

# GUJARAT TECHNOLOGICAL UNIVERSITY

Syllabus for PG Diploma in Bioinformatics, Semester - 1

Subject Name: System Biology

Subject Code: 1310205

W.E.F 2021-22

## 1. Learning Outcomes

Learning Component	Outcome	Learning Outcome (Learner will be able to)
Domain Knowledge		<ul style="list-style-type: none"><li>Understand the fundamentals of system biology and biological networks</li></ul>
Critical thinking, Logic Building, Problem Solving		<ul style="list-style-type: none"><li>Deciphering real-world biological problems in system biology.</li><li>Assess different problem-solving approaches.</li><li>Mapping biological networks.</li></ul>
Effective Communication		<ul style="list-style-type: none"><li>Communicate ideas clearly and effectively.</li></ul>
Professional & Ethical Behavior		<ul style="list-style-type: none"><li>Transparency, honesty and ethical reasoning in devising tools of data handling and processing.</li></ul>

## LO – PO Mapping: Correlation Levels:

1 = Slight (Low); 2 = Moderate (Medium); 3 = Substantial (High), “-“= no correlation

Sub Code: 1310205	PO1	PO2	PO3	PO4	PO5	PO6
LO1: Programming environment and Domain Knowledge	3	3	3	3	2	2
LO2: Critical thinking, Logic Building, Problem Solving	3	3	3	3	2	3
LO3: Effective Communication	3	2	3	3	3	3
LO4: Professional & Ethical Behaviour	2	2	2	3	3	3

2. Course Duration: The course duration is 45 sessions of 60 minutes each.

## 3. Course Contents:

Module No:	Module Content	No. of Sessions	70 Marks (External Evaluation)
1	<b>Introduction to cell biology</b> Molecules of life: Genes and proteins, Transcription networks, Regulation of gene transcription	7	10

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2	<p><b><u>Biological Network</u></b> Types of biological networks Network motifs in transcription regulation, Network motifs in signalling networks, Origins of biological robustness, Optimal gene circuits. Kinetic modelling of biochemical reactions. Kinetic modelling of large scale biomolecular networks, network analysis in systems biology</p>	15	20
3	<p><b><u>Integration of regulatory and metabolic networks</u></b> Gene set Enrichment and Network Analyses In the 'Gene Set Enrichment and Network Analyses' to analyse gene sets. Several tools: Enrichr, GEO2Enrichr, Expression2Kinases and DrugPairSeeker.</p>	15	20
4	<p><b><u>Deep Sequencing Data Processing and Analysis</u></b> Basic steps and popular pipelines to analyze RNA-seq and ChIP-seq data going from the raw data to gene lists to figures. Graph theoretic analysis of biological networks, Biological networks and drug development.</p>	8	20
5	<p><b><u>Practicals</u></b></p> <ol style="list-style-type: none"> <li>1. Exploring systems biology-based databases: KEGG, Reactome, BRENDA, BioCyc, BioModels, SABIO-RK, MetaNetX, JWS Online, BiGG, RHEA, GEM, STRING, APID, ModelSeed, DAVID</li> <li>2. Understanding SBML file format, libSBML, MIRIAM, SBGN</li> <li>3. Importing, studying and constructing toy/published models in Cell Designer/Cell Collective</li> <li>4. Simulating networks in COPASI</li> <li>5. Constructing, annotating and analysing network in Cytoscape and its plugins</li> <li>6. Exploration and Flux analysis of metabolic networks using COBRA Toolbox/RAVEN Toolbox/ COBRAPy</li> <li>7. Metabolomics data Analysis using Metabo Lights, Metabo Analyst</li> </ol>	---	(30 marks CEC)

#### 4. Pedagogy:

- ICT enabled Classroom teaching
- Case study
- Practical/live assignment

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- Interactive classroom discussions

### 5. Evaluation:

Students shall be evaluated on the following components:

	<b>Internal Evaluation</b>	<b>(Internal Assessment – 20 Marks)</b>
<b>A</b>	● Assignments	10 marks
	● Class Presence	5 marks
	● Record maintenance	5 marks
<b>B</b>	<b>Mid-Semester Examination</b>	<b>(Internal assessment-30 Marks)</b>
<b>C</b>	<b>End-Semester Examination</b>	<b>(External assessment-70 Marks)</b>

### 6. Reference Books:

No	Author	Name of the Book	Publisher	Year of Publication / Edition
1	Sangdun Choi	Introduction to Systems Biology	Humana Press	Latest edition
2	Andres Kriete, Roland Eils	Computational Systems Biology	Academic Press	Latest Edition
3	Edda Klipp, Ralf Herwig, Axel Kowald, Christoph Wierling, Hans Lehrach	Systems Biology in Practice: Concepts, Implementation and Application	Wiley-VCH	Latest Edition

Note: Wherever the standard books are not available for the topic appropriate print and online resources, journals and books published by different authors may be prescribed.

### 7. List of Journals/Periodicals/Magazines/Newspapers / Web resources, etc

- <https://nptel.ac.in/courses/102106035>
- <https://archive.nptel.ac.in/courses/102/106/102106068/>
- <https://github.com/CSBiology/>

### Course Outcomes:

On completion of this course, students should be able to:

- Understand the basic concepts, terminology, role and network of Biological Pathways.

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- Gain working knowledge of different system biology tools.
- Develop skills to map biological pathways.