

Clinical Immunology

Contents:	Tolerance Immunity to microbes Allergy Autoimmunity Transplantation Immunodeficiencies Tumorimmunology Immunopharmacology Biologics Immunological skin diseases Immunological lung diseases Clinical epidemiology
Examination:	Essay questions
Teaching:	Lectures
ECTS:	3.0

Tumor Biology

Contents:	Stem cells and cancer Metastasis formation Immunology of tumors Experimental tumor models New approaches for diagnosis and therapy Perspectives Selected cancer research projects
Examination:	MC
Teaching:	lectures + reviews of selected topics in groups of 4 students
ECTS:	2.0

Molecular Biology of Inflammation

Contents:	Calor -Rubor -Tumor - Dolor: Inflammation beyond physiology and pathology to molecular biology The vasculature in inflammation Molecular mechanisms mediating the recruitment of circulating leukocyte Leukocyte signalling pathways involved in tissue trafficking and host defence Leukocyte chemoattractants: diversity and synergies Lipid mediators involved in inflammation Molecular mechanisms involved in injury and repair Haemostasis and inflammation: A two-way interaction Inflammation – good or bad? Molecular mechanisms in resolution of inflammation Chronic inflammatory diseases Current anti-inflammatory approaches/drugs
Examination:	Individual
Teaching:	Lectures
ECTS:	3

Pathogenesis of Infectious Disease

Contents:	Common themes of microbial pathogenesis Molecular host-pathogen interactions Intracellular bacterial pathogens (invasion and survival mechanisms) Bacterial infections of the central nervous system Antibiotic resistance mechanisms Epidemiology of human infections Pathogens and the normal microbiota Origin and evolution of human pathogens Origin and evolution of HIV Endogenous retroviruses
Examination:	Individual
Teaching:	Lectures
ECTS:	3.0

Pharmacology

Contents:	Pharmacology of major organ systems: Heart and vascular system Gastrointestinal system Nervous system Endocrine and reproductive system Immune system Lungs and kidneys Haemopoietic system and haemostasis Antiinfectious therapy
Examination:	MC
Teaching:	Lectures
ECTS:	1.6

Central Nervous System

Contents:	Focus on clinical disorders of the CNS: Vascular injuries of the CNS Inflammatory diseases of the CNS Central and peripheral neurodegenerative diseases Dementia Schizophrenia Affective disorders (depression and mania)
Examination:	MC
Teaching:	Lectures
ECTS:	1.8

Heart

Contents:	<p>Basic cardiac pathobiology: Introduction to cardiac disease Epidemiology of sudden cardiac death Disturbed electrical activation and arrhythmogenesis Heart rate variability & autonomous nervous system Pathophysiology of EC coupling and contraction Disturbed energetics & metabolism Autonomous nervous system and cardiac disease Pathophysiology of myocardial ischemia and infarction Cardiac signaling in disease Structural remodeling & inflammation Genetic mutations & drugs affecting electrical function</p> <p>Diseases and Therapy: Valvular heart diseases Atrial fibrillation Ischemia and infarction Cardiac hypertrophy and heart failure VT, VF & cardiac devices Principles of drug therapy Cell therapy & stem cells</p> <p>Theoretical background of exp. Methodologies: Microelectrode recordings, patch-clamp recording, Optical recordings (voltage and ion-sensitive dyes) of biological signals Cell culture techniques, cell engineering Tissue Perfusion: Biology, Physiology & Measurement Whole heart perfusion</p>
Examination:	MC
Teaching:	Lectures
ECTS:	3.8

Blood

Contents:	<p>Hemostasis and Thrombosis Primary hemostasis and its regulation Secondary hemostasis and its regulation, fibrinolysis Disorders of vascular, primary and secondary hemostasis Thrombophilia and thrombosis Therapeutic principles (antithrombotic and hemostatic therapy)</p> <p>Cellular Hematology Hematopoiesis and blood cells (incl. Hematopoietic stem cells) Anemias (overview) Leukocyte abnormalities Myeloproliferative Neoplasms Myelodysplasia and acute leukemias Lymphoid Neoplasms Antileukemic therapy</p> <p>Transfusion medicine and Immunohematology Principles of transfusion medicine Blood groups, serologic testing</p>
Examination:	MC
Teaching:	Lectures
ECTS:	2.0

Endocrinology

Contents:	Diabetes and its epidemiology Pathology of the endocrine system, tumor receptors, hormone determinations Radioimaging in endocrinology Thyroid disorders Bone growth Pathology of the adrenal glands Hypertension from an endocrinology point of view Pregnancy Gonads / Disorders of sexual development
Examination:	MC
Teaching:	Lectures
ECTS:	2.0

Gastrointestinal Tract

Contents:	Immunology of the GIT Primary immunodeficiencies (Adaptive/Innate). Secondary immunodeficiencies Infections of the GIT Exocrine/endocrine function of the GIT Measurements of exocrine GI function in humans. Consequences of exocrine pancreatic deficiency Enteroendocrine tumours – symptoms, diagnosis and treatment Mobility of GIT Oesophageal motility measurements as a paradigm of diagnosis: treatment of human intestinal motility disorders Clinical conditions (GI/systemic) in which GI motility disorder plays a prominent part in symptoms Malabsorption Intestinal function – using short bowel syndrome as a paradigm. Causes of diarrhoea. Importance of understanding osmolarity and osmolar constituents of intestinal contents. Colorectal cancer
Examination:	MC
Teaching:	Lectures
ECTS:	2.1

Kidney

Contents:	<p>Focus on physiology Renal function revisited Investigative methods for identifying renal tubular disorders Cross-talk between the kidney and blood pressure The "kidneys" in pregnancy Modern renal imaging</p> <p>Focus on diseases Kidney stones - beyond chemical analyses Common molecular mechanisms in uremic bone and blood vessels Molecular mechanisms of renal dysfunction in heart failure, liver cirrhosis and nephrotic syndrome Mechanims of glomerular destruction</p> <p>Focus on therapy Transgenic animals Gene Therapy: how to overcome the barriers in vitro and in vivo Artificial organs for renal replacement Mathematical modelling of renal function and renal replacement therapy</p>
Examination:	MC
Teaching:	Lectures
ECTS:	2.0

Liver

Contents:	<p>Physiology and anatomy of the liver revisited Regulation of liver cell mass (regeneration, stem cells, necrosis, apoptosis) The filter function of the liver Heme and lipid metabolism Liver injury (alcohol, drugs, virus, bacteriae, heavy metals, proteins) Cholestasis Wound healing (stellate cells, fibrogenesis, cirrhosis, ageing, treatment) Portal hypertension: Liver and circulation Portal hypertension: Liver and kidney Portal hypertension: Liver and CNS Carcinogenesis Transplantation</p>
Examination:	MC
Teaching:	Lectures
ECTS:	2.0

Lung

Contents:	<p>Asthma (epidemiology and clinic), asthma models Chronic obstructive pulmonary disease (epidemiology and clinic) α1 antitrypsin deficiency; proteases/antiproteases Inhalation and systemic therapies for obstructive diseases Smoking and lung cancer Cystic fibrosis from genes to clinic Lung injury and repair Acute lung injury and ARDS Lung fibrosis Pulmonary hypertension: pathophysiology Animal models and therapies of pulmonary hypertension Lung defences Community and hospital acquired pneumonia Immune defects and infections Tuberculosis (clinic, epidemiology, diagnostic and new therapies) Respiratory insufficiency (restriction, obstruction, myopathies, neurologic diseases,...) Ventilation (invasive and non-invasive) Pleural diseases Lung transplantation and animal models</p>
Examination:	MC
Teaching:	Lectures
ECTS:	1.0

Skin and Connective Tissue

Contents:	<p>Skin Basis of dermatologic diseases Immunodeficiencies and dermatology</p> <p>Musculo-skeletal system Introduction Metabolic and degenerative arthritis Osteoporosis Pathophysiology of pain Idiopathic polyarthritis Inflammatory and autoimmune disorders Connective tissue diseases and vasculitides: From pathogenesis to clinical presentation</p> <p>Methodologies Histology of dermatologic diseases Determination of auto-antibodies FACS</p>
Examination:	MC
Teaching:	Lectures and practicals
ECTS:	1.0

Scientific Writing

Contents:	<ol style="list-style-type: none"> 1. Principles of good writing-: choosing words 2. Principles of good writing: constructing sentences 3. Principles of good writing: constructing paragraphs 4. Preparing a hypothesis-testing manuscript: Introduction 5. Preparing a hypothesis-testing manuscript: Materials and Methods 6. Preparing a hypothesis-testing manuscript: Results 7. Preparing a hypothesis-testing manuscript: Discussion 8. Preparing Figures and Tables 9. Abstracts for scientific meetings 10. Summary abstracts and titles 11. Writing research proposals/theses: aims – hypotheses – statement of problem
Examination:	in class exam (open book)
Teaching:	Critique of Manuscript + writing a scientific abstract
ECTS:	1.4

Modeling II

Contents:	<p>Use of mathematical models for the quantitative description of biological phenomena:</p> <ol style="list-style-type: none"> (1) Complex physiological systems: Working with large whole body models (Guyton's model, Coleman's HumMod model) and solving physiological models with difference equations, including practical exercises. (2) Cardiac modeling: Biophysical fundamentals and principles of normal and abnormal cardiac electrical activity. Practical exercises with Markovian models of ion channels and the Luo-Rudy model of cardiac electrical function. (3) Neural computation: Biophysics of the membrane, synaptic transmissions, Hodgkiin-Huxley neuron model, Integrate-and-fire neuron model. Learning and memory, behaviorism, perceptron learning, reinforcement learning, attractor networks (Hopfield model). (3) Practical exercises to the Hodgkin-Huxley model, the perceptron, and the Hopfield model.
Examination:	MC
Teaching:	Lectures and practical exercises
ECTS:	2.0

Pharmakodynamic Modeling (PK-PD Modeling)

Contents:	<ol style="list-style-type: none"> 1. Introduction to Pharmacokinetic concepts (absorption, distribution, metabolism and elimination) 2. Pharmacokinetic and multi compartmental analysis ART OF MODELING 3. Basic Pharmacologic principles 4. Basic principles of PK/PD 5. Simple direct effect models 6. Complications in PK analysis (Nonlinear pharmacokinetics Target Mediated Drug Disposition) 7. Delayed response in PK/PD modeling 8. Modeling the Biophase 9. Basic indirect response models 10. Pharmacodynamic drug-drug interactions 11. Physiologically Based PK 12. Integration of lectures
Examination:	MC
Teaching:	Lectures and exercises
ECTS:	3.5

Lecture Series on Advanced Microscopy

Contents:	<p>Introduction to light microscopy Introduction to fluorescence microscopy and laser scanning microscopy Specific applications in fluorescence microscopy (grid projection, etc.) Laser scanning microscopy and specific applications (FRET, FRAP, etc.) and digital image restoration (Huygens and Imaris software) Intravital microscopy Multiphoton-intravital microscopy Calcium-imaging with confocal microscopy Optical projection tomography Time lapse video microscopy Transmission electron microscopy Scanning electron microscopy Stereology Cryo-electron microscopy Quiz or Guest Lecture</p>
Examination:	Individual
Teaching:	Lectures
ECTS:	3.0

Microfluidics and Organs-on-Chip

Contents:	Introduction to BioMEMS (Bio-Microsystems) Micro- and nanofabrication of BioMEMS Microfluidics and scale effects Lab-on-Chip, DNA and protein chips Cells-on-Chip Organs-on-Chip
Examination:	MC
Teaching:	Lectures
ECTS:	2.0

Biostatistics II

Contents:	<p>This course module is an integral part of the education in “Biostatistics, Epidemiology and Study Design” in the master’s programme in Biomedical Sciences.</p> <p>In Biostatistics II the students will learn to apply the acquired knowledge that was introduced in the 2 weeks module in the 3rd year of the bachelor degree programme. They will also learn to use the statistical software package Stata® in order to perform analysis on their own.</p> <p>The learning objectives of this module are: To be familiar with at least one statistical software package and to be able to perform statistical analyses</p> <ul style="list-style-type: none"> - Students are able to provide descriptive statistics graphical summaries of concrete data sets - They can use Stata to provide summary estimates and 95% CIs, and to conduct hypothesis testing - Students are able to perform logistic and linear regression analyses - Students are able to perform basic survival and time-to-event analyses (life table, Kaplan-Meier survival estimates, Cox regression) <p>In addition to the techniques of statistical analyses, the students will have to be able to state specific facts about epidemiologic terms, principles and methods, and to comment findings of epidemiological studies. The students will need to show ability to identify the main study design alternatives and how they relate to each other. Furthermore, students should be able to appreciate the major sources of systematic error and the logistical problems associated with different study designs.</p> <p>To have the students develop these skills, the programme of the module contains a mix of traditional lectures and group work and concrete practicals in which the students apply the theoretical concepts provided in the lectures.</p>
Examination:	Individual
Teaching:	Lectures and practicals/exercises
ECTS:	5.0

Elective Laboratory Modules

Contents:	Goals: (1) To get acquainted with laboratory work in general and with specific experimental techniques in particular (2) To get deeper insights into topics of specific interest to the students (3) To lay the grounds for a possible continuation of the module in the context of the master thesis Selection of elective modules: There will be an online offering of eligible elective topics which will cover <ul style="list-style-type: none">- A short description of the topic(s) offered by a particular lab- Max. number of students accepted for the module- Suggestions for literature to read before starting the module- A list of basic requirements to enter the module (animal experimentation, etc.)
Examination:	Hand in report after each elective module
Teaching:	Laboratory based work - 2 x 3 weeks
ECTS:	2 x 6.5