CURRICULUM

ACADEMIC YEAR 2003-2004

Bachelor's degree programme in Medical Laboratory Technology

(3-year programme)

pursuant to the national General Plan and Regulations of 15 January 1998

Østfold University College

Faculty of Health and Social Studies

The curriculum was approved by the Faculty Board 11 June 1998
Latest revision: June 2003

1 Introduction

1.1 National curriculum

The curriculum in Medical Laboratory Technology at Østfold University College is in accordance with the framework and regulations laid down in the national curriculum called General Plan and Regulations for 3-year programmes in Medical Laboratory Technology, as stipulated by the then Ministry of Church, Education and Research 15 January 1998, pursuant to §46 No 22 in the law of 12 May 1995 No 22 pertaining to universities and university colleges.

1.2 History

In 1969 a two-year programme in physiochemistry was started at Østfold Technical College, as a cooperation between the school and three hospitals: the central hospital of Østfold in Fredrikstad, the central hospital of Vestfold in Tønsberg, and Sarpsborg hospital. Other hospitals have also participated throughout the years. The teaching took place partly in school (one year) and partly in the hospital (one year). In later years students have been divided between two hospitals in the last half of the study programme, with half of the students at the hospital in Fredrikstad and half at the hospital in Tønsberg. Yearly admission of students was 20 in the first years. Since 1991 the programme admits 40 students each year.

In 1977 Østfold Technical College became a part of the regional system of university colleges and was called Østfold College of Engineering. In the same year physiochemists were given public certification.

In 1987 a three-year professional programme for medical laboratory technologists was established by the then Ministry of Culture and Science, based on a merger of the two-year programmes in physiochemistry and medical laboratory technology.

Following the university college reform in 1994, Østfold College of Engineering was merged with a number of other university colleges into Østfold University College. The then Ministry of Church, Education and Research decided that medical laboratory technology was to be a part of the then Faculty of Health Studies in Fredrikstad. In February 1996 new laboratories were opened and the study programme was moved from Sarpsborg to Fredrikstad.

Since 1990 the curriculum has been laid down in a national general plan, which was revised in 1998.

1.2 Medical laboratory technologist – the study and the profession

Medical laboratory technology is the science of how and why information on the conditions of the human body is provided through analyses of human biological matter. Such analyses comprise measuring or proving the existence of components in body fluids, counting blood cells, producing tissue and cell specimens for microscopic evaluation, and providing blood components.

The primary task of medical laboratory technologists is to carry out and be responsible for the analyses performed in medical laboratories. To ensure high quality, medical laboratory technologists must possess knowledge, skills and attitudes related to technology, the possibilities and limitations of analysis methods, statistical control programmes, and the medical significance of analyses and analysis results. The medical laboratory technologist has an important role in diagnosing, monitoring the course of diseases and controlling the effect of treatments, as well as in performing preventive work.

Most medical laboratory technologists work in hospital laboratories. Some are employed in the public health services, public and industrial research laboratories, or as product specialists for medical technical equipment or pharmaceutical products.

2 The bachelor's degree programme at Østfold University College

2.1 Objectives

The degree programme in medical laboratory technology at Østfold University College aims to educate highly qualified, responsible and reflected professionals for medical laboratories. The University College aims to facilitate knowledge, skills and attitudes for the biomedical profession that are in line with society's demands for medical laboratory services.

The curriculum leads to public certification as a medical laboratory technologist (*bioingeniør*).

The University College carries out research and development (R&D) related to curriculum, teaching and profession. The curriculum is state-of-the-art, nationally and internationally; it is future oriented and develops through a constant dialogue with the professional field.

2.2 Content and credit allocation

The study programme is a three-year bachelor's degree programme with a credit allocation of 180 ECTS credits.

The national curriculum has three main subjects:

Main subject 1: Natural science	75 ECTS credits
Main subject 2: Social sciences and humanities	15 ECTS credits
Main subject 3: Medical laboratory subjects	90 ECTS credits

The national curriculum is further divided into minor subjects. Each university college may organise the study differently from what is outlined in the national curriculum.

Østfold University College has chosen subject names different from those used in the national curriculum and has merged some minor subjects into larger units.

Main subject 1: Natural science **75 ECTS credits**

The national curriculum has the following minor subjects:

	ECTS credits
1A Mathematics, statistics and computer science	12
1B Physics with measuring technology	9
1C General and analytical chemistry	15
1D Organic chemistry and biochemistry	15
1E Cell biology with molecular biology and genetics	9
1F Anatomy, physiology and histology	9
1G General immunology and microbiology	6

Østfold University College organises *Main subject 1: Natural scienc*e as the following modules:

	ECTS credits
Natural science modules	
General and analytical chemistry	15
Organic chemistry and biochemistry	15
Mathematics, statistics and computer science	10
Instrumental measuring techniques	10
Human biology modules	
Anatomy, physiology and histology	10
Cell biology	15

Two credits from Mathematics, statistics and computer science are integrated into the modules Instrumental measuring techniques and Medical laboratory subjects.
Elements from Medical laboratory subjects are integrated into Anatomy, physiology and histology.
Cell biology comprises (described in the national curriculum):

- Cell biology with molecular biology and genetics (9 ECTS credits)
- General microbiology (3 ECTS credits)
- General immunology (3 ECTS credits)

Main subject 2: Social sciences and humanities **15 ECTS credits**

The national curriculum has the following minor subjects:

	ECTS credits
Communication, interaction and conflict management	6
Ethics	6
Scientific methods	3

Østfold University College organises taught courses as interdisciplinary teaching blocks for a number of health studies:

Block A (6 ECTS credits): The student role, work methods, communication, cooperation, interdisciplinary work
Block B (4.5 ECTS credits): Ethics
Block C (4.5 ECTS credits): Theory of science and research methods

Main subject 3: Medical laboratory subjects **90 ECTS credits**

The national curriculum has the following minor subjects:

	ECTS credits
3A Laboratory medicine	24
3B Medical laboratory technology – principles and methods	54
3E Quality development and internal quality control	12

Østfold University College integrates the three minor subjects into the following modules:

	ECTS credits
Medical laboratory subjects I	30
Medical laboratory subjects II	45

The national curriculum has introduced new names for some of the subjects. Main subject 1 is called Medical laboratory subjects and comprises the following minor subjects: laboratory medicine, medical laboratory technology, and quality development and internal quality control. The following section describes the meaning and extent of each concept.

Laboratory medicine
This is the knowledge why and how components in biological matter may be of use in diagnosing and monitoring diseases and controlling the effect of treatment, as well as in preventive health work.

Medical laboratory technology
This concept is related to technological work in the laboratory and the main principles that are used when analysing components of human biological matter.

Analysing components has to do with proving the existence of analytes and measuring them, counting blood cells, identifying micro-organisms and testing them antibiotically, producing tissue and cell specimens for microscopic assessment and proving the existence of pathological changes in cells.

Laboratory technology work means the whole technological process from test taking until the result of the analysis, the tissue specimen, or the blood product is a fact. The process comprises everything from organising the work day, choosing equipment and using it, preparing and using reagents, handling reagent kits, calibrators, controls and test material – to understanding and applying analysing instruments. Additionally, it includes the way descriptions of analysing methods and other laboratory procedures are to be understood and complied with. Infection prevention, waste treatment and safety in the laboratory are important components of laboratory technology work, as is also production of blood components.

Measuring or proving the existence of analytes comprises:
- the type of chemical or physical reaction used;
- principles for detection of the reaction result;
- the phase of the detected reaction;
- conditions for reaction, how requirements are met;
- use of calibration models, how to find the connection between detected signal and analyte concentration;
- how are automatic analysing instruments adapted to the above mentioned;
- what procedures for quality control are used.

Proving the existence of micro organisms, identifying them and testing them for antibiotics:
- media used for cultivating;
- cultivation conditions and how to achieve them;
- use of morphological, biochemical, immunochemical and gene technological examinations;
- use of antibiotics to determine the sensitivity of bacteria, and proving sensitivity and resistance;
- automation of the analysing process;
- use of quality control procedures.

Presenting and evaluating tissue and cell specimens:

- means and methods used for fixation, dehydration, decalcination, casting and mounting;
- chemical and/or physical reactions used for adding colour or otherwise rendering tissue and cell components visible;
- requirements for reaction conditions and how they are achieved;
- half- and full-automatic machinery adapted to various stages of the presentation;
- procedures for quality control chosen for the different stages of tissue presentation;
- morphological criteria for inflammation, pre-cancer stages and cancer – related to criteria for normal cell morphology.

Producing and storing blood components:

- requirements and guidelines for blood donation;
- physical methods of separation used for producing blood components;
- conditions for separation and storing and how this is achieved.

Quality development and internal quality control

This is an integrated aspect of medical laboratory technology and laboratory medicine. The quality of analysis results depends on the whole process from ordering tests to the final result. Thus, quality is linked with pre-analytical, post-analytical and analytical variables that may give the wrong result or interpretation. Quality work also means establishing, maintaining and developing a quality system. Such a system should describe:

- Organisation, responsibility and contracting
- Procedures
- Document control
- Developing and maintaining competence
- Dealing with deviations and complaints
- Internal and external audits
- Internal control, health, safety and environment

2.3 Teaching methods

The choice of teaching methods depends on objectives, content, framework factors, students' qualifications and the system of assessment. Teaching methods have been chosen with a view to integrating knowledge, skills and attitudes, as well as to the profession itself. Methods comprise lectures, theoretical studies, laboratory work, demonstrations, work placements, excursions, log writing, group work, discussions, tutorials, project work, seminars, and presentation of own work in speech and writing. The teaching methods involve alternating between theoretical and practical learning and contribute to interdisciplinary thinking and problem solving. The methods are meant to give students more responsibility for their own learning, enhance academic innovation, and help them develop a critical and reflected attitude to knowledge and learning and capabilities for written and oral presentation. Further, they are meant to promote students' personal development: independence, cooperative skills, quality behaviour and responsibility. Student-centred and participation-oriented teaching methods enhance social competence and problem solving skills, and are used increasingly throughout the curriculum.

Work placements involve planning and laboratory work and assessment of one's own work, and they give an experience basis for evaluations. The practical training takes place both in

the Faculty's laboratories and in the laboratories of the partner hospitals. The majority of the teaching methods mentioned above are applied during work placements. Placements are integrated into all three main subjects in the curriculum. The last part of the curriculum is mainly focused on practical, vocational training.

For pedagogical reasons, studies on university premises alternate with placement. Practical training in or closely related to hospital laboratories is integrated into the curriculum. Additionally, the third year of study has a four-week period of work placement allowing students to experience day-to-day laboratory work and the role and tasks of a medical laboratory technologist. Work placement in hospital laboratories is described for each year of study; see 3.2. Content.

2.3 Modular distribution

1st year	Communication and interaction 6 ECTS credits Ethics 4.5 ECTS credits	General and analytical chemistry 15 ECTS credits	Anatomy, physiology and histology 10 ECTS credits	Instrumental measuring techniques 10 ECTS credits	Organic chemistry and biochemistry 15 ECTS credits

2nd year	Theory of science and research methods 4.5 ECTS credits	Cell biology 15 ECTS credits	Mathematics, statistics and computer science 10 ECTS credits	Medical laboratory subjects I 30 ECTS credits Medical laboratory technology, laboratory medicine, quality development and control mainly focusing on -microbiology -pathology -haematology and transfusion medicine

3rd year		Medical laboratory subjects II 45 ECTS credits Medical laboratory technology, laboratory medicine, quality development and control mainly related to -clinical chemistry and nuclear medicine -automation within haematology and clinical chemistry Project 15 ECTS credits

3 Main subjects

3.1 Objectives

Main subject 1: Natural science

Natural science subjects are taught in the 1st and 2nd years of study. Content is described for each year.

The objects of Main subject 1 are closely related to the objects of the medical laboratory subjects (Main subject 3). Natural science subjects form a basis for comprehension, application and assessment of methods of analysis and instruments used in medical laboratories, and for students' comprehension of diseases and the normal functions of the body.

Objectives of the natural science subjects

Students should

- understand the purpose of and be able to apply mathematical and statistical calculations and methods as an aspect of analysis, results and quality control procedures;
- understand the purpose of and be able to apply electronic data processing with measuring and analysing instruments, in administrative routines pertaining to patients and laboratory, and as a statistical tool;
- understand the chemical theories and principles that are the basis of methods of analysis and chemical reactions in the body;
- be able to perform basic laboratory tasks such as choice and use of equipment, producing reagents, proving the existence of and measuring analyte concentration;
- understand the physical principles behind the detection of results of physical or chemical reactions using analysing instruments;
- understand the composition and limitations of analysing instruments and microscopes and be able to use them;
- be able to perform simple error search and implement measures when analysing instruments fail to function.

Objectives of the human biological subjects

Students should

- understand the connection between the composition of the human body and its function on macroscopic, microscopic and molecular levels;
- be able to recognise the microscopic anatomy of the most important organs;
- understand basic genetic and immunological mechanisms;
- understand the structure and function of micro-organisms;
- be able to perform basic laboratory tasks using methods of gene technology, immunology and microbiology.

Main subject 2: Social sciences and humanities

For academic year 2003-2004 social science subjects and humanities are taught as three interdisciplinary blocks (Joint Block A and Joint Block B in the 1st year of study, Joint Block C in the 2nd year of study). Information search in the library is taught, requiring students to learn to use information sources and retrieval systems, assess their sources and choose the information best suited to meet their needs. This instruction continues in the 2nd year of study, linked to mathematics, statistics and computer science, and in the 3rd year of study linked to the exam project.

This main subject is common to all the health and social study programmes. Common content is meant to contribute to joint knowledge and understanding, and a common frame of reference for health and social workers. On this basis attitudes and skills common to all the professions will emerge, improving the will and ability for cooperation.

Students should

- develop communicative and cooperative skills;
- acquire knowledge about other professions and be able to assess own and other practitioners' competence in concrete cooperation;
- develop their capabilities for cooperation with other health practitioners, and with patients and blood donors;
- be able to reflect on and give reasons for their work in relation to professional and ethical perspectives, and to regard their own professional role critically;
- develop a holistic view of the human being and respect human integrity and rights;
- develop an ability to recognise conflicts of value and ethical dilemmas in health work;
- understand the significance of science for general subject knowledge and problem solution;
- be able do document what they are doing, and plan and implement project work.

Objectives for the Joint Blocks

Through Joint Block A students should

- gain insight into the factors that promote or impede learning;
- be aware of their own study methods, strategies of learning and study behaviour;
- be introduced to the requirements for written assignments, and to the philosophy of writing as a central learning strategy;
- develop cooperative skills and teamwork skills;
- get to know the characteristics of different professions as well as common challenges in health and social work;
- gain insight into the central role communication plays when working with people;
- understand the importance of interdisciplinary cooperation and how to handle conflicts.

Through Joint Block B students should

- learn concepts and theories that support ethical reflection;
- learn to recognise the ethical aspect of social policy and health and social work;
- train systematic reflection on situations that are relevant to the profession, and where it is not immediately obvious what would be a moral way of acting;
- understand and be able to use the concepts of paternalism, autonomy, care, empathy and altruism;
- understand the rationale and ethical fundament behind the UN human right system;
- focus on how the value of human life can be understood.

Through Joint Block C students should

- acquire knowledge about scientific methods in order to be able to read research reports and utilise their own and other people's research results in their work;

- learn to give sound reasons for what they do, vis-à-vis clients, other professionals and employers;
- prepare for, implement and document the exam project.

Main subject 3: Medical laboratory subjects

Medical laboratory subjects are mainly taught in the 2nd and 3rd years of study. The course content is described for each year.

The objectives of natural science and humanities subjects are integrated into Main subject 3, in such a way that knowledge, skills and attitudes gained will give a necessary basis for reaching the goals.

Students should

- understand the main principles of analysing components of biological matter (see 2.2 Main subject 3), gain knowledge about and master laboratory tasks from test taking to results;
- be able to assess the reliability of results of analyses, applying skills in medical laboratory technology and knowledge of statistics as well as possibilities, limitations and error sources of various methods;
- be able to plan and implement method validation and draw conclusions from the results;
- be able to understand the importance of holistic quality systems, and assure the quality of laboratory work;
- develop analytic honesty and attitudes that promote quality behaviour such as order, accuracy and compliance with safety measures;
- be able to treat patients with respect and understanding in the test taking situation;
- develop cooperative capabilities towards patients, colleagues and other vocational groups;
- understand the role of the medical laboratory technologist and the place of laboratories within the health services;
- be able to update knowledge and skills so that their competence is maintained and further developed.

3.2 Content

1st year of study

The 1st year of study comprises natural science, human biology, social sciences, and humanities. Elements from medical laboratory subjects are integrated whenever that is natural. This structure has been chosen to mirror the various sides of the biomedical technologist's complex professional role. Work placement in hospital laboratories has a credit allocation of 1 ECTS credit in the 1st year of study.

COMMUNICATION, INTERACTION AND CONFLICT MANAGEMENT
Joint Block A - 4 weeks
The student role – work methods – communication – cooperation and interdisciplinarity. Using computers and the library.

- The role of student: expectations, demands and mastering

- Educational theory, cognitive psychology, group psychology
- Writing assignments. Learning by writing.
- Communication theories and communication in health and social work
- Challenges for today's practitioners in the health and social sector
- Interdisciplinarity, conflicts, conflict management
- Using the university college computer network. Searching for literature in the library.

GENERAL AND ANALYTICAL CHEMISTRY

- Nuclear, molecular and ionic structure, periodical properties and electron structure
- Phase conditions and gaseous laws. Solutions and their colligate properties.
- Stoichiometry. Chemical bindings.
- Thermo dynamics. Reaction kinetics.
- Chemical equilibrium. Acids, bases and buffers. Precipitation, complexes.
- Electro chemistry. Redox reactions, electrolysis, galvanic cells and ionic-selective electrodes.
- Flame emission and nuclear absorption
- Work environment conditions when working with chemical substances
- Basic laboratory technology such as choosing equipment, producing reagents, identifying and measuring analytes.

A laboratory course is integrated and must be passed before sitting for the exam.

ANATOMY, PHYSIOLOGY AND HISTOLOGY

- Medical nomenclature. Cells and various tissues: structure and function.
- The skeleton. The muscular system. The nervous system. The hormone system. Blood and tissue fluid. The heart and circulation system. The respiratory system. The digestive system with stomach, bowels, gall and liver. Kidneys and the urinary tract. Genitals and reproduction.
- Interaction between the organ systems
- Blood test sampling
- Microscoping of cells and tissue from various organs

A laboratory course is integrated and a practical test must be passed before sitting for the exam.

ETHICS

Joint Block B – 3 weeks

- Introduction to ethics and ethical theory: moral philosophy, ethical argumentation, main schools of ethics, ethical dilemmas
- Topics in ethics that are especially relevant to health and social workers: theory of justice, value of human life, paternalism and autonomy, care, empathy and altruism
- Human rights: human rights as moral idea and programme

INSTRUMENTAL MEASURING TECHNIQUES

- Basic electronics: Electronic components. Analogue and digital circuits. How the components function together in instruments that are used in medical laboratories. Use of instrument manuals and coupling diagrams. Planning and implementing error search on instruments. Maintenance and simple repair.
- Optics: Light as waves and particles. Polarisation. Fluorescence, phosphorescence, luminescence, radioactivity. Geometrical optics and wave optics. Fibre optics. Laser.

- Microscopy: Use, focusing and maintenance of microscope. Light track and dissolution. Køhler adjustment. Phase contrast. Fluorescence microscope. Electron microscope.
- Spectrophotometry: Basic principles. Components in spectrophotometers. Spectral wave breadth. The law of Lambert-Beer and deviances from it. Blind tests. Measuring transmission and absorbance. Absorbance of spectra. Choice of measuring wavelength. Concentration measuring with different calibration models. Control and maintenance of spectrophotometers. Pipette control.
- Ionic selective electrodes and biosensors
- Use of procedures for internal control and quality control

Laboratory course and practical test are integrated and must be approved before sitting for the exam.

ORGANIC CHEMISTRY AND BIOCHEMISTRY

- Bindings, functional groups, nomenclature and isometrics
- The most important organic substances: hydrocarbons, alcohols and phenols, substances with carbonyl-functional groups, alkyl halides, and Grignard reagents. Amines, ethers, epoxides.
- Reaction types and reaction mechanisms
- Structure and function of bio-molecules: amino acids/proteins, carbohydrates, fat/lipids/membranes and nucleic acids
- Enzyme kinetics
- Metabolism focusing on katabolic processes. Energy conversion.
- Biochemical separation methods: electrophoresis and chromatography
- Use of various methods for detection, separation and measuring of analytes

A laboratory course is integrated and must be approved before sitting for the exam.

2nd year of study

The 2nd year of study comprises natural science, human biology, social sciences and humanities. The subjects build on subjects and modules from the 1st year and form a basis for developing knowledge, skills and attitudes related to medical laboratory subjects. Laboratory medicine, medical laboratory technology, and quality development and control are seen as one unit. The work placement period has a credit allocation of 5 ECTS credits.

THEORY OF SCIENCE AND RESEARCH METHODS
Joint Block C – 3 weeks
Health and social work perspectives and research perspectives:

- What is the clients' situation?
- What happens to the clients when health professionals intervene?
- How can technology help people?

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

- Mathematical symbols. Logarithms. Linear/non-linear functions. Graphical presentation.
- Exponential and normal functions. Integration and derivation.
- Descriptive statistics. Probability distribution: discrete and continual

- Estimation and hypothesis testing. Types of error. Variance analysis. Correlation and linear regression.
- Statistic quality control
- Computer terminology. Computer net and the Internet. Current software. Laboratory computer systems.
- Privacy protection and computer security
- Use of Excel and other computer tools
- Searching for articles in databases: basic Internet search

A number of obligatory assignments must be approved before sitting for the exam.

CELL BIOLOGY

- The composition and function of the cell, cell division and cell communication
- Classical and molecular-biological genetics
- The composition and function of the immune system. Antigen reactions.
- Infection immunology
- General microbiology and microbial genetics
- Molecular-biological techniques. Immunological techniques. Isolation, cultivating and identification of micro-organisms
- Ethical considerations related to the development and use of medical gene technology

A laboratory course is included and must be approved before sitting for the exam.

MEDICAL LABORATORY SUBJECTS I

(Laboratory medicine, medical laboratory technology, quality development and control within microbiology, pathology, haematology and transfusion medicine.)

Laboratory medicine

(Microbiology, pathology, haematology and transfusion medicine)

Main focus is placed on the use of laboratory testing to diagnose, monitor diseases and control effects of treatments as an element in preventive health work.

Medical microbiology

- Bacteria, viruses, fungi, parasites and priones of human-pathogen importance
- History and classification of aerobe, facultative, micro-aerophile and anaerobe bacteria, viruses, fungi and parasites
- Pathogenesis and reaction of micro-organisms to disease. Infection mechanisms and the body's resistance to micro-organisms. Fighting pathogen micro-organisms. Development of vaccine.

Histopathology and cytology

- Diseases in individual organs or organ systems. The resistance mechanisms of the body.
- Microscopic assessment of pathological changes in tissue and cells, seen in relation to diseases in individual organs or organ systems, and the resistance mechanisms of the body

Haematology

- The haematological organ system with blood cell development, function and morphology
- Pathological conditions in erythroid, myeloid and thrombotic poiesis
- The normal haemostasis and disturbances in it

Transfusion medicine

- Systems of blood group and their clinical importance;
- Immunologically conditioned blood diseases;
- Haemotherapy and transfusion complications.

Medical laboratory technology with quality development and control
(Microbiology, pathology, haematology and transfusion medicine)

- Blood tests and sample reception: ordering, preparing for patients, equipment, test-taking techniques, preparing, treating, storing and sending. Pre-analytical variables including identity screening. Hygiene and infection prevention.
- Blood testing of patients
- Laboratory procedures. The possibilities and limitations of various methods of analysis. Analytical variables. Internal and external quality control. Assessment of analysis results seen in relation to pre-analytical and analytical variables and the medical probability of the results.
- Internal control of health, safety and environment
- The expertise of the medical laboratory technologist, the place of the laboratory in the health sector and ethical problems and dilemmas

Medical microbiology

- Detecting, isolating and identifying micro-organisms. Media. Dye theory and using different dye techniques.
- Cultivating bacteria and fungi on different media and under different conditions. Identifying micro-organisms with the help of morphological examinations and biochemical, immunochemical and gene technological methods.
- Antibiotics testing and resistance determination with agar diffusion technology
- Immunochemical methods for determining bacteria or virus antigen and antimatter

Histopathology and cytology

- Histochemical, enzyme and immunehistochemical techniques, dye theory and dye techniques to produce dyed cross sections of tissue
- Cervix cytology with screening technique
- Cytochemical techniques

Haematology

- Measuring haemoglobin and haemotocrit /EVF, counting blood cells and determining coagulation factors. Estimation of erythrocyte indexes.
- Production and microscopical assessment of blood samples
- Creating a procedure for measuring analytes (method description)

Transfusion medicine

- Blood type serology: haemaglutination with different reaction conditions and techniques to determine blood group antigens and antimatter by pre- and post-transfusion testing, pregnancy testing, and autoimmune diseases
- Producing blood components: selection and bleeding of donor, communication between the laboratory technologist and the blood donor, equipment and techniques for producing blood components, treating and storing blood products
- Accreditation: GMP (Good Manufacturing Practice)

A laboratory course is included and must be approved before sitting for the exam. Students collect their work in portfolios that are used at the oral examination.

3rd year of study

The 3rd year of study focuses on medical laboratory subjects within clinical chemistry and nuclear medicine. These subjects build on and integrate knowledge, skills and attitudes from natural science subjects, social science subjects and humanities. Medical laboratory subjects in haematology are continued form the 2nd year of study, focusing on automation. The minor subjects: laboratory medicine, medical laboratory technology, and quality development and control should be seen as related to one another.

Work placement in hospital laboratories have a credit allocation of 15 ECTS credits and includes a four-week period of unbroken placement. The third-year studies are completed with a project taking its theme from the third-year subjects.

MEDICAL LABORATORY SUBJECTS II

The third-year study comprises laboratory medicine, medical laboratory technology, and quality development and control within clinical chemistry and nuclear medicine, and automation within haematology and clinical chemistry.

Laboratory medicine

(Clinical chemistry and nuclear medicine)

Main focus is placed on the use of laboratory examinations to diagnose, monitor diseases, control effects of treatment, and as an aspect of preventive health care.

- Plasma proteins. Enzymes.
- Fluid or electrolyte balance. Acid or base balance, blood gases
- Carbohydrate and lipid metabolism. Mal-absorption
- Hormones. Medicines and toxic substances. Vitamins, trace elements. Hereditary metabolism. Allergy.
- Component analyses concerning liver or gall diseases, kidney or urinary tract diseases or diseases in the central nervous system. Analyses to monitor foetal placental function.
- Nuclear medical examinations

Medical laboratory technology with quality development and internal quality control

(Clinical chemistry, nuclear medicine and automation)

- Main principles: dye binding reactions, measuring enzyme activity and enzyme-catalysed concentration, electrochemical methods, osmometrics, production and microscopic assessment of urine sediments, blood sedimentation reaction, immunochemical methods with and without tracer, dry chemistry versus wet chemistry, the possibilities and limitations of various analysis methods
- Laboratory procedures
- Pre-analytical, analytical and post-analytical variables. Internal quality control and external quality assessment. Assessment of own work. Uncertainty concerning measurements. Assessment of results of analyses seen in relation to pre-analytical and analytical variables and the medical probability of the results. Descriptions of real problems with reply reports.
- Automatic analysis instruments within haematology and haemostasis: main principles for counting and differentiating blood cells, measuring haemoglobin and determining heamatocrite/EVF, erythrocyte indexes and coagulation factors, monitoring electronic and mechanical parts, and the quality of the analysis process
- Automation within haematology and clinical chemistry: main principles, monitoring electronic and mechanical parts, the quality of the analysis process, dealing with a large number of samples
- Method validation: mapping the accidental and systematic errors (such as interference) of an analysis method, establishing reference area, designing procedures for internal quality control
- Internal control for health, safety and environment. Accreditation.
- Blood testing on patients
- Nuclear medical examinations: tracer techniques, detection systems, scintigraphic examinations, protection against radiation
- The expertise of the medical laboratory technologist, the place of laboratories in the health sector, organisation of biomedical work

Preparing for exam project
The library as an important provider of information when preparing for project work:
- Searching for articles in general or theme-related databases
- Internet search and quality assessment of websites
- How to compose a bibliography

Final examinations in the curriculum
(Subject to change)

Module code	Module name	ECTS credits	Type of examination	Semester
1st year				
HSB1008	General and analytical chemistry	15	Written examination, 5 hours. Scale: A-F	Autumn
HSB1103	Anatomy, physiology and histology	10	Written Examination, 4 hours. Scale: A-F	Autumn
HSB1203	Instrumental measuring techniques	10	Written examination, 4 hours. Scale: A-F	Spring
HSB1308	Organic chemistry and biochemistry	15	Written examination, 5 hours. Scale: A-F	Spring
2nd year				

HSB2008	Cell biology	15	Written examination, 5 hours. Scale: A-F	Autumn
HSB2103	Mathematics, statistics and computer science	10	Written examination, 5 hours. Scale: A-F	Autumn
HSB2203	Medical laboratory subjects I (pathology, microbiology and haematology and transfusion medicine)	30	Oral examination based on student portfolios. Scale: A-F	Spring
3rd year				
HSB3003	Medical laboratory subjects II (clinical chemistry, nuclear medicine and automation)	45	Written examination, 5 hours. Scale: A-F	Spring
HSB3103	Exam project	15	Group project. Written report with oral presentation. Pass/Fail	Spring

Social sciences and humanities (HSB3203, 15 ECTS credits) have mandatory assignments through all the three years: written reports and oral presentations. These are assessed with either a Pass or a Fail.