

COURSE TITLE
BIOCHEMISTRY
(Chemistry Bachelor)

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Classroom site: Viale delle Scienze, Building 17, Room D

Credits (CFU) = 8

COURSE PROGRAM

face-to-face lectures (64 hrs, 8 CFU)

The cell Organizations, biological membranes, cellular compartmentation, the concept of metabolism.

Amino acids General properties and functions, amino acids of proteins, chemical and functional classification, acid–base properties, isoelectric point.

Proteins Biological functions, peptide bond, natural peptides, primary structure and methods of study, post–translational modifications, secondary structure, fibrous proteins (keratin, fibroin and collagen), tertiary structure, supersecondary structures, domains, quaternary structure, allosterism, prion proteins, denaturation and renaturation, folding, chaperonins, HSP, protein classification, plasmatic proteins.

Hemoglobin Structure, oxygen transport, allosteric behaviour, Monod and Koshland theories, the Hill plot, factors influencing hemoglobin oxygenation, the Bohr effect, hemoglobin as pH buffer, formation and transport of bicarbonates, biological buffers, respiratory acidosis and alkalosis, myoglobin, metahemoglobin, pathological hemoglobin, talassemia, hemoglobin synthesis and degradation, biliary pigments, human iron metabolism.

Enzymes Nomenclature and classification, catalytic power, specificity, enzyme-substrate complex, active site, general mechanisms of enzymatic catalysis, enzyme effects on the substrate, dependence of reaction rate from diverse factors, holoenzymes, coenzymes, enzymatic kinetics (K_m and V_{max}), reactions with two substrates, enzymatic inhibition, allosteric enzymes and their kinetics, enzymatic control and regulation, multienzymatic complexes and multifunctional enzymes, isoenzymes, mentions of clinical enzymology.

Vitamins Classification, vitamins: B1, B2, B6, B12 - nicotinic acid and pyridinic nucleotides, pantothenic acid, biotin, folic acids, lipoic acid, vitamins: C, A, D, E, K.

Glucids Monosaccharides and their derivatives, disaccharides, oligosaccharides, storage and structural polysaccharides, glycoproteins, proteoglycans, digestion and absorption, use of glucose, glycogen synthesis and glycogenolysis, hormonal and metabolic control, the Cori cycle, alanine cycle, glycogenesis, glycolysis and its regulation, substrate-level phosphorylation, lactic acid and alcohol fermentation, bypass of 2,3-bisphosphoglycerate, shuttle vectors, oxidative decarboxylation of pyruvic acid, acetyl-CoA, Krebs cycle: regulation and biosynthetic role, anaplerotic reactions, the glyoxylic acid cycle, the pentose cycle, role of NADPH, malic enzyme, gluconeogenesis and glycolysis, metabolic and hormonal regulation.

Free energy variation Electron transport, the respiratory chain, coenzyme Q, cytochromes, oxidative phosphorylation, molecular mechanism, respiratory control, ATP transport, hydrogen peroxide formation and degradation, superoxide ion, reactive oxygen species, hydroxylation reactions.

Membrane transport Passive, facilitated, active transport, Na-K ATPase, glucose pump, Ca ATPase.

Lipids Fatty acids, eicosanoids, simple and complex lipids, cholesterol, biliary acids and salts, biomembranes, lipid digestion and absorption, lipid and plasma lipoproteins transport, synthesis and degradation of fatty acids, desaturation and chain elongation reactions, propionate metabolism, ketogenesis and ketolysis, triglyceride, phospholipids and glycolipids synthesis and degradation, cholesterol synthesis and degradation, metabolic and hormonal regulation of lipid metabolism.

Amino acids metabolism Protein digestion and amino acids absorption, gamma-glutamyl cycle, transamination, deamination, transdeamination, ammonia's role in biologic systems, ammonia elimination in animal species, ureogenesis, glutamine, amino acid decarboxylation, biogenic amines, polyamine, metabolism of aromatic amino acids, tryptophan and methionine.

Nucleotides and nucleic acids Nucleotides structure and function, purinic nucleotides synthesis and degradation, uric acid, pyrimidinic nucleotides synthesis and degradation, nucleic acids, DNA, nucleosomes, RNA.

Hormones Definition and properties, receptors, general mechanism of hormone action, signal transduction, hormone-receptor complex, cyclic AMP cascade, G proteins, Protein kinase A, the RAS oncogene, cyclic GMP, NO, NAF, phosphoinositides cascade, protein kinase C, Ca-calmodulin dependent protein kinase, tyrosine kinase receptors, mechanism of action of the steroid and thyroid hormones, growth factors, mechanism of action of the insulin, glucagon, glycemic control, hormones of adenohypophysis and neurohypophysis, catecholamines, thyroid hormones, parathormone, calcitonin.

TEXTBOOKS

- David L. Nelson, Michael M. Cox — “I principi di biochimica di Lehninger”
(English Title: Lehninger principles of biochemistry) — Zanichelli
- Jeremy M. Berg, John L. Tymoczko, Lubert Stryer — “Biochimica”
(English Title: Biochemistry) - Zanichelli