

iGEM BITS Goa  
&  
CENTRE FOR TECHNICAL EDUCATION  
FIRST SEMESTER 2020-2021

**Course Title:** Applications of Engineering Principles to Life Sciences

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**Instructor-in-Charge:** Shruti Sridhar

**Instructors:** Gourav Saha, Yogen Borkar, Ameya Thete, Pranav Ballaney, Saransh Gokhale

**Course Description:** Synthetic biology is becoming an increasingly important frontier for interdisciplinary research with varied applications. This course attempts to provide an introduction to bioengineering and describe the various engineering principles used therein. This course has four foundational parts:

1. A background to bioengineering;
2. Mathematical simulations of biological systems involving computational approaches;
3. Circuit design and construction; and
4. Experimental approaches to genetic design.

This course would be appropriate for undergraduate students as well as students interested in participating in iGEM (International Genetic Engineering Machine).

A student enrolled in this course would be able to **choose between two tracks:** Track 1 which focuses on studying and building descriptive mathematical models for biological systems; and Track 2 which focuses on the experimental aspects of biology.

**Course Plan:**

Class #	Module	Topics Covered	Practical Work (if any)
1	Course Overview	-	-
2-4	Introduction to Bioengineering	Fundamentals of DNA Primers and PCR Case studies <sup>†</sup> and Applications	Design a primer
5-7	Parts and Design	Registry and Biobricks Biobrick Assembly Switches, Toggles and Toeholds	Design a part
8	Human Practices	Identifying Stakeholders Integrated Human Practices	-
9-12	Genetic Circuits	Operons Kill Switches Biosensors Plasmid Selection and Construction Drug Delivery and Bioremediation	Design a plasmid

13-17	Mathematical Modelling (Track 1)	Chemical Kinetics and Applications ODEs and ODE Solvers Stochastic models Case studies <sup>†</sup> and Examples Applications of Machine Learning Reactor Design and Scaling up of Biochemical Processes	Model a biological system
13-17	Experimental techniques (Track 2)	Lab Safety Molecular biology techniques Proteomic techniques Mutagenesis Instrumentation techniques	Case studies <sup>†</sup>
18-19	Entrepreneurship	Translating viability of an idea	Case studies <sup>†</sup>

† - Case studies would involve implementing the contents of the ongoing topic by investigating projects in synthetic biology.

**Course Evaluation:**

Sl. No.	Component	Weightage
1	Practical Sessions	40%
2	Quizzes*	10%
3	Final Presentation	50%

\* - Check-in quizzes