COURSE LAYOUT

1. GENERAL

SCHOOL	**ANIMAL BIOSCIENCES**		
DEPARTMENT	**ANIMAL SCIENCE**		
STUDY LEVEL	**Bachelor**		
COURSE CODE	**0504**	**SEMESTER**	**3rd**
COURSE TITLE	**INTRODUCTION IN THE BIOCHEMISTRY OF ANIMAL ORGANISMS**		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**ECTS**
Theory: Lectures	2	
Laboratory	2	
		4

COURSE TYPE	Foundation
PREREQUISITES	-
LANGUAGE	Greek
IS THE COURSE OFFERED forERASMUS STUDENTS?	No
COURSE WEB PAGE (URL)	-

2. LEARNING OUTCOMES

Learning Outcomes

The course "Introduction in the Biochemistry of Animal Organisms" aims to familiarize students, in theoretical and practical level, with the biochemistry, i.e. the chemical reactions that take place in the living organisms.

In particular, the course aims to present the structures of macromolecules and how they interact with each other. It gives an introduction i) to the methodology and techniques for the study of macromolecules, ii) to enzymology and the biological role of enzymes, iii) to the flow of genetic information and the role of nucleic acids and, finally, iv) an introduction of the structure and function of biological membranes.

Furthermore, the objective is to combine the knowledge of biomolecules and the basic processes which are involved in basic metabolic pathways of the animal organisms.

Additionally, the course focuses on the understanding of the production, homeostasis and consumption of energy to promote basic features of metabolic processes which are common and evolutionarily conserved in organisms and defined by the information encoded in their genomes.

The aim is to introduce the intermediary metabolism and its regulation together with a picture of the information flow from genes to proteins and the different types of RNA.

General Competenses

- Individual and group work

- Producing new research ideas
- Design and management of projects
- Promotion of free, creative and inductive thinking
- Respect for the natural environment

3. COURSE CONTENT

DESCRIPTION OF LECTURE PROGRAMME

THEME	CONTENT OF THE THEME
Molecular design of life	Definition and object of biochemistry. Monomers and characteristics of biological polymers. Relation between form and function. Chemical bonds in biochemistry. Energy transformations. Water and its biological functions.
Basic compositions of food (feed) and animal organism	Key organic and inorganic molecules used by living systems.
Protein structure and function	Structural and functional classifications of proteins. Primary Structure: amino acids are linked by peptide bonds to form polypeptide chains. Secondary structure: polypeptide chains can fold into regular structures such as the α-helix, the β-sheet, and turns and loops. Tertiary structure: water-soluble proteins fold into compact structures with non-polar cores. Quaternary structure: polypeptide chains can assemble into multi-subunit structures. The amino acid sequence of a protein determines its three-dimensional structure.
Exploring proteins	Purification of proteins. Determination of amino acid sequences by automated Edman degradation. Immunology techniques to investigate proteins. Peptide synthesis by automated solid-phase. Three-dimensional protein structure determination by NMR spectroscopy and X-Ray crystallography.
DNA, RNA, and the flow of genetic information	Structure of nucleic acids. Nucleic acid chains with complementary sequences can form a double-helical structure. DNA is replicated by polymerases that take instructions from templates. Gene expression is the transformation of DNA information into functional molecules. The genetic code. Amino acids are encoded by groups of three bases starting from a fixed point. Most eukaryotic genes are mosaics of introns and exons.
Exploring genes	Basic tools of gene exploration. Recombinant DNA technology. Manipulation of eukaryotic genes. Novel proteins by site-specific mutagenesis.
Enzymes: basic concepts and kinetics	Enzymes are powerful and highly specific catalysts. Classification of enzymes. Mechanisms of enzyme action. Free energy is a useful thermodynamic function for understanding enzymes. Enzymes accelerate reactions by facilitating the formation of the transition state. Catalytic strategies. The Michaelis-Menten model and the kinetic properties of enzymes. Regulation of enzyme activity. Enzymes can be inhibited by specific molecules. Isozymes: means of regulation specific to distinct tissues and developmental stages. Covalent modifications and regulating enzyme activity. Activation of enzymes by specific proteolytic cleavage.
Carbohydrates	Monosaccharides. Complex carbohydrates. Carbohydrate attachment to proteins: glycoproteins.
Lipids and cell membranes	Classification and characterization of lipids. Simple and complex lipids. Fatty acids are key constituents of lipids. Types of membrane lipids. Common features and the diversity of biological membranes. Compartments bounded by internal membranes.

Membrane channels and pumps	Active and passive transport of molecules across a membrane. ATP hydrolysis ions transport across membranes. Secondary transporters. Ion channels. Gap junctions and communication between cells.
Metabolism: basic concepts and design	Characterization of metabolism. Coupled and interconnecting reactions. Oxidation of carbon fuels and cellular energy. Metabolic pathways. Signal-transduction pathways.
Glycolysis and gluconeogenesis	Glycolysis: an energy-conversion pathway in many organisms. Control of the glycolytic pathway. Synthesis of glucose from non-carbohydrate precursors. Reciprocal regulation of gluconeogenesis and glycolysis.
The citric acid cycle	Entry to the citric acid cycle and metabolism through it are controlled. The citric acid cycle as source of biosynthetic precursors.
Oxidative phosphorylation	Oxidative phosphorylation in eukaryotes and mitochondria. Oxidative phosphorylation and electron transfer. The four complexes of the respiratory chain: three proton pumps and a physical link to the citric acid cycle. Proton gradient and synthesis of ATP. Regulation of cellular respiration and the need for ATP.
The pentose phosphate pathway	Generation of NADPH and synthesis of five-carbon sugars. The metabolism of glucose 6-phosphate by the pentose phosphate pathway and its coordination with glycolysis.
Glycogen metabolism	Glycogen breakdown and the interplay of enzymes. Phosphorylase's regulation by allosteric interactions and reversible phosphorylation. Epinephrine and glucagon signal the need for glycogen breakdown. The different pathways for glycogen synthesis and degradation. Reciprocal regulation of glycogen breakdown and synthesis.
Fatty acid metabolism	Triacylglycerols are highly concentrated energy stores. Processing stages for the utilization of fatty acids as fuel. Additional steps for the degradation for certain fatty acids. Synthesis and degradation of fatty acids by different pathways. Elongation and unsaturation of fatty acids by accessory enzyme systems.
Protein turnover and amino acid metabolism	Degradation of proteins to amino acids and its regulation. Removal of nitrogen. Ammonium ion and its conversion into urea in most terrestrial vertebrates. Carbon atoms of degraded amino acids act as major metabolic intermediates. Digestion and absorption of proteins. The biosynthesis of amino acids and its regulation. Inborn errors in amino acid metabolism.
Nucleotide biosynthesis	Synthesis of the pyrimidine ring and of purine bases. Key steps in nucleotide biosynthesis.
The biosynthesis of membrane lipids and steroids	Cholesterol biosynthesis and its regulation. Important derivatives of cholesterol: bile salts and steroid hormones.
Storage, transfer and expression of the genetic information	DNA replication, recombination, and repair. RNA synthesis and splicing. Types of RNA molecules. Protein Synthesis. The control of gene expression.
The integration of metabolism	Highly interconnected pathways. Metabolic profiles of different organs. Food intake and starvation induced metabolic changes. Hormonal control of metabolism.

DESCRIPTION OF LAB PROGRAMME

THEME	CONTENT OF THE THEME
	Use of laboratory devices. Laboratory safety. General notions about solutions.

Introduction of laboratory methods	Titration of solutions with indicators.
	Preparation of buffers. Measurement of pH.
	Volumetric analysis based on reactions of neutralization, reduction-oxidation, precipitation and complex formation.
Amino acids	Increase of acidity of an amino acid after commitment of the amino group.
	Characteristic reactions of detection of amino acids. a) Reaction of ninhydrin b) Reaction of xanthoprotein c) Reaction of tryptophan (Hopkins-Cole Reaction)
Proteins	Biuret Reaction. Denaturation of proteins after heating. Aggregation of denatured protein.
	Precipitation of proteins with trichloroacetic acid
	Identification of casein's isoelectric point
Enzymes	General characteristics of enzymes' catalytic activity. Determination of enzymes' activity.
	Reference curves for identification of p-nitrophenol.
	Acidic phosphatase's catalytic activity.
	Kinetics of acidic phosphatase in relation to the time of incubation.
Carbohydrates	General reaction of carbohydrates – Molisch Reaction.
	Isolation of glycoprotein (mucin) of saliva and detection of additive group
	Benedict Reaction.
	Hydrolysis of starch with hydrochloric acid.
Nucleic acids	Reaction of purines.
	Qualitative reactions of pentoses - Tollens Reaction.
	Qualitative reactions of pentoses – Dieshe Reaction.
	Reaction of phosphate with the Molybdenum Reagent.

4. TEACHING and LEARNING METHODS - EVALUATION

TEACHING METHOD	In class, face to face.
USE OF INFORMATICS and COMMUNICATION TECHNOLOGIES	- PowerPoint and video presentations. - Communication with students via e-mail. - Teaching support through access to on-line databases etc.
TEACHING ORGANISATION	

Activities	***Work load per semester***
Lectures	26

	Laboratory practice	26
	Individual exercises	25
	Group project	23
	Total	100
STUDENTS EVALUATION	The evaluation on the course's theory consists of: 1. Final written examination on the course's theory (80-100%), consisting of: I. Evaluation of elements of the course's theory II. Short-answer questions III. Multiple choice questions 2. Personal written essay and its presentation The evaluation on the course's laboratory practice is determined by the final written examination (100%) consists of: I. Evaluation of elements of the course's theory II. Short-answer questions III. Multiple choice questions	

5. BIBLIOGRAPHY

- Diamandides G. (2017). Intoduction in Biochemistry, 4th Edition, University Studio Press, Thessaloniki, Greece
- Katinakis P. (2007). Biochemistry, 2nd Edition, Embryo Editions, Athens, Greece
- Berg J.M., Tymoczko J.L. and Stryer L. (2002). Biochemistry, 5th Edition, International Edition, New York