STANDARD COURSE SYLLABUS
for academic year 2013/2014

Description of subject matter – Instructional program

Name of subject: BIOPHYSICS
Module code according to standards from A to G

Director of unit conduction the course: Prof. dr hab. Krystyna Michalak
Faculty: Medical
Course of study: medical
Level of studies: Unitary MMed
Form of studies: full-time X extramural X
Year: II Semester: IV
Type of subject: obligatory X elective □
Language of instruction:

<table>
<thead>
<tr>
<th>Name of unit conducting course</th>
<th>Winter semester (hrs.)</th>
<th>Summer semester (hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathedral of Biophysics</td>
<td>-</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>36</td>
</tr>
<tr>
<td>Total: 60</td>
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Educational goals

C1. Description of physical phenomena responsible for processes occurring at the level of biomolecules, membranes, cells and tissues.

C2. Description of physical bases of functioning of senses, circulation, electrical excitability related to signal transduction in the nervous system, neuromuscular transmission and electrical activity of the heart.

C3. Acquisition of basic knowledge in medical physics in relation to therapeutic and diagnostic methods, in which ultrasounds, different forms of electromagnetic waves and radiation are used (e.g. USG, computer tomography, PET, NMR tomography, application of lasers in medicine).

C4. Description of the effects of various physical factors on human organism in the context of therapy choice and protection of patients and medical personnel against hazardous impact of these factors.

C5. To acquaint with various laboratory instruments (used e.g. in spectroscopy, optics, electricity) and the use of specific software as well as to comprehend basic rules applied in the experimental data analysis.

C6. To present selected, modern experimental methods applied in studies of biological systems.

Matrix of educational results for subjects in reference to methods for verifying intended educational results and manner of conducting lessons.

<p>| Number of educational result | Description of educational result (in conformance with detailed educational results defined in standards) | Methods for verifying achievement of intended educational results * | Manner of lessons: ** provide symbol |
|------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| B.W1                         | Describes water-electrolyte balance in the biological systems                                          | Oral interview&lt;br&gt;Written exam                                    | L, C                                |
| B.W3                         | Knows and comprehends the concepts of solubility, osmotic pressure, isotonia, colloidal               | Oral interview&lt;br&gt;Written exam                                    | L, C                                |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Assessment Method</th>
<th>Level</th>
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</thead>
<tbody>
<tr>
<td>B.W5</td>
<td>Knows the physical principles describing the flow of fluids and factors influencing the haemodynamical resistance in relation to the blood flow</td>
<td>Oral interview, Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.W6</td>
<td>Knows the natural and artificial sources of ionizing radiation and its interaction with material medium</td>
<td>Oral interview, presentation, written test, written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.W7</td>
<td>Knows the physicochemical bases of functioning of senses</td>
<td>Oral interview, presentation, written test, Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.W8</td>
<td>Knows the physical bases of non-invasive imaging methods</td>
<td>Oral interview, presentation, written test, Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.W9</td>
<td>Knows physical bases of selected therapeutic techniques, including those using ultrasounds and exposures to light or radiation</td>
<td>Oral interview, presentation, written test, Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.W11</td>
<td>Describes the structure of lipids and polysaccharides as well as their functions in cellular and extracellular structures</td>
<td>Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.W21</td>
<td>Knows the mechanisms of communication between cells and between cell and extracellular matrix and pathways of signal transduction in the cell and examples of disturbances in these processes giving rise to development of cancers and other diseases</td>
<td>Oral interview, presentation, written test, Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.W24</td>
<td>Knows the bases of excitation and conduction in the nervous system and higher nervous functions and also the physiology of striated and smooth muscles and blood function</td>
<td>Oral interview, presentation, written test, Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.W34</td>
<td>Knows the principles of scientific research, experimental and observational as well as in vitro experiments</td>
<td>Oral interview, Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.U1</td>
<td>Applies the laws of physics to explain the impact of external factors such as temperature, acceleration, pressure, electromagnetic field and ionizing radiation on living organism and its elements.</td>
<td>Oral interview, presentation, written test, Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.U2</td>
<td>Evaluates the harmfulness of ionizing radiation doses and applies the rules of radiation protection</td>
<td>Oral interview, presentation, written test, Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.U6</td>
<td>Predicts the direction of biochemical processes in relation to the energetic status of the cells</td>
<td>Written exam</td>
<td>L, C</td>
</tr>
<tr>
<td>B.U10</td>
<td>Uses simple laboratory instruments and assesses the precision of measurements</td>
<td>Oral interview</td>
<td>L, C</td>
</tr>
<tr>
<td>B.U11</td>
<td>Uses the databases, including those available in the internet, searches for the needed information using available tools</td>
<td>Oral interview, presentation</td>
<td>L, C</td>
</tr>
<tr>
<td>B.U12</td>
<td>Finds the appropriate statistical test, carries out basic statistical analysis and uses appropriate methods of data presentation; interprets the results of metaanalysis, and also carries out the analysis of survival probability</td>
<td>Oral interview</td>
<td>L, C</td>
</tr>
<tr>
<td>B.U14</td>
<td>Plans and carries out simple scientific experiments and interprets the results and draws</td>
<td>Oral interview</td>
<td>L, C</td>
</tr>
</tbody>
</table>
conclusions
* e.g. test, presentation, oral response, essay, report, colloquium, oral examination, written examination;
** L - lecture; S - seminar; C - class; EL - e-learning;

Student work input (balance of ECTS points)

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>Lessons on-site (hrs.)</td>
<td>60</td>
</tr>
<tr>
<td>Own work (hrs.)</td>
<td>36</td>
</tr>
<tr>
<td>Summary of student workload</td>
<td>96</td>
</tr>
<tr>
<td>ECTS points for subject</td>
<td>6.5</td>
</tr>
<tr>
<td>Remarks</td>
<td></td>
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</tbody>
</table>

Content of lessons:

1. **Lecture themes:**

1. Intermolecular interactions. Structures and models of biological membranes
2. Application of thermodynamics to description of processes in biological systems
3. Passive and active transport across biological membranes. Bases of bioenergetics
4. Ion channels – types and roles
5. Biophysics of senses - light and vision
6. Biophysics of senses – acoustics and hearing
7. Biophysics of circulation
8. Ultrasounds in diagnosis and therapy
9. Ionizing radiation - properties, effect on matter and application in medicine
10. Nuclear magnetic resonance (NMR) and its application in medicine and biomedical research
11. Electrical activity of the heart and electrocardiography Experimental methods in molecular biophysics
12. Experimental methods in molecular biophysics

2. **Labolatory:**

**Laboratory of Bioacoustics and Biomechanics**
- Doppler effect
- Audiometry
- Sound spectral analysis
- Permeability for nonelectrolytes
- Viscosity
- Ultrasound probe
- Calorimetry
- Ultrasound
- Nuclear magnetic resonans

**Laboratory of Bioelectricity**
- Simulation of action potential generation
- Geiger-Muller counter characteristics
- Nernst equilibrium
- Dipolar model of the heart
- Ionizing radiation attenuation
- Analog model of synaptic transmission
- Resting and action potentials
- Electric activity of heart
Laboratory of Biooptics and Spectroscopy

- Emission spectra
- Nephelometry
- Polarization of light, saccharimeter
- Fluorescence
- Model of eye
- Properties of laser light, Properties of laser light - theory
- Ionizing radiation
- Photoreception

Primary literature:
1. R. Cotterill „Biophysics. An introduction” J. Wiley & Sons, 2004

Secondary literature:
2. P.R. Bergethon „The physical basis of biochemistry” Springer, 1998

Requirements concerning instructional aids (e.g. laboratory, multimedia projector, other ...)

Laboratories are equipped with experimental set ups for each students' group, multimedia projector, computers

Conditions for successful completion of course:
Credit for practical exercises at students' laboratories is granted following verification of theoretical knowledge for each theme (oral interrogation or short written test) and verification of written report for the experimental part. In the case of theoretical exercises, credit requires successful written test.
Written exam consists of approximately 50-80 questions (one out of 5 answers is correct). Positive grade is obtained when student receives score not smaller than 50% + 1 point. Grades higher than sufficient are obtained in proportion to the score and the intervals for subsequent (higher) grades are equal. Analogous system is applied for retake exams. In the case of retake exams the lecturer may propose the oral form of examination.

Name and address of unit conducting course, contact information (tel./email):
Department of Biophysics, T. Chałubińskiego 10 St., 50-368 Wrocław, tel. 71 784 14 00, 71 784 14 01
e-mail: krystyna.michalak@umed.wroc.pl

Person responsible for the course for a given year:
prof. dr hab. Jerzy Mozrzymas

Signature of head of unit conducting the course

Date of syllabus drafting: 22.01.2014r.