



GUJARAT TECHNOLOGICAL UNIVERSITY
Integrated Master of Science (Biotechnology)

Semester: 3

Subject Name: Synthetic Biology

Subject Code: 1330405

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
			ESE (E)	PA (M)	ESE (V)	PA (I)		
4	0	0	4	70	30	0	0	100

Prerequisite:

Students should have the basic knowledge of biology, physics and chemistry.

Rationale:

This course provides deep insight knowledge of synthetic biology and to produces expert that would have sufficient knowledge and expertise to solve the major and urgent problems by using synthetic biology. Synthetic biology is developing field that spans the boundary of biology, engineering, and physical sciences with its goal of engineering biomolecular systems and cellular capabilities for a diverse of applications. This subject aims to offer an introduction to this rapidly evolving field and equip students with foundational skills and critical mindsets that are required for synthetic biology research

Course Content:

Unit No.	Content	No. of Hours	Weightage (%)
1	Introduction to Synthetic Biology History, status, challenges, key milestones in synthetic biology and future.	6	10
2	Advanced biotechnological methods Cloning, mutagenesis, and polymerase chain reaction, synthesis of nucleic acids, DNA sequence determination, synthetic genomics, CRISPR-Cas9, directed evolution, alternative splicing and computational modelling.	15	25
3	Noise in gene expression, bacterial circuits & Functional synthetic systems Origin, propagation, consequences, and control, Robustness and evolvability of genetic networks, Bacterial circuits: Toggle switch, repressilator, Feedback, feed-forward, signal propagators, and band filter, Bacterial communication circuits: Population control and patterning systems, Gene circuit design and engineering: Biobricks/BioFAB and designing softwares, Functional synthetic systems: From modules to systems. In vitro/cell-free systems.	15	25
4	Application of synthetic biology Biomedicine, biomaterials, Biofuels, agriculture, vaccine development, metabolism of engineered organisms, drug delivery platforms, biosensors development and bioremediation.	12	20



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5	Biosafety and Potential risks associated with synthetic biology Hazards to the environment. Cyberbiosecurity, bioterrorism and biowarfare. Risk assessment and regulatory mechanisms. Ethical aspect of Synthetic biology.	12	20
Total Hours:		60	

Textbook:

1. Uri Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall/CRC (2006).
2. Eric Davidson, The Regulatory Genome: Gene Regulatory Networks In Development And Evolution, Academic Press (2006)

Reference Books:

1. Robert Brooks Phillips, Jane Kondev and Julie Theriot, Physical Biology of the Cell, Garland Science (1st edition) (2008).
2. Mark Ptashne and Alexander Gann, Genes and Signals, Cold Spring Harbor Laboratory Press (1st edition) (2001).
3. Selected papers.

Course Outcomes:

No.	Course Outcomes	RBT Level*
1	Regulation of the genes and properties of gene products can be altered with synthetic biology methods	UN,RM
2	Explain the potential application of synthetic biology in biomedicine & biomaterial.	UN,RM
3	Illustrate the scope of biotechnological methods and genome editing tools in synthetic biology.	UN,RM

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create