DEPARTMENT OF MATHEMATICS

2017–18

PREFACE

Dr. A. K. SAHU
M. Sc., Ph.D.
Professor
Head of the Department

The Department of Mathematics ICT, Mumbai offers Master in Engineering Mathematics and Ph. D. programs. It also caters to the instructions of basic courses in Applied Mathematics for all the technology branches, Chemical Engineering and Bachelor of Pharmacy degree students of the institute. The M. Sc. programme in Engineering Mathematics was started in the academic year 2011-2012. This course was supported by UGC under its innovative scheme and is gaining popularity. It is an inter-disciplinary programme giving practical application of mathematics and statistics in engineering, financial and biological applications. Masters students of the department were sent for an academic and industrial visit to Kolkata. The department has upgraded its computer lab by procuring MATLAB and SPSS software.

The department has strong research collaborations with various institutes in India and abroad like Indian Statistical Institute, Kolkata, University of Hyderabad, Visva Bharati University, IIT Bombay, IIT Guwahati, University of Calcutta, University of Mumbai, Arizona State University to name a few. The research activities of the faculties are being published in various peer reviewed international and national journals, conference proceedings and book chapters. Faculties are involved in organizing various national and international level educational programs related to mathematics, statistics and interdisciplinary sciences.

FACULTY

Dr. A. K. SAHU
M.Sc. (Utkal University), Ph.D. (IIT Bombay)
Professor & Head

SUBJECTS TAUGHT:

M.Sc. in Engineering Mathematics:

- Fluid Mechanics I
- Mathematical Biology
- Fluid Mechanics II
- Computational Fluid Dynamics II.
- Mathematical Modeling & Designing
- Heat and Mass Transfer

RESEARCH INTERESTS:

- Computational Fluid Dynamics
- Mathematical Modeling
- Numerical Methods

PUBLICATIONS:

(peer reviewed) so far : 08

CONFERENCE PROCEEDINGS/PAPERS: 10

SEMINARS/LECTURES/

ORATIONS DELIVERED: 14

MASTERS AWARDED AS SINGLE/ CO-GUIDE: 1

POST GRADUATE PROJECT SUPERVISION:05

HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPACT:

My basic research interest is in the field of Computational fluid dynamics (CFD), numerical methods and mathematical modeling. In case of CFD, the thrust is giving to simulate turbulent flows for some realistic problems using latest turbulent models and numerical techniques. As it is known that for turbulent flows, the governing equations for a giving problem are highly nonlinear and it is impossible to obtain an analytical solution. Therefore, the emphasis is given to use efficient numerical techniques such as: finite volume, initial value and finite difference methods to obtain the numerical solutions. Grid generation is also an important aspect of the numerical techniques and emphasis is also giving for this. Mostly for turbulent flows, the problems are chosen related to axial flow impeller, thermal stratification in molten sodium pool, flow inside a cavity etc.

At present, it is observed that nanofluids are gaining importance in thermal engineering due to its improving thermo-physical properties such as thermal conductivity, thermal diffusivity, viscosity and convective heat transfer. Hence, its importance in forced, mixed and natural convection is being studied. It has also been observed that nanofluids have very good heat transfer enhancement properties.

MEMBERSHIP OF IN-HOUSE COMMITTEES

UGPC and PGPC, Academic Council, MIS Committee (TEQIP-II), Steering committee of COE (TEQIP-II), Examination Committee.

Dr. AJIT KUMAR

M.Sc. & Ph. D. (University of Mumbai)

Associate Professor

SUBJECTS TAUGHT:

M.Sc. in Engineering Mathematics:

- Advance Calculus
- Applied Linear Algebra
- Optimization Techniques
- Applied Functional Analysis
- Software Lab-II

RESEARCH INTERESTS:

- Optimization and Statistical Techniques
- Machine Learning and Data Analytics
- Mathematical Pedagogy
- Use of Computer Aided Tools and Mathematical Software in Mathematics

PUBLICATIONS:

(peer reviewed) so far : 05

CONFERENCE PROCEEDINGS/PAPERS: 06

BOOKS PUBLISHED: 04

BOOK (CHAPTERS) PUBLIESHED: 06

SEMINARS/LECTURES/ ORATIONS DELIVERED: 75

POST GRADUATE PROJECT SUPERVISION: 10

HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPACT:

My current area of interest is in the field of Optimization Techniques, Statistical Techniques, Machine Learning, Data Analytics and Mathematical Pedagogy. Currently, two students are pursuing their Ph.D. under my guidance. One student is working in the area of vehicle routing problems and another student is working in the area of data analytics. Many students have done projects on various aspect of machine learning algorithms under my guidance some of which have resulted in conference proceedings.

Mathematical software have potential to facilitate an active approach to learning, to allow students to become involved in discovery and to consolidate their own knowledge, thus developing conceptual and geometrical understanding and a deeper approach to learning. Emergence of such mathematical tools and its ability to deal with most of the undergraduate mathematics cannot be ignored by mathematics educators. While use of computer technologies in many countries in teaching and learning mathematics have made a significant impact at all levels, use of such tools in mathematics teaching at all levels is in its infancy in India. So much so, that many mathematics teachers are not even aware of existence of such tools. I extensively use these software for my teaching and research. One of my aim is to create awareness about innovative use of Mathematical Software among mathematics teachers across the country.

I have been involved with the Mathematics Training and Talent Search (MTTS) programme and Pedagogical Training for mathematics Teachers (PTMT) for last several years in the various capacities. I am a member of national core committee this programme. These programmes have benefited a lot of students and teacher including me in India and have made a significant impact on mathematical science in India.

MEMBERSHIP OF IN-HOUSE COMMITTEES

TEQIP Coordinator for Mathematics Department, Campus Safety and Security, Canteen and Catering, Examination Squad.

SEMINARS / LECTURES / CONFERENCES / SYMPOSIA /WORKSHOPS / SUMMER OR WINTER TRAINING SCHOOLS ATTENDED/ ORAL OR POSTER PRESENTATIONS:

Conference/Workshop attended

- Attended a National Seminar on "Symbiotic Correlation of Mathematics and Information Technology Pan-Industry on January 2018 at the Shailendra Education Society's Arts, Commerce and Science College, Mumbai.
- "Faculty Induction Programme", organized by the National Programme Implementation Unit (NPIU) in collaboration with the College of Engineering Pune during Nov 27– Dec 02, at COEP, Pune.
- "Teacher Training Workshop on Research Based Pedagogical Tools", Sacred Heart College, Kochi, Kerala; 11-14 October, 2017, organized by IISER Pune in collaboration with British Council.
- "International Congress on Mathematics Education (ICME)", Hamburg, Germany held during July 24–31, 2016.

Lectures Delivered

- A course of lectures on Linear Algebra in the MTTS Programme during June 04 to June 16, 2018 at the Indian Institute of Technology, Indore.
- A course of lectures on Foundations in the MTTS Programme during May 21 to June 02, 2018 at the Indian Institute of Technology, Indore.
- Invited lecture on "Use of Linear Algebra to solve real life problems" during "Workshop on Application of Mathematics in Engineering and Real Life", Ramrao Adik Institute of Technology, Navi Mumbai on Feb. 28, 2018.
- A course of lectures on Foundations in the mini-MTTS programme at the University of Tezpur, Assam, January 03–09, 2018.
- Invited to give 2 lectures on "Use of SageMath for teaching and research" at the KTHM college Nashik on December 29, 2017 during a national level workshop on "Role of Mathematical Software in Teaching, Learning and Research".
- Invited to give 4 lectures on "Sage and Python" at NES Ratnam College, Mumbai from December 21-22, 2017 during "Workshop LaTeX and Mathematical Software for teaching and research for college teachers under DBT-Star college scheme."
- Invited lecture on "Why Mathematics" at the Bandodkar College, Thane, on December 09, 2017.
- Invited to conduct a workshop on LaTeX for teachers of the M.D. College, Mumbai on August 05, 2017.
- Invited to give 2 lectures on "Introduction to

Optimization and use of Mathematical Software" on July 07, 2017 at the Vivekanad Education Society Institute of Technology during AICTE-ISTE approved one week STTP Training programme.

- Invited to give a series of lectures on "Regression using R" at the SIES Graduate School of Technology, Navi Mumbai on July 05, 2017 during AICTE –ISTE approved Short Term Training Programme.

EVENTS ORGANIZED AND RESPONSIBILITY (CONVENER /SECRETARY/ MEMBER):

- Organized a workshop on "Python Programming Language" during February 21-24, 2018 at ICT Mumbai organized jointly with NES Ratnam College, Mumbai.
- Organized a hands-on training programme on "MATLAB" on January 23, 2018 at ICT Mumbai.
- The member of advisory committee of a national seminar on Symbiotic Correlation of Mathematics and Information Technology Pan-Industry on January 20, 2018 at the Shailendra Education Society's Arts, Commerce and Science College, Mumbai

DR. V. DIVYA

M.Math. (ISI Bangalore), Ph. D. (University of Genoa, Italy)
UGC Assistant Professor

SUBJECTS TAUGHT:

- B. Chem. Engg.
- Applied Mathematics I
- Applied Mathematics II

M.SC. IN ENGINEERING MATHEMATICS:

- Differential Equations-I
- Differential Equations-II
- Numerical Methods-I
- Numerical Methods-II

RESEARCH INTERESTS:

- Fluid mechanics (theoretical and computational) and applications to fluid-structure interaction
- Non-linear dynamics and reduced-order modelling
- Statistical analysis of turbulence and applications to hydromechanics equations
- Inverse problems and parameter identification

PUBLICATIONS:

International (peer reviewed) so far: 5

National (peer reviewed): 0

CONFERENCE PROCEEDINGS/PAPERS:03

SEMINARS/LECTURES/ ORATIONS DELIVERED:04

POST GRADUATE THESIS SUPERVISION: 01

HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPACT):

My major research interests lie in the area of fluid mechanics and non-linear dynamics. I mainly work on computational modelling of flows around moving immersed boundaries and its applications to fluid-structure interaction. Applications of this research include the flow around a bluff body that is coated with a layer of poro-elastic feathers, and the phenomenon of flocking in bird flight. Some of these problems, that involve very expensive computational resources can also be effectively investigated using methods of reduced-order modelling, wherein some key features of the ambient flows are captured using inexpensive non-linear dynamical models. I am also involved with statistical analysis of turbulence and its applications to hydromechanics, in which there has been a publication.

Dr. AMIYA RANJAN BHOWMICK
M.Sc. (IIT Bombay), Ph. D. (Calcutta University)
Assistant Professor

SUBJECTS TAUGHT:

B. Chem. Engg.

- Applied Mathematics I
- Applied Mathematics II

B. Tech.

- Applied Mathematics – I
- Applied Mathematics-II

M.Sc. in Engineering Mathematics:

- Applied Statistics-I
- Applied Statistics-II
- Advanced Real Analysis
- Machine Learning

RESEARCH INTERESTS:

- Stochastic population dynamics
- Species distribution modeling under climate change
- Machine learning techniques in ecology
- Inference on growth curve models

PUBLICATIONS:

International (peer reviewed): 3
National (peer reviewed): 0

CONFERENCE PROCEEDINGS/PAPERS: 0

SEMINARS/LECTURES/ ORATIONS DELIVERED: 5

POST GRADUATE THESIS SUPERVISION: 03

HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPACT):

My major research interest lies in the area of mathematical biology. I am mainly working on the empirical assessment of the natural population dynamics by using population growth models. The single population dynamic models such as logistic, gompertz etc. are used to study the natural populations and make predictions regarding extinction threats. Stochastic population dynamics are integrated part of the research activities. I am also involved in research work related to species distribution modelling.

Research on Species Distribution Modelling: Biological invasions by alien non-indigenous species are one of the major problems of the present era which impose massive environmental and socio-economic costs. In India about 40% of the floral species have long been recognized to be aliens, but the need for priority conservation efforts has only been felt since the turn of the century. Thus, it is now of utmost importance to predict the potential distribution of invasive alien species and identify suitable environmental conditions that allow the species to spread rapidly. The invasive plant Mikania micrantha was chosen as the test species. Native occurrence records (longitude and latitude) were obtained from the Global Biodiversity Information Facility (GBIF). For Indian occurrences, GBIF records were supplemented with occurrences from herbaria label data and information gathered from published literature. Nineteen climatic variables were obtained from World-Clim databse.

To predict the potential distribution, species distribution models (SDMs) were built by using logistic regression and the climatic variables were chosen by using two cross-validated regularization methods induced by least absolute shrinkage and selection operator (lasso) and the ridge penalty function. This approach has twofold benefits; it deals with the multicollinearity problem efficiently and selects the raw environmental covariates. F-score was utilized to measure the models' performance. Combining the data from both native and alien ranges, seven environmental predictors were selected using four different background choices. Using lasso penalty, mean diurnal range (mean of monthly (max

temp – min temp)) (BIO2), Isothermality (BIO2/BIO7) (×100) (BIO3), Temperature Annual Range (BIO5-BIO6) (BIO7), Precipitation of Wettest Month (BIO13), Precipitation Seasonality (Coefficient of Variation) (BIO15) and Precipitation of Warmest Quarter (BIO18) were found to be strong correlates for all four backgrounds. The predicted probabilities from the model containing these seven selected variables, demonstrated higher invasion risk in the central part of India than the model containing all the predictors.

Accurate analysis of present distributions and effective predictive modelling of future distributions of invasive alien species is of vital importance for the early detection of the invasion and rapid remedial actions downstream. This study may aid in the adoption of management initiatives like early detection and rapid response. This could result in identifying both new populations and established populations to be prioritized for management.

1. Iyer, S. Banerjee, A. K. and Bhowmick, A. R.* Making Choices that Matter - Use of Statistical Regularization in Species Distribution Modelling for Identification of Climatic Indicators - A Case Study with Mikania Micrantha Kunth in India. Ecological Indicators (In Press).
2. Banerjee, A., Chakrabarty, M., Rakshit, N., Bhowmick, A. R. and Ray, S. Environmental factors as indicators of dissolved oxygen concentration and zooplankton abundance: Deep learning versus traditional regression approach, Ecological Indicators 2018 (In Press).
3. Pal, A., Bhowmick, A.R., Yeasmin, F. and Bhattacharya, S. Evolution of Model Specific Relative Growth Rate: Its Genesis and Performance Over Fisher's Growth Rates, Journal of Theoretical Biology (doi: 10.1016/j.jtbi.2018.02.012) Vol-444, pp 11-27, 2018.

SEMINARS / LECTURES / CONFERENCES / SYMPOSIA /WORKSHOPS / SUMMER OR WINTER TRAINING SCHOOLS ATTENDED/ ORAL OR POSTER PRESENTATIONS:

Conference/Workshop Attended

Invited Lectures delivered

- Resource person in the Workshop on "MATLAB and R Training" during 10th-11th July 2018 organized by CPEPA, University of Calcutta.
- Resource person in the Workshop on "Analysis of Biological Data using R Studio" organized by the MGM's College of Engineering and Technology (MGMCET) on 8th and 15th April 2018.
- Resource Person in the Workshop on Statistical Methods and R Programming for Biologists at Indian Statistical Institute, Kolkata during 07th - 13th March 2018. (Part of the organizing committee and invited speaker)
- Resource person in the 'Dr Ganesh Prasad Math Fest 2018' organized on Tuesday, 23rd Jan 2018 as part of 'Indian Mathematician Chair' instituted in the Dept of Maths & Stats, Guru Nanak Khalsa College of Arts, Science and Commerce. Delivered a keynote address on "Applications of Mathematics".
- Resource person in the Short Term Training Programme on "Applicable Mathematics and Statistical Techniques" organized by the Basic Sciences and Humanities Department, Don Bosco Institute of Technology, Mumbai during 2nd – 6th January 2018.

EVENTS ORGANIZED AND RESPONSIBILITY (CONVENER /SECRETARY/ MEMBER):

- Coordinator of the Industry Academic Interaction Program held on October 1, 2018 under TEQIP-III.

SUPPORT STAFF

SRI C. R. BORADE
Lab attendant