

**COURSE OF MEDICINE AND SURGERY**  
**Student Handbook a.y. 2014-2015**

**BIOCHEMISTRY**

II Year	Scientific Field	DISCIPLINE	TUTOR
<b>Biochemistry</b>	BIO/10	<i>Biochemistry</i>	<b>Antonello Rossi</b>
	BIO/11	<i>Molecular Biology</i>	<b>Gennaro Melino</b>
<b>ECM 14</b> <b>Coordinator</b> Antonello Rossi			<b>Giampiero Mei</b>
			<b>Maria Valeria Catani</b>
			<b>Almerinda Di Venere</b>
			<b>Alessandra Gambacurta</b>

**PROGRAM**

MOLECULAR BIOLOGY. Biochemical aspects of the transmission of genetic information. The DNA: nucleosides , nucleotides, the primary structure . Secondary structure of DNA (B, A , Z); differences in the configuration of deoxy -ribose and other structural features. Properties of DNA in solution , hyperchromic effect , denaturation and renaturation. Hybridization. Enzymatic hydrolysis and nucleic acid chemistry. Exonuclease and endonuclease . DNA superhelix , bond number , topoisomerase . Dimensions of DNA. Localization and compaction in prokaryotes and eukaryotes. Histones, nucleosomes, chromatin ( structure and function) . Duplication. Semiconservative DNA synthesis and bidirectionality. The duplication in prokaryotes: Mechanism of action of DNA polymerase. Correcting errors during polymerization. Role of DNA polymerase I and III. Synthesis of fast and delayed strand, Okazaki fragments. The replisome and the enzymes involved. The duplication of the bacterial chromosome . The duplication in eukaryotes: Similarities with that of prokaryotes. DNA polymerase and accessory proteins. Duplication of chromosomes, their ends' and the role of telomerase. Duplication errors. Damage to the DNA deamination of the bases, alkylating agents, intercalating agents, radiation. Mechanisms of DNA repair: direct repair, excision of base or nucleotide. Restriction endonuclease. Biological role and specificity. Palindrome sequences . Their use to study DNA . DNA sequence. Sanger method . RNA . Chemical structure and types . Alkaline and enzymatic hydrolysis. Mechanism of action of ribonuclease. Biosynthesis of RNA (transcription). Promoter sequences. Initiation, elongation, termination of transcription. The enzymes of the transcription in prokaryotes and eukaryotes. . Maturation of ribosomal and transport RNA in prokaryotes and eukaryotes. Enzymes involved. Exons and introns. Autosplicing. Maturation of eukaryotic mRNA: cap insertion, polyadenylation, removal of introns (splicing). Genetic code. Properties and characteristics of the genetic code : codons, universality, degeneration, synonymous codons. Genetic code in mitochondria. Protein synthesis. tRNA . Secondary and tertiary structure, and properties. Activation of amino acids, aminoacyl synthetases. The place of initiation, elongation and termination of translation. Polyribosomes. Energy cost of protein synthesis. Post-translational modifications in proteins. Regulation of transcription. In prokaryotes: Recognition of promoters and factors In eukaryotes: Interaction between proteins and major or minor groove of DNA. Assembly of the transcription complex and the role of transcription factors. Transcription factors to genes of class I, II and III. Hormone receptors. Role of chromatin in the regulation of transcription, histone tails and chromatin conformation, histone acetylase and deacetylase.

Molecular biology techniques : Southern , Northern, Western blotting , plasmids , cloning, recombinant DNA, cDNA , PCR , expression vectors , site-directed mutagenesis . Recombinant proteins. The techniques of molecular biology in the diagnosis of genetic diseases.

**BIOCHEMISTRY**

Proteins: Amino acids: structure and classification. Stereoisomerism. Acid-base properties. Peptide bond. Peptides of biological importance. Primary, secondary, tertiary, quaternary structure of proteins and bonds stabilizing structures.

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Blood proteins and enzymes: Structure, function, diagnostic significance. Albumin. Fibrinogen and mechanisms of blood coagulation. Globulins. High and low density lipoproteins. Heme proteins. Transport and use of oxygen: hemoglobin and myoglobin; structure to function relationship, properties and allosteric cooperativity . Structural proteins; collagen.

Enzymes. Concept of catalysis. Properties of enzymes as catalysts. Classification. Kinetics of reactions enzyme. Michaelis- Menten constant. Factors that affect enzyme activity. Enzyme inhibition. Active sites and allosteric sites. Mechanism of action of enzymes: effects of proximity and orientation, acid-base catalysis , covalent catalysis. Concept of isoenzyme. Enzyme cofactors .

Water-soluble vitamins. Structures and roles as enzyme cofactors.

Carbohydrates. Mono and disaccharides of biological importance. Reserve and structural polysaccharides: starch, glycogen , cellulose; pectin; mucopolysaccharides; dextran. Polysaccharides such as components of bacterial cell walls. Polysaccharides of fundamental substances of animal tissues. Protein N- glycosylated and O- glycosylated. Carbohydrates such as carriers of information.

Lipids. Classification and structure. Properties of fatty acids. Essential fatty acids. Prostaglandins, thromboxanes and leukotrienes. Neutral fats. Phospholipids. Glycolipids. Steroids. Lipids as structural components of the membranes. Lipids deposit as intracellular metabolic fuel .

Fat-soluble vitamins A, D , E, K. Structures and biochemical functions.

Bioenergetics. General principles of chemical thermodynamics. Oxidation-reduction potential. ATP; its role in energy use. Phosphorylation at the substrate level. Mitochondrion. Respiratory chain and its components. Oxidative phosphorylation. Coupling of oxidative phosphorylation to electron transport .

Chemiosmotic mechanism. Energy balance. Uncoupling agents and inhibitors of oxidative phosphorylation .

Some methods of biochemistry investigation and related applications. Centrifugation. Spectroscopic techniques. Electrophoresis techniques.

Digestion and absorption of carbohydrates, lipids and proteins.

Cycles and main metabolic pathways and their interconnection.

Glycolysis. Krebs cycle. Via pentose - phosphate. Glycogen synthesis and glycogenolysis. Gluconeogenesis. - oxidation of fatty acids. Other routes of fatty acid oxidation. Ketogenesis. Biosynthesis of fatty acids .

Biosynthesis of triglycerides. Biosynthesis and catabolism of cholesterol and of its derivatives. Catabolism of proteins. General metabolism of amino acids: transamination, deamination, decarboxylation. Urea cycle.

Biosynthesis and catabolism of heme .

Biosynthesis and catabolism of purine and pyrimidine.

Metabolism of oligoelements.

Overall regulation of metabolism.

### Textbooks

Nelson, Cox, Lehninger Principles of Biochemistry 5th Ed  
Christopher K. Mathews, Kensal E. van Holde, Dean R. Appling and Spencer Anthony-Cahill, Biochemistry, 4th Ed

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**EXAM METHOD**

Oral exam.

**EXAM COMMISSION**

<b>Antonello Rossi (President)</b>			
<b>Gennaro Melino</b>			
<b>Giampiero Mei</b>			
<b>Maria Valeria Catani</b>			
<b>Almerinda Di Venere</b>			
<b>Alessandra Gambacurta</b>			



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