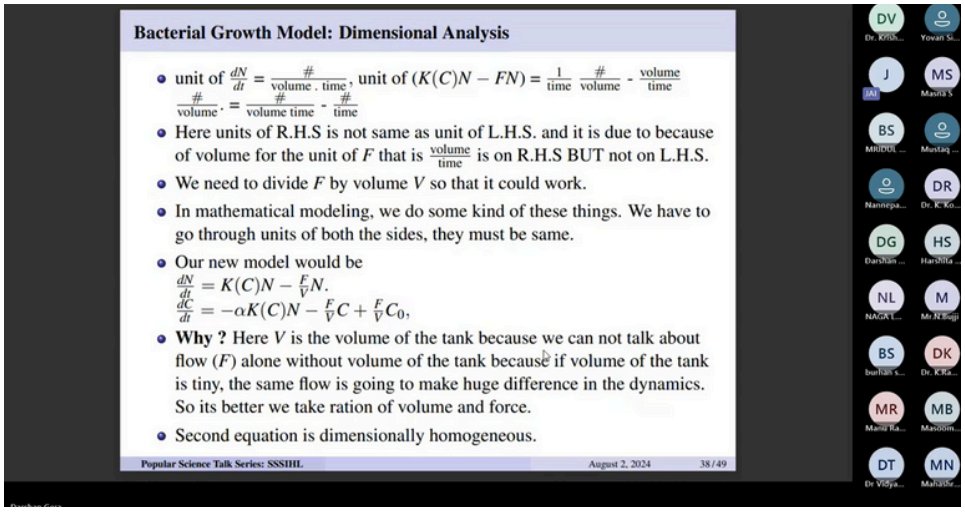
Nondimensionalization is a crucial mathematical technique used in modeling biological and physical processes. It simplifies complex models, reduces parameters, and helps in understanding the underlying dynamics effectively. In this talk, Dr. Jai Prakash Tripathi illustrated the importance of nondimensionalization through a bacterial growth model.

The session covered fundamental questions such as why nondimensionalization is necessary, how it can be systematically applied, and when it should be utilized. Dr. Tripathi demonstrated how this approach aids in reducing computational complexity and enhances model interpretation. His talk provided practical insights into mathematical modeling, especially in biological systems where different scales and parameters play a critical role.

Conclusion

Dr. Tripathi's talk provided an in-depth understanding of nondimensionalization in mathematical modeling, emphasizing its applications in biological systems. The session engaged attendees in discussions about simplifying complex models for better analysis and interpretation.





POPULAR SCIENCE TALK SERIES – I
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Speaker: Dr. B.S.R.V. Prasad, Vellore Institute of Technology, Vellore, India

Date: September 6, 2024

Speaker Bio

Dr. B.S.R.V. Prasad is a mathematician specializing in Mathematical Ecology and Biology. He earned his Ph.D. from Andhra University and left a teaching position to focus on research. His work primarily revolves around developing mathematical models to study ecological interactions, particularly prey-predator dynamics and their role in biological control and conservation.

Dr. Prasad has also contributed to interdisciplinary projects such as the Chilka Lake Ecosystem Modelling project, collaborating with zoologists to develop models for understanding biogeochemical processes in the lake. Currently an Associate Professor at the Vellore Institute of Technology, his research has been widely recognized, including the prestigious Young Scientist Project Award from DST, India, under which he executed a research project worth Rs. 10.56 Lakhs (2014–2017).

His research has been published in renowned journals, and he has actively shared his expertise through talks and presentations at international conferences. He has visited steemed institutions such as the Max Planck Institute of Evolutionary Biology in Germany and the Mathematical Biosciences Institute at Ohio State University, USA. Additionally, he has mentored several research students, contributing significantly to the field of mathematical ecology.

POPULAR SCIENCE TALK SERIES – I
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Talk Title: "Food Supplementation for Predators and Parasitoids: A Double-Edged Sword?"

Abstract

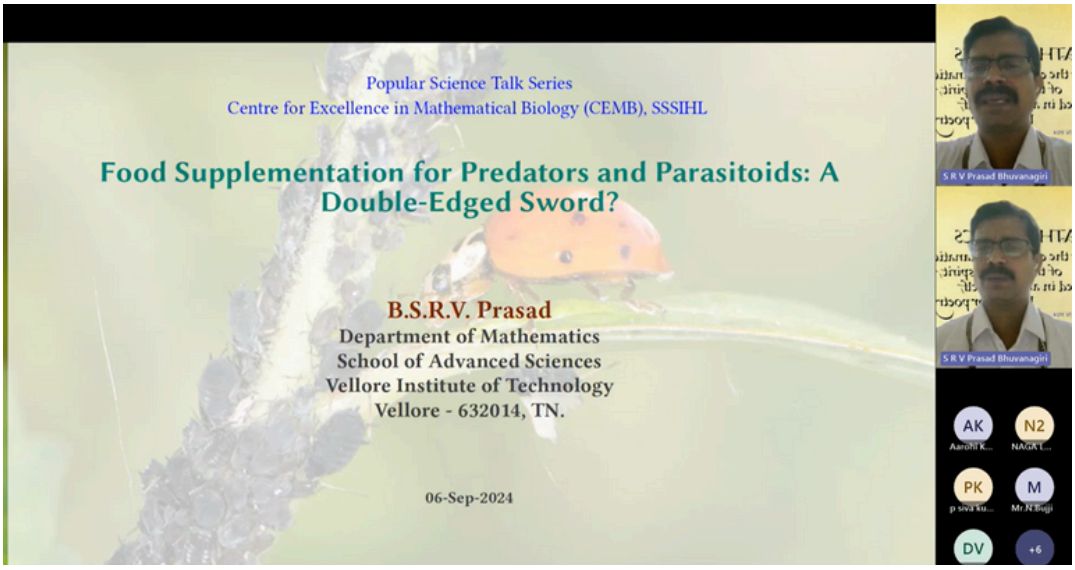
Food supplementation is a widely used ecological intervention to support predators and parasitoids, playing a crucial role in biological control and conservation efforts. However, it presents both benefits and potential drawbacks, making it a double-edged sword.

In this talk, Dr. B.S.R.V. Prasad explored the complexities of food supplementation through mathematical models, highlighting its impact on prey-predator interactions. He discussed how providing additional food resources to predators and parasitoids can enhance their survival and efficacy in controlling pest populations but may also lead to unintended consequences such as altered ecosystem dynamics or dependency on supplementary feeding.

Using insights from mathematical ecology, Dr. Prasad demonstrated various modeling approaches that help predict and analyze these ecological interactions, offering a deeper understanding of sustainable food supplementation strategies.

Conclusion

Dr. Prasad's talk provided valuable insights into the role of food supplementation in ecological systems, demonstrating how mathematical models can guide effective biological control strategies. The session fostered discussions on optimizing conservation methods while mitigating potential risks associated with supplemental feeding.



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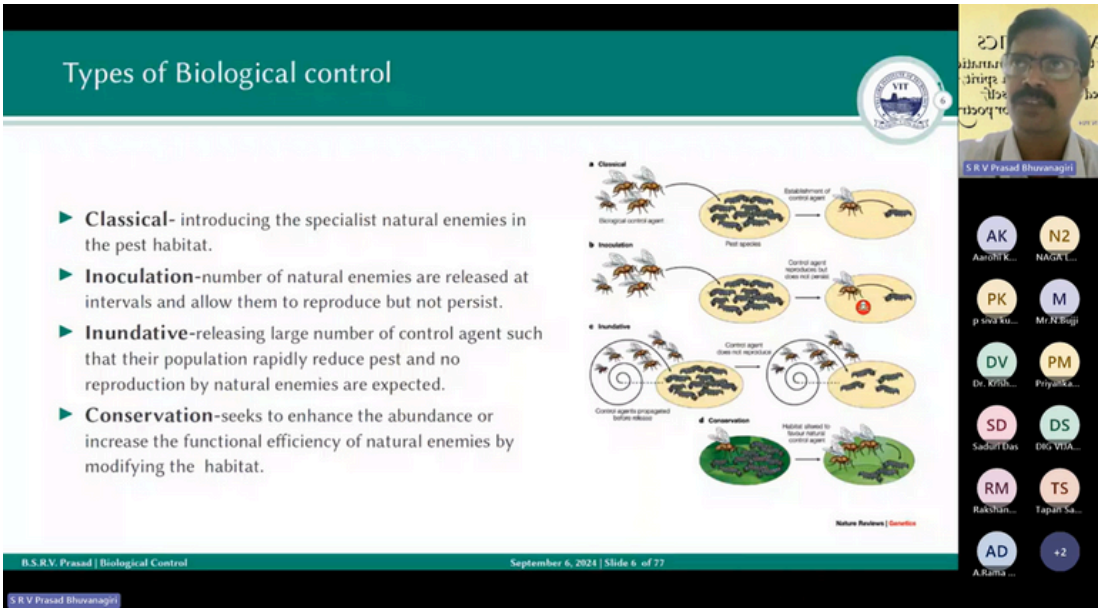

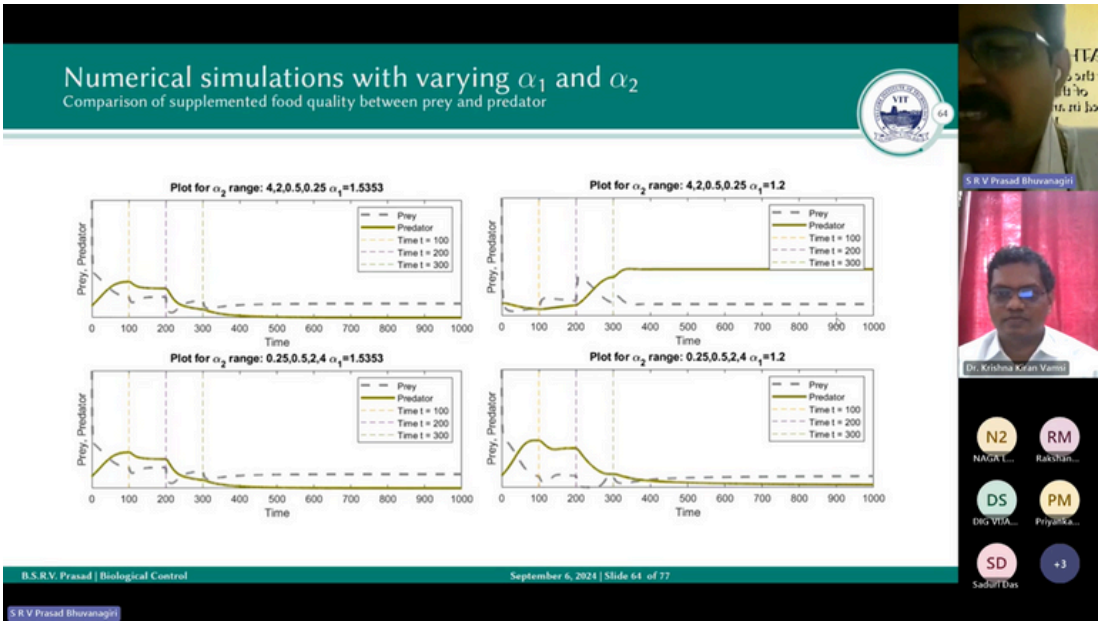

POPULAR SCIENCE TALK SERIES – I
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Speaker: Dr. Bapan Ghosh, Indian Institute of Technology, Indore, India

Date: October 4, 2024

Speaker Bio

Dr. Bapan Ghosh is an Assistant Professor in the Department of Mathematics at IIT Indore. He obtained his M.Sc. in Applied Mathematics from The University of Burdwan and completed his Ph.D. from IIEST, Shibpur, in June 2014. Before joining IIT Indore in 2019, he served as a faculty member at NIT Meghalaya from 2015 to 2019.

Dr. Ghosh's research interests include Applied Dynamical Systems and Mathematical Ecology, and he has published approximately 35 papers in international journals. He has also undertaken research visits to France, Taiwan, and Russia, further contributing to his field.

He is the recipient of multiple prestigious research grants, including the Early Career Award, MATRICS, and Core Research Grant from SERB, as well as Indo-French and Indo-Russian collaborative projects funded by IFCAM and DST, respectively. Additionally, Dr. Ghosh serves as an academic editor for several journals, including Computational and Mathematical Methods (Wiley), Discrete Dynamics in Nature and Society (Wiley), and Communication in Biomathematical Sciences (Indonesian Society of Mathematical Biology).

He has successfully supervised two Ph.D. students, with three more currently under his guidance.

Talk Title: "Fractional Order Modeling of Ecological and Epidemiological Systems: Ambiguities and Challenges"

Abstract

Fractional-order modeling has emerged as a powerful tool in studying ecological and epidemiological systems. Unlike classical integer-order models, fractional-order models allow for better representation of memory effects and long-range interactions in biological systems. However, their application comes with inherent ambiguities and challenges.

In this talk, Dr. Bapan Ghosh explored the mathematical foundations of fractional calculus and its significance in ecological and epidemiological modeling. He discussed how fractional-order derivatives can enhance the accuracy of predictive models but also pose challenges in terms of parameter estimation and computational complexity. Using case studies from his research, he highlighted practical applications of these models in real-world scenarios, such as disease spread and population dynamics.

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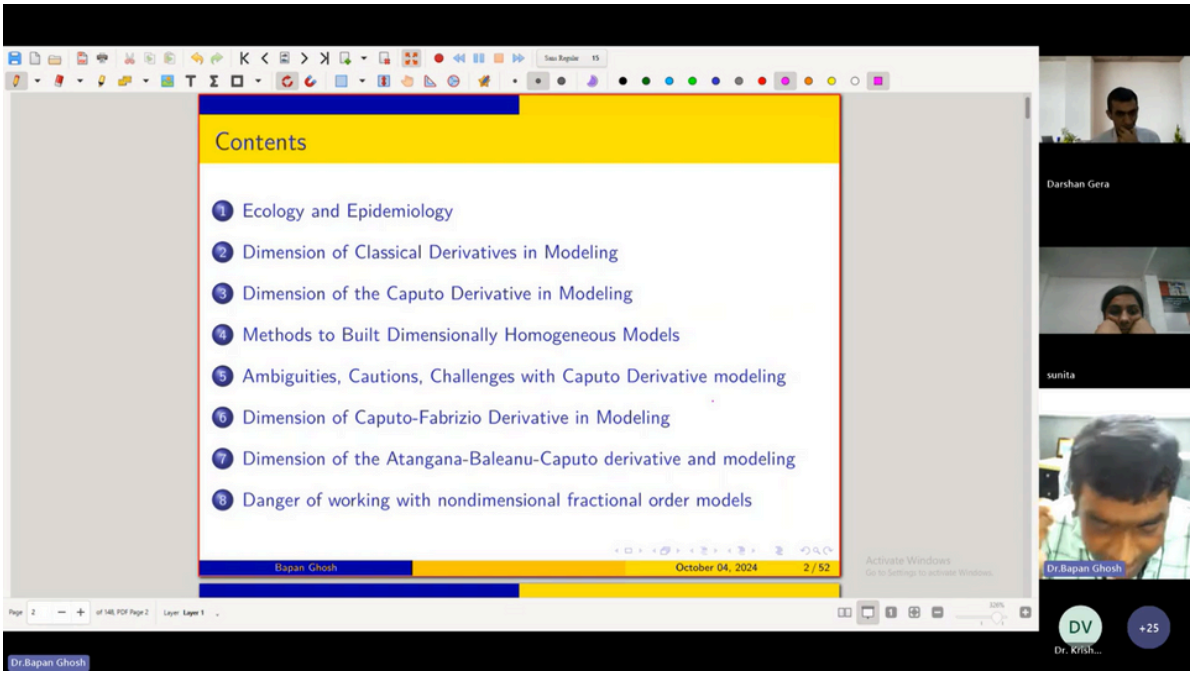
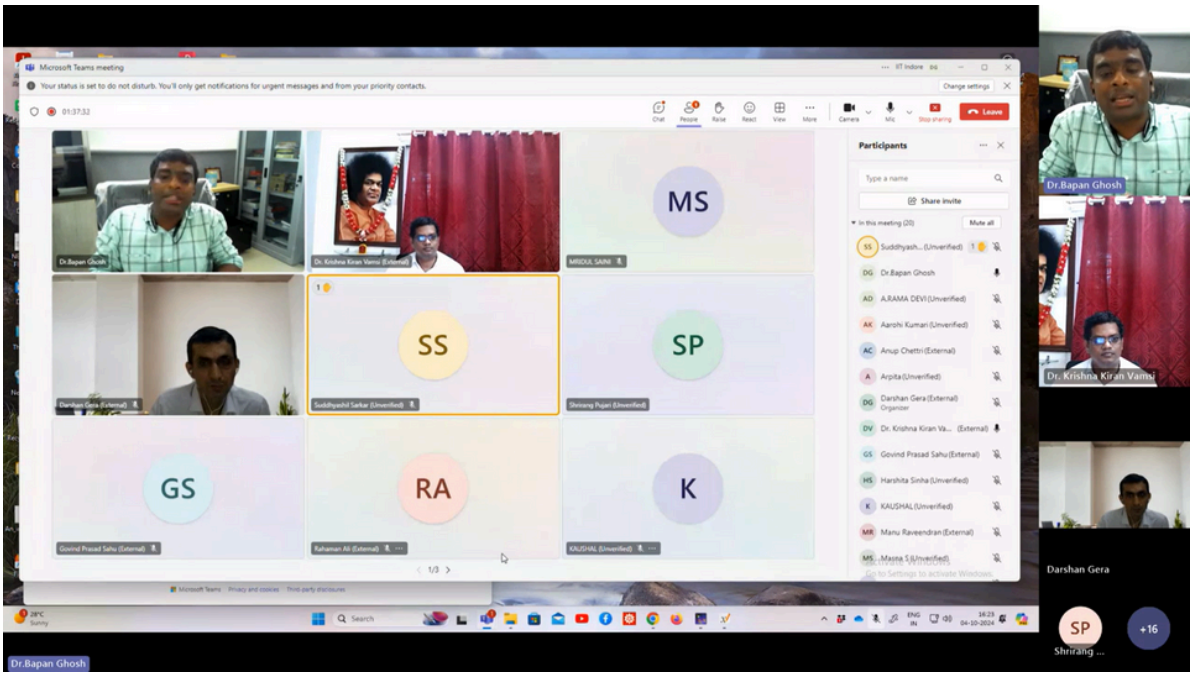
Conclusion

Dr. Ghosh's talk provided a comprehensive overview of the potential and challenges of fractional-order modeling in ecological and epidemiological contexts. His insights into the ambiguities associated with these models sparked engaging discussions among participants, furthering the understanding of their application in biological sciences.





POPULAR SCIENCE TALK SERIES – I
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Speaker: Dr. Bishal Chhetri, Indian Institute of Technology, Kanpur, India

Date: November 15, 2024

Speaker Bio

Dr. Bishal Chhetri is currently an Institute Postdoctoral Fellow at the Department of Mathematics and Statistics, IIT Kanpur. Before joining IIT Kanpur, he worked as a Research Scientist at Karkinos Healthcare Private Limited, where he collaborated with leading scientists and oncologists in the field of early cancer detection.

Dr. Chhetri earned his bachelor's, master's, and Ph.D. degrees from Sri Sathya Sai Institute of Higher Learning. His doctoral research focused on within-host, between-host, and multi-scale dynamics of COVID-19, along with optimal control problems. His expertise lies in disease modeling, mathematical oncology, and nonlinear dynamics.

Currently, his research is centered on developing stochastic mathematical models to analyze cancer progression and employing machine learning and deep learning techniques for early cancer detection and classification. His research findings have been published in prestigious journals, and he actively participates in workshops and conferences, sharing his expertise with the scientific community.

Talk Title: "Understanding Cancer Disease Using Mathematical and Machine Learning Models"

Abstract

Cancer remains one of the most significant health challenges worldwide, requiring innovative approaches to enhance early detection and treatment. Mathematical and machine learning models have shown immense potential in understanding cancer progression and optimizing treatment strategies.

In this talk, Dr. Bishal Chhetri explored how mathematical modeling and machine learning techniques can be leveraged to study cancer dynamics. He provided insights into stochastic mathematical models for cancer progression and demonstrated how deep learning algorithms can assist in early detection and classification of cancer. Drawing from his extensive research, he discussed the integration of theoretical models with real-world clinical data to improve diagnostic accuracy and treatment planning.

Conclusion

Dr. Chhetri's talk provided a compelling perspective on the role of mathematical and machine learning models in understanding and combating cancer. His discussion on integrating theoretical frameworks with practical applications sparked engaging discussions among participants, contributing to the advancement of research in mathematical oncology.

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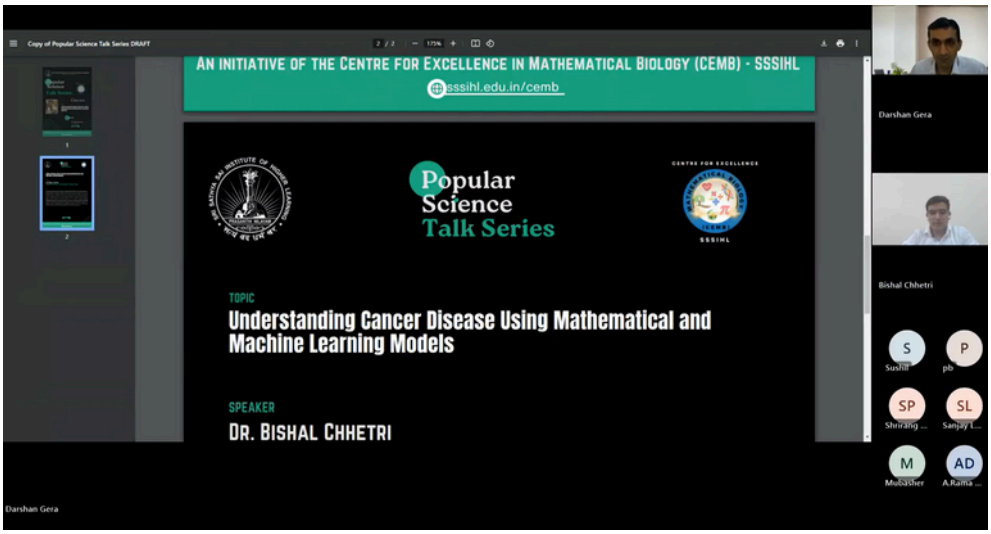

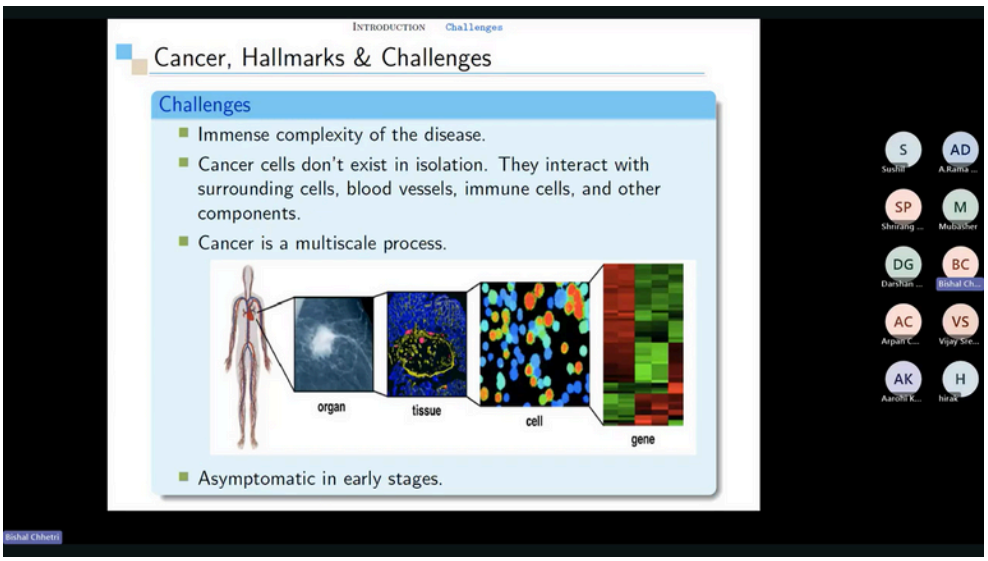

POPULAR SCIENCE TALK SERIES – I
A Report

Speaker: Prof. Mukesh Doble, Distinguished Professor, Saveetha Dental College, SIMATS, India

Date: January 30, 2025

Speaker Bio

Prof. Mukesh Doble is currently a Distinguished Professor at Saveetha Dental College, SIMATS, Founding Director of Theevanam Additives & Nutraceuts Pvt. Ltd. at IIT Madras Research Park, and a Former Professor in the Department of Biotechnology at IIT Madras. He holds B.Tech and M.Tech degrees in Chemical Engineering (IIT Madras), a Ph.D. from the University of Aston (UK), and completed postdoctoral research at the University of Cambridge (UK) and Texas A&M (USA).

With 25 years of industrial experience at Imperial Chemical Industries and General Electric Technology Centers, and 20 years in academia at IIT Madras, Prof. Doble's research interests include biomaterials, drug design, bioreactors, biopolymers, and bioprocesses. He has published over 410 technical papers (SCOPUS H-index = 65, Google Scholar H-index = 71), authored 12 books, and holds 18 granted patents. He has hosted four Swayam/NPTEL MOOC courses and is a Director of two biotechnology startups.

Prof. Doble is a Fellow of the Royal Society of Chemistry, London, and has received numerous accolades, including the Herdillia Award for Excellence in Basic Research, the Lifetime Achievement Award from the Indian Institute of Chemical Engineers, and the Dow Professor M.M. Sharma Distinguished Visiting Professorship at the Institute of Chemical Technology, Mumbai. He also received the 5th National Award for Technology Innovation in the Field of Petrochemicals and Downstream Plastic Processing Industry from the Government of India for his innovation in antimicrobial food wraps. He has been recognized among the top 2% of researchers worldwide by Stanford University for the past three years.

Talk Title: "Silk Fibroin-Based Nano Particle Drug Delivery System Targeting Mycobacterium-Infected Macrophage"

Abstract

Tuberculosis is caused by Mycobacterium tuberculosis, leading to several million deaths globally. Latent tuberculosis is associated with the formation of tubercular granulomas—3D organizations of host immune cells, predominantly alveolar macrophages (>96%). Poor penetration and distribution of anti-TB drugs within granulomas remain a significant challenge, contributing to latent TB.

In this talk, Prof. Mukesh Doble discussed a novel approach using piperine-functionalized, rifampicin-loaded silk fibroin nanoparticles as a potential drug delivery system to treat Mycobacterium smegmatis-infected macrophages. The session covered computational and in vitro studies highlighting the efficiency of this targeted drug delivery system and its potential to enhance TB treatment.

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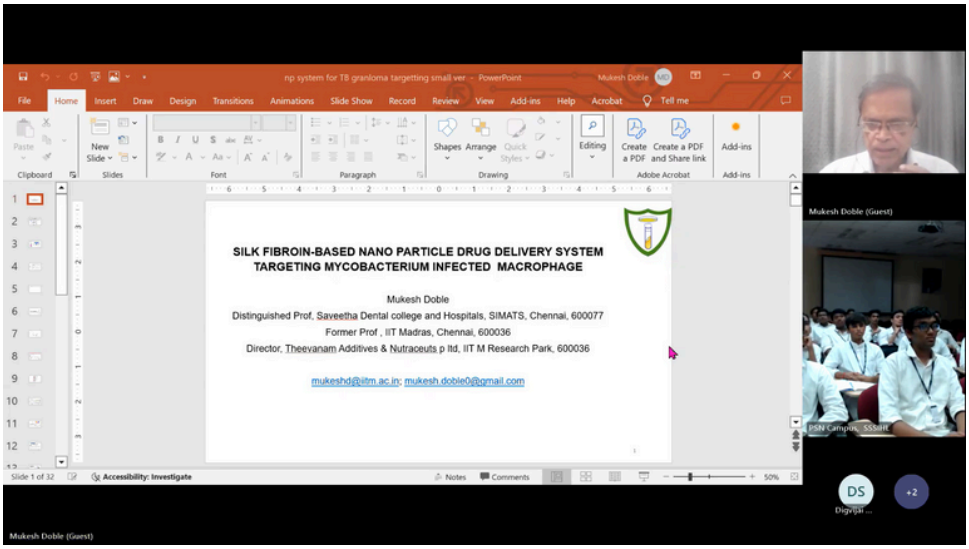
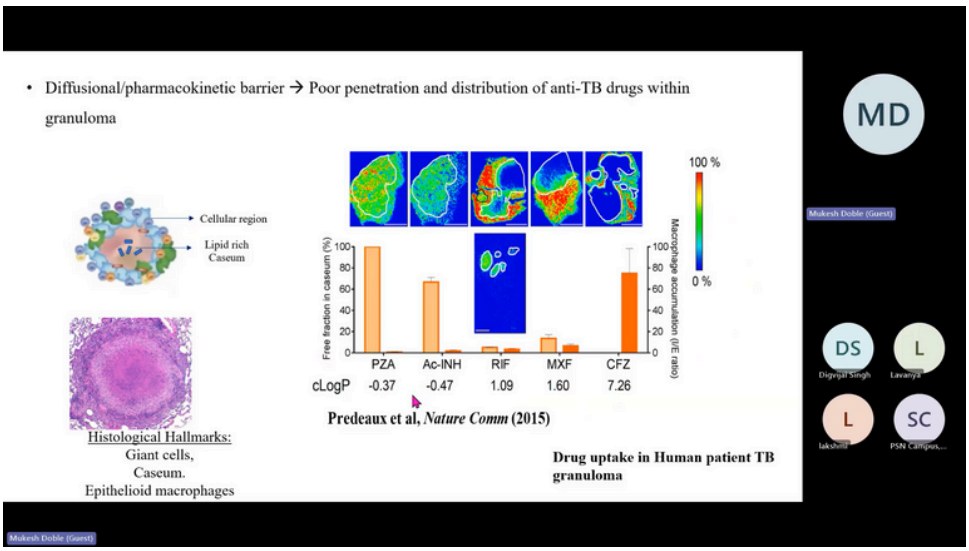
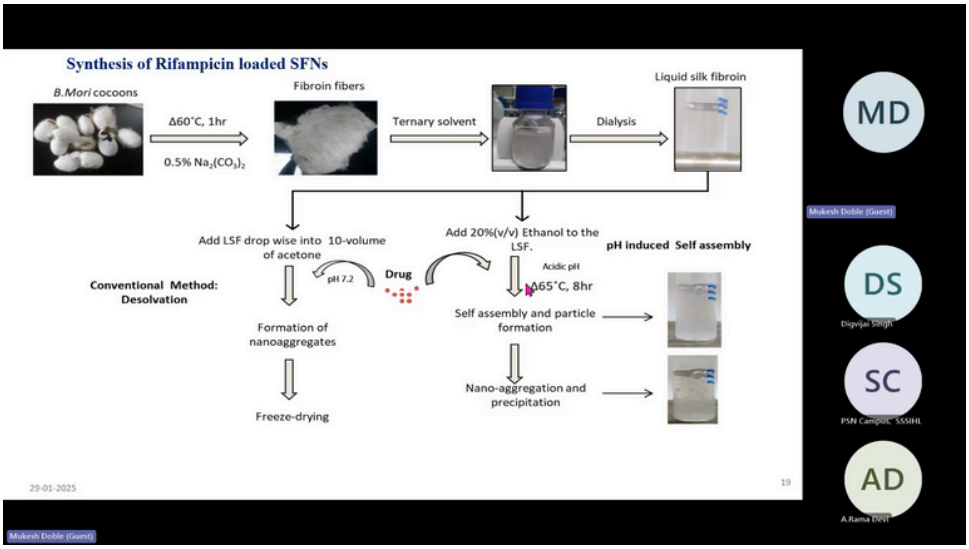
Conclusion

Prof. Doble's talk provided a groundbreaking perspective on targeted drug delivery using silk fibroin-based nanoparticles for tuberculosis treatment. His insights into integrating biomaterials with pharmaceutical applications sparked engaging discussions and offered promising directions for future research in combating infectious diseases.







POPULAR SCIENCE TALK SERIES – I
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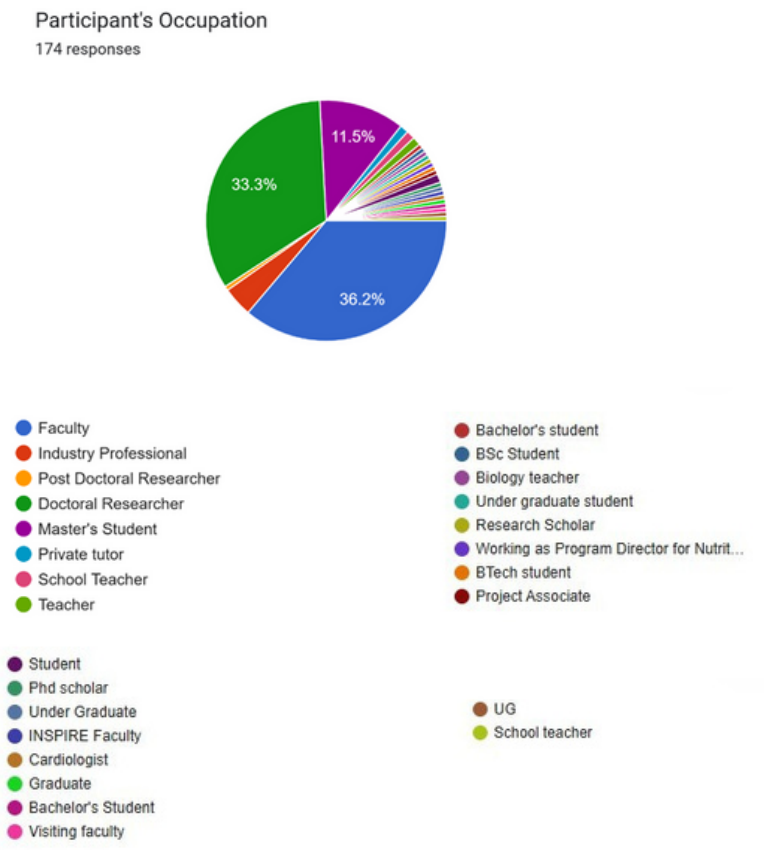
Participants Profiles for Popular Talk Series – I in Mathematical Biology -2024
Number of Participants - 174

The participants for Popular Talk Series – I in Mathematical Biology -2024 included faculty, industry professionals, post-doctoral & doctoral research scholars, post graduate and graduate students who were spread across different parts of India.



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Feedback from Participants on the Certificate Program

- Excellent, Very Good.
- Thank you for enabling this series for open. It is very good initiative and we got benefitted from this series. Hope to get more mathematical and matlab session in the upcoming series-2.
- Excellent and well organized and it's very difficult to organize this type Talk series. Thank you very much sir.
- Very Informative.
- The series is conducted in an excellent manner with eminent speakers sharing their invaluable knowledge and thoughts. And as usual SSSIHL organizers at their best. Thank you for giving me this wonderful opportunity.
- The series was beautifully conducted by SSSIHL and the speakers were very knowledgeable and very eager to spread their knowledge. Though it was an online session the time frame was properly maintained. Looking forward to get a chance to do Ph. D if given a chance so that I can increase my understanding in the subject.

Click here for
Flyer of Popular Science Talk Series - I

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