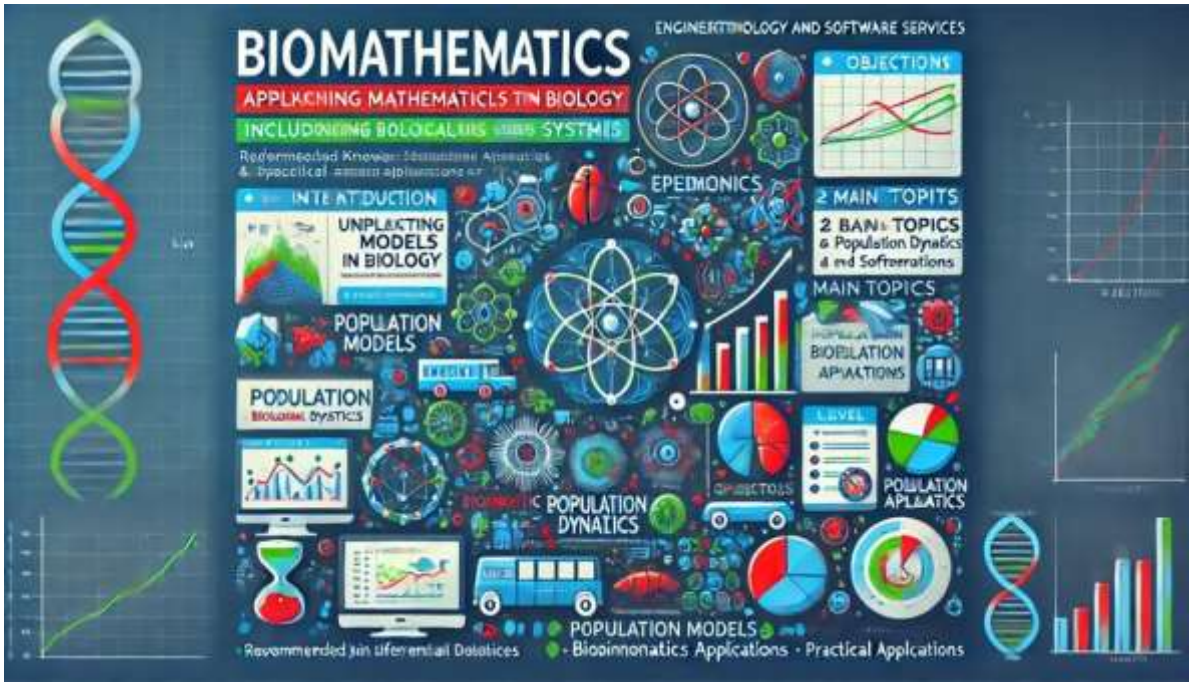
🧬 Biomathematics



🧬 Biomathematics

Course Code: 29006-AUX

Duration: 8 Weeks | 2 Sessions per Week (Theory + Practical)

📚 Introduction:

Biomathematics is the interdisciplinary field where mathematics meets biology.
It provides the mathematical frameworks and tools needed to model, simulate, and analyze biological systems — from the spread of diseases to the dynamics of populations and genetic sequencing.

✨ Course Description:

This course explores how mathematical models are formulated and applied in biological contexts.

Students will learn about population dynamics, epidemiology, and bioinformatics, gaining a solid understanding of how mathematics drives progress in modern biology and healthcare.

🎯 **Course Objectives:**

- Understand the fundamental mathematical models used in biological sciences.
- Apply mathematical techniques to study population growth, spread of diseases, and biological data analysis.
- Develop skills in interpreting biological phenomena through mathematical lenses.

🎯 **Target Audience:**

- Advanced undergraduate and graduate students in Mathematics, Biology, Biotechnology, and Health Sciences.
- Professionals and researchers interested in quantitative biological modeling.
- Anyone with a background in **Differential Equations** and **Statistics**.

🛠️ **Materials and Resources:**

- **Software**: MATLAB, Python (NumPy, SciPy, BioPython libraries).
- **Reading Material**: Research papers, biomathematics textbooks, online biological datasets.
- **Tools**: Simulation environments and epidemiological modeling platforms.

👩‍🏫 **Instruction Method:**

- 1 Theory Session per week (Concepts, Models, Case Studies).
- 1 Practical Session per week (Simulations, Software Usage, Project Work).
- Assignments and exercises based on real-world biological data.
- Group projects and discussions on contemporary biological challenges.

🗂️ **What You Will Learn:**

✅ How to create and analyze **population models** (growth, interaction, extinction).
✅ How to model **epidemics** and predict disease spread (SIR models and beyond).
✅ Basics of **bioinformatics**, including sequence alignment and biological data analysis.
✅ Application of differential equations, probability, and statistics in biological systems.

🗺️ **Detailed Course Outline:**

📆 **Week 1:**

Introduction to Biomathematics

- Overview of mathematical biology.
- The role of modeling in modern biology.

📅 **Week 2:**

Population Dynamics I

- Exponential and logistic growth models.
- Mathematical description of competition and predation.

📅 **Week 3:**

Population Dynamics II

- Advanced population models (age-structured, spatial models).
- Applications in ecology and conservation.

📅 **Week 4:**

Introduction to Epidemiology

- Basic concepts: infection rates, recovery rates, immunity.
- Introduction to the SIR (Susceptible-Infected-Recovered) model.

📅 **Week 5:**

Advanced Epidemiological Models

- SEIR models (adding exposed stage).
- Vaccination strategies and modeling disease control.

📅 **Week 6:**

Introduction to Bioinformatics

- Biological sequences: DNA, RNA, and proteins.
- Sequence alignment and basic database searches.

📅 **Week 7:**

Data Analysis in Biomathematics

- Statistical methods in biology.
- Handling and interpreting biological data.

📅 **Week 8:**

Final Projects and Presentations

- Develop and present a model related to population dynamics, epidemiology, or bioinformatics.
- Real-world biological problem-solving.

🏆 **Final Outcome:**

By the end of this course, you will be able to:

- Build mathematical models to describe biological systems.

- Analyze and simulate biological processes like epidemics and population changes.
- Use computational tools to manage and interpret biological data.
- Integrate mathematical reasoning into biological research and applications.