Courses in English for Exchange Students
Faculty of Biology and Biotechnology
University of Warmia and Mazury in Olsztyn

Short description of the course

Course **Animal and human physiology or Animal physiology with elements of biotechnology** (only one of the two courses may be organized in the same semester)

W: Physiology of the nervous system and cardiovasculary system**. Lectures:** neurons, glia and synapses, excitation and conduction, sense organs and receptors, reflexes, higher function of the nervous system; circulating body fluids, heart characteristics, blood flow dynamics, cardiovascular regulatory mechanisms. **Exercises:** comparison of nervous and endocrine systems, examination of different senses, Power Lab 26T and its application to examine reflexes and hear functions, structural and functional differences between arteries, capillaries and veins, regulation of cardiovascular functions, blood analysis. **S:** Physiology of the digestive system and reproductive system. **Lectures:** Digestion of carbohydrates, proteins and lipids in buccal cavity (mouth), stomach and intestines of humans and different mammalian and avian species, digestive reflxes and neurohormonal regulation of digestive processes; spermatogenesis and its hormonal regularion, regulation of the estrous/menstrual cycle, pregnancy and parturition, development of follicles and corpora lutea, physiology of lactation; **Exercises**: Examination of digestive processes in mouth, stomach, duodenum and jejunum, associations between structures and functions of the male/female reproductive system, examination of spermatozoa structure and motility, Determination of the phase of the cycle, early pregnancy tests, examination of milk content.

Course **Basis of Enzymology**

Understanding and practical application of knowledge of enzymology for the evaluation of chemical processes occurring in living organism in norm and pathology.

Course **Biochemistry in cosmetology**

Goals of the education: The course is a source of the latest knowledge about the natural and chemically or biotechnologically received active compounds with dermoprotective activity. The aim is to deepen the student's knowledge by sensitizing him to the aspects of practical issues related to the health and quality of human life (also in the context of the responsibility of cosmetics manufacturers), as well as the training of the conscious attitudes and responsibility in their private and professional life. **Training contents: Lectures:** The history

of cosmetics. Definition of the cosmetic product. Classification of cosmetic products. Formal and legal issues related to cosmetics (regulations, notification and documentation of cosmetics, labeling of cosmetics). Introduction of cosmetic on the market and evaluation of their safety. Testing the effectiveness of cosmetics. Adverse reactions of cosmetics. The construction and function of skin. Skin aging and factors that accelerate skin aging. The penetration of active ingredients through the skin barrier. The carrier systems used in modern cosmetics and nanocosmetics. INCI nomenclature of ingredients. The basic ingredients of cosmetics. Biologically active compounds used in cosmetics and professional beauty treatments together with mechanisms of their action: natural and synthetic antioxidants, vitamins, amino acids, peptides, proteins, enzymes, hormones, fatty acid derivatives, nucleotides, trace elements. Nutricosmetics and nutrigenomics. **Lab classes:** Exercises in the laboratory. The individual work of the student - performing of analysis and elaboration of results in the following areas: preparation and qualitative evaluation of lecithin from egg yolk and production of liposomes; isolation and determination the activity of the bromelain from pineapple (enzyme peeling); isolation and separation of essential oils from plant materials; preparation of the cosmetic emulsions (creams) enriched with biologically active compounds.

Course **Cytogenetic Diagnostics of Human and Animals**

Methods of chromosome preparation and staining, conventional (banding) and molecular (fluorescence hybridization *in situ* FISH) chromosome staining, karyological analysis of some species of animals and humans, the identification of homologous chromosomes of selected animals species and human. Mechanisms of chromosome aberrations, sister chromatid exchange, abnormal mitosis and meiosis. Sex chromosomes and their evolution among vertebrates. Cytogenetic analysis of the level of ploidy and the process of meiosis as a tool for getting knowledge of changes in the reproductive system and inheritance of vertebrates. Cell cultures. Methods of the chromosomes preparations depending on the object and aims of cytogenetic investigations. FISH and related techniques using for diagnosis. Cytogenetic diagnostics in animal husbandry, veterinary and human medicine. Microscopic analysis of chromosomal preparations. Computer support systems Cytogenetic analysis. The use of conventional staining results for cytogenetic studies of farm animals and diagnostics chromosomal abnormalities animal and human - for examples.

Course **Cytogenetics**

Mitotic and meiotic chromosomes. Methods of chromosome preparation and staining, conventional (banding) and molecular (fluorescence hybridization *in situ* FISH). The steps of karyological analysis; the identification of homologous chromosomes. Mechanisms of chromosome aberrations. Microscopic analysis of chromosomal preparations. Computer support systems Cytogenetic analysis.

Course **Environmental Biochemistry**

Goals of the education: Understanding the mechanisms of metabolic adaptation of organisms to environmental conditions. Understanding the consequences of the appearance of oxygen in the atmosphere for life processes on Earth. Mastery selected methods for measuring oxidative stress. Understanding the molecular basis of interactions and co-evolutionary adaptations that occur between organisms. **Training contents: LECTURES:** Subject matter and scope of environmental biochemistry. Biochemical adaptations of plants, animals and human conditions Environmental: aerobic and anaerobic. Reactive oxygen species - the source, operation, features, and organisms defense mechanisms against them. Low molecular weight antioxidants and antioxidant enzymes. Diseases caused by ROS. Modifications of the respiratory chain in animals with a complex development cycle. Metabolic adaptation blooded animals and living in extreme conditions. **EXERCISE:** Markers of oxidative stress. Antioxidant enzymes (activity assay method Real Time PCR), protein protection, low molecular weight antioxidants.

Course **Fluorescence technique in microbiology**

Fluorochromes, types and applications. The specificity of the use of fluorochromes in microbiology. Fluorescent detection systems used in microbiology. Direct detection (microscopic analysis) and indirect (fluorescent biosensors). Fluorochromes for detecting the presence and physiological state of prokaryotic cells and labeling viruses. Quantitative and qualitative methods of detection. Application of fluorescence in clinical diagnosis, food analysis, environmental monitoring, and monitoring biological processes.

Course **Functional Morphology of Animals**

Classification of the animals according to the structure of the body, functional morphology of animals of different body organization, embryonic development as a property of metazoan life, primary and secondary body cavity. Body symmetry of invertebrates and vertebrates, structure and functions of internal and external skeleton, the muscular system, nervous system and sense organs, the transport of internal and structures for gas exchange in the air and in the water, the digestive system, osmoregulation and excretion, reproduction of animals. Characteristics of cnidarians, flatworms, nematodes, annelids, arthropods, mollusks and Chordata: Cephalochordata, lampreys Petromyzontida, fishes (Actinopterygii, Chondrichthyes) and Tetrapoda (amphibians Amphibia, reptiles Reptilia, mammals Mammalia and birds Aves).

Course **General microbiology**

Origin and evolution of prokaryotic organisms. Structure of bacterial cell. Structure and function of bacterial genoms. Mobile genetic elements and gene transfer. Metabolism of bacteria; energy through respiration and fermentation. Bacteria in natural environments;

role of microorganisms in biogeochemical cycles. Bacterial diversity; principles of bacterial taxonomy; Gram positive and Gram negative bacteria. Characterization and classification of viruses. Microbiota of human body. The nature of infectious diseases, virulence factors. Epidemiology of infection diseases. Basics of industrial microbiology and biotechnology. Principles of microbiological diagnosis; microscopic, culturing and molecular techniques.

Course **Genetic engineering**

Lectures: General rules for selection of genomic, transcriptomic and proteomic methods. Plasmids as vectors. Required properties of various cloning vectors. Cloning of complementary DNA (cDNA) and genomic DNA (gDNA). Construction and screening of gene and genomic libraries. Transformation and transfection. Effective amplification types of nucleic acids (PCR, reverse transcription – RT). Productions of single- and double-strain molecular probes. Electrophoresis, transfer of RNA and DNA onto nylon membranes, hybridisation and autoradiography (Northern, Southern). Sequencing of DNA and in silico analyses of polypeptide precursor sequences (GenBank). Clones and trangenes. Production of recombinant therapeutic proteins. **Exercises:** Production of molecular marker with use of selected plasmid vectors (pBluescript or pUC). Isolation of plasmids from transformed bacteria by column chromatography. Restriction analysis of some selected plasmid vectors. Verification of self abilities in the area of promotion for new methods, reagents and equipments – as a representative member of some biotechnological companies.

Course **Histology**

Familiarization with the types of animal and human tissues through microscopic examination with elements of cytology (different cell types and their functions, structure of extracellular matrix); a role of four types of tissue in the construction of animal organs. Chosen topics include the microscopic technique and light microscopy, an emphasis on practical skills in recognizing types of tissue and histological structures in microscopic view of selected organs.

Course **Human functional anatomy**

Familiarization with the basic systemic anatomy of the human body through gross (macroscopic) examination of body parts and surface (integument) and overview of an orientation (main axes and planes), anatomical terminology. Main principles of human organs structure and levels of structural organization; chosen topics include the relations between structure and functions from systemic to molecular level as concerns the musculoskeletal, digestive, respiratory, circulatory, urinary, reproductive, endocrine and nervous systems with an emphasis on practical skills in recognizing anatomical structures.

Course **Immunology and basics of immunotherapy**

Lectures: Basics of the immune system. Structure and function of the lymphatic system lymphoid organs. The types of immune cells - lymphoid and myeloid line. Formation, forms and mechanisms of innate immunity. Resistance of specific cellular and humoral immunity. The types of antigens and antigen presentation mechanisms. Specific T cells and the cellular response. The mechanisms of cytotoxicity and their role. B cells and specific antibody response. Structure and function of antibodies. Interaction of T and B lymphocytes. Allergy. Tumor immunology. The role of cytokines in regulation of immune system activity. Mechanisms of immune memory. Major Histocompatibility Complex. Mechanisms of immune tolerance and the autoimmunity. Phylogeny and ontogeny of the immune system. Basic of immunotherapy. **Exercises:** Isolation, identification and calculation of the number of white blood cells. Preparing of blood smear and its analysis. Acquisition and identification of coelomocytes. Lymphoid organs and cells of the immune system of mice - techniques of isolation. Preparing a certain cell density and determination of its viability. Determination of erythrocyte sedimentation rate depending on the concentration of immunoglobulins in the serum. The process of aglutination. Evaluation of the ability of leukocytes and the formation of reactive oxygen. The blood group systems. Methods of immunization. The use of markers in the diagnosis of cancer development. Allergy tests. Visit in the diagnostic laboratory.

Course **Medical microbiology**

Bacterial cell morphology and structure. Microbiota of human body. Clinical bacteriology. The nature of infectious disease. General aspects of bacterial pathogenesis. Classification of pathogenic microorganisms. Bacterial virulence factors. Pathomechanisms and clinical syndromes associated with pathogenic bacteria. Characteristics of pathogenic Gram (+) and Gram (-) bacteria. Therapy of bacterial and viral diseases. Resistance to antimicrobial drugs: mechanisms, multiple and cross resistance Clinical virology: characteristic of human viruses. Epidemiological problems of infectious diseases. The influence of physical and chemical factors on bacteria. Mechanisms of antimicrobial resistance in bacteria. The importance of microbiological preparation in diagnostic microbiology. Types of bacteriological media and principles of bacterial cultures. Microbiological diagnostic of S*treptococcus*, *Staphylococcus*, aerobic Gram negative and positive rods and anaerobs.

Course **Microbiological synthesis of polymers**

Structure, chemical methods and types of polymers that are produced by microorganisms. Microorganisms involved in the polymers synthesis. Feedstocks used in the production of polymeric materials. Molecular and biochemical pathways responsible for the accumulation of biomaterials. Basic methods in the microbial synthesis of polymers including the various types of biopolymers and their applications toward both common and new promising polymer products. Challenges and opportunities of biopolymers. Future perspectives.

Course **Mathematical analysis**

The aim of the course is to acquaint with the basic content of mathematical analysis needed in the education of an engineer. The course includes information about the sequences, the real functions, limits, derivatives, integrals and their applications.

Course **Mathematics**

The course covers mathematical contents typical for engineering studies. The subject of the first semester of the course is mainly linear algebra- complex numbers, vector spaces, matrices, systems of linear equations and elements of analytic geometry. The second semester of the course is the use of differential and integral calculus, functions of many variables, the basis of differential equations, elements of probability and mathematical statistics.