SYLLABUS – A COURSE DESCRIPTION

I. General informaion

1. Course name: **Bioimaging**
2. Course code: **01-W-BTA-BIOIMA**
3. Course type (compulsory or optional): **optional**
4. Study programme name: **Biotechnology**
5. Cycle of studies (1st or 2nd cycle of studies or full master's programme): **2nd cycle of studies**
6. Educational profile (general academic profile or practical profile): **general academic profile**
7. Year of studies (if relevant): **I**
8. Type of classes and number of contact hours (e.g. lectures: 15 hours; practical classes: 30 hours):
   lectures: 15 hours
   laboratory classes: 30 hours
   conversatorium: 15 hours
9. Number of ECTS credits: **6**
10. Name, surname, academic degree/title of the course lecturer/other teaching staff:
    dr Anna Kasprowicz-Maluśki, akas@amu.edu.pl
    prof. dr hab. Przemysław Wojtaszek, przemow@amu.edu.pl
    dr hab. Zbigniew Adamski, ed@amu.edu.pl
    dr Tomasz Skrzypczak, tskrzyp@amu.edu.pl
11. Language of classes: **English**
12. Online learning – yes (partly – online / fully – online) / no: **If required, theoretical part (lecture) can be available by MS Teams**

II. Detailed information

1. Course aim (aims)

   This course provides a comprehensive overview of advanced bioimaging techniques including fundamental concepts and applications. During the course we will present broad variety of techniques, including widefield fluorescence microscopy, confocal microscopy and related techniques (FRAP, FRET, FLIM) as well as novel super-resolution techniques, in particular SIM, PALM, STORM, STED. Students will be also introduced to electron microscopies (SEM, TEM, Cryo-TEM) and to versatile approaches for measuring mechanical/chemical properties of biological samples: Raman microscopy, Atomic Force Microscopy (AFM). Course will allow students to design imaging experiments for their own research.

   Course overwiev:

   - Theoretical background of microscopy (optics, physics of light).
   - Principles of different microscope types (widefield fluorescence microscope, confocal microscope, electron microscope); structure and mechanisms of microscope functioning.
   - Novel applications of microscopy techniques in biomedical research.
   - Methods applied in analysis of living and fixed biological samples in different microscope types.
   - Choice of proper imaging method adequate to properties of investigated sample and scientific aim
   - Presentation of scientific software dedicated to processing and quantitative and qualitative analysis of microscopic images.
   - Proper analysis and interpretation of experimental results.
   - Scientific English terminology in microscopy research.
   - Formation of the skills necessary for the presentation and discussion of recent achievements in microscopy research (based on up-to date scientific literature).

2. Pre-requisites in terms of knowledge, skills and social competences (if relevant)

   The knowledge and skills acquired during the course of the study and concerning cell biology, molecular biology, and biophysics.

3. Course learning outcomes (EU) in terms of knowledge, skills and social competences and their reference to study programme learning outcomes (EK)

Course learning outcome symbol (EU)	On successful completion of this course, a student will be able to:	Reference to study programme learning outcomes (EK)

EU_01	Understand the fundamental aspects of microscopy theoretical background (optics, physics of light).	BT_W01
EU_02	Describe basic principles of different microscopes types; understand structure and mechanisms of microscope functioning.	BT_W01
EU_03	Recognize novel applications of microscopy techniques in biomedical research.	BT_W01
EU_04	Assess methods applied in analysis of living and fixed biological samples in different microscope types.	BT_W01, BT_W02
EU_05	Choose proper imaging method adequate to properties of investigated sample and scientific aim.	BT_U01
EU_06	Use microscope in correct way and use software for handling and simple analysis of digital images, as well as for the preparation of microscopy images for publication	BT_U01, BT_W05
EU_07	Gain the knowledge and practical skills of proper analysis and interpretation of experimental results	BT_K01, BT_U01
EU_08	Use the scientific English terminology in microscopy research and discuss up-to date scientific literature from microscopy field.	BT_W09, BT_U05, BT_K02, BT_U03
EU_09	Is aware of ethical guidelines for handling and manipulation of microscopy and image data in research	BT_K05

4. Learning content with reference to course learning outcomes (EU)

Course learning content	Course learning outcome symbol (EU)
Overview of optical microscopy, ray and wave optics, polarization and interference	EU_01, EU_02, EU_08
Introduction to photophysics: fluorescence, fluorescence polarisation and FRET	EU_01, EU_02, EU_08
Theoretical background of electron microscopy	EU_01, EU_02, EU_08
Commercial microscopy systems; fundamental operating principles of different microscope types	EU_02, EU_05, EU_07, EU_08
Novel microscopy techniques (single molecule detection, fluorescence lifetime measurement, superresolution microscopy, two-photon microscopy, Raman microscopy, Atomic Force Microscopy, TIRF)	EU_02, EU_03, EU_04, EU_07, EU_08, EU_05
Image processing and image processing software (open and commercial sources)	EU_06, EU_07, EU_08, EU_09
Probes for light and electron microscopy: antibody labeling, bioluminiscence, fluorescence, fluorescent proteins, labels for nucleic acids, quantum dots	EU_04, EU_08
Tissue preparation for immunocytochemistry and electron microscopy.	EU_04, EU_08, EU_09
Techniques for in vivo imaging of 3D organization, multicellular dynamics and complexity of living organisms.	EU_03, EU_04, EU_05, EU_07, EU_08, EU_09

5. Reading list : fragments indicated by the teachers

1. J. Pawley: Handbook of Biological Confocal Microscopy, Springer, , 2006
2. P. M. Conn: Techniques in Confocal Microscopy, Academic Press , , 2010
3. Kuo, John (Ed.) : Electron Microscopy. Methods and Protocols. Series: Methods in Molecular Biology, Vol. 369. , Springer, , 2007
4. R.W. Roberson, D. E. Chandler : Bioimaging: Current Concepts in Light and Electron Microscopy , Jones&Bartlett Pub., , 2008

Artykuły w czasopismach

1. (): scientific papers provided during conversatory and lecture, ,

III. Additional information

1. Teaching and learning methods and activities to enable students to achieve the intended course learning outcomes (please indicate the appropriate methods and activities with a tick or/and suggest different methods)

Teaching and learning methods and activities	
Lecture with a multimedia presentation	X
Interactive lecture	X
Problem – based lecture	
Discussions	X
Text-based work	X
Case study work	X
Problem-based learning	
Educational simulation/game	
Task – solving learning (eg. calculation, artistic, practical tasks)	X
Experiential work	X
Laboratory work	X
Scientific inquiry method	
Workshop method	
Project work	
Demonstration and observation	X
Sound and/or video demonstration	X
Creative methods (eg. brainstorming, SWOT analysis, decision tree method, snowball technique, concept maps)	
Group work	X

2. Assessment methods to test if learning outcomes have been achieved (please indicate with a tick the appropriate methods for each LO or/and suggest different methods)

Assessment methods	Course learning outcome symbol								
	EU_1	EU_2	EU_3	EU_4	EU_5	EU_6	EU_7	EU_8	EU_9
Written exam									
Oral exam									
Open book exam									
Written test									
Oral test									
Multiple choice test	X	X	X	X	X			X	X
Project									
Essay									
Report						X	X	X	
Individual presentation		X	X	X	X			X	

Practical exam (performance observation)						X			
Portfolio									

3. Student workload and ECTS credits

Activity types	Mean number of hours spent on each activity type
Contact hours with the teacher as specified in the study programme	60
Preparation for classes	30
Reading for classes	30
Essay / report / presentation / demonstration preparation, etc.	30
Project preparation	
Term paper preparation	
Exam preparation	30
Total hours	180
Total ECTS credits for the course	6

4. Assessment criteria according to AMU in Poznan grade system

Very good (bdb; 5,0): outstanding performance without errors
Good plus (+db; 4,5): above the average standard but with minor errors
Good (db; 4,0): generally sound work with some errors
Satisfactory plus (+dst; 3,5): fair but with significant shortcomings
Satisfactory (dst; 3,0): performance meets the minimum criteria
Unsatisfactory (ndst; 2,0): fail – considerable further work is required before the credit can be awarded