**MATHEMATICAL MODELLING: ANALYSIS AND APPLICATIONS**

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IIT Roorkee

**TYPE OF COURSE**: Rerun | Core | UG/PG

**COURSE DURATION**: 4 weeks (20 Jul’ 20 - 14 Aug’ 20)

**EXAM DATE**: 27 Sep 2020

**PRE-REQUISITES**: Basic Calculus

**INTENDED AUDIENCE**: UG students of technical universities/colleges

**COURSE OUTLINE**: This course provides introduction of mathematical modeling and analysis in biological sciences. It is designed for students in both applied mathematics and bio-medical / biological sciences. Due to limited time availability in course, the study material is chosen from population dynamics and bio-chemistry only. This course covers the fundamentals of deterministic models in both discrete and continuous time domain. The major portion of this course includes linear models. However a brief introduction of non-linear modeling concepts and few non-linear models have also been added to make reader familiar with real time complex system modeling. The relevant concepts from differential equations and system theory have also been provided for easy understanding.

**ABOUT INSTRUCTOR**: Dr. Ameeya Kumar Nayak is Associate Professor in Department of Mathematics at IIT Roorkee and actively involved in teaching and research in the direction of numerical modeling of fluid flow problems for last ten years. His research interests are in the fundamental understanding of species transport in macro and micro-scale confinements with applications in biomedical devices and micro electro mechanical systems. He has authored and co-authored more than 32 peer-reviewed journal papers, which includes publications in Springer, ASME, American Chemical Society and Elsevier journals. He is also active in writing book chapter with reputed international publication house.

**COURSE PLAN**:  
**Week 1**: Overview of mathematical modeling and types of mathematical models, Introduction to population dynamics, solution methods of linear difference equations and discrete time model.  
**Week 2**: Linear system theory, stability analysis, role of eigen values & vectors and phase diagrams.  
**Week 3**: Single-species population model, Allee effect, Predator-Prey model, Lotka-Volterra model and SIR model.  
**Week 4**: Introduction to models in chemical-kinetics, Hopf bifurcation, Poincare-Bendixson theory and index theory.