**"Pathobiochemistry" topics for the complex exam**

**Principles of pathobiochemistry (metabolic processes and disturbances)**

* Perturbations in intracellular protein balance – abnormal proteins
* Pathobiochemistry of the secretory pathway
* Disorders of oxygen homeostasis, the hypoxia pathway and its pathobiochemical implications
* Immunopathobiochemistry – allergy
* Mitochondrial diseases
* Pathobiochemistry of peroxisomes
* Pathobiochemistry of cytoskeleton
* Pathobiochemistry of extracellular matrix
* The molecular basis of tumorigenesis
* Apoptosis – autophagy
* The insulin signaling pathway system, pathobiochemistry of diabetes mellitus
* Overview of cholesterol metabolism, function of transcription factors involved in its regulation, disorders of cholesterol metabolism
* Steroid metabolism, its pathological implications and possible corrections
* Role of the liver in the integration of metabolic processes
* The scheme of biotransformation, its main reactions and enzymes
* Alcohol metabolism and pathobiochemistry of alcoholic liver injury
* Mediators and signaling pathways involved in the regulation of hemostasis, endothelium and its dysfunction, coagulation and its disorders
* Pathobiochemistry of psychiatric diseases
* Pathobiochemistry of ageing

*Recommended textbooks for preparation:*

*József Mandl, Raymund Machovich: Medical Pathobiochemistry*

*Lehninger-Nelson-Cox: Principles in Biochemistry*

*Devlin: Biochemistry*

**Molecular biology**

* Deciphering the human genome, individual genome programs, DNA sequencing methods
* DNA sequence variations: polymorphisms and mutations
* Replication in prokaryotes and eukaryotes, properties of DNA polymerases and their use in polymerase chain reaction (PCR)
* Application of PCR in the clinical setting, genetic counselling
* Mechanism of transcription in prokaryotes and eukaryotes
* Regulation of eukaryotic transcription (methylation, histone acetylation)
* Regulation of eukaryotic transcription (transcription factors, enhancer/silencer sequences)
* Study of DNA-protein interaction (electrophoretic mobility shift, EMSA), chromatin immunoprecipitation (ChIP, ChIP-on chip and ChIP-Seq)
* RNA maturation processes, types and role of small RNAs
* Protein synthesis in prokaryotes and eukaryotes, regulation at translational level
* Post-translational processes and regulatory mechanisms
* Recombinant DNA technologies: cloning, reporter genes, expression vectors
* In vitro translation and overexpression of proteins under investigation in eukaryotic cells
* Gene expression analysis using quantitative RT-PCR and Western blot
* Identification of unknown protein using protein sequencing
* Production and application of aptamers
* Controlled mutagenesis in vectors, gene knockout and gene silenced animal models
* Principle of recombinant drug development
* The potential of gene therapy

*Recommended textbooks for preparation:*

*Lehninger-Nelson-Cox: Principles in Biochemistry*

*Devlin: Biochemistry*

**Molecular basis of the regulation of cell functions**

* Types of receptors for extracellular signals, overview of the different signaling pathways
* Ion channels
* Structure of receptors with heterotrimeric GTP-binding proteins, function of heterotrimeric GTP-binding proteins
* Protein kinases and phosphoprotein phosphatases (grouping, structure, function, role), characteristics of the best known protein kinases
* Detailed characterization of the cAMP-mediated signaling pathway
* cGMP signaling pathways, NO as a chemical signal
* Ca2+ as an intracellular mediator
* Main components of signaling pathways triggered by receptors with tyrosine kinase activity
* Function of small molecule GTP-binding proteins, mechanism and role of p21 ras activation
* Signaling pathways from cell organelles, endoplasmic reticulum stress response
* Cross-talk between different signaling pathways
* Cytokine receptors and signaling pathways
* Mechanism of T-lymphocyte activation
* Function of transcription factors regulated by phosphorylation/dephosphorylation
* Signaling pathways with intracellular receptors, "nuclear receptors" binding hormones and metabolic intermediates
* Protooncogenic/oncogenic products in relation to signaling pathways
* Function of protein kinases involved in cell cycle regulation, regulatory mechanism at the G2/M junction
* Role of tumor suppressor gene products in cell cycle regulation

*Recommended textbooks for preparation:*

*József Mandl, Raymund Machovich: Medical Pathobiochemistry*

*Lehninger-Nelson-Cox: Principles in Biochemistry*

*Devlin: Biochemistry*