**Requirements**

Semmelweis University, Faculty of Medicine  
**Name(s) of the Institute(s) teaching the subject:**  
Department of Biophysics and Radiation Biology

| **Name of the subject:** Medical biophysics II.  
**Credits:** 4  
**Total number of hours:** 56  
**Lectures:** 21  
**Practices:** 35  
**Seminars:** -  
**Type of the course (mandatory/elective):** mandatory |

**Academic year:** 2019-2020

**Code of the course: AOKFIZ668_2A**

**Course director (tutor):** Prof. Dr. Miklós Kellermayer  
**Contact details:** Department of Biophysics and Radiation Biology  phone: +36-1-459-1500/60200  
**Position:** professor, head of the department

**Date of habilitation and reference number:** 2004 PTE ÁOK 7/2004/habil

**Aim of the subject and its place in the curriculum:** Aim is to give the knowledge and way of thinking necessary for exact and quantitative understanding of working mechanism of biological systems and the human organism.

**Location of the course (lecture hall, practice room, etc.):** EOK Szent-Györgyi Albert lecture hall and student laboratories of the department.

**Competencies gained upon the successful completion of the subject:** Understanding the physical background of life processes and the environmental factors influencing the organism (radiations). Doing and evaluation of measurements individually, production of laboratory reports.

**Prerequisite(s) for admission to the subject:** Medical biophysics I.

**Minimum and maximum number of students registering for the course:** Maximum: the number of students in the 1st year.  
**Student selection method in case of oversubscription:** -

**How to register for the course:** Registration in the Neptun system.
Detailed thematic of the course:

**Lectures**

1. Generation and properties of X-ray (Dr. Kellermayer)
2. Fundamentals of X-ray diagnostics (Dr. Kellermayer)
3. Thermodynamics: equilibrium, change, laws (Dr. Zrínyi)
4. Transport processes I: Diffusion, Brownian motion. Osmosis (Dr. Veres)
5. Transport processes II: Flow of fluids and gases. Blood as fluid (Dr. Kellermayer)
6. Bioelectric phenomena (Dr. Csik)
7. Sound, ultrasound (Dr. Kellermayer)
8. Biophysics of sensory organs. Vision, hearing. (Dr. Kellermayer)
9. Building blocks of life: water, macromolecules, supramolecular systems (Dr. Kellermayer)
10. Biological motion. Biomechanics, molecular and tissue mechanics (Dr. Mártonfalvi)
11. Methods of investigating biomolecular structure and dynamics. X-ray diffraction, mass spectrometry, infrared spectroscopy (Dr. Kellermayer)
12. Methods of investigating biomolecular structure and dynamics. Radiospectroscopic methods, fundamentals of MRI. (Dr. Kellermayer)
13. Blood circulation and cardiac function (Dr. Kellermayer)
14. Biophysics of pulmonary function. Physical examination (Dr. Kellermayer)

**Practices**

1. Blood pressure measurement, dataprocessing.
2. Coulter counter
3. X-ray measurement
4. Microscopy II.
5. Gamma energy
6. Electrocardiography
7. Pulse generator
8. Sensory function
9. Isotope diagnostics
10. Diffusion
11. Audiometry
12. Fluid flow
13. CAT scan
14. Repetition

Teachers: Dr. Gergely Agócs, Dr. Erika Balog, Csilla Csányi, Dr. István Derka, Dr. Rita Galántai, Dr. Judit Gál-Somkuti, Dr. Dóra Haluszka, Dr. Levente Herényi, Dr. Dávid Juriga, Dr. Katalin Kis-Petik, Dr. Károly Liliom, Dr. Zsolt Mártonfalvi, Dr. Gusztáv Schay, Sr. Dániel Veres, Dr. István Voszka

**Potential overlap(s) with other subjects:** Medical physiology, Medical imaging methods, Ophthalmology, Medical statistics, informatics and telemedicine, Mathematical and physical basis of medical biophysics

**Special training activities required:** -
Policy regarding the attendance and making up absences: Participation in the practical lessons is compulsory. No more than three absences from practices are allowed for any reason, otherwise the semester will not be credited. The missed measurements should be done with another group during the 4 weeks cycle of laboratory practices if possible. (One should ask for the agreement of the teacher of own group and the other group.)

Means of assessing the students’ progress during the semester: There is no midterm test.

Requirement for acknowledging the semester (signature):
1. Participation on at least 75% of the practices, (in case of more than 3 absences the signature for the semester is denied.)
2. Acceptance of the lab. reports. If one has more than 3 „not accepted” lab. reports, the signature is denied. The lab reports must be uploaded to the website at the end of the practice.

Type of the examination: Final exam.
Exam requirements:

Medical biophysics final questions EM 2019-2020

1. Radiations: basic concepts, fundamentals of geometric optics
   Types of radiations. Radiometric quantities (radiance, irradiance, radiation intensity),
   dependence on direction, steradian. Dependence of intensity on distance in case of radiation
   sources of various geometry (graphical representation). Attenuation of radiation passing
   through medium (differential and integral form of the law, interpretation). Geometric optics
   as model. Fermat’s principle. Absolute and relative index of refraction, law of refraction and
   reflection. Calculation of critical angle. Phenomenon of total internal reflection and its
   application.

2. Image formation of simple optical systems
   Image formation on a single curved surface, power, law of image formation. Image formation
   by lenses, principal light rays, lens equation. Magnification and angular magnification.
   Equivalent power of lens systems. Construction of microscope, light rays, magnification.

3. Fundamentals of wave optics
   Oscillations and waves, types of waves. Huygens-Fresnel principle, interference, diffraction
   on slit and optical grating. Calculation of diffraction angle. Concept of polarized light.
   Application of light polarization: polarimetry, phase contrast and polarization microscope
   (the principle briefly). Wave optical limit of resolution. Wave optical meaning of colors.

4. Dual nature of light
   Phenomenon referring to wave nature and interpretation of them. The electromagnetic
   spectrum. Photoelectric effect, its interpretation by Einstein and applications of it. Photon
   energy, the eV scale. Interpretation of momentum of light, application: laser tweezer. Concept
   of matter wave. Parts and resolution of electron microscope.

5. Models of atom, electron as particle and wave
   Models of atom. The Bohr model. Franck-Hertz experiment. Concept of matter wave and
   calculation of its wavelength. Wave nature of electron (wavelength, experimental proofs).
   Wave properties of the free electron, Heisenberg’s uncertainty relation. Characterization of
   bound electron, quantum numbers. Structure of periodic table.

6. Atomic and molecular interactions
   Interactions in physics. General description of intra- and interatomic interactions, potential
   energy, bond distance, bond energy (concepts and graphical representation).
   Electronegativity. Primary bonds (covalent, metallic, ionic), secondary bonds (dipole-dipole,
   van der Waals, hydrogen bond, hydrophobic bond). Atomic radius. Types of scanning probe
   microscopy: STM, AFM (principle, components, application).

7. Multiatomic systems I. ideal and real gases
   Origin of pressure of ideal gases. Maxwell-Boltzmann velocity distribution. State equation of
   real gases (van der Waals equation). Boltzmann distribution and condition of its validity.
   Barometric altitude formula, thermal emission of metals, Nernst equation, equilibrium and
   speed of chemical reactions, Arrhenius plot. Strength of bond, interpretation of breaking of
   various types of bonds by Boltzmann distribution. Temperature dependence of electric
   conductivity of semiconductors.

8. Multiatomic systems II. Solids, liquids and liquid crystals
   Characterization of crystalline state, unit cell, crystal defects. Energy levels in crystals, and
   structure (insulators, conductors, intrinsic and doped semiconductors). Interpretation of
   electric and optical properties of crystalline materials. Function of semiconductor diode.
   Order in liquid state. Properties of mesomorphic state. Thermotropic and lyotropic liquid
   crystalline structures. Biological examples for liquid crystalline systems. Electro- and
   thermo-optical phenomenon and application of them.
9. **Interaction of light with atoms and molecules**
   Light scattering. Rayleigh- and Mie-scattering with examples. Turbidimetry, nephelometry. Dynamic light scattering and the information obtained from it. Law of radiation attenuation and derivation of Beer-Lambert law from it. Measurement of absorption spectrum (parts and function of the equipment) characteristic parameters and information obtained from it. Energy levels and spectra of atoms and molecules.

10. **Thermal radiation**

11. **Luminescence and its forms**

12. **Laser**

13. **Atomic nucleus, isotopes. Ways of radioactive decay, nuclear radiations**


15. **Measurement of nuclear radiations**
    Parts and function of the devices used for measurement of nuclear radiations: scintillation counter, detectors based on gas ionization, thermoluminescent dosimeter, photographic (film) methods, semiconductor detectors. Field of application of them.

16. **Dosimetry, dose concepts, radiation protection**
    Biological effects of ionizing radiations: mechanism of radiation effect (physical, chemical, biological phases) stochastic and deterministic effect.
    Dose concepts: absorbed dose, exposure, equivalent dose, effective dose, dose rate.
    Measurement of exposure, relations of doses in air and in tissue, weighting factors and meaning of them.
    Radiation protection: ALARA-principle (graphical explanation) dose limits.

17. **Fundamentals of isotope diagnostics. Viewpoints for selection of the proper isotope**
    Information obtained from isotope tests. Cost-benefit principle. Viewpoints for selection of the isotope: chemical element (definition of radiopharmaceutical), activity, half-life, type and energy of emitted radiation, practical significance of them. Parts and function of Te-generator.
18. Methods of isotope diagnostics, fundamentals of radiotherapy

19. Types of biological signals, signal processing
Classification of signals according to different viewpoints (with examples). Comparison of signals (decibel scale). Fourier-theorem for periodic and aperiodic signals (examples). Typical frequency and amplitude ranges of biological signals. Voltage divider, parts and function of filter circuits for alternating current. Function of amplifier, functions showing the working of amplifier, effect of feedback. Digitalization of analogue signals. Shannon-Nyquist theorem. Processing of pulse signals, examples for medical application.

II. semester

20. Production and characterization of x-rays and its interaction with matter

21. Fundamentals of x-ray diagnostics

22. Fluid flow

23. Diffusion and the laws of it. Osmosis

24. Thermodynamics I
Types of thermodynamic systems. The human body as a thermodynamic system. Types of energies in thermodynamic systems, internal energy and its components. Change of internal energy. Extensive and intensive quantities. I. law of thermodynamics and its applications for biological systems. Entropy, thermal and configurational entropy, its connections with order.

25. Thermodynamics II

26. Bioelectric phenomena I. The resting potential
potential due to stimulation (experiment, biological examples). Changes in the membrane potential as the function of time and space, factors influencing it.

27. **Bioelectric phenomena II. The action potential and its propagation**
Temporal changes in membrane potential and ion currents during the action potential. Electrochemical potential as driving force. Propagation of action potential, saltatory propagation, speed of propagation, refractory period and its role. Synapse. Electric signals measured on the body surface, detection of them and the diagnostic methods related to them.

28. **Production and characterization of ultrasound. Ultrasound diagnostics and therapy**

29. **Water and biological macromolecules**

30. **Biophysics of sensory organs**

31. **Biomechanics: biomolecular and tissue mechanics**

32. **Molecular mechanisms of biological motion**
Structure and types of motor proteins. Duty cycle, the typical range of force and working distance, processivity. Basic phenomena of muscle biophysics: contraction, summation, tetanus, isometric and isotonic contraction, work and power. Force-velocity curve. Sliding filament model. Parts of the contractile apparatus, duty cycle of myosin, regulation of muscle contraction.

33. **Examination of biomolecular structure: X-ray crystallography and mass spectrometry.**

34. **Examination of biomolecular structure: radio spectrosopies**
Stern–Gerlach-experiment, magnetic moment, splitting of energy levels in magnetic field (Zeeman-effect), Larmor-precession, resonance condition Macroscopic magnetization (Boltzmann-distribution). Relaxations, relaxation times (T1, T2). Spin echo. NMR and ESR
spectroscopies. Bases of MRI: space coding, imaging: proton density, T1 and T2 weighting. Special MRI methods.

35. Biophysics of blood circulation and heart function
Function of the blood vessel system. Flow as a transport process. Changes in pressure, cross section of vessels, total cross section, and flow velocity in the blood vessel system. Mechanics of the elastic vessel wall. Pressure relations in the arterial system, auxiliary factors of circulation. Combined description of mechanical and electric function of the heart. Pressure changes during the heart cycle. Work of the heart.

36. Respiratory biophysics. Biophysical basis of physical examination

Practice questions on the semifinal exam 2019/20 1. semester (EM)

1. Microscopy I.
   Theoretical background:
   - types of optical lenses, parameters of them
   - image formation of convex lenses
   - lens laws
   - image formation and magnification of microscope
   - resolving power of microscope (Abbe’s principle)

Quantities to be determined based on the given data:
   - calibration value of eyepiece scale and size of the object.

2. Refractometry
   Theoretical background:
   - law of light refraction, definition of index of refraction
   - critical angle, total reflection
   - formation of Snell circle
   - factors influencing the value of index of refraction
   - parts and function of Abbe-refractometer

Quantities to be determined based on the given data after proper graphical representation:
   - the unknown concentrations.

3. Light absorption
   Theoretical background:
   - derivation of Lambert-Beer law from the absorption law
   - absorbance, transmittance and the relation of them
   - absorption spectrum and the information available from it
   - parts of absorption spectrometer
   - application of absorbance measurement in laboratory diagnostics

Quantities to be determined based on the given data after proper graphical representation:
   - photon energy belonging to electron transition (in eV units)

4. Polarimetry
   Theoretical background:
   - linearly polarized, circularly polarized light and the connection between them
   - definition and interpretation of optical activity
- Biot-law, specific rotation
- parts and function of polarimeter

**Quantities to be determined based on the given data:**
the type of given sugar and the unknown concentration.

5. Optics of the eye
   
   **Theoretical background:**
   - refractive media and image formation of the eye
   - accommodation
   - refractive disorders of eye and the way for correction of them
   - limiting angle of vision, visual acuity (visus), factors influencing the visual acuity
   - distribution of photoreceptors on the retina

   **Quantities to be determined based on the given data:**
   accommodation power and visual acuity.

6. Nuclear medicine
   
   **Theoretical background:**
   - parts of scintillation counter
   - possible processes happening in the scintillation crystal
   - processes happening in the photomultiplier
   - signal selection, function of the discriminator, sources of noise pulses
   - optimal setting of scintillation counter

   **Quantities to be determined based on the given data after proper graphical representation:**
   the optimal discrimination level.

7. Gamma-absorption
   
   **Theoretical background:**
   - attenuation law of radiation, attenuation coefficient, mass attenuation coefficient
   - processes of attenuation on the atomic scale (photoeffect, Compton-scattering, pair production, elastic scattering)
   - the dependence of mass attenuation coefficients due to different processes on the photon energy
   - viewpoints of radiation protection

   **Quantities to be determined based on the given data after proper graphical representation:**
   \( D, \mu, \mu_m \) for all the absorbents and \( \varepsilon, \tau_{eps}, \sigma_{eps} \).

8. Resonance
   
   **Theoretical background:**
   - elastic deformation, Hooke’s law
   - harmonic oscillation
   - undamped and damped free oscillation
   - driven oscillation, resonance
   - effect of external force (depending on the distance) on the driven oscillation (working principle of AFM)

   **Quantities to be determined based on the given data after proper graphical representation:**
   the spring constant.

9. Skin impedance
   
   **Theoretical background:**
   - definition and components of impedance
   - electric model of the skin and the possible simplifications on the model
   - frequency dependence of capacitive reactance, approximation of skin impedance in case of low and high frequencies
   - practical applications of impedance measurement
Quantities to be determined based on the given data:
specific resistance and specific capacity of the skin.

10. Dosimetry
Theoretical background:
- the most important basic concepts in dosimetry
- function of thermoluminescent dosimeter
- application of the ionization chamber as dose rate measuring device
Quantities to be determined based on the given data after proper graphical representation:
Voltage – current diagram of the ionization chamber. Name the ranges of the diagram and
determine the exposure rate and absorbed dose rate in air.

11. Amplifier
Theoretical background:
- gain, gain level
- frequency response curve of the amplifier
- negative feedback
- advantages and disadvantages of feedback
Quantities to be determined based on the given data after proper graphical representation:
The maximum gain level, cut-off frequencies of the transfer band. Can it be used for the
amplification of ECG signal?

II. semester

1. Coulter-counter
Theoretical background:
- parts and function of the equipment
- function of ID, DD and multichannel analyzer
- additional methods for counting different types of blood cells
Quantities to be determined based on the given data after proper graphical representation:
Calibration value, unknown blood cell concentration, RBC discrimination level

2. Diffusion
Theoretical background:
- phenomenon of diffusion and its mathematical description: Fick’s I. and II. law.
- solution of Fick’s II. law in case of concrete experimental conditions (to be listed)
- determination of the amount of material diffused out by the measurement of conductance
Quantities to be determined based on the given data after proper graphical representation:
The diffusion coefficient and the Stokes radius of hydrated K⁺ and Cl⁻ ions

3. X-ray I.
Theoretical background:
- parts and function of the X-ray tube
- production, spectrum and diagnostic energy range of X-radiation
- power of Bremsstrahlung and efficiency of X-ray tube
Based on the given spectra make a graph, which proves Duane–Hunt-law.

4. X-ray II.
Theoretical background:
- attenuation of X-ray intensity
- application of filters in X-ray diagnostics
- atomic processes of attenuation, dependence of their mass attenuation coefficients on the
photon energy
- explain which photonenergies are the best for X-ray diagnostics
Based on the given data make a graph that shows the relationship between the mass attenuation coefficient of photoeffect and the atomic number of the absorbent.

5. Gamma energy

Theoretical background:
- energy transformations in the scintillation counter, energy selectivity
- possible applications of discriminators
- spectrum of gamma radiation and the pulse amplitude spectrum
- give an example for dual isotope labeling, and explain its advantage

Quantity to be determined based on the given data after proper graphical representation:
The unknown photon energy

6. Audiometry

Theoretical background:
- physical characteristics of sound
- the human hearing range, threshold of hearing, threshold of pain
- loudness, loudness level and the connection between them
- interpretation of the audiogram

Based on the given data construct the hearing threshold curve and the audiogram

7. Pulse generator

Theoretical background:
- characteristic parameters of square pulses
- types of multivibrators, practical application of them

Determine the parameters of the pulse series shown on the attached graph (amplitude, pulse duration time, period time, frequency, duty cycle, and the energy of one pulse)

8. ECG

Theoretical background:
- explain the formation of the ECG curve, and its components
- types of ECG leads
- Einthoven-triangle, integral vector
- parts of the ECG equipment, differential amplifier

Based on the attached ECG curves construct the integral vector and determine the heart rate

9. Flow

Theoretical background:
- stationary and pulsed, laminar and turbulent flow
- Hagen–Poiseuille-law and the conditions of its validity
- changes of pressure, cross section and flow velocity in the circulatory system
- electrical model of the vascular system (analogies)

Based on the given data determine the number of branches in part B and C of the model

10. Sensor

Theoretical background:
- model of the sensory system
- stimulus, receptor potential, action potential, sensation
- explain the role of voltage – frequency conversion in the sensation process
- psychophysical laws

Based on the given data after proper graphical representation whether the model supports the Weber–Fechner or the Stevens-law.

11. CAT-scan

Theoretical background:
Type and method of grading:
The final grade is the average of the 3 parts if all are better than 1. The grade is rounded up or down according to the decision of the second examiner. If for one part the student gets 1.5 we do not calculate the average, but the final grade can be max. 2. If any of the grades is 1, the final grade will be 1.

How to register for the exam: Through Neptun system

Opportunities to retake the exam: According to the educational rules of the university

Literature, i.e. printed, electronic and online notes, textbooks, tutorials (URL for online material):
Lecture notes, homework problems on the homepage of the department.
Damjanovich-Fidy-Szőllősi (eds): Medical Biophysics (2009)
Medical biophysics practices (Semmelweis Publisher, 2015)

Signature of the tutor:

Signature(s) of the head(s) of the Institute(s):

Date: 2019. 09. 16.

Credit Transfer Committee’s opinion:

Comment of the Dean’s Office:

Signature of the Dean:

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1 Dékáni Hitüadó tölthet ki, jóváhagyást követően.
2 Az elméleti és gyakorlati oktatást örökra (hétékre) lebontva, sorszámozva külön-külön kell megadni, az előadók és a gyakorlati oktatók nevének felülvizsgálásával. Mellékletben nem csatolható!
3 Pl. terepgyakorlat, körlikelemezés, felmérés készítése stb.
4 Pl. házi feladat, beszámoló, zártfelvételi stb. témákra és időpontja, pótlásuk és javításuk lehetősége.
5 Elméleti vizsga esetén kérjük a tételsor megadását, gyakorlati vizsga esetén a vizsgázatás témakörét és módját.
6 Az elméleti és gyakorlati vizsga beszámításának módja. Az évközi számonkérés eredményeink beszámításti módja.
Semmelweis University, Faculty of Medicine
Name of the Institute: Department of Medical Biochemistry

Name of the course: Medical Biochemistry I.
Credits: 5
Total number of hours: 70; lectures (hours): 42; practices (hours): 28
Type of the course: obligatory

Academic year: 2019/2020

Code of the course: 2

Name of Head of the Department: Professor László Csanády M.D. Ph.D. D.Sc.
Contact details: H-1094 Budapest, Tűzoltó u. 37-47. tel: +36-1-459-1500#60010 email: csanady.laszlo@med.semmelweis-univ.hu
Position: Temporary Head of Department
Habilitációjának kelte száma: 2013

Aim of the course:
The aim of this course is to examine biologically important molecules – namely amino acids, carbohydrates, lipids and nucleotides – identify their contributions to metabolic processes emphasized from a medical point of view, examine the structure and function of proteins, and address mechanisms of catalysis performed by enzymes. Furthermore, three basic biochemistry modules are outlined: The enzymology module, encompassing general principles of enzyme kinetics and how enzymes influence efficiency and controllability of chemical processes in biological systems, as well as how they affect structure and regulation of metabolic pathways; the bioenergetics module, addressing the relationships between mass-energy conversions in the human body emphasizing nutritional aspects, also elaborating on thermodynamic aspects of metabolism; and the 'first' intermediary metabolism module, presenting the salient features of carbohydrate and lipid metabolism which are essential for understanding physiological and pathological processes of the human body. During practices, students apply the theoretical knowledge acquired at lectures as part of case-oriented discussions in an effort to interpret – from a molecular point of view – medically relevant conditions.

Location of the course (lecture hall, practice room, etc.):
Premises located in the Basic Medical Sciences building (laboratory rooms located on the first floor and lecture halls located on the ground floor).

Upon the successful completion of the curriculum, the student should be able to:
Identify biochemical structures, know and understand the reactions in which medically important molecules participate; know and understand inter-organ biochemical processes; know and understand integrated metabolic functions of the human body. Overall, such knowledge is essential for understanding physiological and pathological processes and, consequently, for making sound medical decisions.

Prerequisite(s) for admission to the course: Medical Chemistry

Terms and Conditions for Starting Student Course (Minimum, Maximum), Student Selection Method: Not applicable for compulsory subjects

How to apply for the course: Application is through the Neptun online system

The course in thematic details:
| Lectures: weekly 2x70 min (3 hours) | Practices (P): 2 hours every week |
| Lecturers: | Prof. Ádám Veronika (ÁV)  
Prof. Csanády László (CSL)  
Prof. Kolev Kraszimir (KK)  
Dr. Komorowicz Erzsébet (KE)  
Dr. Szöllősi András (SZA)  
Dr. Töröcsik Beáta (TB)  
Prof. Tretter László (TL) |
|---|---|
| **1.** The role of proteins in the living world. The chemical structure of proteinogenic amino acids. The peptide bond. The primary, secondary and tertiary structure of proteins.  
(CSL, SZA) | **P:** Structural and chemical characteristics of amino acids; pH and temperature dependent properties. |
| **2.** Preprotein forms of proteins, e.g. procollagen-collagen. Comparison of the structure-function aspects of myoglobin and haemoglobin.  
(CSL, SZA, KK, TL) | **P:** Current protein diagnostic and structural test methods and their medical applications. |
| **3.** Kinetic models of enzymatic function. Michaelis-Menten kinetics. Significance of the Michaelis constant (Km). Inhibition of enzymatic reactions. Importance of inhibitor types in drug design.  
(KK, TL) | **P:** Interpretation of pathological conditions stemming from alterations in protein structure, elucidated by atomic resolution techniques. |
| **4.** Structure and kinetics of metabolic pathways. Principles of metabolic control. Strategies for identifying enzymes as drug targets.  
(TL)  
(KK, TL) | **P:** Quantitative characterization of enzyme functions and its importance in the interpretation of pathophysiological conditions. |
<p>| 7 | Glycolysis Metabolism of fructose and galactose, pathological aspects. Regulation of glycolysis and gluconeogenesis. (AV, BT) | P: Carbohydrates in the diet. Food fibers and additives. |
| 9 | Blood glucose level and its regulation II; hyperglycemia. Biochemistry of diabetes mellitus (DM) type I and type II (AV, TB) | P: Fructose intolerance; McArdle’s disease |
| 10 | Metabolism of lipids – overview. Absorption of lipids. Metabolism of chylomicrons. (AV, TB) | P: Structure and function of the most important lipids in the body and in the diet. |</p>
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<th>Chapter</th>
<th>Description</th>
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Potential overlap(s) with other topics: none

Requirement for special study: not applicable

Policy regarding attending practice; policy regarding absences:
Practices are mandatory. It is not possible to make up for missed practices. In case of absences amounting to more than 3 practices, the semester is not acknowledged. Arriving to a practice with a delay of more than 10 minutes is considered an absence.

Means of assessing acquired knowledge during the semester: not applicable
**Requirement for acknowledging the semester, and for allowing the student to take the semi-final exam:** In case of absences amounting to more than 10.5 hours, the semester is not acknowledged.

**Exam Type:** Colloquium (semi-final), Form: written test exam, based on material of the official textbook, lectures and practices published at the department's Moodle e-learning system ([https://itc.semmelweis.hu/moodle/](https://itc.semmelweis.hu/moodle/)).

**Exam Requirements:** The material for the written test exam is the material of the lectures and practices in the subject, with the corresponding textbook chapters.

**Types and modes of grading:**
The competition is held on week 13, and the structure of the competition is the same as that of the semi-final. Top 5% scorers are exempted from the semi-final exam.

The grade of the semi-final exam is based on:

**Written test:**
This test consists of multiple choice questions (MCQs) from which max 65 points can be obtained.

Grade calculation of the semi-final exam:
- 60-65: grade 5 (excellent)
- 49-59: grade 4 (good)
- 41-48: grade 3 (satisfactory)
- 33-40: grade 2 (pass)

If 32 and below, then the grade of the semi-final exam is ‘fail’.

**How to apply for the exam:** The exam dates are announced on the 12th week of the semester. We provide at least one exam date each week. Applications are made in the Neptun system in accordance with the University Study and Exam Rules.

**Opportunities to repeat the exam:** an exam can be re-taken only after two calendar days.

**Printed, electronic and online notes, textbooks, tutorials, and literature for online learning:**
*Harper’s Biochemistry (30th edition, or latest)*

Online material published at the department’s Moodle e-learning system ([https://itc.semmelweis.hu/moodle/](https://itc.semmelweis.hu/moodle/)).

**A tárgyat meghirdető habilitált oktató (tantárgyfelelős) aláírása:**

A gesztorintézet igazgatójának aláírása:

**Beadás dátuma:**

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**OKB vëleménye:**

**Dékâni hivatal megjegyzése:**

**Dékân aláírása:**

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1 Csak abban az esetben kell megadni, ha a tárgy az adott nyelven is meghirdetésre kerül.

2 Dékâni Hivatal tölti ki, jóváhagyást követően.
Az elméleti és gyakorlati oktatást órákra (hetekre) lebontva, sorszámozva külön-külön kell megadni, az előadók és a gyakorlati oktatók nevének feltüntetésével. Mellékletben nem csatolható!

Pl. terepgyakorlat, kórlapelemzés, felmérés készítése, stb.

Pl. házi feladat, beszámoló, zárthelyi stb. témaköre és időpontja, pótlásuk és javításuk lehetősége.

Elméleti vizsga esetén kérjük a tételsor megadását, gyakorlati vizsga esetén a vizsgátatás témakörét és métdját.

Az elméleti és gyakorlati vizsga beszámításának módja. Az évközi számonkéresek eredményeink beszámítási módja.
**Requirements**

<table>
<thead>
<tr>
<th>Semmelweis University, Faculty of Medicine</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name(s) of the Institute(s) teaching the subject:</strong></td>
</tr>
<tr>
<td>Department of Genetics, Cell- and Immunobiology Semmelweis University, Faculty of Medicine</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Name of the subject:</strong> Cell Science</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Credits:</strong> 3</td>
</tr>
<tr>
<td><strong>Total number of hours:</strong> 42</td>
</tr>
<tr>
<td><strong>lectures:</strong> 14</td>
</tr>
<tr>
<td><strong>practices:</strong> 28</td>
</tr>
<tr>
<td><strong>seminars:</strong> 0</td>
</tr>
<tr>
<td><strong>Type of the course (mandatory/elective):</strong> mandatory</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Academic year:</strong> 2019/2020</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Code of the course</strong>: AOKGEN666_1A</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Course director (tutor):</strong> Prof. Edit Buzás</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contact details:</strong> Department of Genetics, Cell- and Immunobiology Semmelweis University, Faculty of Medicine</td>
</tr>
<tr>
<td><strong>Position:</strong> professor and chairman</td>
</tr>
<tr>
<td><strong>Date of habilitation and reference number:</strong> Budapest, 2nd of June 2009. Number: 273</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Aim of the subject and its place in the curriculum:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Cell Science is developed for medical students as a part of the Basic Module. The Curse presents the most important aspects of cell-morphology and cell function. Cell Science Course provides a detailed discussion of compartmentalization in the eukaryotic cell as well as describes the most significant characteristics of the basic cellular functions (migration, endocytosis, cell-cell communication, division, stem cell differentiation, ageing and cell death). The practices introduce the students to the microscopic techniques used for cell morphological studies. The purpose of the course is to demonstrate the complexity of cell structure and function relationships as well as to present basic methods of in vitro cell culturing and their potential medical applications</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Location of the course (lecture hall, practice room, etc.):</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>NET building: Selye János Lecture Hall and Lab rooms L13-L16</td>
</tr>
<tr>
<td>1089 Budapest, Nagyvárad tér 4.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Competencies gained upon the successful completion of the subject:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge of cell morphology, assignment of major cellular functions to organelles.</td>
</tr>
<tr>
<td>Usage of light microscope (bright field) for studying biological samples.</td>
</tr>
<tr>
<td>Knowledge of other microscopic techniques (fluorescence microscopy; super-resolution microscopy).</td>
</tr>
<tr>
<td>Knowledge of basic biological sample preparation techniques (section, smear, monolayer, suspension).</td>
</tr>
<tr>
<td>Ability to evaluate immune fluorescence images.</td>
</tr>
<tr>
<td>Ability to recognize cellular organelles and macromolecular complexes and sample preparation methods on electron micrographs. Interpretation of co-localization of cellular organelles.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Prerequisite(s) for admission to the subject:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Minimum and maximum number of students registering for the course:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student selection method in case of oversubscription:</strong> no selection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>How to register for the course:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>through NEPTUN system</td>
</tr>
</tbody>
</table>
**Detailed thematic of the course:**

*Lectures:*

1. Cell theory. Model cells in Medicine
2. Cell membrane
3. Structure and function of the nucleus
4. Endoplasmic reticulum
5. Golgi complex, vesicular transport and secretion
6. Endocytosis. Autophagy
7. Cell adhesion and cell junctions
8. Cytoskeleton
9. Cellular movement
10. Structure and function of mitochondria and peroxisomes
12. Cell cycle and mitosis
13. Stem cells and differentiation
14. Cellular aging and cell death

*Practices:*

1. The light microscope
2. The general cell structure. Light microscopic microtechnique
3. The electron microscope. Cell membrane
4. The interphase nucleus. Cyto/Histo-chemistry
5. Immunohistochemistry. Super-resolution microscopy
6. Cell and tissue culture
7. Endoplasmic reticulum
8. Golgi complex and secretion
9. Endocytosis and lysosomes
10. Cell surface differentiation, enzyme-histochemistry
12. Mitosis
13. Meiosis
14. Cell death (necrosis and apoptosis)

The order of topics may vary

Lecturers: Prof Edit Buzás, Dr. András Kristóf Fülöp, Dr László Kőhidai, Dr. Sára Tóth
Practice teachers: teaching staff of the Department of Genetics, Cell and Immunobiology.

**Potential overlap(s) with other subjects:**

There is no substantial overlap with other subjects, but some subject e. g. Histology I, Molecular cell biology and Biophysics is partly based on the knowledge of cell morphology and cellular functions

**Special training activities required:**

- 

**Policy regarding the attendance and making up absences:**

The classes can be only attended in an appropriate mental and health condition. There is a possibility to make up for absences during the current school week after prior consultation with practical teachers.

**Means of assessing the students’ progress during the semester:**

The ability of setting a light microscope for sample examination is controlled by the practice teacher.

**Requirement for acknowledging the semester (signature):**

According to the Study and Examination Policy § 7.: 75% practice class attendance, and attendance on midterm is required for signature.
**Type of the examination:**
written

**Exam requirements:**

<table>
<thead>
<tr>
<th>Theoretical part</th>
<th>Practical part</th>
</tr>
</thead>
<tbody>
<tr>
<td>The structure of the cell membrane</td>
<td>The light microscope</td>
</tr>
<tr>
<td>Function of the cell membrane</td>
<td>The light microscopic microtechniques</td>
</tr>
<tr>
<td>Extension of the cell membrane glycanalx, membrane skeleton</td>
<td>The electronmicroscopy</td>
</tr>
<tr>
<td>The nucleus I: the chromatin</td>
<td>The electronmicroscopic microtechniques</td>
</tr>
<tr>
<td>The nucleus II: the nucleolus</td>
<td>Histological staining and cytochemical reaction</td>
</tr>
<tr>
<td>The nucleus III: interchromatin</td>
<td>Immunocytochemistry</td>
</tr>
<tr>
<td>The nucleus IV: nuclear envelop and pore</td>
<td>Super-resolution microscopy</td>
</tr>
<tr>
<td>Rough endoplasmic reticulum</td>
<td>Cell culturing</td>
</tr>
<tr>
<td>Smooth endoplasmic reticulum</td>
<td>Artificial tissues – basics of regenerative medicine</td>
</tr>
<tr>
<td>Golgi-complex</td>
<td>Recognition and evaluation of the light-microscopic slides studied during the semester</td>
</tr>
<tr>
<td>Vesicular transport</td>
<td>Recognition of cellular organelles and sample preparation techniques in electronmicrographs</td>
</tr>
</tbody>
</table>
Type and method of grading:
The written exam score should achieve 50% of the total scores for passing.

How to register for the exam:
Signing up and modification of the exam days can be arranged exclusively online in the students’ registration system Neptun.

Opportunities to retake the exam:
According to the Study and Examination Policy.

Literature, i.e. printed, electronic and online notes, textbooks, tutorials (URL for online material):
Presentations and documents are available at the website of the Department (http://gsi.semmelweis.hu/index.php/en/education)

Signature of the tutor:

Signature(s) of the head(s) of the Institute(s):

Date:
26.09.2019

Credit Transfer Committee’s opinion:

Comment of the Dean’s Office:

Signature of the Dean:

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1 Dékáni Hivatal tölti ki, jóváhagyást követően.
2 Az elméleti és gyakorlati oktatást órákra (hetekre) lebontva, sorszámozva külön-külön kell megadni, az előadók és a gyakorlati oktatók nevének feltüntetésével. Mellékletben nem csatolható!
3 Pl. terepgyakorlat, körlacelemzés, felmérés készítése stb.
4 Pl. házi feladat, beszámoló, zárt helyi stb. témaköre és időpontja, pótlásuk és javításuk lehetősége.
5 Elméleti vizsga esetén kérjük a tételes megadását, gyakorlati vizsga esetén a vizsgázatás témakörét és módját.
6 Az elméleti és gyakorlati vizsga beszámításának módja. Az évközi számonkérések eredményeink beszámítási módja.
**REQUIREMENTS**

<table>
<thead>
<tr>
<th>Semmelweis University, Faculty of Medicine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name(s) of the Institute(s) teaching the subject: Department of Family Medicine</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name of the subject: Medical Profession</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits: 2</td>
</tr>
<tr>
<td>Total number of hours: 30 lectures: 12 practices: 18 seminars: 0</td>
</tr>
<tr>
<td>Type of the course (mandatory/elective): mandatory</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Academic year: 2019/2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code of the course¹: AOKCSA248_1A</td>
</tr>
</tbody>
</table>

| Course director (tutor): Prof. Dr. Kalabay László |
| Contact details: 06-1-355-8530 |
| Position: Director |
| Date of habilitation and reference number: 205/2003 |

<table>
<thead>
<tr>
<th>Aim of the subject and its place in the curriculum:</th>
</tr>
</thead>
<tbody>
<tr>
<td>An overview of medical profession. Formation of the consciousness of profession, personal careers.</td>
</tr>
<tr>
<td>The attitude of the medical doctor. Communication with colleagues and the members of the medical staff. An overview of different levels of health care. The organization, function activity of the clinical department and general medicine praxis. Characteristics of the clinical work. Overview of the scientific activity of the clinical department. Raising interest on joining to it.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location of the course (lecture hall, practice room, etc.):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture hall, family practices, clinics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Competencies gained upon the successful completion of the subject:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Introduction to medical interviewing</td>
</tr>
<tr>
<td>• Introduction to anamnesis and basic communication techniques</td>
</tr>
<tr>
<td>• Introduction to the physical examination</td>
</tr>
<tr>
<td>• Learning basic investigation techniques</td>
</tr>
<tr>
<td>• Learning the basic skills of the physical examination</td>
</tr>
<tr>
<td>• Introduction to hand disinfection and blood taking</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prerequisite(s) for admission to the subject:</th>
</tr>
</thead>
</table>

| Minimum and maximum number of students registering for the course: |
|Student selection method in case of oversubscription:|
| 15 students/group |

<table>
<thead>
<tr>
<th>How to register for the course:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration for the course in the 'Neptun’ system</td>
</tr>
</tbody>
</table>
**Detailed thematic of the course**:  
Detailed topic of the subject:  
1st week: cardiology lecture  
2nd week: family medicine lecture  
3rd week: obstetrics and gynecology lecture  
4th week: surgery lecture  
5th week: paediatrics lecture  
6th week: psychiatry lecture  
7th week: internal medicine, surgery, paediatrics, psychiatry, obstetrics and gynecology, family medicine, orthopaedics, traumatology, cardiology, dermatology, urology, pulmonology, neurology, according to the attendance sheet  
8th week: internal medicine, surgery, paediatrics, psychiatry, obstetrics and gynecology, family medicine, orthopaedics, traumatology, cardiology, dermatology, urology, pulmonology, neurology, according to the attendance sheet  
9th week: internal medicine, surgery, paediatrics, psychiatry, obstetrics and gynecology, family medicine, orthopaedics, traumatology, cardiology, dermatology, urology, pulmonology, neurology, according to the attendance sheet  
10th week: internal medicine, surgery, paediatrics, psychiatry, obstetrics and gynecology, family medicine, orthopaedics, traumatology, cardiology, dermatology, urology, pulmonology, neurology, according to the attendance sheet  
11th week: internal medicine, surgery, paediatrics, psychiatry, obstetrics and gynecology, family medicine, orthopaedics, traumatology, cardiology, dermatology, urology, pulmonology, neurology, according to the attendance sheet  
12th week: internal medicine, surgery, paediatrics, psychiatry, obstetrics and gynecology, family medicine, orthopaedics, traumatology, cardiology, dermatology, urology, pulmonology, neurology, according to the attendance sheet

Week 13: Skills lab  
Week 14: Exam: Essay

**Potential overlap(s) with other subjects**:  

**Special training activities required**:  
Completed attendance sheet

**Policy regarding the attendance and making up absences**:  
It’s compulsory for the student to attend 75 percent of the training sessions, but if needed the student can join another training group to be able to meet this requirement if they missed some of the training sessions in the original group.

**Means of assessing the students’ progress during the semester**:

**Requirement for acknowledging the semester (signature)**:  
It’s compulsory for the student to attend at least 75 percent of the training sessions.

**Type of the examination**:  
Essay

**Exam requirements**:  
Essay, typed, 1,400 characters as the minimum length, Times New Roman font, font size 12, single spacing. The experiences of the students (lectures and practices) of medical profession, with short case stories. What kind of medical profession is the most attractive for the student?  
Deadline for handing in the essay is the 14th week
**Type and method of grading**:  
Grade 1: Exam date was missed, number of characters <1400,  
Grade 2: no personal example  
Grade 3: 1 personal example, too general drafting, without personal experience  
Grade 4: 1 minor technical mistake  
Grade 5: Precise writing, 4-5 personal examples  

**How to register for the exam**:  
Registering for the exam in the ‘Neptun’ system  

**Opportunities to retake the exam**: In accordance with the Studies and Exams Code  

**Literature, i.e. printed, electronic and online notes, textbooks, tutorials (URL for online material)**:  

**Signature of the tutor**:  

**Signature(s) of the head(s) of the Institute(s)**:  

**Date**:  

---  

**Credit Transfer Committee’s opinion**:  

**Comment of the Dean’s Office**:  

**Signature of the Dean**:  

---  

1 Dékáni Hivatal tölti ki, jóváhagyást követően.  
2 Az elméleti és gyakorlati oktatást órákra (hetekre) lebontva, sorszámozva külön-külön kell megadni, az előadók és a gyakorlati oktatók nevének feltüntetésével. Mellékletben nem csatolható!  
3 Pl. terepgyakorlat, kórlapelemzés, felmérés készítése stb.  
4 Pl. házi feladat, beszámoló, zárthelyi stb. témaköre és időpontja, pótlásuk és javításuk lehetősége.  
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6 Az elméleti és gyakorlati vizsga beszámításának módja. Az évközi számonkérések eredményeinek beszámítási módja.
**Requirements**

**Semmelweis University, Faculty of Medicine**

**Name(s) of the Institute(s) teaching the subject:**
Department of Anatomy, Histology and Embryology

**Name of subject:** Macroscopic anatomy I.

**Credits:** 7

**Total number of hours:** 7
- **Lectures:** 1
- **Practices:** 6
- **Seminars:** 0

**Type of subject:** mandatory

**Academic year:** 2019/2020.

**Subject code:** AOKANT667_1A

**Subject Director/Coordinator:** Dr. Szél Ágoston

**Contact details:** Semmelweis University, Department of Anatomy, Histology and Embryology, +36-30-900-2378

**Position:** Professor, Head of Department

**Date of habilitation and reference number:** 134/1997.

**Learning objectives, the role of Macroscopic Anatomy in the medical curriculum:**
Demonstration of the macroscopic composition of the human body specifically to provide the future clinicians/medical doctors with a valid body of information with relevance to clinically significant morphological structures. Teaching is done in the form of lectures and dissection classes.

**Location of the course (lecture room, seminar rooms, etc., addresses):**
Semmelweis University, Department of Anatomy, Histology and Embryology
Budapest 1094, Tűzoltó utca 58.

**Competencies gained upon the successful completion of the subject:**
Understanding the macroscopic composition of the human body together with the position and topographical relation of organs. Clear understanding of structure and function. Ability to perform basic preparatory tasks during dissection. Identification of general directions/landmarks on the cadaver together with the recognition of significant organs/body parts. Acquiring knowledge of surface features and/or sectional anatomy forming basis for clinical diagnostics (palpation, auscultation, etc.) and radiology/imaging methods.

**Prerequisite(s) for admission to the subject:**
none (subject is offered in the 1st semester)

**Number of students (minimal, maximal) required for Course/Subject registration, selection criteria for students in case of oversubscription:**
obligatory for all registered students, on the basis of registration via the NEPTUN system

**Registration for the subject:**
Via the NEPTUN system.

**Detailed list of topics covered in the subject:**

List of lectures
1. week: General introduction, terminology
2. week: Joints and movements of the shoulder and shoulder girdle,
3. week: Joints and movements of the elbow
4. week: Joints and movements of the hand
5. week: Pelvis. Joints and movements of the hip
6. week: Joints and movements of the knee
7. week: Joints and movements of the foot
8. week: Composition of thorax, diaphragm
9. week: Composition of the abdominal wall. Inguinal and femoral canals
10. week: Composition and movements of the vertebral column
11. week: General composition of the skull. Sphenoid, ethmoid. Cavities of the viscerocranium
12. week: Temporomandibular joint, muscles of mastication. Neck muscles and movements, cervical fasciae
13. week: Oral cavity, palate, faucial isthmus, pharynx
14. week: Nasal cavity, paranasal sinuses, larynx

Topics for the dissection classes
1-4. weeks: Bones, joints and muscles of the upper limb. Dissection of the upper limb.
5-7. weeks: Bones, joints and muscles of the lower limb. Dissection of the lower limb. Cadaver dissection
8-10. weeks: Cadaver dissection: limbs, superficial layers of the trunk, inspection of the structure of the body wall on prosected specimens (torso).
11-14. weeks: Inspection of the bony skull together with head and neck prosections. Dissection of the head and neck regions.

Potential overlap(s) with other subjects:
Microscopic Anatomy and Embryology I - II.

Special training activities required:
All students are required to demonstrate their knowledge and motivated practical work by the completion and demonstration of a dissected specimen or region once during the two semesters of the Academic year.

Policy regarding the attendance and making up absences:
Active participation in practical lessons/dissection room sessions is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester. Absences are therefore limited in 25%. Attendance will be recorded in the dissection room classes.

Means of assessing the students’ progress during the semester:
During the semester, both practical and theoretical knowledge will regularly be evaluated. Attendance is obligatory at the two mid-term tests. Students absent from the mid-term test should reattend at a given timepoint or their semester will not be accepted. Anatomy mid-terms may be oral or written exams. Oral exams, held in the dissection room, are composed of both identification of several structures on the specimen and theoretical questions related to the subject. The written mid-term test is organised as an e-learning type examination where a valid SeKa account (including a user name,password) is required.
The time and topics of midterm tests will be announced in the departmental homepage at the beginning of the semester (http://semmelweis.hu/anatomia).

Requirement for acknowledging the semester (signature):
Active participation in dissection room sessions is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester.
Absences are therefore limited in 25%. Attendance will be recorded in the dissection room classes.

**Type of examination:**

Seminifinal (written and oral) examination, topics: subject matter of the semester. Seminifinal examinations consist of written and oral (practical and theoretical) parts
1. Written pretest (e-learning module)
2. Macroscopic Anatomy (identification of structures on true anatomical specimens) including relevant theoretical questions from the subject matter of the semester

**Examination requirements:**
During the semifinal examination the knowledge of students will be tested. Seminifinal examinations are composed of written and oral (practical and theoretical) parts.

**Topic list for the semifinal examination:**

**Macroscopic Anatomy I.**

**Musculoskeletal Anatomy**

| General osteology, classification of bones |
| Bones, spaces and connections of the skull, external and internal skull bases |
| Neurocranium, components and cavities (anterior, middle and posterior cranial fossae) |
| Viscerocranium, components and cavities (walls and connections of the nasal cavity, orbit, oral cavity, pterygopalatine and infratemporal fossae) |
| Bones of the axial and appendicular skeleton |
| Vertebrae, ribs, sternum |
| Bones of the girdles and limbs |
| General arthrology |
| Fibrous and cartilaginous joints |
| Components of the synovial joints |
| Classification of synovial joints; movements and mechanisms |
| Structure of the vertebral column, the gross anatomy of the muscles acting upon it |
| Movements and muscles of the head&neck (atlantooccipital and atlantoaxial joints) |
| Joints of the shoulder girdle, the gross anatomy of the muscles acting upon them |
| Shoulder joint, the gross anatomy of the muscles acting upon it |
| Elbow joint, the gross anatomy of the muscles acting upon it |
| Structure and movements of the radiocarpal joint, gross anatomy of the muscles acting upon it |
| Metacarpophalangeal and interphalangeal joints, the gross anatomy of the muscles concerned with the movements |
| Carpometacarpal, metacarpophalangeal and interphalangeal joints of the thumb, the gross anatomy of the muscles concerned with the movements |
| Hip joint and the gross anatomy of the muscles concerned with the movements |
| Knee joint and the gross anatomy of the muscles concerned with the movements |
| Ankle joint together with the gross anatomy of the muscles acting upon it |
| Subtalar and talocalcaneonavicular joints, the muscles acting upon them |
| Temporomandibular joint and the gross anatomy of the muscles acting on it |
| Architecture and classification of bones |
| Structure and actions of somatic muscles |
| Osteofibrous structure of the thoracic cage (bones, joints, ligaments, movements) |
| Muscles and movements of the thorax |
| Muscles of the back and nape (occipital region) |
| Axilla, the quadrangular and triangular spaces |
| Cubital fossa |
| Muscles and cross section of the arm |
| Muscles and cross section of the forearm |
| Osteofibrous spaces and muscle compartments of the hand, tendinous sheaths |
| Muscles and spaces of the abdominal wall, rectus sheath |
| Composition of the pelvis (bones, ligaments and membranes) |
Inguinal canal, femoral canal
Subinguinal hiatus, vascular and muscular compartments; adductor canal, femoral canal
Muscles of the buttock, the posterior abdominal wall and the pelvis (external and internal muscles of the hip)
Osteofibrous compartments, muscles and cross section of the thigh
Popliteal fossa
Osteofibrous compartments, muscles and the cross section of the leg
Structure of the foot, arches of the foot
Osteofibrous compartments of the foot, tendinous sheaths
Muscles of mastication
Muscles of facial expression
Superficial muscles of the neck, muscle triangles
Deep muscles of the neck and the laminae of the cervical fascia

**Vessels and nerves**
Dorsal branches of the spinal nerves, intercostal nerves
Cervical plexus, brachial plexus, lumbar plexus, sacral plexus.
Innervation of limbs
Innervation of the trunk
Cutaneous innervation
Axillary artery and branches
Arteries and veins of the arm, forearm, and hand
Arteries and veins of the lower limb

**Lymphatic drainage**
Lymph nodes and vessels of the limbs
Lymphatic drainage of the thoracic wall including the mamma
Lymph nodes and lymphatic vessels of the head&neck

**Internal organs of the head & neck region**
Subclavian artery and its branches
Common and external carotid arteries and their branches
Maxillary artery and its branches
Veins of face and neck
Oral cavity (divisions, boundaries)
Floor of mouth, sulcus lateralis linguæ
Types and morphology of teeth
Blood supply and innervation of teeth
Tonsils (anatomy)
Faucial isthmus, palate
Macroscopy of the tongue
Salivary glands together with topography
Pharynx and parapharyngeal spaces
Blood supply and innervation of pharynx
Pharyngeal muscles
Nose, nasal cavity (boundaries, nasal meatus, vessels)
Paranasal sinuses (connections, vessels)
Larynx (shape, position, vessels, nerves)
Skeleton and joints of larynx
Laryngeal ligaments (fibroelastic membranes, mucous membrane)
Muscles of larynx, innervation

**Type and method of grading**:

Semifinal examinations are composed of written theoretical and oral practical parts. The written theoretical examination is done using an e-learning module while the practical examination is
conducted in the dissection room on real prosected cadaver specimen. Examiners are delegated by the course directors with the consensus of the Head of Department. Students will receive two separate marks to the two parts of the examination. In case of an unsuccessful (fail=1) examination part, the whole semifinal examination needs to be retaken. Those with a 4 (good) or 5 (excellent) written examination mark are exempted from rewriting the written pretest in the retake examination in case failing during the practical part of the given semifinal examination. The final mark is calculated on the basis of the results (marks) gathered during the written and oral parts of the given examination under the supervision of the president of the examination committee.

**Registration for examinations:**

Via the NEPTUN system.

**Opportunities to retake the exam:**

According the Study and Examination Policy

**Literature, i.e. printed, electronic and online notes, textbooks, tutorials (URL for online material):**

**Recommended textbooks**

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>ISBN</th>
<th>Year</th>
</tr>
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<tbody>
<tr>
<td>Sobotta Atlas of Human Anatomy</td>
<td>Waschke &amp; Paulsen</td>
<td>9780702052507</td>
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<tr>
<td>Gray’s Anatomy for students with STUDENT CONSULT Online Access</td>
<td>Drake, Vogl, Mitchell</td>
<td>9780702051319</td>
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<td>McMinn and Abrahams’ Clinical Atlas of Human Anatomy</td>
<td>Abrahams, Spratt, Loukas &amp; van Schoor</td>
<td>9780723436973</td>
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<tr>
<td>Functional Anatomy, Histology and Embryology for medical and dental students</td>
<td>Réthelyi and Szentágothai</td>
<td></td>
<td>2018</td>
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<tr>
<td>Gray's Anatomy. The Anatomical Basis of Clinical Practice</td>
<td>Standring</td>
<td>9780702052309</td>
<td>2015</td>
</tr>
<tr>
<td>Netter's Clinical Anatomy with Online Access</td>
<td>Hansen</td>
<td>9781455770632</td>
<td>2014</td>
</tr>
<tr>
<td>Bräuer: Sobotta Flashcards (Muscles; Bones, Ligaments, and Joints)</td>
<td></td>
<td></td>
<td>2013</td>
</tr>
<tr>
<td>RMH McMinn: Last’s Anatomy, Regional and Applied</td>
<td></td>
<td></td>
<td>1990</td>
</tr>
<tr>
<td>Regional Anatomy</td>
<td>Tömböl</td>
<td>963 242 186 8</td>
<td>2008</td>
</tr>
<tr>
<td>Sectional Anatomy – Workbook</td>
<td>Nemeskéri</td>
<td></td>
<td>2001</td>
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</table>

**Further study aids:**

To be downloaded from the homepage of the Department of Anatomy, Histology and Embryology
Signature of Subject Director/Coordinator:

Signature(s) of the head(s) of the Institute(s):

Date: 2019. 09. 17.

Credit Transfer Committee’s opinion:

Comment of the Dean’s Office:

Signature of the Dean:

1 Csak abban az esetben kell megadni, ha a tárgy az adott nyelven is meghirdetésre kerül.
2 Dékáni Hivatal tölti ki, jóváhagyást követően.
3 Az elméleti és gyakorlati oktatást órákra (hetekre) lebontva, sorszámozva külön-külön kell megadni, az előadók és a gyakorlati oktatók nevének feltüntetésével. Mellékletben nem csatolható!
4 Pl. terepgyakorlat, kórlemezész, felmérés készítése, stb.
5 Pl. házi feladat, beszámoló, zárthelyi stb. témaköre és időpontja, pótlásuk és javításuk lehetősége.
6 Elméleti vizsga esetén kérjük a tételek megadását, gyakorlati vizsga esetén a vizsgált témakörét és módját.
7 Az elméleti és gyakorlati vizsga beszámításának módja. Az évközi számonkérések eredményeink beszámítási módja.
**REQUIREMENTS**

<table>
<thead>
<tr>
<th>Semmelweis University, Faculty of Medicine</th>
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</table>

**Name(s) of the Institute(s) teaching the subject:**
Department of Anatomy, Histology and Embryology

**Name of subject:** Macroscopic anatomy I.

**Credits:** 7

**Total number of hours:** 7  lectures: 1  practices: 6  seminars: 0

**Type of subject:** mandatory

**Academic year:** 2019/2020.

**Subject code:** AOKANT667_1A

**Subject Director/Coordinator:** Dr. Szél Ágoston

**Contact details:** Semmelweis University, Department of Anatomy, Histology and Embryology, +36-30-900-2378

**Position:** Professor, Head of Department

**Date of habilitation and reference number:** 134/1997.

**Learning objectives, the role of Macroscopic Anatomy in the medical curriculum:**

Demonstration of the macroscopical composition of the human body specifically to provide the future clinicians/medical doctors with a valid body of information with relevance to clinically significant morphological structures. Teaching is done in the form of lectures and dissection classes.

**Location of the course (lecture room, seminar rooms, etc., addresses):**

Semmelweis University, Department of Anatomy, Histology and Embryology
Budapest 1094, Tűzoltó utca 58.

**Competencies gained upon the successful completion of the subject:**

Understanding the macroscopical composition of the human body together with the position and topographical relation of organs. Clear understanding of structure and function. Ability to perform basic preparatory tasks during dissection. Identification of general directions/landmarks on the cadaver together with the recognition of significant organs/body parts. Acquiring knowledge of surface features and/or sectional anatomy forming basis for clinical diagnostics (palpation, auscultation, etc.) and radiology/imaging methods.

**Prerequisite(s) for admission to the subject:**

none (subject is offered in the 1st semester)

**Number of students (minimal, maximal) required for Course/Subject registration, selection criteria for students in case of oversubscription:**

obligatory for all registered students, on the basis of registration via the NEPTUN system

**Registration for the subject:**
Via the NEPTUN system.

**Detailed list of topics covered in the subject:**

*List of lectures*
1. week: General introduction, terminology
2. week: Joints and movements of the shoulder and shoulder girdle,
3. week: Joints and movements of the elbow
4. week: Joints and movements of the hand
5. week: Pelvis. Joints and movements of the hip
6. week: Joints and movements of the knee
7. week : Joints and movements of the foot
8. week: Composition of thorax, diaphragm
9. week: Composition of the abdominal wall. Ingual and femoral canals
10. week: Composition and movements of the vertebral column
11. week: General composition of the skull. Sphenoid, ethmoid. Cavities of the viscerocranium
12. week: Temporomandibular joint, muscles of mastication. Neck muscles and movements, cervical fasciae
13. week: Oral cavity, palate, faucial isthmus, pharynx
14. week: Nasal cavity, paranasal sinuses, larynx

**Topics for the dissection classes**
1-4. weeks: Bones, joints and muscles of the upper limb. Dissection of the upper limb.
5-7. weeks: Bones, joints and muscles of the lower limb. Dissection of the lower limb. Cadaver dissection
8-10. weeks: Cadaver dissection: limbs, superficial layers of the trunk, inspection of the structure of the body wall on prosed specimens (torso).
11-14. weeks: Inspection of the bony skull together with head and neck prossections. Dissection of the head and neck regions.

**Potential overlap(s) with other subjects:**
Microscopic Anatomy and Embryology I - II.

**Special training activities required**: All students are required to demonstrate their knowledge and motivated practical work by the completion and demonstration of a dissected specimen or region once during the two semesters of the Academic year.

**Policy regarding the attendance and making up absences**: Active participation in practical lessons/dissection room sessions is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester. Absences are therefore limited in 25%. Attendance will be recorded in the dissection room classes.

**Means of assessing the students' progress during the semester**: During the semester, both practical and theoretical knowledge will regularly be evaluated. Attendance is obligatory at the two mid-term tests. Students absent from the mid-term test should rettend at a given timepoint or their semester will not be accepted. Anatomy mid-terms may be oral or written exams. Oral exams, held in the dissection room, are composed of both identification of several structures on the specimen and theoretical questions related to the subject. The written mid-term test is organised as an e-learning type examination where a valid SeKa account (including a user name&password) is required. The time and topics of midterm tests will be announced in the departmental homepage at the beginning of the semester (http://semmelweis.hu/anatomia).

**Requirement for acknowledging the semester (signature)**: Active participation in dissection room sessions is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester.
Absences are therefore limited in 25%. Attendance will be recorded in the dissection room classes.

**Type of examination:**

Semifinal (written and oral) examination, topics: subject matter of the semester. Semifinal examinations consist of written and oral (practical and theoretical) parts

1. Written pretest (e-learning module)
2. Macroscopic Anatomy (identification of structures on true anatomical specimens) including relevant theoretical questions from the subject matter of the semester

**Examination requirements:**

During the semifinal examination the knowledge of students will be tested. Semifinal examinations are composed of written and oral (practical and theoretical) parts.

**Topic list for the semifinal examination:**

**Macroscopic Anatomy I.**

**Musculoskeletal Anatomy**

General osteology, classification of bones

Bones, spaces and connections of the skull, external and internal skull bases

Neurocranium, components and cavities (anterior, middle and posterior cranial fossae)

Viscerocranium, components and cavities (walls and connections of the nasal cavity, orbit, oral cavity, pterygopalatine and infratemporal fossae)

Bones of the axial and appendicular skeleton

Vertebrae, ribs, sternum

Bones of the girdles and limbs

General arthology

Fibrous and cartilaginous joints

Components of the synovial joints

Classification of synovial joints; movements and mechanisms

Structure of the vertebral column, the gross anatomy of the muscles acting upon it

Movements and muscles of the head & neck (atlantooccipital and atlantoaxial joints)

Joints of the shoulder girdle, the gross anatomy of the muscles acting upon them

Shoulder joint, the gross anatomy of the muscles acting upon it

Elbow joint, the gross anatomy of the muscles acting upon it

Structure and movements of the radiocarpal joint, gross anatomy of the muscles acting upon it

Metacarpophalangeal and interphalangeal joints, the gross anatomy of the muscles concerned with the movements

Carpometacarpal, metacarpophalangeal and interphalangeal joints of the thumb, the gross anatomy of the muscles concerned with the movements

Hip joint and the gross anatomy of the muscles concerned with the movements

Knee joint and the gross anatomy of the muscles concerned with the movements

Ankle joint together with the gross anatomy of the muscles acting upon it

Subtalar and talocalcaneonavicular joints, the muscles acting upon them

Temporomandibular joint and the gross anatomy of the muscles acting upon it

Architecture and classification of bones

Structure and actions of somatic muscles

Osteofibrous structure of the thoracic cage (bones, joints, ligaments, movements)

Muscles and movements of the thorax

Muscles of the back and nape (occipital region)

Axilla, the quadrangular and triangular spaces

Cubital fossa

Muscles and cross section of the arm

Muscles and cross section of the forearm

Osteofibrous spaces and muscle compartments of the hand, tendinous sheaths

Muscles and spaces of the abdominal wall, rectus sheath

Composition of the pelvis (bones, ligaments and membranes)
Inguinal canal, femoral canal
Subinguinal hiatus, vascular and muscular compartments; adductor canal, femoral canal
Muscles of the buttock, the posterior abdominal wall and the pelvis (external and internal muscles of the hip)
Osteofibrous compartments, muscles and cross section of the thigh
Popliteal fossa
Osteofibrous compartments, muscles and the cross section of the leg
Structure of the foot, arches of the foot
Osteofibrous compartments of the foot, tendinous sheaths
Muscles of mastication
Muscles of facial expression
Superficial muscles of the neck, muscle triangles
Deep muscles of the neck and the laminae of the cervical fascia

**Vessels and nerves**
Dorsal branches of the spinal nerves, intercostal nerves
Cervical plexus, brachial plexus, lumbar plexus, sacral plexus.
Innervation of limbs
Innervation of the trunk
Cutaneous innervation
Axillary artery and branches
Arteries and veins of the arm, forearm, and hand
Arteries and veins of the lower limb

**Lymphatic drainage**
Lymph nodes and vessels of the limbs
Lymphatic drainage of the thoracic wall including the mamma
Lymph nodes and lymphatic vessels of the head & neck

**Internal organs of the head & neck region**
Subclavian artery and its branches
Common and external carotid arteries and their branches
Maxillary artery and its branches
Veins of face and neck
Oral cavity (divisions, boundaries)
Floor of mouth, sulcus lateralis linguae
Types and morphology of teeth
Blood supply and innervation of teeth
Tonsils (anatomy)
Faucial isthmus, palate
Macroscopy of the tongue
Salivary glands together with topography
Pharynx and parapharyngeal spaces
Blood supply and innervation of pharynx
Pharyngeal muscles
Nose, nasal cavity (boundaries, nasal meatus, vessels)
Paranasal sinuses (connections, vessels)
Larynx (shape, position, vessels, nerves)
Skeleton and joints of larynx
Laryngeal ligaments (fibroelastic membranes, mucous membrane)
Muscles of larynx, innervation

**Type and method of grading**: 
Semifinal examinations are composed of written theoretical and oral practical parts. The written theoretical examination is done using an e-learning module while the practical examination is
conducted in the dissection room on real prosected cadaver specimen. Examiners are delegated by the course directors with the consensus of the Head of Department. Students will receive two separate marks to the two parts of the examination. In case of an unsuccessful (fail=1) examination part, the whole semifinal examination needs to be retaken. Those with a 4 (good) or 5 (excellent) written examination mark are exempted from rewriting the written pretest in the retake examination in case failing during the practical part of the given semifinal examination. The final mark is calculated on the basis of the results (marks) gathered during the written and oral parts of the given examination under the supervision of the president of the examination committee.

**Registration for examinations:**

Via the NEPTUN system.

**Opportunities to retake the exam:**

According the Study and Examination Policy

**Literature, i.e. printed, electronic and online notes, textbooks, tutorials (URL for online material):**

**Recommended textbooks**


Bräuer: Sobotta Flashcards (Muscles; Bones, Ligaments, and Joints) URBFI, 2013.


Regional Anatomy, by T Tömöl, Medicina 2008, ISBN 963 242 186 8


**Further study aids:**

To be downloaded from the homepage of the Department of Anatomy, Histology and Embryology.
(http://semmelweis.hu/anatomia) or from Knowledgebase on the Library homepage: (https://lib.semmelweis.hu/knowledge_base).

<table>
<thead>
<tr>
<th>Signature of Subject Director/Coordinator:</th>
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<th>Signature(s) of the head(s) of the Institute(s):</th>
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<th>Credit Transfer Committee’s opinion:</th>
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</table>

1. Csak abban az esetben kell megadni, ha a tárca az adott nyelven is meghirdetésre kerül.
2. Dékáni Hivatal tölti ki, jóváhagyást követően.
3. Az elméleti és gyakorlati oktatást órákra (hetekre) lebontva, sorszámozva külön-külön kell megadni, az előadók és a gyakorlati oktatók nevének feltüntetésével. Mellékletben nem csatolható!
4. Pl. terepgyakorlat, kórlapelemzés, felméré készítése, stb.
5. Pl. házi feladat, beszámoló, zárrhelyi stb. témákör és időpontja, pótlásuk és javításuk lehetősége.
6. Elméleti vizsga esetén kérjük a tételsor megadását, gyakorlati vizsga esetén a vizsgázatás témakörét és módját.
## REQUIREMENTS

**Semmelweis University, Faculty of Medicine**

**Name(s) of the Institute(s) teaching the subject:**
Department of Anatomy, Histology and Embryology

**Name of subject:** Macroscopic anatomy II.

**Credits:** 9

**Total number of hours:** 9 - lectures: 2  practices: 7  seminars: 0

**Type of subject:** mandatory

**Academic year:** 2019/2020.

**Subject code:** AOKANT667_2A

**Subject Director/Coordinator:** Dr. Szél Ágoston

**Contact details:** Semmelweis University, Department of Anatomy, Histology and Embryology, +36-30-900-2378

**Position:** Professor, Head of Department

**Date of habilitation and reference number:** 134/1997.

### Learning objectives, the role of Macroscopic Anatomy in the medical curriculum:

Demonstration of the macroscopical composition of the human body specifically to provide the future clinicians/medical doctors with a valid body of information with relevance to clinically significant morphological structures. Teaching is done in the form of lectures and dissection classes.

### Location of the course (lecture room, seminar rooms, etc., addresses):

Semmelweis University, Department of Anatomy, Histology and Embryology
Budapest 1094, Tűzoltó utca 58.

### Competencies gained upon the successful completion of the subject:

Understanding the macroscopical composition of the human body together with the position and topographical relation of organs. Clear understanding of structure and function. Ability to perform basic preparatory tasks during dissection. Identification of general directions/landmarks on the cadaver together with the recognition of significant organs/body parts. Acquiring knowledge of surface features and/or sectional anatomy forming basis for clinical diagnostics (palpation, auscultation, etc.) and radiology/imaging methods

### Prerequisite(s) for admission to the subject:

Macroscopic Anatomy I.

### Number of students (minimal, maximal) required for Course/Subj ect registration, selection criteria for students in case of oversubscription:

obligatory for all registered students, on the basis of registration via the NEPTUN system

### Registration for the subject:

Via the NEPTUN system.

### Detailed list of topics covered in the subject:

*List of lectures*
2. week: Vessels, conducting system of the heart. Surface projection of the heart, pericardium. Auscultation points Stomach and small intestines (duodenum, jejunum, ileum)
3. week: Liver, gall bladder, pancreas, spleen. Large intestine, rectum
5. week: Organs, vessels and nerves of the retroperitoneum Morphology and coats of the testicle
6. week: Morphology of the epididymis, spermatic cord, seminal vesicle and prostate Morphology of penis and male urethra. Male perineum
7. week: Ovary, Fallopian tube and uterus Vagina, female perineum, external genital organs
8. week: Blood supply and lymphatic drainage of the abdomen and lesser pelvis Introduction to the study of the nervous system. Meninges, hemispheres, CSF, lateral ventricles
10. week: Intracranial topography Cranial nerve nuclei
11. week: Olfactory nerve (CN 1), optic nerve (CN 2). Orbit Extraocular muscles and eye movements. Protective and lacrimal apparatus of the eye
12. week: Oculomotor nerve (CN 3), trochlear nerve (CN 4), abducent nerve (CN 6) Trigeminal nerve (CN 5)
13. week: Facial nerve (CN 7) Glossopharyngeal nerve (CN 9), vagus nerve (CN 10), accessory nerve (CN 11), hypoglossal nerve (CN 12)
14. week: Anatomy of the middle and internal ears Sympathetic and parasympathetic nervous systems

Topics for the dissection classes
1-3. weeks: Opening of the thorax, dissection of the thoracic cavity. 4-7. weeks: Opening of the abdominal cavity, dissection/inspection of the abdominal organs 8-9. weeks: Dissection/inspection of the perineum together with organs of the lesser pelvis. 10-12. weeks: Dissection/inspection of the brain and spinal cord. 13-14. weeks: Dissection of head and neck regions, inspection of prosections

Potential overlap(s) with other subjects:
Microscopic Anatomy and Embryology I - II.

Special training activities required:
All students are required to demonstrate their knowledge and motivated practical work by the completion and demonstration of a dissected specimen or region once during the two semesters of the Academic year.

Policy regarding the attendance and making up absences:
Active participation in practical lessons/dissection room sessions is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester. Absences are therefore limited in 25%. Attendance will be recorded in the dissection room classes.

Means of assessing the students’ progress during the semester:
During the semester, both practical and theoretical knowledge will regularly be evaluated.
Attendance is obligatory at the two mid-term tests. Students absent from the mid-term test should reattend at a given timepoint or their semester will not be accepted. Anatomy mid-terms may be oral or written exams. Oral exams, held in the dissection room, are composed of both identification of several structures on the specimen and theoretical questions related to the subject. The written mid-term test is organised as an e-learning type examination where a valid SeKa account (including a user name&password) is required. The time and topics of midterm tests will be announced in the departmental homepage at the beginning of the semester (http://semmelweis.hu/anatomia).

**Requirement for acknowledging the semester (signature):**

Active participation in dissection room sessions is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester. Absences are therefore limited in 25%. Attendance will be recorded in the dissection room classes.

**Type of examination:**

Final (written and oral) examination, topics: subject matter of the subjects Macroscopic Anatomy I-II. Final examinations consist of written and oral (practical and theoretical) parts
1. Written pretest (e-learning module)
2. Macroscopic Anatomy (identification of structures on true anatomical specimens) including relevant theoretical questions from the subject matter of the semester

**Examination requirements:**

During the semifinal examination the knowledge of students will be tested. Semifinal examinations are composed of written and oral (practical and theoretical) parts.

**Topic list for the semifinal examination:**

**Macroscopic Anatomy I.**
*(see there)*

**Macroscopic Anatomy II.**

* Circulatory system
  * Shape, external features of heart
  * Chambers of heart
  * Endocardium, ostia, valves of heart
  * Skeleton of heart, anuli fibrosi
  * Structure of heart wall
  * Pulse generating and conducting system of heart
  * Pericardium
  * Position and surface projections of heart
  * Percussion and auscultation (area of cardiac dullness, heart sounds)
  * Radiology of heart
  * Pulmonary circulation
  * Ascending aorta, arch of aorta and its branches
  * Thoracic aorta and its branches
  * Abdominal aorta and its branches
  * Celiac trunk and its branches
  * Superior mesenteric artery and its branches
  * Inferior mesenteric artery and its branches
  * External and internal iliac artery and its branches
  * Internal pudendal artery and its branches
  * Superior vena cava and its tributaries
  * Inferior vena cava and its tributaries
  * Azygos and hemiazygos veins and their tributaries
  * Portal vein and its tributaries, portocaval anastomoses
Cutaneous veins and lymphatic vessels of trunk

**Digestive system**
Tongue (parts, vessels, innervation)
Salivary glands (anatomy)
Isthmus of fauces
Palate, palatine muscles
Pharynx, (shape, position, parts, muscles)
Topography of the pharynx, para- and retropharyngeal spaces
Esophagus (anatomy)
Stomach (shape, position, parts)
Peritoneal relations of stomach
Blood supply and innervation of stomach
Duodenum (shape, position, divisions, vessels)
Jejunum-ileum (shape, position, vessels)
Rectum, anal canal (shape, position, vessels)
Liver (shape, position)
Gall bladder and biliary passages (anatomy)
Liver (peritoneal relations, vessels)
Circulation of liver, liver sinusoids
Pancreas (shape, position, vessels)
Peritoneum, greater and lesser omentum, mesentery, omental bursa

**Respiratory system**
Trachea and bronchial tree
Lung (shape, parts, surfaces, hilum)
Lung (position, topography, vessels, nerves)
Surface projection of pleura and lung

**Body cavities**
Thoracic wall
Pleura, pleural cavity
 Mediastinum (divisions and content)
Diaphragm
Abdominal cavity (divisions and surface projections)
Abdominal wall (muscles, fasciae)
Rectus sheath
Hernia sites

**Urogenital system**
Kidney (shape, position, hilum, sinus, capsules)
Kidney (section, vascular architecture)
Renal pelvis and calyces
Ureter
Urinary bladder (shape, position, muscles, vessels)
Female urethra
Testis (shape, position, vessels)
Epididymis, vas (ductus) deferens, spermatic cord
Scrotum, coats of testis
Seminal vesicle
Prostate
Male urethra, bulbourethral gland
Penis (shape, position, mechanism of erection, vessels, nerves)
Pelvic floor, male perineum
Hernia canals (inguinal and femoral)
Ovary (shape, position, vessels)
Uterine tube (shape, position, vessels)
Uterus (shape, parts, wall, cavity)
Uterus (position, supporting structures, vessels)
Broad ligament (lig. latum) and its components
Vagina, female perineum
External female genital organs (mons pubis, labia, vestibule of vagina, greater vestibular gland, vessels)

**Macroscopy of the nervous system**

- Intracranial topography
- Dura mater, dural sinuses
- Arachnoid mater, pia mater, cisterns, CSF circulation
- Description and meninges of the spinal cord
- Brain stem (medulla oblongata, pons, midbrain)
- Cranial nerves, brain, dural and skull exits
- Cerebellum
- Diencephalon (parts, blood supply).
- Thalamus, hypothalamus
- Lateral ventricles
- III. ventricle
- IV. ventricle
- Hemispheres
- Basal ganglia
- Internal carotid artery (course, parts and branches)
- Vertebral artery (course and branches)
- Circle of Willis
- Veins of the brain
- Branches of cranial nerves (CN 3, CN 4, CN 5, CN 6, CN 7, CN 9, CN 10, CN 11, CN 12)
- General composition of the autonomic nervous system
- Sympathetic system (cranial, cervical, thoracic and lumbar parts)
- Sympathetic trunk
- Parasympathetic system (cranial and sacral parts)
- Extraocular muscles. Eye movements.
- Eyelids, conjunctiva, fasciae of the orbit, lacrimal apparatus

**Type and method of grading**: 6

Final examinations are composed of written theoretical and oral practical parts. The written theoretical examination is done using an e-learning module while the practical examination is conducted in the dissection room on real prospected cadaver specimen. Examiners are delegated by the course directors with the consensus of the Head of Department. Students will receive two separate marks to the two parts of the examination. In case of an unsuccessful (fail=1) examination part, the whole semifinal examination needs to be retaken. Those with a 4 (good) or 5 (excellent) written examination mark are exempted from rewriting the written pretest in the retake examination in case failing during the practical part of the given semifinal examination. The final mark is calculated on the basis of the results (marks) gathered during the written and oral parts of the given examination under the supervision of the president of the examination committee.

**Registration for examinations:**

Via the NEPTUN system.

**Opportunities to retake the exam:**

According the Study and Examination Policy
Literature, i.e. printed, electronic and online notes, textbooks, tutorials (URL for online material):

**Recommended textbooks**


Bräuer: Sobotta Flashcards (Muscles; Bones, Ligaments, and Joints) URBFI, 2013.


Regional Anatomy, by T Tömböl, Medicina 2008, ISBN 963 242 186 8


Further study aids:

To be downloaded from the homepage of the Department of Anatomy, Histology and Embryology (http://semmelweis.hu/anatomia ) or from Knowledgebase on the Library homepage: (https://lib.semmelweis.hu/knowledge_base).

Signature of Subject Director/Coordinator:

Signature(s) of the head(s) of the Institute(s):

Date: 2019. 09. 17.

Credit Transfer Committee’s opinion:
Comment of the Dean’s Office:

Signature of the Dean:

1 Csak abban az esetben kell megadni, ha a tárgy az adott nyelven is meghirdetésre kerül.
2 Dékáni Hivatal tölti ki, jóváhagyást követően.
3 Az elméleti és gyakorlati oktatást órákra (hetekre) lebontva, sorszámozva külön-külön kell megadni, az előadók és a gyakorlati oktatók nevének feltüntetésével. Mellékletben nem csatolható!
4 Pl. terepgyakorlat, körlapüzemzés, felmérés készítése, stb.
5 Pl. házi feladat, beszámoló, zárthelyi stb. témaköre és időpontja, pótlásuk és javításuk lehetősége.
6 Elméleti vizsga esetén kerjük a tételsor megadását, gyakorlati vizsga esetén a vizsgázatás témakörét és módját.
7 Az elméleti és gyakorlati vizsga beszámításának módja. Az évközi számonkérések eredményeink beszámítási módja.
** REQUIREMENTS **

<table>
<thead>
<tr>
<th>Semmelweis University, Faculty of Medicine</th>
</tr>
</thead>
</table>

**Name(s) of the Institute(s) teaching the subject:**  
Department of Anatomy, Histology and Embryology  

**Name of subject:** Microscopic anatomy and embryology I.  
**Credits:** 5  
**Total number of hours:** lectures: 2, practices: 3, seminars: 0  
**Type of subject:** mandatory  

**Academic year:** 2019/2020.  

**Subject code:** AOKANT674_1A  

**Subject Director/Coordinator:** Dr. Szél Ágoston  
**Contact details:** Semmelweis University, Department of Anatomy, Histology and Embryology, +36-30-900-2378  
**Position:** Professor, Head of Department  
**Date of habilitation and reference number:** 134/1997.  

**Learning objectives, the role of Microscopic Anatomy and Embryology in the medical curriculum:**  
Demonstration of the fine structure of cells and tissues composing the organs of the human body specifically to provide the future clinicians/medical doctors with a valid body of information describing the microscopical elements of clinically significant morphological structures (including cell biology, general histology and the histology of organs). General embryology demonstrates the steps of the formation of a new human being together with the stages of intrauterine development, including the clinically relevant aspects of the development of organ systems. Teaching is done in the form of lectures and histology laboratory classes  

**Location of the course (lecture room, seminar rooms, etc., addresses):**  
Semmelweis University, Department of Anatomy, Histology and Embryology  
Budapest 1094, Tűzoltó utca 58.  

**Competencies gained upon the successful completion of the subject:**  
Understanding the microscopical composition of the human body together with the understanding of human development in order to draw parallels with macroscopical anatomy. Clear understanding of histological structure and function. Ability to identify basic structural elements within the tissue specimen. Identification of general directions/landmarks within digitized tissue slides.  

**Prerequisite(s) for admission to the subject:**  
Cell sciences, cell biology  

**Number of students (minimal, maximal) required for Course/Subject registration, selection criteria for students:**  
obligatory for all registered students, on the basis of registration via the NEPTUN system  

**Registration for the subject:**
Via the NEPTUN system.

**Detailed list of topics covered in the subject:**

**List of lectures**

1. week: Epithelial tissues, cell contacts, intercellular connections  
   - Glandular epithelium
2. week: Connective tissue cells and fibres. Extracellular matrix  
   - Blood. Corpuscular elements. Red bone marrow, erythropoiesis, Formation of leukocytes
3. week: Supporting tissues (cartilage, bone)  
   - Ossification, bone remodelling
4. week: Muscle tissues  
   - Histology of vessels
5. week: Histology of the tongue and teeth  
   - Histology of the airways
6. week: Gametes, fertilization, cleavage, blastulation  
   - Implantation. Placenta, placental circulation, fetal membranes
7. week: Histology of the esophagus and stomach  
   - Microscopical anatomy of the small and large intestines
8. week: Molecular basis for gastrulation. Formation, differentiation and derivatives of the germinal layers  
   - Neurulation, folding of the embryo. Body axes, left-right lateralization, asymmetry
9. week: Histology of the liver and pancreas  
   - Pharyngeal arches, development of the foregut
10. week: Development of the face, malformations  
   - Development of the midgut and hindgut
11. week: Microscopical anatomy of urinary organs  
   - Development of the urinary system
12. week: Histology of the male and female genital systems  
   - Development of the genital system
13. week: Development of the peritoneum (peritoneal relations)  
   - Development of the heart
14. week: Development of arteries and veins  
   - Development of the respiratory system. Fetal circulation

**Histology laboratories**

1. week: Introduction, epithelial tissues
2. week: Connective tissue cells and fibres. Blood
3. week: Cartilage, bone
4. week: Smooth, skeletal and cardiac muscle types
5. week: Lip, tongue, lingual papillae. Tooth bud
6. week: Larynx, trachea, lung
7. week: Esophagus, stomach
8. week: Duodenum, jejunum, ileum, colon
9. week: Liver, gall bladder, pancreas
10. week: Midterm test
11. week: Urinary system
12. week: Male genital system I.
13. week: Male genital system II. Female genital system I.
14. week: Female genital system II.

**Potential overlap(s) with other subjects:**

- Macroscopic Anatomy I - II.
- Cell sciences, cell biology
- Certain chapters of Biochemistry and/or Physiology
<table>
<thead>
<tr>
<th>Special training activities required 4:</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
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</table>

<table>
<thead>
<tr>
<th>Policy regarding the attendance and making up absences:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active participation in histology laboratory classes is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester. Absences are therefore limited in 25%. Attendance will be recorded in the histology laboratory classes.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Means of assessing the students’ progress during the semester 5:</th>
</tr>
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<tbody>
<tr>
<td>During the semester the knowledge of the students will be evaluated. Attendance is obligatory at the two mid-term tests. Students absent from the mid-term test should reattend at a given timepoint or their semester will not be accepted. Histology and Embryology mid-terms are written examinations organised as e-learning type examination where a valid SeKa account (including a user name&amp;password) is required. The time and topics of midterm tests will be announced in the departmental homepage at the beginning of the semester (<a href="http://semmelweis.hu/anatomia">http://semmelweis.hu/anatomia</a>).</td>
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<tr>
<th>Requirement for acknowledging the semester (signature):</th>
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<tbody>
<tr>
<td>Active participation in the Histology laboratory sessions is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester. Absences are therefore limited in 25%. Attendance will be recorded in the Histology classes.</td>
</tr>
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</table>

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<thead>
<tr>
<th>Type of examination:</th>
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<tbody>
<tr>
<td>Semifinal (written and oral) examination, topics: subject matter of the semester (Microscopic Anatomy and Embryology I). Semifinal examinations consist of written theoretical and oral practical parts.</td>
</tr>
<tr>
<td>1. Written pretest (e-learning module)</td>
</tr>
<tr>
<td>2. Microscopic Anatomy - identification of structures on digitized tissue slides - including relevent theoretical questions from the subject matter of the semester</td>
</tr>
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<tr>
<th>Examination requirements 6:</th>
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<tbody>
<tr>
<td>During the semifinal examination the knowledge of students will be tested. Semifinal examinations are composed of written and oral (practical and theoretical) parts with the latter being conducted with the use of digitized histological tissue slides.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic list for the semifinal examination:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microscopic Anatomy and Embryology I.</td>
</tr>
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<table>
<thead>
<tr>
<th>General Histology</th>
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<tbody>
<tr>
<td>Concept of basic tissues</td>
</tr>
<tr>
<td>Definition and classification of epithelial tissue</td>
</tr>
<tr>
<td>Simple epithelia</td>
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<tr>
<td>Stratified epithelia</td>
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<tr>
<td>Membrane specializations of epithelia</td>
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<tr>
<td>Glandular epithelia</td>
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<tr>
<td>Pigment epithelium, sensory neuroepithelium</td>
</tr>
<tr>
<td>Cells of connective tissue</td>
</tr>
<tr>
<td>Ground substance and fibres of connective tissue</td>
</tr>
<tr>
<td>Types of connective tissue</td>
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<tr>
<td>Blood and the corpuscular elements of blood</td>
</tr>
<tr>
<td>Histology of the bone marrow, maturation of erythrocytes and platelets</td>
</tr>
<tr>
<td>Differentiation of granulocytes, lymphocytes and monocytes</td>
</tr>
<tr>
<td>Histology of cartilage</td>
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<tr>
<td>Histology of the bone tissue</td>
</tr>
<tr>
<td>Intramembranous ossification</td>
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<tr>
<td>-------------------------------</td>
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<tr>
<td>Endochondral ossification</td>
</tr>
<tr>
<td>Growth and remodeling of bone</td>
</tr>
<tr>
<td>Smooth muscle and myoepithelial cells</td>
</tr>
<tr>
<td>Skeletal muscle tissue</td>
</tr>
<tr>
<td>Cardiac muscle tissue</td>
</tr>
</tbody>
</table>

**Histology of organs**

- Wall structure of hollow organs
- General composition of parenchymal (solid/compact) organs

**Circulatory system**

- Histological structure of arteries and arterioles
- Composition of capillaries and veins

**Digestive system**

- Lip
- Tooth
- Tooth bud
- Salivary glands
- Oesophagus
- Stomach
- Divisions of small intestine
- Fine structure of the intestinal vili
- Large intestine
- Histology of vermiform appendix
- Liver
- Gall bladder
- Pancreas

**Respiratory system**

- Larynx
- Trachea
- Lung

**Urogenital system**

- Histology of kidney (+JGA)
- Ureter
- Urinary bladder
- Testicle
- Epididymis
- Vas deferens
- Spermatic cord
- Seminal vesicle
- Prostate
- Penis
- Ovary, oogenesis and the corpus luteum
- Uterine tube
- Uterus (proliferative, secretory phases) menstrual cycle
- Vagina

**General Embryology**

- Spermatogenesis, spermiogenesis
- Oogenesis
| Fertilization, cleavage of the zygote |
| Blastocyst formation; the bilaminar embryonic disc |
| Implantation |
| Formation of body axes |
| Formation of the intraembryonic mesoderm; the notochord |
| Neurulation (neural tube and neural crest) |
| Derivatives of ectoderm |
| Derivatives endoderm |
| Differentiation of the intraembryonic mesoderm; formation and derivatives of the somites |
| Derivatives of the intermediate mesoderm |
| Lateral plate mesoderm and its derivatives |
| Folding of the embryo |
| Development of the primitive cardiovascular system, the fetal circulation |
| The structure and function of the placenta |
| Development of the fetal membranes (chorion and amnion) and the umbilical cord |
| Periods of embryonic / fetal life |
| Twin formation |

**Development of internal organs**

- Development of the heart, looping of the heart tube
- Formation of atria, development of the interatrial septum
- Formation of ventricles, development of the aorticopulmonary septum
- Development of arteries
- Development of the inferior vena cava
- Development of the portal vein
- Development of the superior vena cava, azygos and hemiazygos veins
- Fetal circulation

- Face development
- Development and differentiation of the foregut
- Derivatives of pharyngeal pouches and grooves
- Derivatives of pharyngeal arches
- Development of the tongue
- Tooth development
- Development and differentiation of the midgut
- Development and differentiation of the hindgut
- Formation of the liver and pancreas

- Formation of the nasal cavity and paranasal sinuses
- Development of the lower airways including the lungs
- Kidney development
- Development of the urinary passages
- Gonadal development
- Development of the male genital tract
- Development of the female genital tract
- Development of the male/female external genitals
- Development and divisioning of the body cavities
- Development of the peritoneum

**Type and method of grading**:  

Semifinal examinations are composed of written theoretical and oral practical parts. The written theoretical examination is done using an e-learning module while the practical examination is conducted with the help of digitized histological tissue slides.
Examiners are delegated by the course directors with the consensus of the Head of Department. Students will receive two separate marks to the two parts of the examination. In case of an unsuccessful (fail=1) examination part, the whole semifinal examination needs to be retaken. Those with a 4 (good) or 5 (excellent) written examination mark are exempted from rewriting the written pretest in the retake examination in case failing during the practical part of the given semifinal examination. The final mark is calculated on the basis of the results (marks) gathered during the written and oral parts of the given examination under the supervision of the president of the examination committee.

Registration for examinations:

Via the NEPTUN system

Opportunities to retake the exam:

According the Study and Examination Policy

Literature, i.e. printed, electronic and online notes, textbooks, tutorials (URL for online material):

List of textbooks


The Developing Human – Clinically Oriented Embryology, 10th ed. by KL Moore, TVN Persaud and M Torchia, Saunders, 2015; ISBN 9780323313384


Further study aids:

To be downloaded from the homepage of the Department of Anatomy, Histology and Embryology (http://semmelweis.hu/anatomia) or from Knowledgebase on the Library homepage: (https://lib.semmelweis.hu/knowledge_base).

Signature of Subject Director/Coordinator: [Signature]

Signature(s) of the head(s) of the Institute(s):

Date: 2019. 09. 17.

Credit Transfer Committee’s opinion:
Csak abban az esetben kell megadni, ha a tárgy az adott nyelven is meghirdetésre kerül.

Dékáni Hivatal tölti ki, jóváhagyást követően.

Az elméleti és gyakorlati oktatást órákra (hetekre) lebontva, sorszámozva külön-külön kell megadni, az előadók és a gyakorlati oktatók nevének feltüntetésével. Mellékletben nem csatolható!

Pl. terepgyakorlat, kórlopelemzés, felmérés készítése, stb.

Pl. házi feladat, beszámoló, zárhelyi stb. témaköre és időpontja, pótlásuk és javításuk lehetősége.

Elméleti vizsga esetén kérjük a tételsor megadását, gyakorlati vizsga esetén a vizsgáltatás témakörét és módját.

Az elméleti és gyakorlati vizsga beszámításának módja. Az évközi számonkérések eredményeink beszámítási módja.
**REQUIREMENTS**

**Semmelweis University, Faculty of Medicine**

**Name(s) of the Institute(s) teaching the subject:**
Department of Anatomy, Histology and Embryology

**Name of subject:** Microscopic anatomy and embryology II.

**Credits:** 4
**Number of hours:** 4 lectures: 2 practices: 2 seminars: 0

**Type of subject:** mandatory

**Academic year:** 2020/2021.

**Subject code**: AOKANT674_2A

**Subject Director/Coordinator:** Dr. Szél Ágoston

**Contact details:** Semmelweis University, Department of Anatomy, Histology and Embryology, +36-30-900-2378

**Position:** Professor, Head of Department

**Date of habilitation and reference number:** 134/1997.

**Learning objectives, the role of Macroscopic Anatomy in the medical curriculum:**

Demonstration of the fine structure of cells and tissues composing the organs of the human body specifically to provide the future clinicians/medical doctors with a valid body of information describing the microscopical elements of clinically significant morphological structures (including cell biology, general histology and the histology of organs).

General embryology demonstrates the steps of the formation of a new human being together with the stages of intrauterine development, including the clinically relevant aspects of the development of organ systems. Teaching is done in the form of lectures and histology laboratory classes.

**Location of the course (lecture room, seminar rooms, etc., addresses):**

Semmelweis University, Department of Anatomy, Histology and Embryology
Budapest 1094, Tüzoltó utca 58..

**Competencies gained upon the successful completion of the subject:**

Understanding the microscopical composition of the human body together with the understanding of human development in order to draw parallels with macroscopical anatomy. Clear understanding of histological structure and function. Ability to identify basic structural elements within the tissue specimen. Identification of general directions/landmarks within digitized tissue slides.

**Prerequisite(s) for admission to the subject:**

Microscopic anatomy and embryology I
Cell sciences, cell biology
Macroscopic Anatomy I-II

**Number of students (minimal, maximal) required for Course/Subject registration, selection criteria for students:**
obligatory for all registered students, on the basis of registration via the NEPTUN system.

**Registration for the subject:**

Via the NEPTUN system

**Detailed list of topics covered in the subject:**

**List of lectures**

1. week: Cellular components of lymphatic tissue. Thymus, tonsils, MALT
   - Structure and circulation of lymph nodes and spleen
2. week: Microscopy of the CNS – fine structure of the spinal cord
   - Microscopy of the CNS – spinal reflexes, receptors, effectors, monosynaptic/proprioceptive reflexes
3. week: Microscopy of the CNS – Nociceptive (withdrawal) and autonomic reflex arcs
   - Microscopy of the CNS – Fine structure of the cerebral cortex. Cortical fields, Brodmann area
4. week: Microscopy of the CNS – Diencephalon, thalamic nuclei
   - Microscopy of the CNS – Sensory systems, epicritical and protopathic pathways
5. week: Microscopy of the CNS – Motor systems, pyramidal tract
   - Microscopy of the CNS – Structure and connections of the basal ganglia. Motor pathways arising from the brain stem
6. week: Microscopy of the CNS – Microscopy of the cerebellum, pathways. Functional considerations
   - Microscopy of the CNS – Hypothalamus, the hypothalamo-hypophysial system
7. week: Microscopy of the CNS – Brainstem monoaminergic systems
   - Microscopy of the CNS – Limbic system
   - Differentiation of the brain vesicles
9. week: Formation and derivatives of the neural crest and placode ectoderm
   - Development of the skull
10. week: Development of the vertebral column, limb development
    - Skin and appendages. Mammary gland
11. week: Fibrous and vascular coats of the eyeball. Lens, chambers of the eye, vitreous body,
    - accommodation
12. week: Optic nerve, visual pathway, visual cortex, disorders. Visual reflexes
    - Middle ear - tympanic cavity, tympanic membrane, auditory ossicles
13. week: Bony and membranous labyrinth. Vestibular system
    - Spiral organ of Corti. Auditory pathway, auditory cortex
14. week: Microscopy of the CNS – Olfactory and gustatory systems
    - Drugs of abuse, opiates and receptor mediated actions in the CNS

**Histology laboratories**

1. week: Thymus, tonsils
2. week: Lymph node, spleen
3. week: Histology of the peripheral nervous system
4. week: Histology of the central nervous system
5. week: Endocrine system
6. week: Midterm test (Histological slides of weeks 1-5)
7. week: Microscopy of the CNS - consultation
8. week: Microscopy of the CNS - consultation
9. week: Midterm test Microscopy of the CNS Development of the nervous system
10. week: Histology of palm skin, scalp skin. Mammary gland
11. week: Histology of the organ of vision
12. week: Histology of the organ of hearing
### Potential overlap(s) with other subjects:

- Macroscopic Anatomy I - II.  
- Cell sciences, cell biology  
- Certain chapters of Biochemistry. The endocrine system and the central nervous system are also discussed in Physiology

### Special training activities required:

- none

### Policy regarding the attendance and making up absences:

Active participation in histology laboratory classes is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester. Absences are therefore limited in 25%. Attendance will be recorded in the histology laboratory classes.

### Means of assessing the students’ progress during the semester:

During the semester the knowledge of the students will be evaluated. Attendance is obligatory at the two mid-term tests. Students absent from the mid-term test should reattend at a given timepoint or their semester will not be accepted. Histology and Embryology mid-terms are written examinations organised as e-learning type examination where a valid SeKa account (including a user name&password) is required. The time and topics of midterm tests will be announced in the departmental homepage at the beginning of the semester ([http://semmelweis.hu/anatomia](http://semmelweis.hu/anatomia)).

### Requirement for acknowledging the semester (signature):

Active participation in the Histology laboratory sessions is obligatory for every student. Students should attend at least 75% of the scheduled hours to gain a signature proving the validity of the semester. Absences are therefore limited in 25%. Attendance will be recorded in the Histology classes.

### Type of examination:

Final (written and oral) examination, topics: subject matter of the subjects Microscopic Anatomy and Embryology I-II. Final examinations consist of written theoretical and oral practical parts.

1. Written pretest (e-learning module)  
2. Microscopic Anatomy - identification of structures on digitized tissue slides - including relevant theoretical questions from the subject matter of the semester

### Examination requirements:

During the semifinal examination the knowledge of students will be tested. Semifinal examinations are composed of written and oral (practical and theoretical) parts with the latter being conducted with the use of digitized histological tissue slides.

### Topic list for the semifinal examination:

**Microscopic Anatomy and Embryology I.**  
(see there)

**Microscopic Anatomy and Embryology II.**

**Lymphatic organs**  
Histological structure of lymph nodes  
Spleen (fine structure and circulation)  
Thymus
Tonsils, MALT

**Development of the nervous system and organs of special senses**
Development and primary differentiation of the neural tube
Development of brain vesicles
Development of the peripheral nervous system (neural crest, placodes)
Development of the organ of vision
Development of the organ of hearing&equilibrium

**Development of the locomotor system**
Membranous and cartilaginous neurocranium and viscerocranium
Development of the limbs and vertebral column
Development of the muscular system

**Neurohistology**
Histology of the neurons developing from the neural tube
Glial cells
Histology of the neurons and supporting cells developing from the neural crest
Fine structure of peripheral nerves
Receptors and effectors
Interneuronal synapses

**Microscopy of the central nervous system**
Fine structure (microscopy) of the spinal cord
Proprioceptive reflexes
Nociceptive reflexes
Autonomic reflexes
Fine structure of the medulla oblongata
Fine structure of the pons
Fine structure of the midbrain
Classification of cranial nerve nuclei
Tracts of the brain stem
Reticular formation, monoaminergic systems
Fine structure of the cerebellum
Cerebellar afferents and efferents
Fine structure of the thalamus
Hypothalomo-hypophyseal system
Fine structure of the basal ganglia
Fine structure of the cerebral cortex, cortical fields
Tracts of the protopathic sensibility (anterolateral system)
Tracts of the epicritic sensibility (posterior funiculus/medial lemniscus)
Corticospinal tract (pyramidal tract)
Extrapyramidal system
Limbic system (nuclei and tracts)

**Endocrine organs**
Gross and microscopical anatomy of the pituitary gland; development of the posterior lobe
Blood supply, histology and development of the anterior and intermediate lobes of the pituitary gland
Microscopical anatomy of the pineal gland
Microscopical anatomy and the development of the thyroid gland
| **Microscopical anatomy and the development of the parathyroid gland** |
| **Microscopical anatomy and the development of the suprarenal gland** |
| **Histology of the islands of Langerhans** |

**Organs of special senses**

- Microscopical structure of the skin (scalp and palm)
- Histology of the mammary gland (lactating and non-lactating)
- Coats of the eyeball
- Chambers of the eye, vitreous body
- Lens, accomodation
- Visual pathway, visual reflexes
- External ear, tympanic membrane. Tympanic cavity, auditory tube, hearing ossicles.
- Organ of Corti. Auditory pathway
- Vestibular system
- Bony and membranous labyrinth
- Cochlea and cochlear duct
- Organs of olfaction and taste

**Type and method of grading**:  

Final examinations are composed of written theoretical and oral practical parts. The written theoretical examination is done using an e-learning module while the practical examination is conducted with the help of digitized histological tissue slides. Examiners are delegated by the course directors with the consensus of the Head of Department. Students will receive two separate marks to the two parts of the examination. In case of an unsuccessful (fail=1) examination part, the whole semifinal examination needs to be retaken. Those with a 4 (good) or 5 (excellent) written examination mark are exempted from rewriting the written pretest in the retake examination in case failing during the practical part of the given semifinal examination. The final mark is calculated on the basis of the results (marks) gathered during the written and oral parts of the given examination under the supervision of the president of the examination committee.

**Registration for examinations:**

Via the NEPTUN system

**Opportunities to retake the exam:**

According the Study and Examination Policy

**Literature, i.e. printed, electronic and online notes, textbooks, tutorials (URL for online material):**

**List of textbooks**

Further study aids:

To be downloaded from the homepage of the Department of Anatomy, Histology and Embryology (http://semmelweis.hu/anatomia) or from Knowledgebase on the Library homepage: (https://lib.semmelweis.hu/knowledge_base).

Signature of Subject Director/Coordinator:

Signature(s) of the head(s) of the Institute(s):

Date: 2019. 09. 17.

Credit Transfer Committee’s opinion:

Comment of the Dean’s Office:

Signature of the Dean:

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1 Csak abban az esetben kell megadni, ha a tárgy az adott nyelven is meghirdetésre kerül.
2 Dékáni Hivatal tölti ki, jóváhagyást követően.
3 Az elméleti és gyakorlati oktatást órákra (hetekre) lebontva, sorszámozva külön-külön kell megadni, az előadók és a gyakorlati oktatók nevének feltüntetésével. Melléklebben nem csatolható!
4 Pl. terepgyakorlat, körápecsizás, felmérés készítése, stb.
5 Pl. házi feladat, beszámoló, zárrhelyi stb. témaköre és időpontja, pótlásuk és javításuk lehetősége.
6 Elméleti vizsga esetén kérjük a tételek megadását, gyakorlati vizsga esetén a vizsgáztatás témakörét és módját.
7 Az elméleti és gyakorlati vizsga beszámításának módja. Az évközi számonkérés eredményeink beszámítási módja.
### REQUIREMENTS

**Semmelweis University, Faculty of Medicine**

**Name(s) of the Institute(s) teaching the subject:**
Department of Biophysics and Radiation Biology

| **Name of the subject:** Medical biophysics I. |
| **Credits:** 4 |
| **Total number of hours:** 56 lectures: 21 practices: 35 seminars: - |
| **Type of the course (mandatory/elective):** mandatory |
| **Academic year:** 2019-2020 |

**Code of the course**: AOKFIZ668_1A

**Course director (tutor):** Prof. Dr. Miklós Kellermayer

**Contact details:** Department of Biophysics and Radiation Biology phone: +36-1-459-1500/60200

**Position:** professor, head of the department

**Date of habilitation and reference number:** 2004 PTE ÁOK 7/2004/habil

**Aim of the subject and its place in the curriculum:** Aim is to give the knowledge and way of thinking necessary for exact and quantitative understanding of working mechanism of biological systems and the human organism.

**Location of the course (lecture hall, practice room, etc.):** EOK Szent-Györgyi Albert lecture hall and student laboratories of the department.

**Competencies gained upon the successful completion of the subject:** Understanding the physical background of life processes and the environmental factors influencing the organism (radiations). Doing and evaluation of measurements individually, production of laboratory reports.

**Prerequisite(s) for admission to the subject:**

**Minimum and maximum number of students registering for the course:**

**Student selection method in case of oversubscription:** -

**How to register for the course:** Registration in the Neptun system
Detailed thematic of the course:

Lectures
Introduction. Radiations in medicine. Quantities and laws for characterization of common properties of radiations (Dr. Herényi)

Phenomena related to light and geometrical optics. Fermat principle. Light reflection and refraction on planar and curved surfaces, medical optical devices, geometrical optics of the human eye. (Dr. Kellermayer)

Wave optics as a model. Huygens–Fresnel-principle. the most simple experiment for light interference and its consequences. Resolving power. Light polarization. Color mixing, color vision. Light as electromagnetic wave and as particle. How these two completely different properties can be proven? (Dr. Kellermayer)

Structure of matter, matter wave, atomic and molecular interactions. Atomic force microscopy. (Dr. Kiss)

Boltzmann distribution, examples. Structural categories of many-particle materials: gas-, liquid-, solid (crystalline)-state of matter, general characteristics. Liquid crystalline (mesomorphic) materials. (Dr. Kellermayer)

Electronic states in (crystalline) solid materials. Insulators, conductors, semi-conductors. Electric, thermal and optical properties, electro-optical applications. (Dr. Kellermayer)

Interactions of light with matter. Light scattering, light absorption. Basic principles of absorption spectrometry. (Dr. Kellermayer)

Laws of thermal radiation and luminescence. Examples for application of them. (Dr. Mártonfalvi)

Fundamentals of light amplification. Laser oscillator and its conditions. Properties and medical applications of laser radiation (Dr. Kaposi)

Atomic nucleus, radioactivity, nuclear radiations. Interactions of nuclear radiations with matter. Radioactive isotopes, physical basis of radioisotope tracing. (Dr. Smeller)

Dosimetry, radiation protection. Nuclear measurement techniques (Dr. Smeller)

Main problems of nuclear medicine. Radioactive radiations in medical practice. Diagnostic and therapeutic applications of ionizing radiations. Gamma camera. (Dr. Voszka)


Practices
1 Introduction
2 Light emission
3 Resonance
4 Microscopy I.
5 Refractometry
6 Light absorption
7 Skin impedance
8 Optics of the eye
9 Nuclear medicine
10 Polarimetry
11 Amplifier
12 Dosimetry
13 Gamma absorption
14. Repetition
Teachers: Dr. Gergely Agócs, Dr. Erika Balog, Csilla Csányi, Dr. István Derka, Dr. Rita Galántai, Dr. Judit Gál-Somkuti, Dr. Dóra Haluszka, Dr. Levente Herényi, Dr. Dávid Juriga, Dr. Katalin Kis-Petik, Dr. Károly Liliom, Dr. Zsolt Mártonfálvi, Dr. Gusztáv Schay, Sr. Dániel Veres, Dr. István Voszka

**Potential overlap(s) with other subjects:** Medical physiology, Medical imaging methods, Ophthalmology, Medical statistics, informatics and telemedicine, Mathematical and physical basis of medical biophysics

**Special training activities required:** -

**Policy regarding the attendance and making up absences:** Participation in the practical lessons is compulsory. No more than three absences from practices are allowed for any reason, otherwise the semester will not be credited. **The missed measurements should be done with another group during the 4 weeks cycle of laboratory practices if possible. (One should ask for the agreement of the teacher of own group and the other group.)**

**Means of assessing the students' progress during the semester:** There is no midterm test.

**Requirement for acknowledging the semester (signature):**
1. At least 50 points in the test in Mathematical and physical bases of medical biophysics.
2. Participation on at least 75% of the practices, (in case of more than 3 absences the signature for the semester is denied.)
3. Acceptance of the lab. reports. If one has more than 3 „not accepted” lab. reports, the signature is denied. The lab reports must be uploaded to the website at the end of the practice.

**Type of the examination:** Semifinal exam.
Exam requirements:

Medical biophysics semifinal questions EM 2019

1. Radiations: basic concepts, fundamentals of geometric optics
Types of radiations. Radiometric quantities (radiance, irradiance, radiation intensity),
dependence on direction, steradian. Dependence of intensity on distance in case of radiation
sources of various geometry (graphical representation). Attenuation of radiation passing
through medium (differential and integral form of the law, interpretation). Geometric optics
as model. Fermat’s principle. Absolute and relative index of refraction, law of refraction
and reflection. Calculation of critical angle. Phenomenon of total internal reflection and its
application.

2. Image formation of simple optical systems
Image formation on a single curved surface, power, law of image formation. Image formation
by lenses, principal light rays, lens equation. Magnification and angular magnification.
Equivalent power of lens systems. Construction of microscope, light rays, magnification.

3. Fundamentals of wave optics
Oscillations and waves, types of waves. Huygens-Fresnel principle, interference, diffraction
on slit and optical grating. Calculation of diffraction angle. Concept of polarized light.
Application of light polarization: polarimetry, phase contrast and polarization microscope
(the principle briefly). Wave optical limit of resolution. Wave optical meaning of colors.

4. Dual nature of light
Phenomenon referring to wave nature and interpretation of them. The electromagnetic
spectrum. Photoelectric effect, its interpretation by Einstein and applications of it. Photon
energy, the eV scale. Interpretation of momentum of light, application: laser tweezer. Concept
of matter wave. Parts and resolution of electron microscope.

5. Models of atom, electron as particle and wave
Models of atom. The Bohr model. Franck-Hertz experiment. Concept of matter wave and
calculation of its wavelength. Wave nature of electron (wavelength, experimental proofs).
Wave properties of the free electron, Heisenberg’s uncertainty relation. Characterization of
bound electron, quantum numbers. Structure of periodic table.

6. Atomic and molecular interactions
Interactions in physics. General description of intra- and interatomic interactions, potential
ergy, bond distance, bond energy (concepts and graphical representation).
Electronegativity. Primary bonds (covalent, metallic, ionic), secondary bonds (dipole-dipole,
microscopy: STM, AFM (principle, components, application).

7. Multiatomic systems I. Ideal and real gases
Origin of pressure of ideal gases. Maxwell-Boltzmann velocity distribution. State equation of
real gases (vander Waals equation). Boltzmann distribution and condition of its validity.
Barometric altitude formula, thermal emission of metals, Nernst equation, equilibrium and
speed of chemical reactions, Arrhenius plot. Strength of bond, interpretation of breaking of
various types of bonds by Boltzmann distribution. Temperature dependence of electric
conductivity of semiconductors.

8. Multiatomic systems II. Solids, liquids and liquid crystals
Characterization of crystalline state, unit cell, crystal defects. Energy levels in crystals, and
structure (insulators, conductors, intrinsic and doped semiconductors). Interpretation of
electric and optical properties of crystalline materials. Function of semiconductor diode.
Order in liquid state. Properties of mesomorphous state. Thermotropic and lyotropic liquid
crystalline structures. Biological examples for liquid crystalline systems. Electro- and
thermooptical phenomenon and application of them.
9. Interaction of light with atoms and molecules
Light scattering. Rayleigh- and Mie-scattering with examples. Turbidimetry, nephelometry. Dynamic light scattering and the information obtained from it. Law of radiation attenuation and derivation of Beer-Lambert law from it. Measurement of absorption spectrum (parts and function of the equipment) characteristic parameters and information obtained from it. Energy levels and spectra of atoms and molecules.

10. Thermal radiation

11. Luminescence and its forms

12. Laser

13. Atomic nucleus, isotopes. Ways of radioactive decay, nuclear radiations


15. Measurement of nuclear radiations
Parts and function of the devices used for measurement of nuclear radiations: scintillation counter, detectors based on gas ionization, thermoluminescent dosimeter, photographic (film) methods, semiconductor detectors. Field of application of them.

16. Dosimetry, dose concepts, radiation protection
Biological effects of ionizing radiations: mechanism of radiation effect (physical, chemical, biological phases) stochastic and deterministic effect. Dose concepts: absorbed dose, exposure, equivalent dose, effective dose, dose rate. Measurement of exposure, relations of doses in air and in tissue, weighting factors and meaning of them.

Radiation protection: ALARA-principle (graphical explanation) dose limits.

17. Fundamentals of isotope diagnostics. Viewpoints for selection of the proper isotope
Information obtained from isotope tests. Cost-benefit principle. Viewpoints for selection of the isotope: chemical element (definition of radiopharmaceutical), activity, half-life, type and energy of emitted radiation, practical significance of them. Parts and function of Te-generator.
18. Methods of isotope diagnostics, fundamentals of radiotherapy

19. Types of biological signals, signal processing
Classification of signals according to different viewpoints (with examples). Comparison of signals (decibel scale). Fourier-theorem for periodic and aperiodic signals (examples). Typical frequency and amplitude ranges of biological signals. Voltage divider, parts and function of filter circuits for alternating current. Function of amplifier, functions showing the working of amplifier, effect of feedback. Digitalization of analogue signals. Shannon-Nyquist theorem. Processing of pulse signals, examples for medical application.

Practice questions on the semifinal exam 2019/20 I. semester (EM)

1. Microscopy I.
   *Theoretical background:*
   - types of optical lenses, parameters of them
   - image formation of convex lenses
   - lens laws
   - image formation and magnification of microscope
   - resolving power of microscope (Abbe’s principle)

   *Quantities to be determined based on the given data:*
   calibration value of eyepiece scale and size of the object.

2. Refractometry
   *Theoretical background:*
   - law of light refraction, definition of index of refraction
   - critical angle, total reflection
   - formation of Snell circle
   - factors influencing the value of index of refraction
   - parts and function of Abbe-refractometer

   *Quantities to be determined based on the given data after proper graphical representation:*
   the unknown concentrations.

3. Light absorption
   *Theoretical background:*
   - derivation of Lambert-Beer law from the absorption law
   - absorbance, transmittance and the relation of them
   - absorption spectrum and the information available from it
   - parts of absorption spectrometer
   - application of absorbance measurement in laboratory diagnostics

   *Quantities to be determined based on the given data after proper graphical representation:*
   photon energy belonging to electron transition (in eV units)

4. Polarimetry
   *Theoretical background:*
   - linearly polarized, circularly polarized light and the connection between them
   - definition and interpretation of optical activity
   - Biot-law, specific rotation
- parts and function of polarimeter

Quantities to be determined based on the given data:
the type of given sugar and the unknown concentration.

5. Optics of the eye

Theoretical background:
- refractive media and image formation of the eye
- accommodation
- refractive disorders of eye and the way for correction of them
- limiting angle of vision, visual acuity (visus), factors influencing the visual acuity
- distribution of photoreceptors on the retina

Quantities to be determined based on the given data:
accommodation power and visual acuity.

6. Nuclear medicine

Theoretical background:
- parts of scintillation counter
- possible processes happening in the scintillation crystal
- processes happening in the photomultiplier
- signal selection, function of the discriminator, sources of noise pulses
- optimal setting of scintillation counter

Quantities to be determined based on the given data after proper graphical representation:
the optimal discrimination level.

7. Gamma-absorption

Theoretical background:
- attenuation law of radiation, attenuation coefficient, mass attenuation coefficient
- processes of attenuation on the atomic scale (photoeffect, Compton-scattering, pair production, elastic scattering)
- the dependence of mass attenuation coefficients due to different processes on the photon energy
- viewpoints of radiation protection

Quantities to be determined based on the given data after proper graphical representation:
$D$, $\mu$, $\mu_n$, for all the absorbents and $\varepsilon$, $\tau_{\text{abs}}$, $\sigma_{\text{abs}}$.

8. Resonance

Theoretical background:
- elastic deformation, Hooke's law
- harmonic oscillation
- undamped and damped free oscillation
- driven oscillation, resonance
- effect of external force (depending on the distance) on the driven oscillation (working principle of AFM)

Quantities to be determined based on the given data after proper graphical representation:
the spring constant.

9. Skin impedance

Theoretical background:
- definition and components of impedance
- electric model of the skin and the possible simplifications on the model
- frequency dependence of capacitive reactance, approximation of skin impedance in case of low and high frequencies
- practical applications of impedance measurement
Quantities to be determined based on the given data:
specific resistance and specific capacity of the skin.

10. Dosimetry
Theoretical background:
- the most important basic concepts in dosimetry
- function of thermoluminescent dosimeter
- application of the ionization chamber as dose rate measuring device

Quantities to be determined based on the given data after proper graphical representation:
Voltage - current diagram of the ionization chamber. Name the ranges of the diagram and determine the exposure rate and absorbed dose rate in air.

11. Amplifier
Theoretical background:
- gain, gain level
- frequency response curve of the amplifier
- negative feedback
- advantages and disadvantages of feedback

Quantities to be determined based on the given data after proper graphical representation:
The maximum gain level, cut-off frequencies of the transfer band. Can it be used for the amplification of ECG signal?

Type and method of grading:
The final grade is the average of the 3 parts if all are better than 1. The grade is rounded up or down according to the decision of the second examiner. if for one part the student gets 1,5 we do not calculate the average, but the final grade can be max. 2. If any of the grades is 1, the final grade will be 1.

How to register for the exam: Through Neptun system

Opportunities to retake the exam: According to the educational rules of the university

Literature, i.e. printed, electronic and online notes, textbooks, tutorials (URL for online material):
Lecture notes, homework problems on the homepage of the department.
Damjanovich-Fidy-Szőllősi (eds): Medical Biophysics (2009)
Medical biophysics practices (Semmelweis Publisher, 2015)

Signature of the tutor: 

Signature(s) of the head(s) of the Institute(s): 

Date: 2019. 09. 16.

Credit Transfer Committee’s opinion:

Comment of the Dean’s Office:
Signature of the Dean:

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3 Pl. terepgyakorlat, körlapelemzés, felmérés készítése stb.
4 Pl. házi feladat, beszámoló, zárthelyi stb. témaköre és időpontja, pótlásuk és javításuk lehetősége.
5 Elméleti vizsga esetén kérjük a tételes megadását, gyakorlati vizsga esetén a vizsgáztatás témakörét és módját.
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