Topic list 1 to the exam*
in Biochemistry and Molecular Biology

(*On the exam students choose two topics)

A1.
Energetics an factors that determine the direction of (bio)chemical processes, high energy bonds, high energy compounds.

A2.
The nucleotides, the concept and storage of system information. The primary and secondary structure of. Proteins that influence/change the secondary structure.

A3.
The tertiary structure of nucleic. Nucleosomal and higher structural organizations of the DNA.

A4.
The problems and roles of the replication process, and their solutions: the functions and enzymatic features of the (core) polymerase complex. The elongation reactions during replication, the direction and mechanism. Supplementary functions and processes in the replication fork.

A5.
The initiation and termiantion processes during replication. Finishing works. Replication strategies.

A6.
The causes, frequency and dangers of changes in the DNA encoded information, Ames' test, repair mechanisms.

A7.
The definition of genetic and extragenetic information and the gene and its structure. Features of the structural segment of genes. The role of the regulatory part of genes. The function of signals. Genome density.

A8.
Possible ways and main characters of rearrangements in the genome: examples with their mechanisms.

A9.
Types and functions of RNA-s. RNA polymerases and their functions, the comparison of properties of RNA and DNA polymerases. The initiation, elongation and termination of RNA synthesis, some inhibitors of RNA synthesis.

A10.
The roles and nature of the post-transcriptional modification processes. mRNA export to the cytosol, factors that determine the half life of mRNA.

A11.

Amino acid activation, the role and significance in translation of coupling the amino acids to tRNA-s. The structure of ribosome. The initiation of translation in prokaryotes and eukaryotes.

A12.
The elongation of the polypeptide chain, the roles of elongation factors, factors that ensure the fidelity of translation. Termination of translation, the dynamics and energetics of protein synthesis.

A13.
Some inhibitors of translation (cycloheximide, chloramphenicol, streptomycine, teracycline. The cooperation of ribosomes and the endoplasmic reticulum in the formation of some of the proteins in eukaryotes. Post-translational modifications and their roles. The types of glycosylations and the tarns-glycosylation reactions. Targeting and transport of proteins into the different compartments of a cell. Factors that determine the half life of proteins, intracellular protein degradation.

A14.
Types and mechanisms of regulation of gene expression. Examples of prokaryotic gene expression regulation (the Lac- and Trp-operon).

A15.
The mechanism of gene expression regulation in neukaryotes. The epigenetic information and its function along with the chromatin structure on gene expression.

A16.
The levels of control in the realization of molecular system information (genetic information). The control of mRNA stability as a possible means of quantitative regulation of enzymes. The possibilities, the extent and necessity of changes and variations in the system information in the molecular adaptation of organisms and species.

A17.
Molecular biotechnologies: the principles of cloning, and the utilization of molecular biotechnology in research and technology. Biological system informatics: the principles and applications of genomics (genome analysis), transcriptome and proteome analysis (with some examples).

B18.
Structure and chemistry of amino acids and the peptide bond. Primary sequence and sequence comparisons.

B19.
The secondary, tertiary and quaternary levels of organisation in the structure of proteins and their stabilisation, intermediate structure elements.

B20.
Native, denatured and aggregate state of proteins. The driving forces behind protein folding.

B21.
The role of the primary structure in the formation of the tertiary structure and function. The mechanism of protein folding, the main steps in the folding process, folding in vivo, the catalyst of foldin.

B22.
The kinetic description of single-substrate enzyme ractions, kinetic parameters, measures of enzyme activity the diagrams of enzyme ractions.

B23.
Interpretation of enzyme catalysis (rate enhancement). The optimal range of kinetic parameter values.

B24.
Structural interpretation of enzyme reactions, reaction models. Types of complex enzyme mechanisms. Characteristics of modulated enzymes.

B25.
The kinetics and mechanism of reversible inhibiton types of enzymes. The irreversible inhibition.

B26.
The influence of physiololgical conditions on the activity of enzyme: the adaptation of enzymes to the physical and chemical conditions of their environment. Control of catalytic activity with proteolysis and employing isozymes.

B27.
Control of catalytic activity with allostery and with reversible chemical modification.

B28.
The main characteristics of substarte conversion reactions. The structural basis of substarte specificity in pancreatic serine proteases.

B29.
The mechanism of peptide bond hydrolysis by enzymes which use active serine: the stages and steps in the reaction, the energetics of the reaction.

B30.
The structural basis of O_2 binding in myoglobin, structural mechanisms for avoiding the toxic effects of O_2, the toxicity of CO.

B31.
Molecular adaptation I - Structural mechanisms of hemoglobin in the O_2 transport function: the structural basis of accelerating the rate of O_2 exchange and of the incerase in O_2 carrying capacity.

B32.
Molecular adaptation II - hemoglobin variants and their adaptive value.