Załącznik nr 4 do zarządzenia nr 118 Rektora UJ z 19 grudnia 2016 r.

Sylabus modułu zajęć na studiach wyższych

Nazwa Wydziału	Faculty of Biochemistry, Biophysics and Biotechnology
Nazwa jednostki prowadzącej moduł	Faculty of Biochemistry, Biophysics and Biotechnology
Nazwa modułu	**Fluorescence and Confocal Microscopy**
Klasyfikacja ISCED	
Język kształcenia	English
Cele kształcenia	Student knows basic information about wide-field (transmission and fluorescence) and confocal microscopy, as well as a logic of proper recording of images and using a microscope as a comprehensive scientific tool. Student knows (both theoretically and practically) modern achievements of microscopy techniques.
Efekty kształcenia dla modułu	Knowledge: Student is able to explain functioning of an optical microscopy (especially phase-contrast microscopy, fluorescence interference contrast microscopy, dark-field and white-field microscopy) in simple cases. Student is able to describe the role of key parts of an optical path and to explain working of a scanning confocal microscopy. Student is able to explain the functioning of advanced microscopy methods (its use and limits) as well as to propose their proper use during solving different experimental problems. Abilities: Student creates optimal instrumental conditions for recording images with optimal resolution and contrast, , i.e. voksel's size, during registering and reconstructing 3D images. Student properly records images of live animal cells in in vitro cultures, time-lapse sequences of live cells and fast movements of organelles. Student uses a confocal microscope in order to obtain quantitative data about a given intra-cellular system.

	Social skills: Student cooperates with other members of a group and works over his task efficiently, aiming to obtain his goal.
Metody sprawdzania i kryteria oceny efektów kształcenia uzyskanych przez studentów	Continous knowledge and work assessment during classes. 5 tests checking students' knowledge and abilities. Practical exam assessing problem-solving abilities and awareness of microscopy techniques' uses and its limits. Theoretical exam
Typ modułu	Facultative
Rok studiów	2 or 3 year, first cycle (Molecular and Cellular Biophysics) 1 or 2 year, second cycle (Molecular Biotechnology)
Semestr	Winter
Forma studiów	Stationary
Imię i nazwisko koordynatora modułu i/lub osoby/osób prowadzących moduł	Prof. dr hab. Jerzy Dobrucki
Imię i nazwisko osoby/osób egzaminującej/egzaminujących bądź udzielającej zaliczenia, w przypadku, gdy nie jest to osoba prowadząca dany moduł	Dr Mirosław Zarębski, mgr Agnieszka Hoang-Bujnowicz, mgr Julita Wesołowska
Sposób realizacji	Lecture, Class
Wymagania wstępne i dodatkowe	No
Rodzaj i liczba godzin zajęć dydaktycznych wymagających bezpośredniego udziału nauczyciela akademickiego i studentów, gdy w danym module przewidziane są takie zajęcia	Lecture – 20 h Class – 25 h
Liczba punktów ECTS przypisana modułowi	4 (Molecular and Cellular Biophysics) or 5 (Molecular Biotechnology)
Bilans punktów ECTS	[MOLECULAR AND CELLULAR BIOPHYSICS] Lectures' attendance – 20 h Classes attendance – 25 h Preparing for classes – 25 h Gathering information for exercises – 15 h Preparing for exam – 20 h

	In sum: 105 h = 4 ECTS [MOLECULAR BIOTECHNOLOGY] Lectures' attendance – 20 h Classes attendance – 25 h Preparing for classes – 45 h Preparing for test – 15 h Preparing for exam – 25 h In sum: 130 h = 5 ECTS
Stosowane metody dydaktyczne	Expository methods – Power Point presentation Practical methods – laboratory classes Problem methods – conversatory lecture
Forma i warunki zaliczenia modułu, w tym zasady dopuszczenia do egzaminu, zaliczenia, a także forma i warunki zaliczenia poszczególnych zajęć wchodzących w zakres danego modułu	In order to do a practical and theoretical exam it is necessary to achieve 60% of points from three tests. Obtaining a good result from tests and classes gives a student a possibility of avoiding practical exam. Practical exam, 50% of the points in order to pass Theoretical exam, 50% of the points in order to pass
Treści modułu (z podziałem na formy realizacji zajęć)	Lectures: Basic information about detection of cellular components and processes by optical methods, with special attention focused on fluorescence methods. Investigating cellular structure and function of intact cells in vitro using various microscopy methods employing low molecular weight and protein fluorescent probes. Detection of interactions between molecules (protein-protein, receptor-ligand, DNA-intercalator, etc.) using fluorescence quenching, Förster resonance energy transfer, fluorescence lifetimes. Applications of FRAP, FLIP, FRET, FLIM, FLIM-FRET, „speckle microscopy", CARS microscopy in investigating protein localisation, diffusion, dynamics, post-translational modifications in situ, and interactions between cells and cell components, in cells cultured in vitro. Confocal microscopy of large biological objects – light sheet microscopy, multibeam microscopy and related techniques. The newest developments in the field of optical super-resolution microscopy, including STORM (stochastic optical reconstruction microscopy), SIM (structured illumination microscopy), STED (stimulated emission depletion microscopy). Practical training: (1) Basic information pertaining to wide field microscopy

	(transmission and fluorescence), principles of operation, selecting proper parameters, and methods of improving image contrast. (2) Principle of operation of a confocal microscope, instrumental conditions for recording images with optimal resolution and contrast, registering and reconstructing 3D images. (3) Principles of recording images of live animal cells in in vitro cultures. Recording time-lapse sequences of live cells. Recording of fast movements of organelles. (4) Examples of protein dynamics - mobility of linker histones H1, and core H2B, H3, H4 histones in live cells (FRAP). Phototoxicity issues. (5) Applications of measurements of fluorescence lifetimes using confocal microscopy. (6) Super-resolution imaging of cell components using STORM microscopy.
Wykaz literatury podstawowej i uzupełniającej obowiązującej do zaliczenia danego modułu	Handbook of Biological Confocal Microscopy, edited by J. Pawley, Springer, Fluorescence Microscopy: From Principles to Biological Applications, edited by Ulrich Kubitscheck, Wiley. F.W.D. Rost, Fluorescence Microscopy, Cambridge University Press