BIST

Barcelona Institute of Science and Technology

upf. Universitat Pompeu Fabra Barcelona

Master of Multidisciplinary Research in Experimental Sciences 2019/2020

bist.eu/master | @_bist

OUTLINE

CALENDARS

ACADEMIC YEAR

SEPTEMBER						
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

OCTOBER						
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

NOVEMBER						
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DECEMBER						
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
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30	31					

JANUARY						
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2

FEBRUARY						
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	

MARCH						
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

APRIL						
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

MAY						
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18	19	20	21	22	23	24
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JUNE						
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29	30					

JULY						
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20	21	22	23	24	25	26
27	28	29	30	31		

- Welcome Ceremony
- Initial Training Period
- Research Training Period
- Deadlines
- Training Days
- Winter School
- Thesis Presentations
- Holidays

INITIAL TRAINING PERIOD

SEPTEMBER						
9	10	11	12	13	14	15
	Masters Ceremony	Holiday	SDA	SDA		
			SDA			
16	17	18	19	20	21	22
		SDA	SAR	RRSC		
SDA		RRSC	SDA			
23	24	25	26	27	28	29
SDA	Holiday	SDA	SAR			
RRSC		RRSC	SDA			
OCTOBER						
30	1	2	3	4	5	6
SDA	SAR	SDA	SAR			
RRSC		RRSC	SDA			
7	8	9	10	11	12	13
SDA	SAR	SDA		SAR		
			SDA	SDA		
14	15	16	17	18	19	20
	SAR	SDA	SDA	BIST Welcome		
RRSC		RRSC	SDA			
21	22	23	24	25	26	27
SDA	SAR	RRSC	RRSC			
SDA		RRSC	RRSC			

SDA	Statistics & Data Analysis
SAR	Seminars in Advanced Research
RRSC	Responsible Research and Science Communication

TRAINING DAYS

November 29	December 2	February 3	March 2
SDA	SAR	SAR	SAR
RRSC			RRSC
March 31	**May 4**	**June 8**	**July 3**
SAR	SAR	SAR	SAR
RRSC	RRSC	RRSC	RRSC

RESEARCH TRAINING PERIOD

10 Sep	Masters Ceremony
12 Sep	Start of Program
28 Oct	Start of Major Project
4 Nov	Deadline for Minor Project assignment
4 Nov	Deadline for Major Project Initial Report
30 Mar	Deadline for Mid-Project Report
30 Jun	Deadline for Final Report
10 Jul	Deadline Master Thesis scientific paper
22-24 July	Oral presentations

LAB TIME

- Major Project: From Oct 28 2019 to July 31 2020
- Minor Projects: 10 weeks (approx.) between Nov 4 2019 and Jul 31 2020
- Master Thesis: From Jul 1 to Jul 24 2020.

ACADEMIC BOARD

MMRES Directors

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Alba Echarte
IRB Barcelona

DIRECTORY AND LOCATIONS

			CONTACT	
Center	**Web**	**Location**	**Academic Committee**	**Technical Committee**
DCEXS Universitat Pompeu Fabra Barcelona Department of Experimental and Health Sciences	upf.edu/web/biomed	Dr. Aiguader 88, 08003, Barcelona	Rubén Vicente Principal Investigator Ruben.vicente@upf.edu	Donna M Ramírez Academic Officer Donna.ramirez@upf.edu
CRG CRG Centre for Genomic Regulation	Crg.eu	Dr. Aiguader 88, 08003, Barcelona	Luciano Di Croce Group Leader Luciano.DiCroce@crg.eu	Anna Solé Academic Officer imma.falero@crg.eu
IBEC IBEC Institute for Bioengineering of Catalonia	Ibecbarcelona.eu	C/Baldiri Reixac 10-12, Parc Científic de Barcelona 08028	Elena Martínez Group Leader emartinez@ibecbarcelona.eu	Karem García HR Technician kgarcia@ibecbarcelona.eu
ICFO ICFO	Icfo.eu	Parc Mediterrani de la Tecnologia, Avinguda Carl Friedrich Gauss, 3, 08860 Castelldefels	Rob Sewell Staff Scientist Coordinator of Academic Programs robert.sewell@icfo.eu	Mireia Vilamala Internships & Fellowships mireia.vilamala@icfo.eu
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IFAE IFAE Institut de Física d'Altes Energies	Ifae.es	Edifici Cn, Campus Universitari de la UAB, 08193 Bellaterra,	Rafel Escribano Group Leader rescriba@ifae.es	Rafel Escribano Group Leader rescriba@ifae.es
IRBB IRB Barcelona Institute for Research in Biomedicine	irbbarcelona.org	C/Baldiri Reixac 10-12, Parc Científic de Barcelona 08028	Roger Gomis Group Leader roger.gomis@irbbarcelona.org	Alba Echarte Academic Officer alba.echarte@irbbarcelona.org

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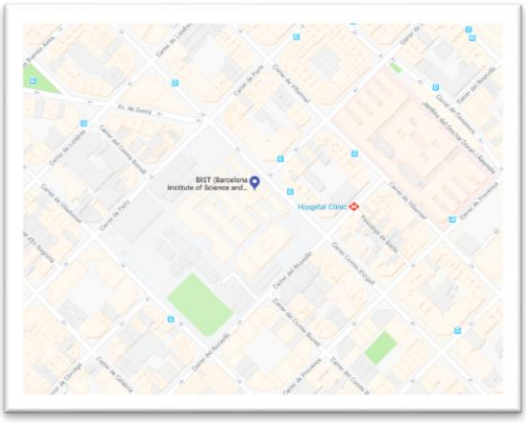

SYLLABUS

Statistics & Data Analysis (SDA)

Overview

Coordinator: Hafid Laayouni
Contact: Hafid Laayouni (hafid.laayouni @upf.edu)
Teaching staff: Marius Costache, Ramon Miquel and Hafid Laayouni
ECTS: 5
Workload: 125 hrs.
Term: 1st
Location: UPF Campus Mar (Dr. Aiguader 80)
Comments: Students must bring their laptop for the hands-on sessions

Teaching guide

Presentation of the course

This course focuses on statistical methods to analyse Research data in Experimental Sciences. The course starts with a crash course in the programming tools needed to complete the subject, and an introduction to useful tools for their research projects. The format is a 4-day workshop, modelled on and taking advantage of open-source online materials.

After a general introduction on probability theory and parameters estimation, an emphasis will be made on statistical inference, along with a general introduction to Bayesian statistics. The course comprises 5 ECTS credits, involving approximately 30 hours of plenary lectures, and 20 hours of exercises and hands-on computer classes. The subject is based on the understanding of key methodological concepts and tools and on the application of Python resources to solve statistical analysis. As this is an intensive course, students are advised of the need for strong interaction with the lecturers and of the need to keep the class material up to date.

The subject focuses on practical implementation of different types of tools for statistical inference. Thus, the methods covered are strongly based on a good understanding of basic principles of probability and programming.

Prerequisites in order to follow the itinerary

Previous programming knowledge and notions of probability are required. A Python Bootcamp is organised for 4 days at the beginning of the course to introduce python language to all students.

Associated competences

General competences

Instrumental:

Proficient reading/writing/listening of scientific English related to the subject.

Interpersonal:

Group work
Ability to solve by yourself a given problem

Systemic:

Analysis and synthesis abilities
Ability to search for information

Specific competences

1. To understand the concept of probability.
2. To understand Bayes' Theorem.
3. To distinguish statistical description from inference.
4. To understand the concept of random variable.
5. To become familiar with central trend and dispersion measures.
6. To understand the concept of probability distribution.
7. To become familiar with the most common kinds of distributions.
8. To understand the implication of large numbers' use and convergence.
9. To understand the concept of confidence intervals and standard error.
10. To understand the concept and application of Monte Carlo techniques.
11. To understand the concept of estimator and its main properties.
12. To master standard techniques for parameter estimation such as least-squares and maximum likelihood fits.
13. To master standard techniques for error propagation.
14. To understand the concept of hypothesis testing.
15. To understand the concept of Type I and II errors.
16. To master the concept of ANOVA and its different designs.
17. To master the concept of contingency tables and the relevant testing procedures.
18. To master the concept of and procedures for Regression and Correlation Analysis.
19. To understand resampling methods.
20. To understand the concepts of multiple regression and correlation.
21. To understand the concept and procedures for Likelihood ratio tests, Linear tests, Non-linear tests and machine learning.
22. To understand the concept of Bayesian Statistics.
23. To master parameter estimation in a Bayesian framework.
24. To master hypothesis testing ("model selection") in a Bayesian framework.
25. To become familiar with Markov chain Monte Carlo and its applications in Bayesian statistics.

Learning aims

To understand and apply algorithms and methods currently used in multidisciplinary research in experimental sciences to perform statistical analysis upon data.

Contents

Block 0: Python Bootcamp
Block 1: Basic concepts of probability
Block 2. Law of large numbers and convergence
Block 3. Basic probability density functions
Block 4. Introduction to Monte Carlo techniques
Block 5. Parameter estimation
Block 6. Hypothesis testing 1
Block 7. Hypothesis testing 2
Block 8. Hypothesis testing 3
Block 9. Bayesian statistics

Calendar

week	Learning activity	Theory and / or Practical	Lecturer	Date	Time*	Room
1	Introduction	T	HL	12-sep	10:00 - 13:00	61.107
1	Bootcamp	Bootcamp	Bootcamp Team	12-sep	15:00 - 18:00	61.107
1	Bootcamp	Bootcamp	Bootcamp Team	13-sep	10:00 - 13:00	61.107
2	Introduction	T	HL	16-sep	15:00 - 18:00	61.107
2	Bootcamp	Bootcamp	Bootcamp Team	18-sep	10:00 - 13:00	61.107
2	Bootcamp	Bootcamp	Bootcamp Team	19-sep	15:00 - 18:00	61.206(08)
3	Basic probability density functions	T	HL	23-sep	10:00 - 13:00	61.107
3	Sampling distribution / Law of large numbers and convergence	T	HL	25-sep	10:00 - 13:00	61.107

3	Sampling distribution / Law of large numbers and convergence	T	HL	26-sep	15:00 - 18:00	61.206(08)
4	Hypothesis testing	T	HL	30-sep	10:00 - 13:00	61.107
4	Hypothesis testing	T	HL	02-oct	10:00 - 13:00	61.107
4	Hypothesis testing	T/P	HL	03-oct	15:00 - 18:00	61.206(08)
5	Hypothesis testing	T/P	HL	07-oct	10:00 - 13:00	61.107
5	Hypothesis testing	T/P	HL	09-oct	10:00 - 13:00	61.107
5	Hypothesis testing	T/P	HL	10-oct	15:00 - 18:00	61.206(08)
5	Bayesian statistics	T/P	RM	11-oct	15:00 - 18:00	61.107
6	ML	T/P	MC	16-oct	10:00 - 13:00	61.107
6	Bayesian statistics	T/P	RM	17-oct	10:00 - 13:00	61.107
6	Bayesian statistics	T/P	RM	17-oct	15:00 - 18:00	61.206(08)
7	ML	T/P	MC	21-oct	10:30 - 13:30	61.107
7	ML	T/P	MC	21-oct	15:00 - 18:00	61.226
	Exam		HL	29-nov	15:00 - 18:00	tbc

*Students must be at the classroom at 10.00 and 15.00. Sessions are scheduled to start at 10.10 and 15.10.

Assessment

General assessment criteria

The evaluation will consist of two parts:

Task	Description	Weight
Coursework	Practical works and eventually exercises delivered during the course	50%
Exam	A final take home exam at the end of the course	50%

All assessment and exercises to be delivered are to be individual work, that is, students can and are advised to discuss and work together to resolve assessments, but the final resolution and presentation must be individual. Disciplinary action will be taken against students who breach guidelines (e.g. colluding with other students or copying other students' work).

Course Materials

Course materials available on GitHub at https://github.com/philipp-germann/BIST-Python-Bootcamp

Preliminary Requirements

Students are requested to bring their own laptop with a working installation of Anaconda Python 3.6. Installation instructions and additional resources are given here.

Recommended Installation

Version: Anaconda Python 3.6
Distribution: Anaconda with Jupyter and Spyder (or another editor)
Packages: NumPy, SciPy, MatplotLib, Pandas, Seaborn, Scikit-learn
Version Control: Git

Online Resources

Learn X in Y minutes where X = Python
Learn Python
10 Minutes to Pandas
Pythonic Perambulations
Subtleties of Colour

Useful Courses

Software Carpentry - Programming with Python
Software Carpentry - Plotting and Programming with Python
Software Carpentry – Version Control with Git
Software Carpentry - Instructor Training
Python - Python Tutorial
Data Carpentry – Python for Ecologists
AstroEd – Python for Physics and Astronomy
SciPy – Lecture Notes, particularly the Statistics in Python chapter
J.R. Johansson – Scientific Computing with Python
Institute of Space Sciences – Python for Astronomy and Particle Physicists.

Teaching Resources

https://www.otexts.org/book/biostat
http://onlinestatbook.com/
http://www.biostathandbook.com/

Other References

Best Practices in Scientific Computing
Good Enough Practices in Scientific Computing

Bibliography

M.L. Samuel, J.A. Witmer, A. Shaffner. Statistics for the Life Sciences.
G. Cowan; "Statistical Data Analysis", 1998, Oxford University Press
Stuart et al., "Kendall's Advanced Theory of Statistics", Vol 2A. Wiley.
F. James, "Monte Carlo Theory and Practice", Rep. Prog. Phys. 43 (1980) 73.
D. Sivia and J. Skilling, "Data Analysis, A Bayesian Tutorial", 2nd ed., 2006, Oxford University Press
E.T. Jaynes, "Probability Theory: The Logic of Science", Cambridge University Press.
W.T. Press et al., "Numerical Recipes: The Art of Scientific Computing", Cambridge University Press.

Responsible Research and Science Communication (RRSC)

Overview

Coordinator: Carolina Llorente, UPF
Contact: Carolina Llorente (carolina.llorente@upf.edu);
Teaching Staff: Carolina Llorente (UPF); Gavin Lucas (The Paper Mill); Maruxa Martínez (PRBB); Caroline Broad (Broad Associates)
ECTS: 5
Workload: 125 hrs.
Term: 1st 2nd, 3rd
Location: UPF Campus Mar (Dr Aiguader, 80) and BIST Centers

Description of the subject

The course is a developmental training programme which is focused on enhancing the effectiveness of future researchers by providing an opportunity to build their understanding, skills and confidence in basic knowledge of responsible research, project management and effective communication. It also encourages critical discussions and thorough reflection on the wider impact of concrete research and innovation (R&I) aspects and the overall science and technology system. It equips students with knowledge and skills to understand Responsible Research and Innovation (RRI) approach and to promote and facilitate such discussion and reflection processes, and gives them the opportunity to be part of such activities. The course also focuses on different skill sets for scientific communication: how to gather information, and how to communicate science to peers, multidisciplinary peers and to general public. During the course students will learn to gather, manage and summarise scientific information and also they will develop their abilities in three key channels for traditional scientific communication (poster presentations, scientific articles, and oral presentations) and by designing, performing and evaluating a public engagement activity for general public.

The course is divided into three different domains:

BLOCK I: RRI and public communication

BLOCK II: Project management

BLOCK III: Scientific communication

Objectives

On completion of this course students will be able to:

- Understand methods to facilitate dialogue on R&I with different actors: multidisciplinary peers, strategic stakeholders (users, consumers, patients, industry representatives, policy makers, CSO representatives), media and the general public
- Develop public communication skills
- Adapt these methods to their specific R&I process or development

- Carry out a dialogue activity to discuss a specific R&I process or development and analyse the participants' different perspectives on and assessment of the R&I issue under debate
- Develop attitudes and techniques on effective planning and project management
- Develop techniques to effectively communicate with thesis supervisor and relevant people for the success of the thesis
- Develop an individual plan for the coming year and identify the things that need to be done now in order to secure the job they want
- Develop techniques to communicate the outputs of their research projects in different ways: poster, paper and oral presentation

Methodology

Block I: RRI and public communication.

In this course, students will have the opportunity to experience both sides of deliberation activities. Thereby it will be possible for them to reflect on different societal aspects of R&I developments (including issues of sustainability, societal equality, gender, open science, open access etc.) applied to their own research. Students will not only be sensitised for the embeddedness of R&I, but also how different actors engage in mutual discussions on these matters, including the challenges and opportunities that such engagement entails.

Students will get to know and discuss different methods to facilitate dialogues on R&I and related developments. In groups they will prepare and conduct presentations on different related methods suggested by the course instructor. Groups of students supervised by the course instructor will design and implement a dialogue "experiment". Thus, each student will experience both the side of the facilitator and that of a participant. At the end of the course students will assess their own public engagement activity and present it in an oral presentation.

Block II: Project Management.

The focus of the block is project management techniques which create effective interactions and a well-managed research project implementation. This course will build on your existing skills and can be applied directly to your research.

Research requires a display of initiative, commitment and persistence. Project management compliments those skills by providing process, monitoring, communication and risk response.

On this course, students will develop:

- An understanding of the impact project management skills can have on your research project
- An introduction to foundation project management tools and their application in research projects
- An insight into project management responsibilities in maintaining relationships and communication channels

This training course is full of activity and discussion. The class will be working in small groups and applying project management theory onto a research project.

Block III: Science Communication.

Throughout this workshop series, the instructor will introduce basic concepts in written and visual communication, as a common theme for scientific communication, and will expand and build upon these in each successive session. As part of the students' learning process, the instructor will reinforce the culture of always considering the Why of each scientific task (Why am I doing this? What do I want to achieve?), rather than just applying a formula for how it 'should'

be done. Thus, the students will develop their scientific skills through autonomous thinking, rather than just applying standard practice.

Calendar

Initial Training Period

Learning activity	Session	Type (Theory and / or practical)	Lecturer	Date	Time	Room (UPF)
Explaining my research: multidisciplinary peers	1	T/P	Carolina Llorente	18-sept	15:00-17:00	61.109
Exploring RRI	2	T/P	Carolina Llorente	20-sept	10:00-12:00	61.107
Scientific integrity 1	3	T	Maruxa Martinez	23-sept	15:00-17:00	61.109
Scientific integrity 2	4	T	Maruxa Martinez	25-sept	15:00-17:00	61.109
Other Shared values	5	T/P	Carolina Llorente	30-sept	15:00-17:00	61.109
Overview of dialogue approach	6	T/P	Carolina Llorente	02-oct	15:00-17:00	61.109
Public communication skills. Knowing the public	7	T/P	Carolina Llorente	14-oct	15:00-17:00	61.109
Public engagement approach: Planning a participatory activity	8	P	Carolina Llorente	16-oct	15:00-17:00	61.109
Project Management	9	T/P	Caroline Broad	23-oct	9:00 - 17:00	61.107/61.109
Reading Effectively	10	T	Gavin Lucas	24-oct	10:00-17:00	61.107/61.109

Training Days

Learning activity	Session	Type	Lecturer	Date	Time	Location
Preparing Scientific poster	11	T	Gavin Lucas	29-nov*	14:00-19:00	ICFO
RRI approach: ongoing process	13	P	Carolina Llorente	02-mar	15:00-17:00	ICN2
RRI approach: how to evaluate	14	P	Carolina Llorente	31-mar	15:00-17:00	DCEXS
Final public engagement presentations	15	P	Carolina Llorente	4-may	15:00-17:00	IRBB
Writing your thesis	16	T	Gavin Lucas	02-jun	14:00-19:00	CRG
Preparing Oral presentation	17	T	Gavin Lucas	03-jul	14:00-19:00	IBEC

*tbc

Assessment

Activity	Weight
Block I – RRI and Public Comm.	40%
Block II – Project Management	30%
Block III – Scientific Comm.	30%

Active participation in sessions will be taken into account for the final grade. This course does not have a final exam; the assessment will be done continuously throughout the course. This will be through several deliveries, oral presentations and self-assessment activities.

Seminars in Advanced Research (SAR)

Overview

Coordinator: Robert Sewell and Rubén Vicente
Contact: robert.sewell@icfo.eu; ruben.vicente@upf.edu
Teaching staff: Robert Sewell, Rubén Vicente and invited speakers
Total credits: 5 ECTS
Workload: 125 hrs.
Term: 1st, 2nd and 3rd terms
Location: UPF Campus Mar (Dr. Aiguader 80) and BIST Centers + DCEXS

General description of the subject

This course provides broad exposure to multidisciplinary research in experimental sciences. The aim is to give students direct contact with inspirational speakers, introduce cutting-edge challenges in contemporary research, and help prepare students to understand what is involved in pursuing a cutting-edge research career in academia or industry, and specifically for pursuing a PhD at a leading international institution.

There are two main components of the course:

Research Seminars: Designed to complement the hands-on training they will receive in carrying out their research projects. These seminars are presented by PIs from the UPF and BIST research centres during the Initial Training Period, and invited external speakers during the Training Days.

Group Discussion Sessions: During the training days, there will be a student-led group discussion session emphasising critical evaluation of scientific literature. These will involve faculty from the UPF and BIST, and the invited external speakers.

Objectives

- Meet researchers from participating institutions, and outstanding international scientists
- Learn about important contemporary research topics
- Discuss topics relevant to becoming a successful scientist
- Learn about and discuss some of the challenges involved in multidisciplinary research

Methodology

Seminars and discussion sessions with BIST/UPF PIs and invited external speakers, including student-led presentation and discussion of scientific publications. Students will be required to prepare and lead a discussion session based on a research article on the presented topic, which they must choose and research.

Format

Research Seminars

Speakers will be invited to present a lecture, and lead discussions about their chosen research topic and general challenges in undertaking multidisciplinary research / pursuing a research career.

There will be 8 lectures from BIST/DCEXS PIs, and 8 seminars from invited speakers, with a standard format:

- 30-minute introduction explicitly aimed at the level of the MSc students, giving a general introduction and background to the speaker's chosen topic
- 60-minute seminar on a topic arising from their own work, which might include research that the speaker has led, or an open challenge in the field
- 30-minutes discussion, which may open onto more general topics about pursuing a research career

Note that the order is flexible, and for the external seminars the students will be responsible for leading the introductory discussion via a presentation of a research paper from the invited external speaker.

In the case of the BIST/DCEXS PIs, the introduction may include an overview of research themes at their institute.

For the invited external speakers, the research seminar will be open to everyone at the hosting institute, and publicly announced. Where possible, we will arrange an informal Q&A session over coffee with the speaker and MSc students.

Group Discussion Sessions

During the training days, there will be a student-led discussion of a research paper. Students will be required to choose and present a research paper on a topic related to the seminar that day in consultation with the invited external speaker, and lead the group in a discussion of the paper and the seminar.

Students will undertake this task in groups of 3 or 4 students. The assignment of students to each Discussion Session will be defined during the initial training period.

Calendar

Initial Training Period - Research Seminars

Session	Date	Time	Speaker	Center	Room
1	19 SEP	10:30-12:30	Javier Macia	DCEXS	61.107
2	26 SEP	10:30-12:30	Silvia Muro	IBEC	61.107
3	1 OCT	10:30-12:30	Arben Mercoçi	ICN2	61.107
4	3 OCT	10:30-12:30	Nuria Lopez	ICIQ	61.107
5	8 OCT	10:30-12:30	Sara Sdelci	CRG	61.107
6	11 OCT	10:30-12:30	Maria García Parajo	ICFO	61.107
7	15 OCT	10:30-12:30	Aurelio Juste	IFAE	61.107
8	22 OCT	10:30-12:30	Angel Nebreda	IRBB	61.107

Training Days - Group Discussion Sessions

Session	Date	Center	Speaker	Affiliation
9	2 DEC	ICIQ	Luis Liz-Marzan	CIC biomaGUNE
10	3 FEB	IFAE	Günther Dissertori	Institute for Particle Physics and Astrophysics. ETH Zürich
11	2 MAR	ICN2	Maria José Alonso	CIMUS Research Institute
12	31 MAR	IBEC	Viola Vogel	Laboratory of Applied Mechanobiology. ETH Zurich
13	4 MAY	DCEXS	Andrés Hidalgo	CNIC
14	8 JUN	CRG	Robert Schneider	Deutsches Forschungszentrum für Gesundheit und Umwelt (GmbH)
15	3 JUL	IRBB	Michaela Frye	Deutsches Krebsforschungszentrum.

Assessment

Attendance of at least 80% of the seminars and group discussion sessions is required to pass the subject.

Students are expected to participate actively in group discussions.

Task	Description	Weight
Participation in Seminars	Students are expected to participate actively in group discussions.	20%
Tests	There will be a short online quiz following each seminar using questions provided by the lecturers	40%
Classwork	Oral presentation summarizing the chosen research article; students must also lead discussion session	40%

Advanced Techniques in Experimental Sciences (ATES, Winter School)

Overview

Coordinators: Jordi Arbiol (ICREA & ICN2), Maria García-Parajo (ICREA & ICFO)
Contact: Jordi Arbiol (arbiol@icrea.cat),
Lecturers: Aitor Mugarza (ICN2); Belén Ballesteros (ICN2); Cesar Moreno (ICN2); Christian Neissner (PIC); Daniel Kerzberg (IFAE); Emilio Gualda (ICFO); Francisco Belarre (ICN2); Gabriel Gomila (IBEC); Jérémy David (ICN2); Jordi Andilla (ICFO); Jordi Fraxedas (ICN2); Jorge Jiménez (IFAE); Julien Colombelli (IRBB); Laurent Ladepeche (ICFO); M. Chiara Spadaro (ICN2); Manel Martínez (IFAE); Marcos Rosado (ICN2); Maria Marsal (ICFO); Neus Domingo (ICN2); Nikos Giakoumakis (IRBB); Pablo Guerra (IBMB); Pablo Loza (ICFO); Santi Serrano (IEEC); Sara Martí-Sánchez (ICN2); Sébastien Tosi (IRBB); Timo Zimmermann (CRG).
ECTS: 5
Workload: 125 hrs.
Term: 2nd
Location: BIST Centers
Prerequisites: None

General description of the subject

Intensive winter school combining theoretical courses and hands-on training in a selected topic in multidisciplinary science. This course will take full advantage of the research and academic facilities at the centres. The topic and location(s) will rotate each year.

The topic for 2019/20 will be **Microscopy & Imaging Science**, covering the following five topics:

1. Optical microscopy
2. Electron microscopy
3. Scanning probe microscopy
4. Raman imaging and spectroscopy
5. Imaging technology and approaches in astrophysics / cosmology

Objectives

- To acquire knowledge in thematic advanced techniques in experimental science
- To develop the hands-on practical and technical skills in specific experimental and/or theoretical techniques
- To gain experience working in groups

Methodology

Lectures, research seminars, and hands-on training in specific experimental techniques.

Location & Organisation

The winter school will be hosted by the BIST research centres, with the location rotating each year depending on the topic. This year ICFO will host the symposium, with input from IRB, CRG, ICN2, IBEC and IFAE researchers. Practical training will be undertaken at each centre to take advantage of their research and training facilities.

Assessment

Task	Description	Weight
Participation	Participation in lectures and classes during school	30%
Coursework & Tests	Assessment via coursework and tests given during and immediately after the workshop	70%

Research Project (Major Project)

Overview

Coordinator: Rubén Vicente, Núria Bayó
Contact: Rubén Vicente (ruben.vicente@upf.edu); Núria Bayó (nbayo@bist.eu)
Academic Tutors: Rubén Vincente (UPF), Elena Martínez (IBEC), Robert Sewell (ICFO), Luciano Di Croce (CRG), Rafel Escribano (IFAE), Mónica Perez Temprano (ICIQ), Arben Merkoçi (ICN2), Roger Gomis (IRB Barcelona)
ECTS: 20
Workload: 500 hrs.
Term: 1st 2nd & 3rd
Location: BIST Centers & DCEXS

Description of the subject

Hands-on, intensive training-through-research. The aim is to provide in-depth training in a specific discipline. The student chooses and develops during five months one of the projects offered by the BIST-DCEXS research groups and re-enforces the training in multidisciplinary science provided in the initial period.

Training Component: Under the guidance of their supervisor, students will gain a broad understanding of theoretical concepts and standard research techniques in their field, and a deep understanding of the background to their research topic.

Research Component: Students will join a research team at one of the BIST institutes / DCEXS and develop a research project assigned and supervised by a principal investigator. During this time, the student will perform calculations and/or experiments, analyse data, describe and discuss results, research the literature, and other tasks required to successfully carry out a research project. The aim is to acquire key conceptual knowledge and experimental skills, familiarise the student with the organisation and functioning of a research team, and provide the student with first-hand knowledge of life as a researcher, as a first step towards pursuing a future research career.

Objectives

- To acquire advanced knowledge in a field of the experimental sciences
- To develop the practical and technical skills required for a specific discipline on experimental sciences
- To learn good practices to design, record and discuss experiments.
- To analyse and communicate properly scientific results.

Methodology

Training Component: The methodology combines guided independent learning through reading textbooks and scientific literature, with regular tutorial sessions with supervisor, and hands-on training in the laboratory.

Research Component: Students complete a guided research project, with clear goals in terms of acquiring conceptual knowledge and technical skills, as well as expected research outcomes. Progress is monitored through regular structured reports and research group meetings.

Assessment

Task	Description	Weight
Initial report	1-page initial project plan description	10%
Mid-project report	2-page assessment of progress, discussing challenges that may have arisen, and re-evaluating project plan	10%
Poster presentation	During a symposium, student should prepare a poster presentation about their projects to be evaluated through oral examination by external examiner. Training Component: The poster should reflect the state of the art in the field Research Component: Presentation of research plan, RRI aspects and multidisciplinary approach.	20%
Final assessment	Research Component: final report with 2-page summary of key findings, and placing these in the context of the state of the art in the field. Training Component: Oral presentation to the research group.	20%
Supervisor Evaluation	Training Component: Assessment of the student's understanding of the field, and their performance in learning new concepts and techniques Research Component: Assessment of student's performance in carrying out research project	40%

The assessment of the initial, mid-term and final reports will be done by the coordinator of the subject. The deadlines for submitting the reports are:

-**Initial report**: during the first three weeks after initiation of the research project.

-**Mid-term report:** end of March.

-**Final report**: mid-June.

The assessment of the poster presentation will be done during the BIST Winter School symposium in January by a committee of experts.

The supervisor will be responsible for the assessment of the oral presentation performed in the research group and will generate a general report evaluating the student's performance.

Interdisciplinary Research Training (Minor Project)

Overview

Coordinator: Rubén Vicente
Contact: Rubén Vicente (ruben.vicente@upf.edu); Núria Bayó (nbayo@bist.eu)
Academic Tutors: Rubén Vincente (UPF), Elena Martínez (IBEC), Robert Sewell (ICFO), Luciano Di Croce (CRG), Rafel Escribano (IFAE), Mónica Perez Temprano (ICIQ), Arben Merkoçi (ICN2), Roger Gomis (IRB Barcelona)
ECTS: 10
Workload: 250 hrs.
Term: 1st & 2nd
Location: BIST Centers & DCEXS

Description of the subject

The aim of this subject is to provide students with complementary training in a different research discipline to that of their major project. Students are required to carry out a 10-week stay in a different research group (the host group). The aim is to gain complementary conceptual knowledge and experimental skills. Students will gain experience working in a different research environment, and an ability to analyse the multidisciplinary component of a research project.

Objectives

To acquire advanced knowledge in a different field of the experimental sciences to that of the main project

To develop the practical and technical skills required for a specific discipline on experimental sciences

To train multidisciplinary approaches to a given research topic

Methodology

Students gain supervised, hands-on training guided by the principal investigator of the host group. Student and supervisor will develop clear goals in terms of acquiring conceptual knowledge and technical skills. Progress is monitored through regular structured reports. Assessment is via these reports, and evaluation by the supervisor and PI of the host group.

Assessment

Task	Description	Weight
Training plan	1-page summary of research goal, and concepts & techniques that should be required during the training period, relating these to the major research project	30%
Training report	Oral presentation (in the research group) 2-page summary relating research and training outcomes to the objectives of the major project. Self-assessment of outcome of training relative to initial plan	30%
Supervisor Evaluation	Assessment of student's performance during the training period	40%

The assessment of the training plan will be done by the coordinator of the subject. This report must be sent during the first two weeks after initiation of the interdisciplinary research project.

The assessment of the written training report will be done by the coordinator of the subject.

The supervisor will be responsible for the assessment of the oral presentation performed in the research group and will generate a general report evaluating the student performance.

Master's Thesis

Overview

Coordinator: Rubén Vicente, Núria Bayó
Contact: Rubén Vicente (ruben.vicente@upf.edu); Núria Bayó (nbayo@bist.eu)
Academic Tutors: Rubén Vincente (UPF), Elena Martínez (IBEC), Robert Sewell (ICFO), Luciano Di Croce (CRG), Rafel Escribano (IFAE), Mónica Pérez Temprano (ICIQ), Arben Merkoçi (ICN2), Roger Gomis (IRB Barcelona)
ECTS: 10
Contact Hours: 250
Term: 3rd
Location: BIST Centers & DCEXS

Description of the subject

The student will write a research manuscript in the format of a scientific paper, based on the original results obtained by the student during their research training. In addition, the student will make a public oral presentation and defence of this work to an examining committee.

Objectives

- To elaborate a scientific manuscript with the different sections of a scientific article
- To put in practice the knowledge acquired in data analysis in the results section
- To present in the introduction and discussion sections the aspects related to responsible research and multidisciplinary approach derived from the project
- To practise oral communication of scientific results
- To demonstrate the acquisition of advanced knowledge during the master's in the discipline of the projects performed

Assessment

Task	Description	Weight
Scientific manuscript	Written report of project results	50%
Oral presentation	20-minute presentation of project in front of committee	30%
Oral defense	10-minute questions by committee	20%

The scientific manuscript should be sent to the coordinator of the TFM the second week of July for evaluation.

The oral presentation will be done in from of an external committee during the last week of July.

Students should attend all the oral presentations within the same evaluation session.

Notes

Notes

The BIST research centres are:

Member institutions of the board: