Bio-organic chemistry - Web course

COURSE OUTLINE

In this course the basics in Bioorganic Chemistry, its inception and its today's platform will be focused. In a truly interdisciplinary way bioorganic chemistry unites the central questions of biochemistry, medicinal chemistry, organic chemistry, and spectroscopy. This new curriculum should be applicable at almost any institution, one that is more useful and relevant to the majority of our audience while also at least maintaining and possibly improving the education at the interface of chemistry and biology.

This course will describe the historical connection between organic chemistry, physical chemistry and biology in its introductory part. Slowly it will provide an overview of amino acids, peptides and their recent advances; enzyme chemistry; nucleic acids- from the basic to the recent research trend toward gene detection technology and drug discovery.

Thus, this course will be an appetizer for all students of chemistry at almost any institution want to continue their study at the interface of chemistry and biology.

COURSE DETAIL

Module 1:

Introduction to Bioorganic Chemistry: Overview of Bioorganic Chemistry- Historical Connection Between Organic and Biological Chemistry; Weak Interactions in Organic and Biological World; Proximity Effect in Organic Chemistry; Molecular Recognition; Chemistry of the Living Cells; Analogy Between Biochemical and Organic Reaction. **(8 lectures)**

Module 2:

Bioorganic Chemistry of Amino Acids: Introduction-Overview of Chemical Biology; Amino Acids and their Asymmetric Synthesis; Chemistry of Peptide Bonds; Peptide Secondary Structures and Tools for Stabilization; Natural b -amino Acids and b-peptides; b-Turn Peptidomimetics; b-lactam based peptidomimetics; Expanding the Genetic Code: Background; Synthesis and Application of Unnatural Amino acids. **(11 Lectures)**

Module 3:

Bioorganic Chemistry of Enzymes: Introduction to Enzyme Catalysis and Kinetics; The Catalytic Triad; Enzyme Inhibiton and Drug design; Enzyme in Organic Chemistry; Antibody Catalyzed Organic Reaction; Enzyme Models: Biomimetic Polyene Cyclisation; Squalene Biosynthesis. **(11 Lectures)**

Module 4:

Bioorganic Chemistry of Nucleic Acids: History, Sugars and bases; Conformation of sugar-phosphate backbone; hydrogen bonding by bases; the double helix; A, B, and Z double helices; Stability of Double Helix ; DNA intercalators; Chemical synthesis of DNA; Catalytic RNA, siRNA; micro RNA; Expanding the Genetic Alphabets: Background; Synthesis and Application of Unnatural Nucleosides; Fluorescently Labeled Nucleosides and oligonucleotide probes; Single Nucleotide Polymorphism (SNPs) and Introducing Hap Map Project; Homogeneous DNA Detection; Microarray based DNA Detection; Basics of Peptide Nucleic Acids; Concepts of Antigene/Antisense Therapy; Goal for Personalised Medicine. **(16 lectures)**

Sl. No.	Lecture No.	Lecture Titles	Page No.	No. of Hours
	Module-1: Introduction to Bioorganic Chemistry (8 lectures)			**8 hrs**
	1	Defining Bioorganic Chemistry	1-13	1 hr

NPTEL

http://nptel.iitm.ac.in

Chemistry and Biochemistry

Pre-requisites:

- Organic Chemistry background specially, preliminary knowledge of organic reaction mechanisms, reactive intermediates, organic transformations, and stereochemistry. Most of the topics will be found in the NPTEL site.

Additional Reading:

1. Biochemistry Illustrated, 5th Ed., by Campbell.
2. Lehninger Principles of Biochemistry, 5th Ed. by Nelson and Cox.
3. Proteins, Enzymes, Genes: the Interplay of Chemistry and Biology by J.S. Fruton, Yale University Press, **1999**. (xii 1 783 pages).

Hyperlinks:

1	2	Biomimetic Chemistry-The Enzyme Models	13-25	1 hr
	3	Historical Connection and Weak Interactions in chemistry and biology	26-33	1 hr
	4	Proximity Effect in Organic Chemistry and Molecular Recognition;	34-42	1 hr
	5	Molecular Recognition	43-52	1 hr
	6	Chemistry of the Living Cells	53-66	1 hr
	7	Analogy Between Biochemical and Organic Reaction-I	67-75	1 hr
	8	Analogy Between Biochemical and Organic Reaction-II	76-80	1 hr

2	**Module 2: Bioorganic Chemistry of Amino Acids (11 lectures)**			**11 hrs**
	1	Overview of Chemical Biology	1-13	1 hr
	2	Amino Acids-Structure, Properties, Classes	14-22	1 hr
	3	Stereochemistry of Amino Acids and Synthesis	23-30	1 hr
	4	Peptide Bonds and Synthesis	31-39	1 hr
	5	Peptide Secondary Structures	40-48	1 hr
	6	Natural b -amino Acids and b-peptides	49-57	1 hr
	7	Biological importance of b-peptides	58-63	1 hr
	8	b-Turn Peptidomimetics	64-71	1 hr
	9	b-Turn Peptidomimetics and b-lactam based peptidomimetics	72-79	1 hr

Introduction to the Human Genome Project, published by the National Human Genome Research Institute, is aimed at students, teachers and other nonacademic institutions, will be found at **http://www.genome.gov**

Coordinators:

Dr. S.S. Bag
Department of ChemistryIIT Guwahati

	10	Expanding the Genetic Code-Background	80-88	1 hr
	11	Synthesis and Application of Unnatural Amino acids	89-96	1 hr

	Module 3: Bioorganic Chemistry of Enzymes (11 lectures)			**11 hrs**
	1	Different Facets of Enzyme Catalysis	1-17	1 hr
	2	Thermodynamics and Kinetics of Enzyme Catalysis	18-35	1 hr
	3	The Catalytic Triad	36-40	1 hr
	4	Enzyme Inhibition and Drug Design-1	41-54	1 hr
3	5	Enzyme Inhibition and Drug Design-2	55-65	1 hr
	6	Enzyme in Organic Chemistry-1	66-74	1 hr
	7	Enzyme in Organic Chemistry-2	75-83	1 hr
	8	Antibody Catalyzed Organic Reaction-1	84-97	1 hr
	9	Antibody Catalyzed Organic Reaction-2	98-106	1 hr
	10	Enzyme Models and Biosynthesis of Squalene	107-114	1 hr
	11	BiomimeticPolyeneCyclizations	115-130	1 hr

	Module 4: Bioorganic Chemistry of Nucleic Acids (16 lectures)			**16 hrs**
	1	History of Sugars and bases and Nucleic Acids-I	1-7	1 hr
		History of Sugars and bases and Nucleic Acids-II	8-14	1 hr
	2	Hydrogen Bonded Base Pairs and Double Helix	15-30	1 hr

4	3	Stability, Properties, and functions of DNA-I	31-38	1 hr
	4	Stability, Properties, and functions of DNA-II	39-43	1 hr
	5	DNA intercalators	43-47	1 hr
	6	Chemical synthesis of DNA	48-57	1 hr
	7	Catalytic RNA, siRNA; micro RNA;	58-72	1 hr
	8	Expanding the Genetic Alphabets	73-86	1 hr
	9	Fluorescently Labeled Nucleosides and oligonucleotide probes and SNPs	87-94	1 hr
	10	Hap Map Project and Homogeneous DNA Detection	95-104	1 hr
	11	Microarray based DNA Detection	105-111	1 hr
	12	Basics of Peptide Nucleic Acids	112-115	1 hr
	13	Gene Therapy-I	116-124	1 hr
	14	Gene Therapy-II	125-132	1 hr
	15	Antigene/Antisense Therapy	133-140	1 hr
	16	Goal for Personalised Medicine.	141-155	1 hr

References:

1. Hermann Dugas: Bioorganic Chemistry-A chemical Approach to Enzyme Action; 3rd Edition.
2. The organic chemistry of enzyme-catalyzed reactions, by Richard B. Silverman, Academic Press, San Diego, **2000**, 717 pp.
3. Amino acids, peptides and proteins, by J. S. Davies, Royal Society of Chemistry, UK, Vol. 35, **2006**.
4. Biochemistry, 5th Ed. (Hardcover) by Lubert Stryer, Jeremy M. Berg, and John L. Tymoczko.
5. Page, M. I. In The Chemistry of ?-Lactams; Page, M. I. Ed.; Chapman Hall **1992**, p. 79.