Nine Month Online Certificate Program on Infectious Disease Modeling - A Report

The Centre for Excellence in Mathematical Biology (CEMB) of Sri Sathya Sai Institute of Higher Learning (SSSIHL) has organized a nine month online Certificate Program on "***Infectious Disease Modeling***" from March - November, 2024.

This interdisciplinary online certificate program provided a comprehensive introduction to key areas of mathematical modeling and data analysis in the context of disease dynamics and ecological systems. It covered foundational topics such as infectious disease modeling, stability analysis, and bifurcation analysis, while also exploring advanced methods like delay differential equations, stochastic modeling, and AI/ML techniques. Additionally, the program introduced systems biology and emphasizes the importance of scientific communication and research ethics for effectively conveying research findings and ensuring responsible scientific practices.

The various modules covered in this online certificate program and details regarding the same include the following:

Module 1 - Introduction to basic Infectious Disease Modeling
By Dr. D. K. K. Vamsi, SSSIHL Puttaparthi

This module introduced the basics of disease modelling, including key terminologies, types of deterministic models and applications of infectious disease models. Participants learned to build and analyse compartmental models (SIR, SEIR etc.) and interpret their results for predicting outbreaks.

Module 2 - Basics of Stability Analysis
By Dr. P. Muthu, NIT Warangal

In this module mathematical foundations focused on mathematical frameworks such as linear systems, uncoupled linear systems, fundamental theorem for linear systems, eigen values, Jacobian forms were discussed. Diagonalization of linear systems, it's use and important theorems like stable manifold theorem and Hartman-Grobman theorems to analyse local behaviour of non-linear systems were discussed.

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Module 3 - Bifurcation Analysis
By Dr. Bapan Ghosh, IIT Indore

This module touched the complex topic, bifurcation in deterministic models based on system of ordinary differential equations. Classification of bifurcation in ecological models, necessary and sufficient conditions of bifurcation were discussed. Saddle-node bifurcations, Transcritical bifurcation, Pitch-fork bifurcation were discussed using prototype equations. Hysteresis and Hopf bifurcation were also discussed.

Module 4 - Introduction to Ecological Modeling
By Dr. Jai Prakash Tripathi, CURAJ Rajasthan

This module delved into single species population dynamics models like exponential model, logistic model, models with harvesting and Alee effect. Later on, different models for interacting populations were discussed and the module concluded with realistic prey-predator models.

Module 5 - Delay Differential Equations and Stochastic modeling
By Prof. Joydip Dhar, IITM Gwalior

This module contained advanced topics. In this module the need for system of delay differential equations to frame more realistic population dynamic models was discussed. Different types of delays in single species population models, effect of delays on population dynamics and biological interpretation of delays in dynamical systems were discussed.

Module 6 - Data Analysis and Manipulation using Mathematica
By Prof. Sandip Banerjee, IIT Roorkee

This module was based on data driven modelling. Participants gained insights into importing and exporting data and explored statistical approaches like probability distribution, curve fitting and time series analysis etc. Likelihood estimation, inference for parameter estimation and model validation was discussed in brief.

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Module 7 - AI/ML methods for Disease Dynamics
By Prof. B. V. Rathish Kumar, IIT Kanpur

In this module machine learning techniques like neural networks used in disease modelling were discussed. An introduction to datasets in disease modelling was given. Use of common performance matrices and how these matrices help in evaluating reliability and generalizability of models was explored. The module concluded with IDD-case studies to demonstrate practical implications.

Module 8 - Introduction to Systems Biology
By Dr. Mohit Kumar Jolly, IISc

This module introduced quantitative modelling of biological systems; emergent dynamics of simple mathematical models were discussed briefly. Applications based on cellular behaviour to organ-level physiology were discussed.

Module 9 - Scientific Communication & Research Ethics
By Dr. A. S. Vishwanathan, SSSIHL

With this module the course concluded with the emphasis on the need for scientific communication and strategies to be adopted for clarity and effective scientific communication. Second part stressed on ethical standards and guidelines in scientific research.

* Each module approximately spanned for a duration of one month

In conclusion this certificate program equipped participants with theoretical knowledge and practical skills to frame, implement and interpret disease models effectively and ethically, contributing to improved public health strategies.

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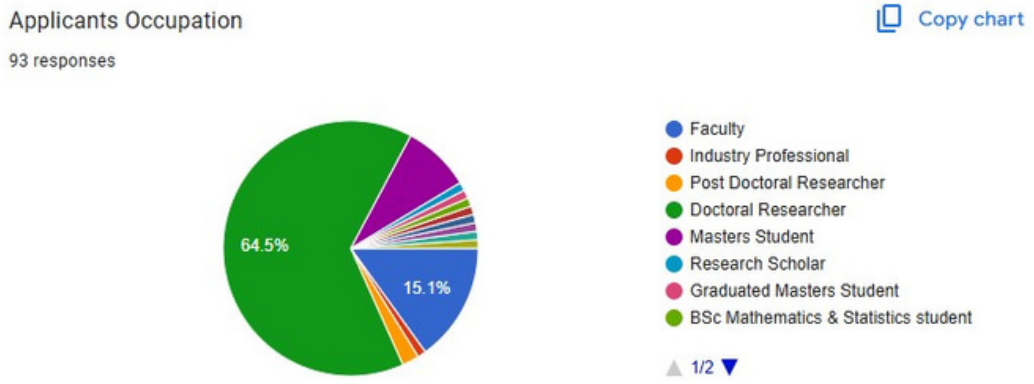
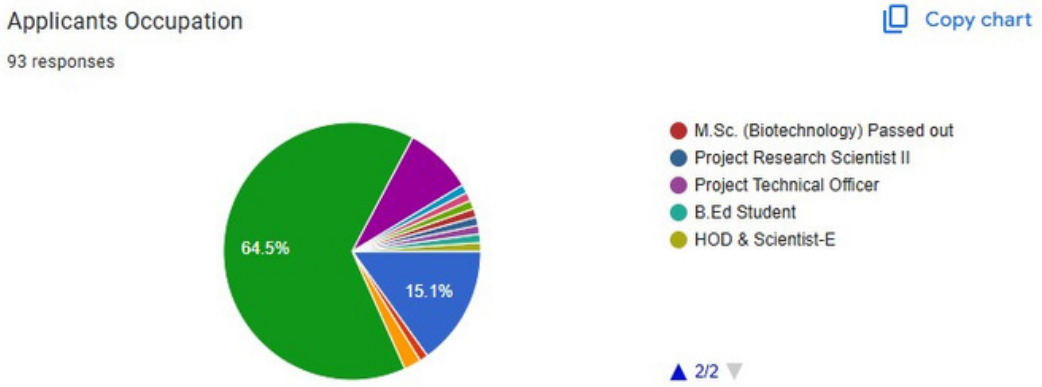
Participants Profiles for Certificate Program

Number of Participants - 93

The participants for this certificate program 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

- The course was very well coordinated. The lectures were informative. The organizing committee is very considerate. Being from purely life sciences background I faced some difficulty in understanding the fine details of the topics. Some topics were purely mathematics-based. However, I could grasp the overall picture of the applications. Would be looking forward to more courses purely designed for life sciences background students.

- I really appreciate whole team to organise such a workshop and connect the researchers on one platform for developing research ideas and knowing the procedure for completion in their respective topics. I expect more such programs from the team and the experts in the field of Mathematical modelling like they have arranged in this workshop.

- This certificate program which ran almost 9 months provided us the platform to interact and learn from the world known mathematicians. It was not possible through any conference or some days workshop. I highly appreciate the dedication and arrangement of Prof. Vamsi Sir and management of the institute to conduct this ultimate program. Different faculties delivered lectures and notes on a wide span of mathematical modeling. Some practical session also conducted to give hand on training experience. Such sessions could also be increased. I request the organizers to conduct more programs some of them should be covering short span of modeling and offline sessions. In the last I again congratulate Prof. Vamsi sir for the successful completion of this unique and useful program and lot of thanks from my side for cooperating us during the program.

- The program was thoughtfully designed, covering each topic in depth while keeping sessions engaging and accessible. The instructors were highly knowledgeable and responsive to questions, making complex concepts much easier to understand. Thank you to everyone involved for a fantastic experience! I highly recommend this program to anyone interested in Mathematical Modeling. A special thanks to Dr. DKK Vamsi for co ordinating with us through out the program with patience and all support. I really appreciate his help.

- I found this class to be both informative and engaging. The instructor's clear explanations and use of interactive discussions greatly aided my understanding of complex topics. However, the pace occasionally felt swift, particularly when covering more challenging material. Allowing additional time for review or providing supplementary examples in these areas could further enhance comprehension. Overall, this class provided a valuable learning experience, and I appreciate the thoughtful effort invested in delivering high-quality instruction.

- This certificate program has been invaluable for building my foundational knowledge in mathematical biology. I am deeply grateful to all sirs for their teaching throughout the program. Their knowledge and insights have greatly contributed to my understanding and growth in this field.

- Very intense and immense. Gained a ton of knowledge, insights, techniques, approaches, and learnt the Core of Disease Modelling thoroughly.

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- This 9 month long program was really useful in learning an interdisciplinary subject. The recordings of all the classes were really useful in checking the content and compensate for the missed classes.
- Well organized, Quality lectures. Thanks for giving me the opportunity to attend this certificate program and gain knowledge.
- This course is very much useful for research thank you sir.
- This certificate program is a great initiative and it is a very useful one for the people having their careers in Mathematical biology. It was really wonderful to explore the machine learning part and also learning many things from renowned professors. Also organisers response to the participants are really good like creating drive link for recorded videos, lecture notes. Thank you organisers for this amazing course.
- Very good programme sir. Very useful. In future conduct programme like this on writing some research papers on different papers topics of modelling.
- The overall program was really helpful for my M.Sc. program and I got a lot of advanced knowledge related to my course.
- I found this certificate program interesting and worthwhile. It significantly inspired me to push the limits and exposed me to many concepts and finer aspects of the population dynamics and mathematical modeling.

Click here for Flyer of Certificate Program

Click here for Detailed Schedule of Certificate Program

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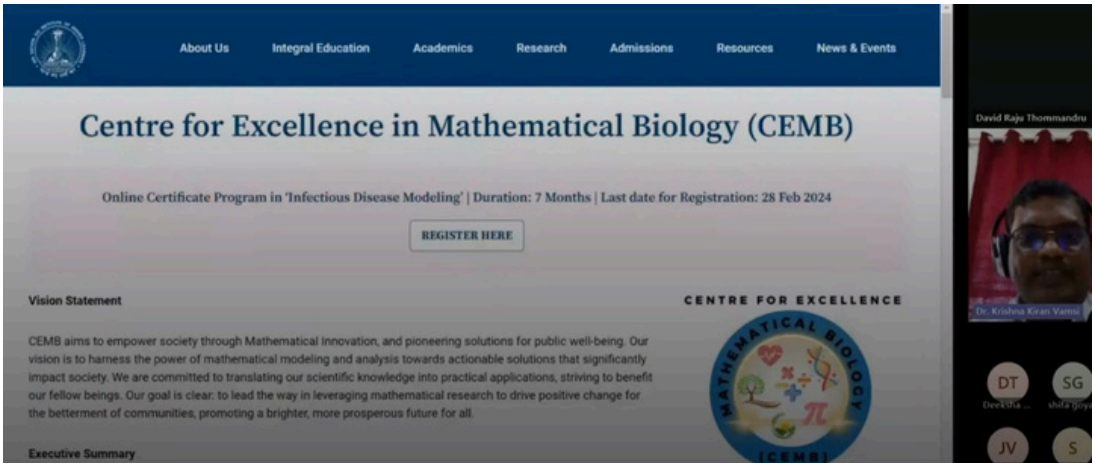

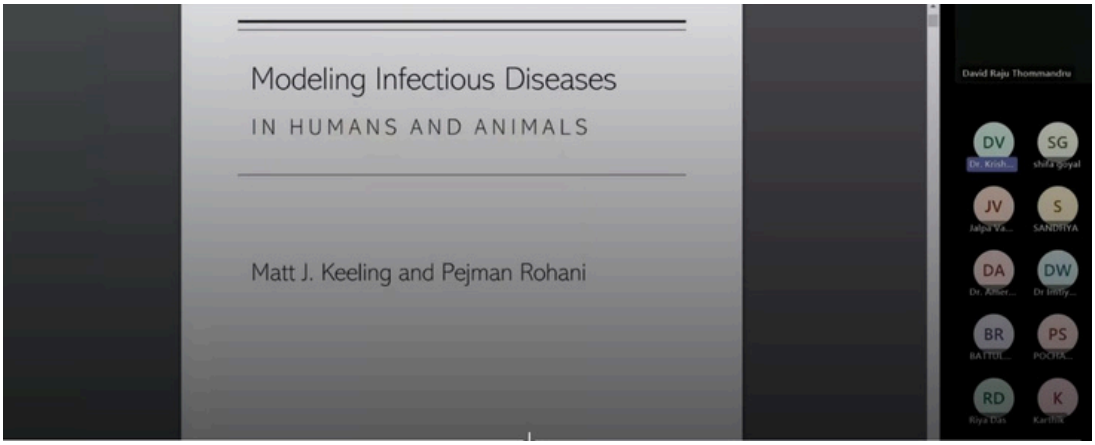

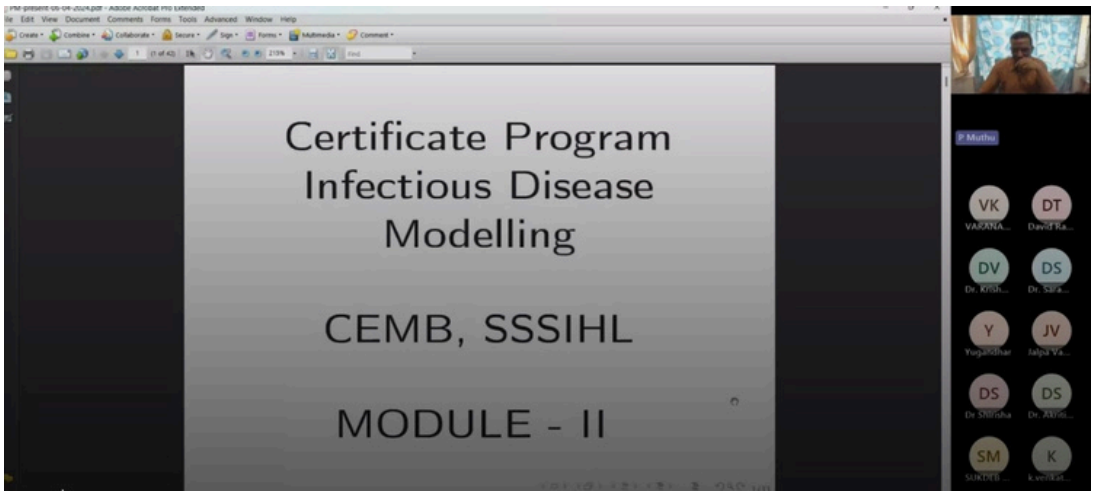

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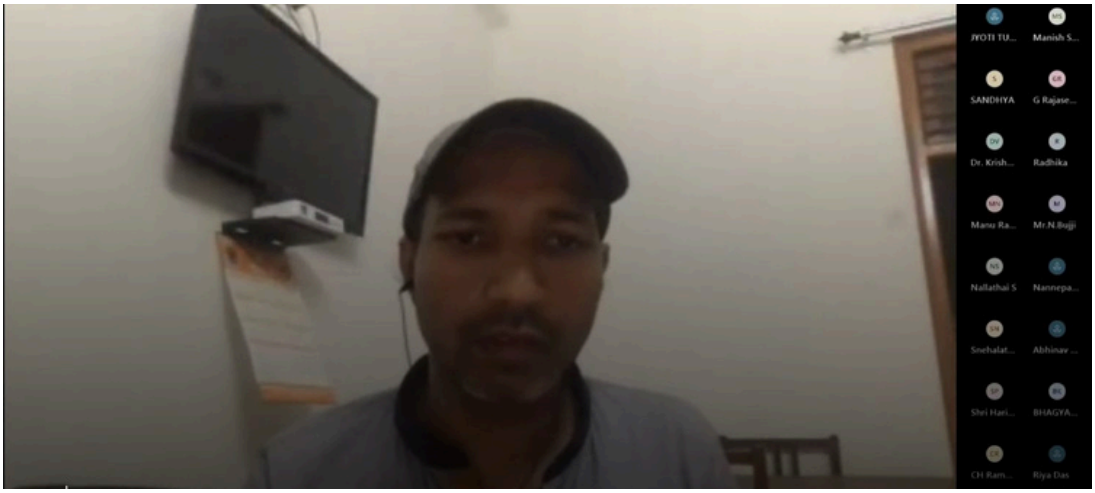

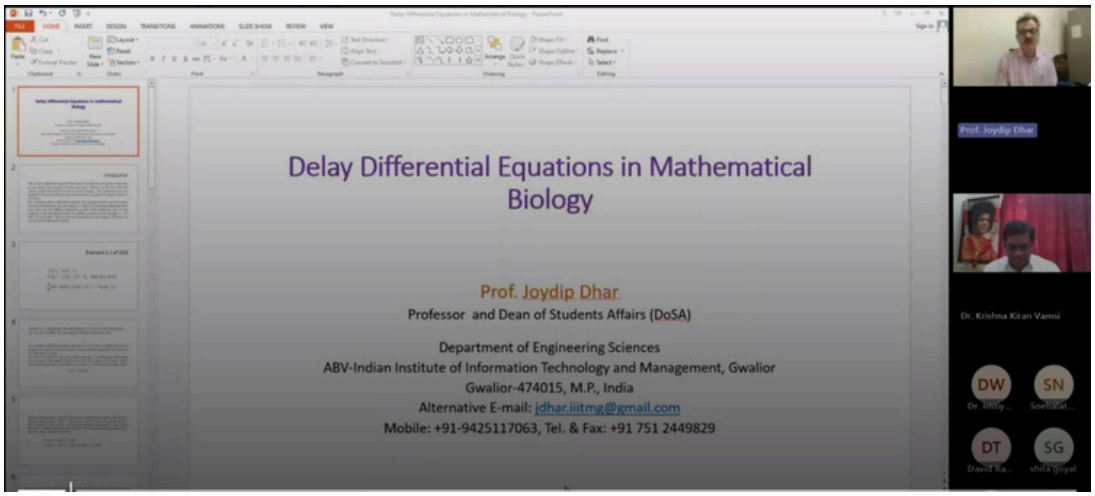

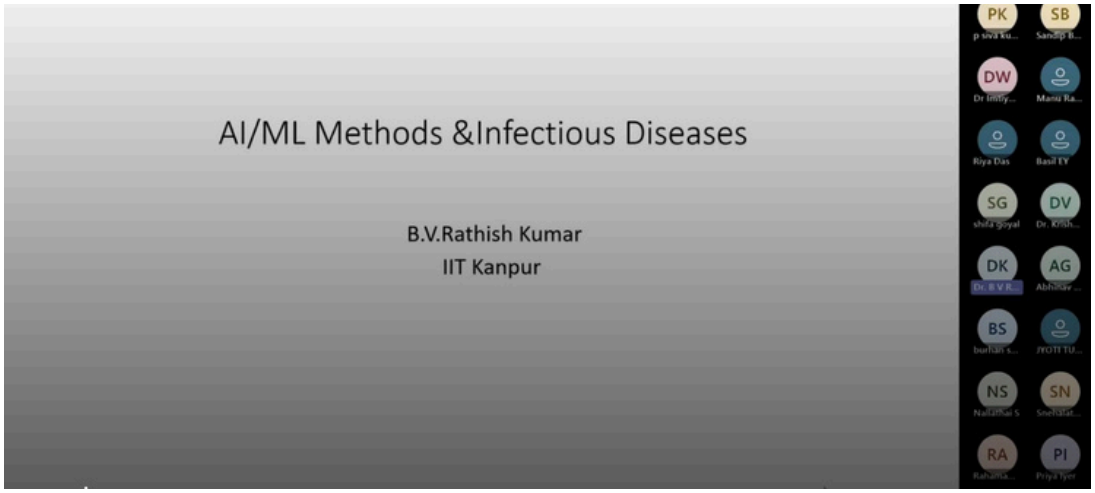

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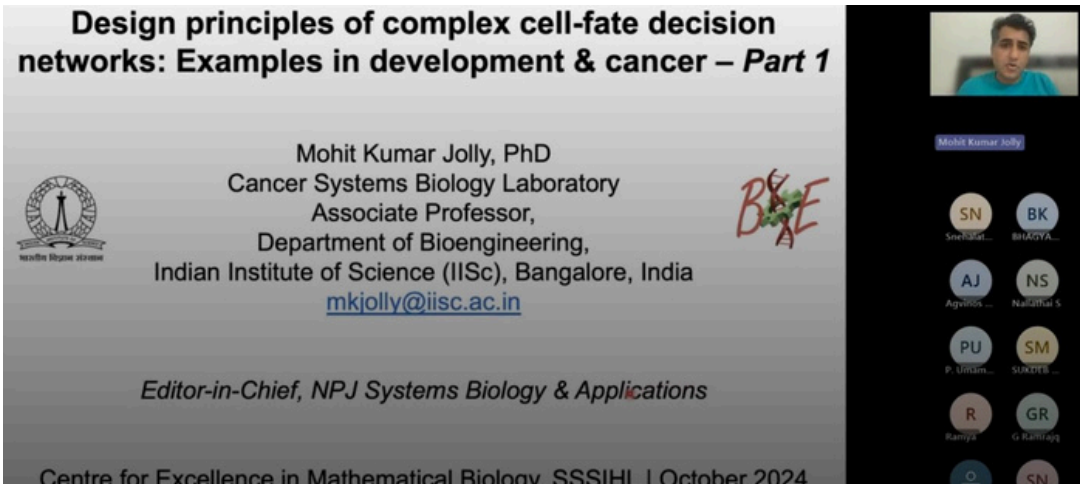

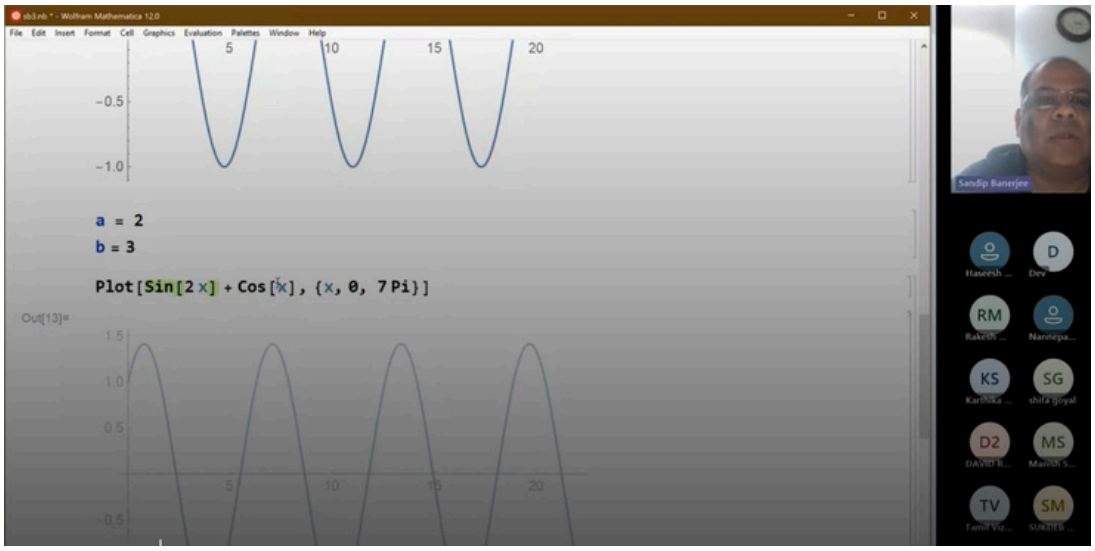

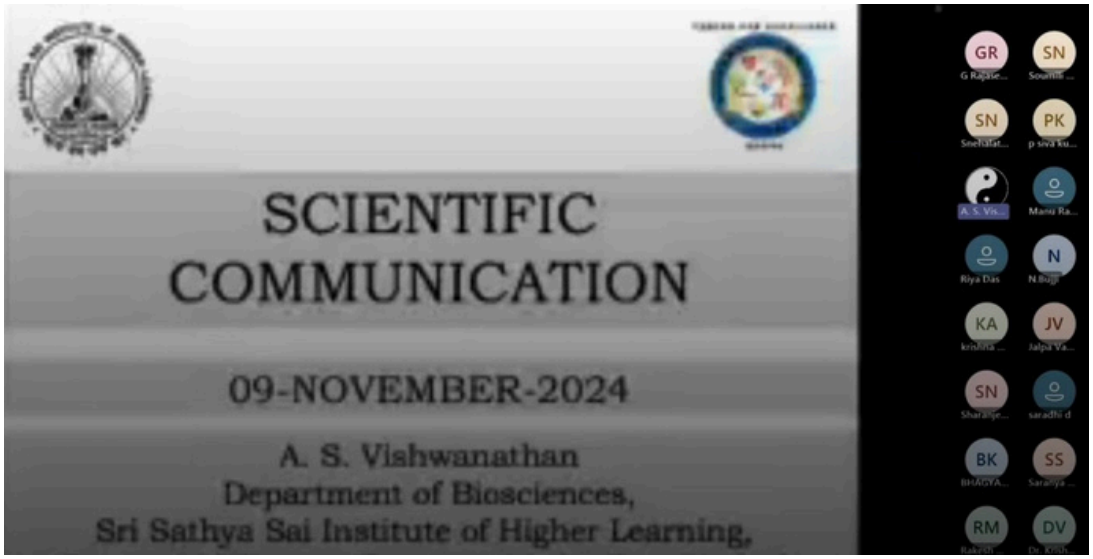

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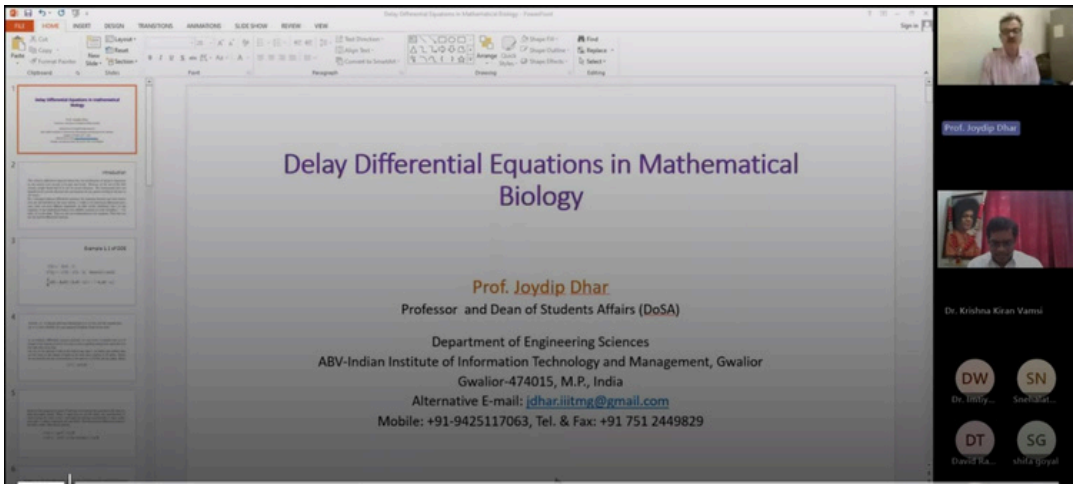

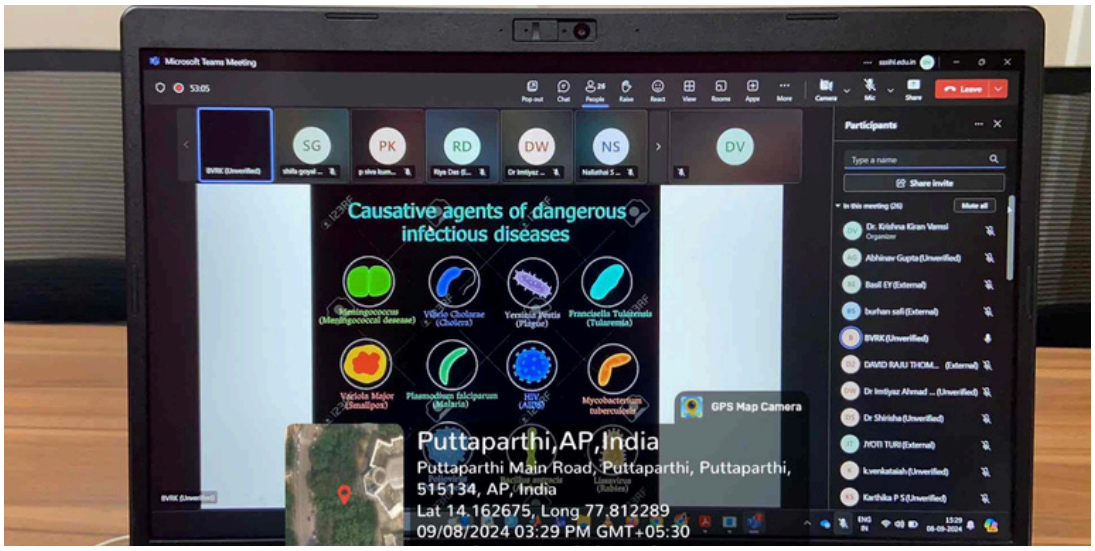

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