## Medical and Life Sciences

## Furtwangen University, Schwenningen Campus

### International course program Winter term 2026/27:

### Biomedical and Life Sciences

| Course number | title | credits |
|---|---|---|
| *MTZ 10060* | Scientific Techniques | 2 ECTS |
| *MTZ 20045* | Quality Management | 2 ECTS |
| *MTZ 20064* | Cell Biology | 3 ECTS |
| *MTZ 20075* | Biochemistry 2 | 2 ECTS |
| *MTZ 10016* | Hygiene | 2 ECTS |
| *MTZ 20067* | Methods in Molecular Medicine | 3 ECTS |
| *MTZ 20068* | Pathobiochemistry | 3 ECTS |
| *MTZ 20070* | Research project | 5 ECTS |
| *MTZ 20071* | Project seminar | 1 ECTS |
| *MTZ 10063* | Stem Cell Biology | 2 ECTS |
| *MTZ 20072* | Tumor Biology | 2 ECTS |
| *MTZ 20074* | Specific Aspects of Chemistry | 3 ECTS |
| *MTZ 10065* | Analysis of Omics data | 2 ECTS |
| *MTZ 20076* | Bioinformatics | 4 ECTS |

For more information about the courses please see next pages.

## Further offered components

- Bachelor courses in German are also open to international students
- German language classes (A1 – B2), 3 or 6 ECTS
- The HFU Business School offers several courses in English

***MTZ 10060* Scientific Techniques** (S / 2 ECTS / weekly)

Instructor: Prof. Dr. Edgar Seemann

Content:

- Writing a scientific work (planning, outline, structure, the scientific language, conclusion, the critical discussion path).
- Creating a scientific presentation (structure of meaningful diagrams, structure of the slides, use of voice during the presentation, supporting/convincing body language).
- Criteria for success in science (solution-oriented thinking, development of professional networks, focused objectives, efficient execution of tasks).

Prerequisites: None
Assessment: presentation (Pass or fail)

***MTZ 20045* Quality Management** (Lc / 2 ECTS / weekly)

Instructor: Mr. Thomas Kutschenreiter

Learning outcomes: After successful participation in the course the students can …

... explain specific terms from QM, name the development of the series of standards, describe the differences between the DIN / EN / ISO series, explain and distinguish between individual process steps, explain the importance of risk management for companies, name various risk classifications, describe differentiated handling of complaints, explain customer satisfaction using the example of the KANO model.

... Interpret and apply relevant standards in a legally compliant manner through the methodological competence imparted and plan and execute the writing phase in parallel with the practical work

Content:

Nomenclature; History; / Introduction: Standards (DIN EN ISO), Process-oriented QM -Process types; / Core: performance, management and support processes; Risk management (risk assessment; handling ; methods); Complaint management (what are complaints, handling ; procedure) / Customer satisfaction.

Prerequisites: None
Assessment: Term paper (graded)

***MTZ 20064* Cell Biology** (Lc / 3 ECTS / weekly)

Instructor: Dr. Becker-Feldmann

Learning outcomes: After successful participation in the course the students can …

... draw a detailed draft of the cell structure, membrane constitution and tissue organization and describe the main function of each cellular compartment.

... independently evaluate cell-cell communication types and analyze and match specific cell signalling mechanisms.

... compare the main mechanisms of cell survival and cell death and evaluate disease diagnosis from transformed cellular characteristics.

Content:

1. Introduction to the cell: cells, biosynthesis, proteins 2. Cell organization: membrane structure and transport 3. Cell organization: cellular compartments 4. Vesicular traffic 5. Cell communication 6. The cell cycle 7. Apoptosis 8. The cytoskeleton 9. Cellular network: cell junctions, cell adhesion, the extracellular matrix 10. Stem cells and tissue renewal

Prerequisites: Knowledge of biomedical basics, provided in the course Biomedical Basics.
Assessment: Written examination (graded)

***MTZ 20075* Biochemistry 2** (Lc / 2 ECTS / weekly)

Instructor: Prof. Dr. Nicolas Werbeck

Content:

- Important metabolic pathways (anabolic and catabolic), e.g. in carbohydrate, fatty acid, amino acid and nucleotide metabolism.
- General principles of metabolic regulation and enzymatic catalysis.
- Selected examples of pathobiochemical consequences.

Prerequisites: Basic knowledge of biochemistry, provided in the course Biochemistry 1.
Assessment: Written examination (graded)

***MTZ 10016* Hygiene** (S / 2 ECTS / weekly)

Instructor: Prof. Dr. Markus Egert

Description:
Hygiene - the science of preserving human health, historical aspects of hygiene, disinfection, sterilisation, conservation, hospital hygiene, prevention of infectious diseases, food and kitchen hygiene, the hygiene hypothesis, water hygiene, soli and air hygiene, psychohygiene, selected aspects of mycology and parasitology.

Prerequisites: Basic knowledge of microbiology
Assessment: presentation (Pass or fail)

***MTZ 20067* Methods in Molecular Medicine** (Lc, S / 3 ECTS / weekly)

Instructor: Prof. Dr. Hans-Peter Deigner

Content:

Methods of molecular medicine, examples from genomics, transcriptomics (e.g. microarrays, diagnostic applications, methods of DNA and RNA sequencing, next-generation sequencing), proteomics (e.g. ProteinChips) , metabolomics (basics of different methods of mass spectrometry) and immunology, relation to individual genetics (e.g. SNPs, satellites, chromosomal aberrations, genomic diseases, monogenetic and non-mendelian diseases, development of cancer) and presentation of specific case studies. Current aspects of biobanking.

Prerequisites: not specified
Assessment: Written examination (graded)

***MTZ 20068* Pathobiochemistry** (Lc, S / 3 ECTS / weekly)

Instructor: Prof. Dr. Nicolas Werbeck

Content:

Selected examples of biochemical/biomolecular processes associated with diseases: “Sickle Cell Anemia - A molecular disease”, Metabolic Disorders (Carbohydrate Metabolism, Mitochondria and ROS, Amino Acid Metabolism,Lipid metabolism, Purine and Pyrimidine Metabolism), Disorders in Cellular Communication 53 (Principles of Cellular Communication and Signal Transduction,Insulin – Diabetes Mellitus, Thyroid Hormones), Cell Cycle Disorders (Principles of the Cell Cycle, Cancer), Integrated Topics (e.g.Metabolic Functions of the Liver and Liver Diseases, Acid-Base an Electrolyte Imbalances, Neurodegenerative Diseases).

Prerequisites: Knowledge of biochemistry, provided in the courses Biochemistry 1 and Biochemistry 2.
Assessment: Written examination (graded)

***MTZ 20070* Research project** (5 ECTS)

Supervisor: different topics are offered and supervised by professors and lecturers

Learning outcomes: After successful participation in the course the students can …

... Conduct research on selected topic, select, discuss, and compare literature.

... present a report on a scientific project and its results, write a scientific paper on a scientific topic and perform the discussion of a scientific topic under guidance.

... select, analyze and evaluate the most important results of a project and begin to argument scientifically.

Content:

Comprehensive theoretical adressment of a scientific problem from the context of Molecular and Technical Medicine. Preparation of a written paper in the form of a "review article".

Prerequisites: Successful completion of the first two semesters
Assessment: Seminar Paper (graded)

***MTZ 20071* Project seminar** (S/ 1 ECTS / block course)

Instructor: Prof. Dr. med. Nicolas Werbeck

Description:

In order to pass the student research project (MTZ 20038), the student must also successfully participate in the seminar "Course Work Presentations". The student presents in 10min using Powerpoint or similar. The date is already fixed at the beginning of the semester and can be found in the general schedule of the faculty. Active participation during the discussions is required. Attendance is compulsory for the duration of the entire seminar.

Corequisites: MTZ 20038 student project
Assessment: presentation (graded)

***MTZ 10063* Stem Cell Biology** (S / 2 ECTS / weekly)

Instructor: Dr. Angela Magin

Learning outcomes: After successful participation in the course the students can …

... define stem cells based on their specific properties and distinguish between different stem cell types.

... present and critically evaluate scientific publications on the topic of stem cell biology in a comprehensible manner.

... identify potential clinical applications of stem cells

... derive own research questions and study designs, capture research relevant results and present them in a clinical context.

... realistically assess the possibilities and difficulties of cell-based therapies, critically evaluate media reports about stem cells and stem cell therapies, discuss ethical aspects of working with stem cells in a scientifically sound manner

Content:

- Basics: stem cell definition and properties, function of stem cells in the adult body and during embryonic development

- Methods of stem cell biology: cell isolation, culture and analysis

- Stem cell types: physiological (embryonic, hematopoietic, mesenchymal, neural and tissue specific stem cells) and non-physiological stem cells (cancer stem cells, induced pluripotent stem cells)

Prerequisites: Basic knowledge of cell biology, molecular biology and genetics. Successful completion of the first two semesters.
Assessment: multiple assignments (pass or fail)

**MTZ 20072 Tumor Biology**

Instructor: Dr. Becker-Feldmann (Lc / 2 ECTS / weekly)

Learning outcomes: After successful participation in the course the students can …

… list the six hallmarks of cancer and describe the basic aspects of cancer pathology.

… evaluate the importance of the tumor microenvironment in tumor progression.

… categorize different cancer stages using the information on angiogenesis, invasion and metastasis formation.

… discuss the advantages and disadvantages of standard therapy.

… evaluate new strategies for cancer therapy based on the mechanisms of tumor-immunity interactions.

Content:

- From gene to disease; biology and genetics of cells and organisms
- The six most important characteristics of cancer
- Most important cellular oncogenes:growth factors and their receptors
- Tumor repressor genes: pRB, cell cycle control, p53 and apoptosis
- "Eternal life": cell immortality and tumorigenesis
- Angiogenesis, invasion and metastasis
- Rational treatment options for cancer: challenges and modern treatment approaches
- Immunotherapy: tumor-immunity communication

Prerequisites: Basic knowledge of cell biology, molecular biology and genetics. Successful completion of the first two semesters.

Assessment: Written examination (graded)

***MTZ 20074*** **Specific Aspects of Chemistry** (Lc / 3 ECTS / weekly)

Instructor: Prof. Dr. Hans-Peter Deigner

Learning outcomes: After successful participation in the course the students can …

... recognize and name synthesis strategies in terms of orthogonal protecting group strategies; Ligation reactions; derivatization reactions.

... work out different synthesis strategies from the area of the chemistry of biomolecules.

... assess reactivities based on the functional groups of biomolecules.

... give examples for the synthesis of bio(glyco)mimetics and their application.

... name examples of the practical professional application of ligation reactions.

Content:

Chemistry of biomolecules (carbohydrates, amino acids, DNA/RNA) with focus on:

- Protective group strategies
- Glycosylation strategies
- Solid phase syntheses (peptides, oligosaccharides and both combined)
- Ligation reactions ("click" chemistry: 3+2 cycloaddition, oxime/hydrazone, inverse Diels Alder, etc.)

Current applications from research and development in particular:

- Bio(glyco)mimetics
- Carbohydrate-based antibiotics
- Derivatization strategies

Prerequisites: Knowledge provided in the chemistry courses of the first two semesters (general chemistry, organic chemistry, biochemistry 1).

Assessment: written examination (graded)

***MTZ 10065* Analysis of Omics Data** (Lab, S/ 2 ECTS / weekly)

Instructor: F. Abdelati

Learning outcomes: After successful participation in the course the students can …

... summarize the basic principles of object-oriented programming

... know and understand the algorithms used to construct local and global alignments

... understand the necessary steps of the analysis of omics-data and justify them by examples

... perform an analysis of omics-data using the statistical software R in combination with Bioconductor and interpret the results

Content:

Data import, quality control, preprocessing and normalization, statistical analysis and enrichment analysis using microarray, RT-qPCR and metabolomics data.

Prerequisites: Basic knowledge of biostatistics
Assessment: multiple colloquia (pass or fail)

***MTZ 20076* Bioinformatics** (Lc, Lab/ 4 ECTS / weekly)

Instructor: Prof. Dr. Edgar Seemann

Learning outcomes: After successful participation in the course the students can …

... understand the program code of simple bioinformatic programs

... work with bioinformatic algorithms such as BLAST and to modify key parameters such as substitution matrices based on the considered problem.

Content:

Introduction to bioinformatics, sequence analysis, global alignment, local alignment, substitution matrices, PAM, BLOSUM, Needleman-Wunsch algorithm, Smith-Waterman algorithm, FASTA, BLAST, multiple sequence alignment, progressive alignment, STAR algorithm, CLUSTAL algorithm, position-specific substitution matrices. Introduction to object-oriented programming, Karol the robot, top-down programming approach, good programming style, program debugging, classes and objects, inheritance, object properties and methods, public vs. private, data types, control structures (loops, conditions), arrays, lists, strings, hash-maps, error handling, abstract classes.

Prerequisites: Basic knowledge of biostatistics
Assessment: 50 % multiple assignments, 50% written examination, (graded)

Lc: Lecture
S: Seminar
Lab: Lab/Practical
Tu: Tutorials
1 ECTS = 25 – 30 hours workload altogether