Sveučilište u Rijeci
University of Rijeka

BIOtech
Odjel za biotehnologiju
51000 Rijeka, Radmile Matejčić 2
Tel. +385 51 584 550
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e-mail: ured@biotech.uniri.hr

Detailed curriculum for the course:

Advanced microscopy in Neuroscience

Academic year: 2020/2021

Program: Biotechnology for the Life Sciences
Biotechnology and drug research

Course code: EBIL163

ECTS points: 3

Language of the course: English

Teaching hours: 30 hours (15 lectures, 5 seminars, 10 practical work)
Online: 12 hours (40%)

Pre-requisites for enrolment: N/A

Course leader and contact information:

Title and name: Assist. Prof. Jelena Ban
Address: Radmile Matejčić 2, 51000 Rijeka, Croatia
E-mail: jelena.ban@biotech.uniri.hr
Consultation hours: previous agreement by email

Course dates: 07/06/2021-18/06/2021

Teaching staff: Assist. Prof. Jelena Ban (15L+5S+9P)
Zrinko Baričević, M.Sc. (6P+ 1P x 2 groups)

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Required literature:

1. Michael W. Davidson & Mortimer Abramowitz, Optical Microscopy (2002).
2. Maria Elisabetta Ruaro, Jelena Ban and Vincent Torre: "Characterization of embryonic stem (ES) neuronal differentiation combining atomic force, confocal and DIC microscopy imaging". "Embryonic Stem Cells / Book 3", InTech - Open Access Publisher, ISBN 978-953-307-632-4, October 2011. DOI: 10.5772/24014
3. Stefan W. Hell, „Nanoscopy with Focused Light", Nobel Lecture (2014).

Course description:

In the last 20 years, fluorescent microscopy has undergone extremely important advances, especially in resolution, approaching nanometer dimensions. The aim of this course is to describe the principles of modern microscopy with application in Neuroscience. The course could be a continuation of the elective course "Microscopy" (EBIL 157, 1st year of study, lecturer: Assist. Prof. Željka Maglica, PhD).

Students will be introduced to the working principle of modern techniques of fluorescence microscopy: starting from standard light, fluorescence and confocal microscopy, to super-resolution and atomic force microscopy (AFM). These techniques will be accompanied by concrete examples of their application in the field of Neuroscience, such as the differentiation of embryonic stem cells into neurons whose efficiency can be "manipulated" by using nanostructured substrates of different softness and composition. The activity of neural networks can be effectively observed using fluorescent calcium indicators (so-called calcium imaging) and at the same time study the interaction of neurons and glial cells. Induced pluripotent stem cells (iPSCs) have potential clinical applications in the treatment of neurodegenerative diseases, but further *in vitro* research is needed to confirm their efficacy and eliminate possible risks.

The aim of the course is to upgrade the basic knowledge in the field of optical microscopy and to inform students with the basics of modern achievements, with their application in Neurobiology and finally to facilitate the selection of adequate techniques for a specific biological problem in future scientific work.

The seminars will introduce students to scientific research in the field of Neuroscience using techniques described during the lectures. During the practical work, students will prepare a biological sample for microscopy, practice the basics of working on a fluorescent microscope, and analyze the obtained images. Demonstration exercises on the atomic force microscope (AFM) will give students a basic knowledge of its use and possibilities.

Learning outcomes:

After completing the course program, students will be able to:

- Define and explain the basic principles of different types of fluorescence microscopy
- Understand and describe the application of each type of microscopy
- Prepare and present a seminar paper from the recent articles in fluorescent microscopy

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- Independently prepare a biological sample for microscopy and analyze it on a light and confocal microscope
- Independently process and analyze images obtained by microscopy

Detailed course content:

Lectures
L1: History of microscopy (1 hour)
L2: Nervous system cells (2 hours)
L3: CNS cell cultures and markers in neuroscience (2 hours)
L4: In vitro neuronal differentiation of embryonic stem cells and induced pluripotent stem cells (iPSC, 2 hours)
L5: Glial cells (2 hours)
L6: Nanomaterials and 3D cultures in neuroscience (2 hours)
L7: Live cell imaging (2 hours)
L8: Super-resolution microscopy (2 hours)

Seminars
S1: Fluorescence microscopy (1 hour)
S2: Fluorescent labeling of actin filaments in neuronal cells (3 hours)
S3: Recap (1 hour)

Practical exercises
P1: Selection of an adequate combination of primary and secondary antibodies (1 hour)
P2: Immunofluorescence assay (4 hours)
P3: Analysis of samples on optical and fluorescent microscope (2 hours)
P4: Fluorescent image analysis (2 hours)
P5: Introduction to the atomic force microscope (AFM, 1 hour)

Requirements, methods of assessment and evaluation:

Regular class attendance: lectures, seminars and exercises are mandatory.
During the course, the student can collect a total of 100 points. Continuous assessment makes 50 maximum points (of which 35 points for active participation in seminars, 10 points for practical exercises and 5 points for active participation in classes). The final written exam is 50 maximum points.

Examination deadlines:

The final exam will be **18.06.2021. 9:00 AM, O-269.**

For those who need to retake the test, the second test sitting will be **02.07.2021. 9:00 AM, O-269.**

Additional test sittings (maximum two more) will be by arrangement between the students and teacher.

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Qualification and grades (according to *Pravilniku o studijima Sveučilišta u Rijeci*):

Distribution of grade points: 50% continuous teaching and 50% final exam
Students who during the continuous part of the course achieved:

- from 0 to 24.9% of grade points cannot take the final exam
- more than 25% of the grade points can take the final exam.

Final grades
The following grades will be awarded based on the final score:

Percentage score	ECTS grade	Numerical grade
90% to 100%	A	Excellent (5)
75% to 89.9%	B	Very good (4)
60% to 74.9%	C	Good (3)
50% to 59.9%	D	Satisfactory (2)
0% to 49.9%	F	Unsatisfactory (1)

The final grade is based on the sum of percentage points accumulated during the course and on the final exam. Passing grades are excellent (5), very good (4), good (3) and satisfactory (2).

Schedule of classes:

Date	Group	Time	Room or platform	Activity	Teacher
7.06.2021.	all	9:00-10:00	MS Teams	L1	J.Ban
7.06.2021.	all	10:00-11:30	MS Teams	L2	J.Ban
8.06.2021.	all	14:00-16:00	MS Teams	L3-4	J.Ban
9.06.2021.	all	13:00-15:30	O-269	L4-5	J.Ban
10.06.2021.	all	10:00-10:45	O-269	S1	J.Ban

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10.06.2021.	all	11:00-12:30	O-269	L6	J.Ban
11.06.2021.	all	9:00-12:00	MS Teams	L7-8	J.Ban
14.06.2021.	all	9:00-11:30	O-269	S2	J.Ban
15.06.2021.	all	8:00-9:00	O-237	P1	J.Ban
15.06.2021.	Group 1	9-13	O-237	P2	J.Ban
15.06.2021.	Group 2	9-13	O-237	P2	Z.Baričević
15.06.2021.	Group 1	13:30-15	O-239	P3	J.Ban
15.06.2021.	Group 2	15-16:30	O-239	P3	Z.Baričević
16.06.2021.	all	9:30-11:00	O-239	V4	J.Ban
16.06.2021.	Group 1	11:00-11:45	O-251	V5	Z.Baričević
16.06.2021.	Group 2	11:45-12:30	O-251	V5	Z.Baričević
17.06.2021.	all	13:30-15:30	online	S3	J.Ban
18.06.2021.	all	9:00-11:00	O-269	Final exam	J.Ban

Additional information:

Lab coats and closed shoes are mandatory for performing exercises in the laboratory (P2).

Academic integrity

Students are required to respect the principles of academic integrity, and refer to the documents: *Ethical rules of the University of Rijeka* and *Ethical rules for students*.