In the name of God

Tehran University

Institute of Biochemistry & Biophysics

Course Descriptions
Courses: Masters and Ph.D.
Field: Biochemistry

Course title: Enzymology
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☑ Ph.D. ☐ MSc & Ph.D. ☐

Course Objectives:

Students familiarity with the mechanism of action of enzymes and their qualitative and quantitative comparison with chemical catalysts, the role and importance of enzymes in industrial production and the necessity of their engineering in this regard

Headlines:

- Introduction: Illustrating the impact of enzymology on our lives through some examples from medical and biotechnological industries
- Enzyme nomenclature
- Understanding the mechanisms used by enzymes to increase reaction rate through examples from simple chemical reactions
- Mechanistic basis of chemical reactions catalyzed by cofactors
- Chemical nature of enzymatic reactions catalyzed by serine proteases, cysteine proteases, metalloproteases, aspartic proteases, ribonucleases, glycosidases
- Mechanisms of enzyme inhibitors
- Michaelis–Menten equations, Lineweaver–Burk plot, Eadie–Hofstee diagram
- Site directed mutagenesis of enzymes and its role in deciphering the mechanism of enzyme action
- Application of Recombinant DNA technology to enzyme engineering

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
30%	_____	Written Test: 70%	__ _____
		Practical: -	

References:

1. An Introduction to Enzyme and Coenzyme Chemistry, by T. Bugg, John Wiley 2012
2. Athel Cornish – Bowden, Fundamentals of Enzyme Kinetics, Portland press, 2004.

Course title: Advanced Molecular Biology
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☑ Ph.D. ☐ MSc & Ph.D. ☐

Course Objectives:

Promotion of students' knowledge on the field of molecular biology. In this course students will get familiar with the history and the experiments which led to the discovery of discussed biological phenomena. At the end they will be able to compare molecular mechanisms of replication, transcription and translation in the prokaryotic and eukaryotic system.

Headlines:

- History and philosophy of molecular biology; The concept of the gene; Forward and reverse genetics
- Genome and its organization in prokaryotes and eukaryotes; introducing of the epigenetic modifications in eukaryotic systems.
- DNA replication and its regulation in prokaryotes and eukaryotes with emphasis on the fate of chromatin modifications after DNA replication
- Mutations and DNA damage and repair in prokaryotes and eukaryotes; Genome elimination and its biological implications; Molecular mechanisms of genome instability
- Transcription and its regulation in prokaryotes
- Transcription and its regulation in eukaryotes (Chromatin structure and its effects on transcription, post-transcriptional events including RNA processing and post-transcriptional control of gene expression) and introducing of different DNA binding proteins
- Translation and its regulation in prokaryotes and eukaryotes
- Brief description of main molecular methods which have been used in the study of central dogma discussed in each session.

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
20%	_____	Written Test: 80%	__ _____
		Practical: -	

References:

1. Robert F. Weaver, Molecular Biology, latest edition, McGraw Hill; (currently 5th ed. 2012).
2. Brue Alberts, Molecular Biology of the Cell, latest edition, Garland Science; (currently 6th ed. 2015.

Course title: Biochemistry of Nucleic Acids
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☑ Ph.D. ☐ MSc & Ph.D. ☐

Course Objectives:

Students' familiarity with rotations, links, structural diversity and space building of proteins and nucleic acids RNA, DNA

Headlines:

- Definition of nucleic acids, torsion angles in nucleotides, sugar puckering, helical parameters.
- Ionization of bases, tautomeric and modified bases.
- Structure and conformation of bases, sugar and phosphate.
- Contor-diatance map, allowed and disallowed structures.
- Forces stabilizing nucleic acids, base pairing, hydrogen binding and stacking.
- Spectroscopic, thermodynamic description of base pairing.
- Polymorphism of DNA structure, Hydration, A, B, C, … H, G and Z structures.
- DNA supercoiling, nucleosomes
- Classification of RNA, Stem, Loop, and buldge structures
- RNA structures, primary, secondary, and tertiary structures, U-turn and stability.
- Degradation of nucleic acids
- Nucleoside drugs and antisense

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
5%	_____	Written Test: 85%	10%
		Practical: -	

References:

1. Saenger W, Principles of Nucleic Acids Structure, Springer, 1984
2. Cantor CR and Schimmel PR, Biophysical Chemistry Part 1 Freeman, 1980

Course title: Structure and Function of Proteins
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☑ Ph.D. ☐ MSc & Ph.D. ☐

Course Objectives:

Promotion of student's knowledge in the field of structure and function of proteins, and its relation to organism's functions.

Headlines:

- Amino acids as the basis for structure and function.
- Primary structure: peptide bound and its chemical and physical characters.
- Secondary structure: Helical structures, and structures and random structures.
- Tertiary structure: proteins three dimensional formation Domain and motifs
- Quaternary structure: proteins with number of subunits.
- Structure and function of fibrous proteins.
- Structure of membrane proteins.
- Structure of active proteins.
- Mechanism of protein folding.
- Proteins structure prediction.
- Biological function of proteins.
- Proteins biotechnology.

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
5%	30%	Written Test: 65%	__ _____
		Practical: -	

References:

1. Engelbert Buxbaum, Fundamental of Protein Structure and Function, Wiley, 2007.
2. David Whitford, Protein Structure and Function, Wiley, 2005.

Course title: Metabolic Regulation
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☑ Ph.D. ☐ MSc & Ph.D. ☐

Course Objectives:

To familiarize graduate students with various mechanisms of enzyme regulation involved in a cell's metabolism and how the signaling elements are involved.

Headlines:

- Introduction: a survey on the significance of metabolic control and regulation on well-being of biological system
- Enzymatic reactions: kinetic and thermodynamics
- Diversity of regulatory mechanisms: short/long term regulation of enzymes, influence of hormones and cell signals, influx/outflux of metabolites through biological membranes, tissue variation
- A survey on fuel digestion and absorption from the gut and lipoproteins metabolism
- Regulation in integrated metabolism of carbohydrates, lipids and proteins under different physiological conditions (fed state, hunger, work load and exercise)
- How some of the cell signaling elements influence metabolic regulation?

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 90%	__ _____
		Practical: -	

References:

1. Keith N. Frayn, Metabolic Regulation: a Human Perspective, 3rd ed, Wiley-Blackwell, 2010.
2. David M. Gibson and Robert A. Harris, Metabolic Regulation in Mammals, Taylor and Francis, 2003.

Course title: Immunobiology
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

The basic principles of the components and mechanisms of working with the immune system on human immune responses against infectious agents are outlined.

Headlines:

- Introduction to Immunobiology
- Innate Immunology
- Hematoposis
- Antigens
- Antibodies and B cell developments
- The Major Histocompatibility Complex and its Function
- T cell Receptor and T cell developments
- Antigen Processing and Presentation
- Cell Mediated Immunity
- The Humoral Immune Response
- Immune Regulation
- Immunological Tolerance and Autoimmunity

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
0%	50%	Written Test: 50%	__ _____
		Practical: -	

References:

1. Janeway's Immunobiology, Edited by K. Murphy, P. Travers and Walport, 2012.
2. Immunology, Edited by Kuby, 2013

Course title: Immunochemistry
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

The description of how the antigen and antibody are prepared, the determination of the antibody's characteristics and the kinetics of the antigen-antibody response, and hence the principles of immunosuppression will be discussed.

Headlines:

- Introduction to the Immune System and classification of Immune Assay
- Antigens and the binding protein-protein (hapten to carrier or enzymes ,fluorochromes or radioactive to antibody)
- Antibody, Preparation of polyclonal and monoclonal antibody, Isolation and purification of antibody and antibody fragments and antigen-antibody complex disassembly
- Reaction kinetics of antigen - antibody
- Methods of Immuno Assay in the broth, jelly or using antibodies attached to lable (Agglutination, precipitation, RIA, ELISA, PCR ELISA, Elispot, Dot ELISA, Western blotting)
- Immunohistochemistry
- Immunocytochemistry

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 90%	__ _____
		Practical: -	

References:

1. Principles and practice of immunoassay, Edited by C.P. Price, D.J. Newman, 1997.
2. Immunochemical protocols, Edited by R. Brun, 2005.
3. Immunochemistry, Edited by D. M. Weir, 1986.

Course title: Biochemistry of Neuronal System
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Improving student's knowledge in the field of neuron cells, glia, cellular and molecular structures and also the effect of neural system on the organism's behavior.

Headlines:

- Brain and neuronal systems anatomy.
- Limbic, cortex, spinal cord and peripheral.
- Structure of neuronal system structure and function of neural cell, structure and function of glial cells.
- Action potential, excitation, sodium – potassium pumps function.
- Functional of synapses, interaction mechanism of neurotransmitters with receptors, acetylcholine and acetylcholine esterase.
- Catecholamine's mechanism, Dopamine, Serotonin, …., Amino acids neurotransmitters, prostaglandins.
- Carbohydrates, amino acids, lipids, proteins and steroids in brain.
- PNS neural system, visual, tactile and taste.
- Introduction to neural networks in the brain.

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	10%	Written Test: 80%	__ _____
		Practical: -	

References:

1. Dale Purves, George J, Augustine, Neuroscience, Sinauer Associate Inc, 2004.
2. Eric R. Kandel, Principal of Neural Science, 5th ed. Mac Grow Hill, 2013.

Course title: Biochemistry of Cognitive Networks
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Improving student's information in the field of semantic interaction of biomolecules such as proteins, metabolites, and their activity on organism's intelligence.

Headlines:

- The anatomy of CNS such as Hippocampus Amygdale, Cortex layers and brain stem, ….
- Neural connections of interbrain cells definition of glia cells, neurons, axon, Dendrite cell membrane functions.
- Biochemical factors in brain functional networks. Neurotransmitters (acetylcholine, glutamate, GABA, Dopamine, Serotonin, Melatonin, peptides.
- Neuroprotective factors, short peptides, insulin.
- Physical factors: Electromagnetic fields.
- Behaves related to functional neuronal networks in brain, normal, neurodegenerative.
- Environmentally affected connections visual Hearing, Touch, ….
- Neurodegenerative diseases, Alzheimer, Parkinson metabolic disorders, Epilepsy.

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
5%	20%	Written Test: 75%	__ _____
		Practical: -	

References:

1. Edmund T.Rolls and Alexandro Trevis, Neural Network and Brain Function, 4th ed. MTT Press, 2009.
2. Sangeetha Menon Brain, Self and Consciousness, Springer, 2014.

Course title: Cell Signaling Biochemistry
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Description of the structural and biochemical properties of cellular symptoms and their regulation. The tools used by the cell in transmitting messages, based on the messaging organization and the interaction of the messenger paths.

Headlines:

- Basic of cell signaling
  - Cell signaling: Why, When and Where?
  - Tools for Cell signaling
  - Modular Structure of Signaling Proteins and Signaling Complexes
  - Regulatory Modification
  - Organization of Signaling
  - Signaling Networks
  - Spatial and Temporal Aspects of Signaling
- Receptors in cell signaling
  - Structure and Function of Nuclear Receptors
  - Structure and Function of Trans membrane Receptors
    - G-protein –coupled receptor
    - Receptors with Tyrosine- specific protein kinase activity
    - Receptor with Ser/Thr-specific protein kinases activity
- Intracellular Messenger Substances:"Second Messengers"
  - cAMP
  - Calciun
  - Lipid messengers
  - Reactive Oxygen Species
  - Reactive Nitrogen Species
- Mtor signaling regulation of protein synthesis and degradation
- Methods used in studying cell signaling

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
----------	_____	Written Test: 80% Practical: -	20%

References:

1. Cell Signaling Biology, Edited by Michael J. Berridge 2014
2. Biochemistry of Signal Transduction and Regulation5th Edition, Edited by G. Krauss 2014

Course title: Membrane Biochemistry
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

The purpose of this course is to introduce students to the most important biological organization, namely cell membrane, lipid and protein structures of membrane, various applications and internal and external communications of membranes.

Headlines:

- Introduction to biological membranes
- Bio membranes, Structural Organization and Basic Function
- Biosynthesis of phospholipids
- Biosynthesis of membrane proteins
- Mobility of lipids and proteins in bio membranes
- Fluidity of membranes
- Cellular cytoskeleton (Microtubule, Intermediate filament, Actin)
- Cell-Cell adhesion and communication
- Protein sorting
- Transport across cell membrane
- Passive and active transport
- Molecular mechanisms of vesicular traffic

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
5%	10%	Written Test: 60%	25%
		Practical: -	

References:

1. Harvey Lodish, et al., Molecular Cell Biology, 6th ed. Freeman Company, 2008.
2. Stillwell W., An Introduction to Biological membrane: From Bilayers to Rafts, Elsevier, 2013.

Course title: Chromatin and epigenetics
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Identification of genetic material compositions, including structural levels and their function in transcription and replication

Headlines:

- Chromatin definition and its building blocks.
- Histone proteins, classification, structure, motifs, their variants, Histone Like proteins.
- Interaction of histones with DNA, different levels of chromatin structure (solenoid, Zig-Zag, Helical ribbon, irregular model, chromatids, Centromere, telomere
- Non-histone proteins, HMGs structure and their role in chromatin structure and function.
- Epigenetic definition: histones acetylation, methylation, phosphorylation, Ubiquitination, ADP-ribosylation, DNA methylation, microRNAs (miRs).
- Active and inactive chromatin, epigenetic and histones cross-talk, histone code, HPs, SiRNA, polycombs…
- Chromatin and transcription: remodeling factors, models and epigenetic.
- Chromatin and replication, histone chaperones and histones assembly
- Chromatin and signaling, cancer and diseases.
- Seminars

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	10%	Written Test: 70%	10%
		Practical: -	

References:

1. Workman TL and Abmayr SM, Fundamentals of Chromatin, Springer, 2014.
2. Allis CD et al, Epigenetics , CSHL press Europe , 2015

Course title: Proteomics
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Students' familiarity with the application of mass spectrometers in determining the structure and function of proteins

Headlines:

- Introduction including the definitions, history and importance of proteomics and its comparison with genomics and transcriptomics
- The outline of proteomics projects
- Section 1: Mass spectrometry based proteomics
- Two-dimensional gel electrophoresis including isoelectric focusing and SDS-PAGE
- Protein staining strategies in proteomics
- DIFFERENTIAL GEL ELECTROPHORESIS (DIGE)
- Analysis of stained 2D gels
- In-gel protein digestion
- Principles of mass spectromers used in proteomics: MALDI-TOF, ESI-MS, ESI-Tandem MS
- Protein and peptide separation in proteomics including reverse phase and MudPIT
- Protein identification
  - Peptide Mass Fingerprinting
  - Protein sequencing using Tandem MS
- Studying protein modifications using mass spectrometers
- Tissue scanning by mass spectrometry
- Surface enhanced Mass spectrometry
- Isotope coated affinity Tag and its application in analytical and functional proteomics
- Section 2: Mass spectrometry independent proteomics
- Application of the affinity chromatography in identifying novel protein-protein interactions
- Yeast two hybrid
- Phage display technology
- DNA micro array
- Protein and peptide microarray
- Self-assembling protein microarray

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
30%	_____	Written Test: 70%	__ _____
		Practical: -	

References:

1. Introduction to proteomics by D. Libler, (2002)
2. Principals of proteomics (R. Twyman), (2013)
3. Methods in protein biochemistry H. Tschesche (2012)
4. Current protocols in protein science G. P. Taylor (2016)
5. Protein-Protein Interactions: A Molecular Cloning Manual, Second Edition by E. Golemis and P. D. Adams (2005)

Course title: Structural and functional studies of proteins involved in health and disease
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Familiarity with the structure and function of proteins that contribute to health and disease. Also, the knowledge and use of useful sites and software for analyzing the sequence and structure and function of proteins

Headlines:

- An introduction to amino acids and the post-translational modifications of proteins
- Protein structure: from primary to quaternary structure
- Protein function: protein with varying functions
- Structural and functional studies of proteins involved in:
  - Diet and health
  - Human diseases caused by bacteria (e.g. Listeria monocytogenes and Shigella flexneri)
  - Crop spoilage caused by bacteria (e.g. Bacillus subtilis)
  - Biosynthesis of Vitamin B12 by bacteria (e.g. Rhodobacter capsulatus)
  - Angiogenesis and neurogenesis in humans
- A brief introduction into a valuable structural method for studying proteins:
  - X-ray Crystallography
- Common softwares for protein structure visualisation, analysis and interpretation
- Protein data bank

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
5%	_____	Written Test: 80% Practical: -	15%

References:

1. Arthur M. Lesk, Introduction to Protein Science, Architecture, Function and Genomics 2nd ed. Oxford University Press, 2010.

Course title: Chaperones
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Familiarity with the main role of chaperones in terms of structure, interference in the folding, transfer, assembly of proteins and nucleic acids.

Headlines:

- Proteins synthesis, quality control, proteins folding and unfolding.
- Classification of chaperones in prokaryotes and eukaryotes.
- Heat shock proteins (GroEL, TRiC, HSP60. 70. 90, ……).
- Co-chaperones and protein folding.
- ER chaperones and glycoproteins folding.
- Chaperones in proteins aggregation/disaggregation, assembly, transport, ….
- Nucleic acids chaperones.
- Chemical chaperones and pharmacochaperones.
- Chaperones and Diseases, signaling…

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 80% Practical: -	10%

References:

1. Jackson S, Molecular Chaperones, Springer 2013.
2. Macario AJL, et al., The chaperonopathies , Springer, 2013.

Course title: Recombinant DNA methods
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Students' acquaintance with new molecular biology methods related to purification, alteration, and placement of DNA in different carriers for transfer to the cells and expression of target DNA.

Headlines:

- Different methods of separating DNA containing recombinant components, Southern Blot technique and PCR technique
- Vectors (definition, isolation and maintenance methods, plasmids, lambda virus, cosmids, single-stranded phages, animal and plant viruses
- Enzymes used, restricting enzymes, other enzymes
- Probes and their application
- Separating mRNA, making cDNA and Northern Blot, Western blot and Microarray techniques
- DNA binding to the carrier
- Carriers entering the host cells
- Recombinant Recognition (R-Mapping, PCR) methods.
- Expression of foreign genes in hosts other than E.coli
- Entry and expression of external genes in eukaryotic host (yeast, etc.)
- Entry and expression of external genes in plant cells. Examples of using the above methods, and a look at the future

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 90%	__ _____
		Practical: -	

References:

1. Karl Drlica, Understanding DNA and Gene Cloning: A Guide for the Curious, 4th Ed, Wiley and sons, 2006.
2. Dominic W. S. Wong, the ABCs of Gene Cloning, 2nd ed., Springer, 2006.

Course title: Chemical Biology of Peptides
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

The teaching of basic and applied topics in peptides and pseudo-peptides science

Headlines:

- Introduction to structure and function of peptides
- Peptides combinatorial synthesis
- Determination of the peptide sequences using the mass spectrometry
- Introduction to the click chemistry and its applications in biology
- Structure and function of glycopeptides, lipopeptides, and pegylated peptides
- Peptidomimetics: Introduction, structure and function
- Peptide foldamers

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 90%	__ _____
		Practical: -	

References:

1. Andrew B. Hughes, Amino Acids, Peptides and Proteins in Organic Chemistry, Volume 1-5, Wiley- VCH Press, 2009-2012.

Course title: Chemical Synthetic Biology
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Understanding the primary and key biochemical requirements in the design and construction of natural systems and new components synthesized in the laboratory containing the minimum living conditions based on biochemical and biophysical studies.

Headlines:

- Investigation of the probiotic chemistry and the homochirality reasons in biological macromolecules
- Self-assembly and self-replication in biological systems
- Vesicles based biological models
- Design and preparation of ribonucleic acids and proteins composed of unnatural monomers
- Design and study of routes resulted in systems with limited life conditions
- Ethical issues in chemical synthetic biology

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 70%	20%
		Practical: -	

References:

1. Pier L. Luisi and Cristiano Chiarabelli, Chemical Synthetic Biology, Wiley-VCH Press, 2011.

Course title: Medicinal Chemistry: DNA Targeting Drugs
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

To familiarize the students with the most recent strategies and in drug designs against nucleic acids

Headlines:

- Introduction: a survey on the progress of drug designs against nucleic acids
- A review on analytical tools for investigation drug: DNA interaction
- The anti-proliferative effects of some intercalating drugs
- New strategies used for design and production of mustards
- Cross-linking agents used on anticancer drugs
- Enediyene antibiotics used against DNA
- Nucleic acid sequence reading drugs
- New strategies in design of artificial restriction enzymes against nucleic acids
- New strategies in design of artificial transcription factors to block gene expression
- A survey on the application of siRNA and micRNAs to silence gene translation

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 90%	__ _____
		Practical: -	

References:

1. Robert E. Smith, Medicinal Chemistry-Fusion of Traditional and Western Medicine: pp 452-468, 2nd Ed, Betham Science, 2014.
2. David Klussmann, The aptamer Handbook: Functional Oligonucleotides and their Applications, Wiley-VCH, 2006.

Course title: Bioinorganic Chemistry
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

The study of fundamental principles in biological inorganic chemistry and the study of the structure and function of metalloproteins, metalfoldamer and the study of the role of metals in health and disease

Headlines:

- Introduction to inorganic chemistry
- Chemistry of metalloproteins
- Metallo-foldamers
- Metal ion coordination
- Metals in health and disease

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 90%	__ _____
		Practical: -	

References:

1. Gerard Jaouen, Bioorganometallics, John Wiley Press, 2006.
2. Games C. Dabrowiak, Metals in Medicine, John Wiley Press, 2013.

Course title: Design of Enzyme Inhibitors
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

To familiarize graduate students with the common strategies applied in designing enzyme inhibitors for application in pharmaceutical, biomedical and agricultural fields.

Headlines:

- Introduction: a survey on the industrial significance of enzyme inhibitor
- Classification of various strategies used in enzyme inhibitor designs
- Design of affinity-based reagents on enzyme inhibitors
- Design of photoaffinity-based reagents on enzyme inhibitors
- Design of multisubstrate-based analogues on enzyme inhibitors
- Design of transition-state-based analogues on enzyme inhibitors
- Diversity and efficacy of mechanism-based enzyme inhibitor

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
20%	_____	Written Test: 80%	__ _____
		Practical: -	

References:

1. Hsiu-Chung Yang, et al. Enzyme Technologies: Pluripotent Players in Discovering Therapeutic Agents. John Wiley and Sons, 2014.
2. Robert A. Copeland, Evaluation of Enzyme Inhibitors in Drug-Discovery: A guide for Medicinal Chemists and Pharmacologists, 2nd Ed. John Wiley and Sons Inc. 2013.

Course title: Introductory Macromolecular X-ray Crystallography
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Introduction to familiarity with the macromolecular crystallographic technique and the steps required to obtain a three-dimensional protein structure from the start, that is, the expression and purification of proteins to the end, that is, the insertion of a protein structure into a protein database.

Headlines:

- An introduction to X-ray crystallography
- Expression and purification of proteins for crystallography
- Protein crystallization
- Crystal preparation for crystallography
- Sources and detectors for data collection
- Diffraction and symmetry
- Data collection and processing
- Introduction to phasing
- Necessary softwares for data analysis and structure determination:
  - Mosflm, Scala , Molrep or PHASER, Refmac5 and Coot
- Validation and structure deposition in the Protein Data Bank

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
5%	5%	Written Test: 90%	__ _____
		Practical: -	

References:

1. David Blow, Outline of Crystallography for Biologists, Oxford University Press, First Published, 2002 reprinted 2010.
2. Gale Rhodes, Crystallography Made Crystal Clear, 3rd ed. Academic Press, 2006.

Course title: Macromolecular X-ray Crystallography 2
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: Introductory Macromolecular X-ray Crystallography
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

After familiarization with the macromolecular crystallographic technique in the lesson "Introductory Macromolecular X-ray Crystallography", this tutorial will provide you with more details and familiarity with the programs necessary to process the data, complete its review and obtain the final structure. This lesson sets out the necessary details for someone who wants to apply crystallography.

Headlines:

- A reminder on the 'Introductory Macromolecular X-ray crystallography' course
- X-ray diffraction from protein crystals and the use of Mosflm program
- Evaluation of data quality and information given through Scala, pointless and Mathews
- Routine methods used to determine protein structure; SAD, MAD, MR
- An example of a structure solved with MR using Molrep and Phaser
- Electron density map and validation using Coot program
- Refinement of data using Refmac in CCP4 program
- Validation of the final model using the Ramachandran plot
- Deposition of the final structure in the Protein Data Bank
- Assessing and visualizing the final structure using Pymol and Chimera

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
5%	5%	Written Test: 80%	10%
		Practical: -	

References:

1. David Blow, Outline of Crystallography for Biologists, Oxford University Press, Fist Published 2002, reprinted 2010.
2. Gale Rhodes, Crystallograph Made Crystal Clear, 3rd ed. Academic Press 2006.

Course title: Principles and Techniques of Electron Microscopy
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Due to the considerable application of different techniques of electron microscopes in most researches, especially in biology, biochemistry and medicine, the purpose of this course is to familiarize students with the principles, concepts and application of different techniques of electron microscopy in research, especially in biological fields.

Headlines:

- Introduction- Historical Milestones of EM
- Electromagnetic Radiation, Diffraction Phenomenon, Electrons, Waves and Resolution
- Design of Electromagnetic lenses, Design of the TEM
- Basic system making up a TEM and major operational modes of the TEM
- Specimen preparation for TEM (fixation, dehydration, infiltration of resin, Embedding, Curing of the embedment)
- Ultramicrotomy and the sectioning process, Cryo-ultramicrotomy
- Specimen staining and contrast method for TEM
- Production of the electron micrograph
- Autoradiography
- Immunocytochemistry
- Enzyme Cytochemistry
- The scanning Electron Microscope
- Specimen preparation for SEM
- Intermediate and High voltage microscopy
- Interpretation of micrographs

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 80%	10%
		Practical: -	

References:

1. John J. Bozzola and Lonine D. Russell, Electron Microscopy, Principles and Techniques for Biologist, 2nd ed. Jones and Bartlett Publishers, 1999.
2. MA Hayat, Principles and Techniques of Electron Microscopy, Biological Application, 4th ed. Cambridge University Press, 2006.
3. John Kuo, Electron Microscopy, methods in molecular biology, Third edition, Humana Press, 2014.

Course title: Advanced Topics in Biochemistry
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Students' acquaintance with molecular types and basis of cell death

Headlines:

- A-Programmed cell death
  - Introduction including the history, cell death as the basis of life in vertebrates, its role in embryogenesis and post birth
  - Intrinsic apoptosis pathway
  - Extrinsic apoptosis pathway
  - Caspases
  - Inhibitor of Apoptosis Proteins and their antagonist
  - The mechanism of action of Bcl-2 family of proteins
  - Necroptosis, lysosomal cell death, and Autophagy
  - Unfolded protein response and ER stress
  - Cancer treatment based on apoptosis
- B- Protein degadation
  - Definition, quality control, and classification.
  - Proteasomal degradation: Ub structure, Ub enzymes (E1, E2, E3….) and their mechanism of action.
  - Proteasome structure and the role of each subunit in protein degradation.
  - Mechanism of lysosomal degradation. Chaperones and protein degradation.
  - Ubiquitination of membrane proteins, lysosomal and proteasomal degradation.
  - ESCORTs in membrane proteins degradation.
  - Degradation and disease.

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
30%	_____	Written Test: 70%	__ _____
		Practical: -	

References:

1. Apoptosis Senescence and Cancer by Gewirtz, Holt, and Grant (2007)
2. Mayer RJ et al. (2006, latest ed) Protein degradation, Vols 1-3, Wiley

Course title: Methods in Genetic Engineering
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Students' acquaintance with conventional and new methods of molecular biology and genetics to make changes in DNA and genome

Headlines:

- Introduction: Definitions of genetic engineering and b biotechnology and their importance
- DNA separation technologies
- Viral and non-viral vectors and promoters
- Enzymes used in molecular biology
  - Nucleases
  - Ligases
  - Polymerases
  - Others
- Probes and their applications
- Preparation of cDNAs
- Strategies for Primer design
- PCR including Hot start, touch down, Real time, and digital PCR
- DNA sequencing, dideoxy and next generation
- Site directed mutagenesis
- Gene synthesis
- DNA transfer into viral and non-viral vectors
- Transformation of cells by vectors
- Host selection
- Identification of transformed cells using blotting techniques and PCR
- Gene expression in eukaryotic and prokaryotic hosts
- Cre-Lox technology in genetic engineering
- Genetic modification using Zinc Finger nucleases
- Clustered regularly interspaced short palindromic repeats (CRISPR) technology and its applications
- Biotechnology and genetic engineering applications

- Practical section: Growing bacteria – PCR - DNA isolation - DNA digestion and horizontal electrophoresis

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
30%	_____	Written Test: 70% Practical: -	__ _____

References:

1. An Introduction to Genetic Engineering 3rd Edition, by Desmond S. T. Nicholl (2008)
2. Transgenic Mouse Methods and Protocols (Methods in Molecular Biology) 2nd ed. by M. H. Hofker and J. Van Deursen (2011)
3. Current Protocols in Molecular Biology (2016)

Course title: Methods of extraction and identification of biological macromolecules
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

Student's familiarity with conventional biochemical methods for purification and identification of biochemical macromolecules. Students' acquaintance with the foundations of common spectroscopic methods used in biochemistry and their application in vital sciences studies.

Headlines:

- Different methods of extraction of biomolecules from natural sources (microbes, plant tissues and animals); Construction of solutions and buffers; Primary extraction of materials from raw extracts by distribution between water / organic phase, Salt precipitation, Sedimentation by organic solvents, Condensation, Isolation Filtration and centrifuges
- Purification of extractives by chromatography: General principles include Partition coefficient, Diffusion effect, Retardation factor, Retention (V, T), Column capacity, efficiency, resolution
- Types of chromatography, ion exchange, gel filtration, hydrophobic, reluctance, chromatofocusing, TLC thin film chromatography, HPLC, FPLC, etc.
- Electrophoresis: General principles of electrophoretic power, acrylamide gel (with and without) SDS, molecular weight determination, iso-electrophoresis, agar gel, two-dimensional electrophoresis, Northern, Western, Southern, Immuno-electrophoresis and identification by viscometry, calcium photometric and fractometry
- Introduction to basic concepts in spectroscopy including: HOMO and LUMO electron balance, vibrational levels, electromagnetic interactions and electrons in molecular orbitals, types of interactions of matter and electromagnetic waves, and the introduction of spectroscopic absorption and diffusion, UV-Visible spectroscopy, spectroscopic fluorescence, Spectroscopy Circular Dichroism, Spectroscopy FT-IR, NMR
- Introduction to Fluorescence Energy Transfer (FRET) and its Application in Vital Sciences
- Introduction to Light Scattering and its Application in Biochemistry
- Some Examples of Using Spectroscopic Methods in Vital Sciences

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 90% Practical: -	__ _____

References:

1. R. Katoch, Analytical Techniques in Biochemistry and Molecular Biology, Springer-verlag, 2011.
2. Gordon G. Hammes, Spectroscopy for the Biological Sciences, Wiley, 2005.
3. A. Hofmann, Methods of Molecular Analysis in the Life Sciences, Cambridge University Press, 2014.

Course title: Biomedical mass spectrometry
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

To familiarize the graduate students with mass spectrometer used in biomedical fields.

Headlines:

- Basics of mass spectrometry techniques
- Main differences of mass spectrometer used by chemists and biochemists
- Advances in molecular ionization techniques of mass spectrometer
- Mass spectrometry in characterization of biological small molecules
- Therapeutic drug monitoring by mass spectrometry
- Quantitative mass spectrometry
- Imaging mass spectrometry: Application in Oncology and Neurobiology

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
10%	_____	Written Test: 90%	__ _____
		Practical: -	

References:

1. Kenzo Hiraoka, Fundamentals of Mass Spectrometry, Springer, 2013.
2. Alisa G. Woods & Costel C. Darie, Advancements of Mass Spectrometry in Biomedical Research, Springer, 2014.

Course title: Computational Drug Design
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

An introduction to drug design by computational methods.

Headlines:

- Definition of drug and its receptor
- History and discovery of novel drugs
- Drug development process
- Main issues in drug discovery process
- Drug design process
- Ligand-based drug design
- Structure-based drug design
- Tools and computational techniques (homology modeling, molecular mechanics, protein folding, docking, pharmacophore models, QSAR, 3D-QSAR, Chemoinformatics)
- ADMET
- Virtual Screening
- Fragment-based drug design

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
20%	20%	Written Test: 30%	30%
		Practical: -	

References:

1. Young D.C. Computational Drug Design: A Guide for Computational and Medicinal Chemists. Wiley-Interscience. 2009
2. Bultinck P., Tollenaere J.P., Langenaeker W., Winter H.D. Computational Medicinal Chemistry for Drug Discovery. CRC. 2003.
3. Zheng, Y., Rational Drug Design Methods and Protocols, Springer. 2012.
4. Tari, L. W. Structure-Based Drug Discovery, Springer. 2012.

Course title: Molecular Modeling
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☐ MSc & Ph.D. ☑

Course Objectives:

To make the students familiar with basic topics in molecular modeling with emphasis on biological systems.

Headlines:

- Historical introduction to the development of methods and issues in molecular modeling.
- The mathematical expression of molecular structures, coordinate systems for describing molecular movements, coordinate and internal variables.
- Introduction to quantum approaches in molecular modeling e.g. Hartree-Fock, density function, and semi-empirical methods.
- Concepts related to potential energy surface of simple and complex molecules, minimum and saddle points.
- Energy minimization methods and algorithms, and structure optimization e.g. steepest descent, and conjugate gradient methods.
- Molecular mechanic approaches and force fields.
- Force fields for biological systems e.g. CHARMM, and AMBER.
- Methods and algorithms of analysis and searching conformations e.g. simulated annealing, and evolutionary algorithms.
- Elements of molecular dynamics simulation
- Concepts and methods of molecular structure analysis, structural similarity measurement, structural superposition, coarse-grained coordinate calculation e.g. radius of gyration, RMSD, number of atom contacts, accessible surface area, …
- Methods for the description of the solvent and its effects on molecular modeling, including implicit and explicit solvent models, generalized Born model and multicenter models
- Methods of analysis and prediction of protein-ligand binding e.g. molecular docking.

Evaluation Method

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
40%	30%	Written Test: 30%	0%
		Practical: -	

References:

1. Molecular Modeling Principles and Applications, Andrew R. Leach, Pearson Education, 2001.
2. Molecular Modeling of Proteins, Andreas Kukol, Springer (Humana Press), 2008.
3. New Algorithms for Macromolecular Simulation, T. J. Barth, M. Griebel, D. E. Keyes, R. M. Nieminen, D. Roose, T. Schlick, Springer, 2006.

Course title: Glycolipobiology
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☑ MSc & Ph.D. ☐

Course Objectives:

Familiarity with the Structure and Importance of Glycoproteins and Proteolipids in Biology and Major Applications in Biology of Glycans and Lipoproteins

Headlines:

- Introduction: Biological role of Glycan
- The diversity and common structural features of glycoproteins and glycolipids
- Cell position(s) of Glycosylation of proteins in different physiological conditions
- Enzymes involved in glycosylation of proteins
- Glycans detecting proteins, their categorization and their diagnostic principles
- The most modern methods of structural analysis of glycoproteins and glycolipids
- Glycans involvement in bacterial, viral and other human diseases, especially cancer and metastases
- The position of Glycans in the pharmaceutical industry
- The position of biotechnology in the production of Glycans

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
20%	_____	Written Test: 80%	__ _____
		Practical: -	

References:

1. Susan A. Brooks et al., Functional and molecular Glycobiology, Bios scientific publishers, 2002.
2. Ajit Varki, et al., Essential of Glycobiology, 2nd Ed, Cold Spring Harbor, 2009.

Course title: Advanced Biochemistry of Proteins and Nucleic acids
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☑ MSc & Ph.D. ☐

Course Objectives:

Study of chemical changes in proteins by binding small molecules and macromolecules and interacting proteins with nucleic acids

Headlines:

- Introduction to protein and nucleic acids structure and function, structural and functional motifs.
- Proteins modifications through binding of small molecules, methyl, acetyl….
- Modifications of proteins through glycosylation, acylation, ADP-ribosylation., Ubiquitination, motifs, structure and function.
- Interaction of proteins with nucleic acids at amino acids and nucleotides level.
- Structural motifs SPK, HMG-box…..
- Interaction of regulatory proteins with DNA, HTH, HLH, Zinc finger, Leu-zipper and other motifs
- Interaction of proteins with RNAs, RRM, KH and …. Motifs.
- Seminars

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
20%	_____	Written Test: 80%	__ _____
		Practical: -	

References:

1. Branden & Tooze (latest edition) Introduction to protein structure, Garland Pub.
2. Walsh CT (2006) Post translation modification of proteins, RC Pub.
3. Rice PA, Correl CC (2008) Protein-Nucleic acid interactions, Structural biology, RSC Pub.

Course title: Mechanism of enzyme action
Number of units: 2
The number of hours: 32
Unit type: Theoretical
Course type: Specialized-Optional
Prerequisite: -
Practical training: has it ☐ doesn't have ☑ Scientific journey ☐ Workshop ☐ Laboratory ☐ Seminar☐
Degree: MSc ☐ Ph.D. ☑ MSc & Ph.D. ☐

Course Objectives:

Familiarity with the required techniques and the way of study the mechanism of action of enzymes and interpreting the results of the studies with several examples with the aim of capability in the design of drugs, insecticides and other materials of industrial value.

Headlines:

- The importance of studying the mechanism of action of enzymes
- Different and general methods of Chemistry of enzymes:
  - Catalysis by approximation
  - Catalysis by covalent modification
  - Acid/base catalysis
  - Strain catalysis
- Important methods for determining the mechanism of action of enzymes:
  - Kinetic tools
  - Use of labeled materials
  - Use of inhibitors
  - Use of various Spectroscopic Techniques
  - Use of Space Chemistry
- A comprehensive review of the mechanisms of action of the enzymes from the following groups:
  - Isomerization reactions
  - Molecular displacement reaction
  - Exclusion and elimination reactions
  - Carboxylation and dicarboxylation reactions
  - Oxidation and resuscitation reactions

Evaluation method:

Continuous evaluation (To be specified in percentage)	midterm (To be specified in percentage)	Final Test (To be specified in percentage)	Project (To be specified in percentage)
30%	_____	Written Test: 70%	__ _____
		Practical: -	

References:

1. Christopher Walsh, Enzymatic reaction mechanisms; Freeman and Co., N. Y., 1979.
2. Perry A. Frey and Adrian D. Hegeman, Enzyme Reaction Mechanism, Oxford university press, 2007.