



Universitat  
Pompeu Fabra  
*Barcelona*

Barcelona Institute  
of Science and  
Technology

# Master of Multidisciplinary Research in Experimental Sciences 2018/2019

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# 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

DECEMBER						
					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

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

JUNE						
					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

SEPTEMBER						

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				

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			

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					

JULY						
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						
			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		

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			

MAY						
		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		

AUGUST						

- Welcome Ceremony
- Initial training period (UPF)
- Training days (rotating through BIST Centers & DCEXS)
- Winter School & Symposium (ICN2, ICFO)
- Research Training Period (BIST Centers & DCEXS)
- Deadlines
- Thesis presentations
- Holidays

## Initial Period Training

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

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

## Training Days

<b>December 3</b>	<b>December 4</b>	<b>December 12</b>	<b>January 10</b>
SDA	SDA		SDA
SDA	SDA	SAR	SDA
<b>January 11</b>	<b>February 8</b>	<b>February 12</b>	<b>March 4</b>
SAR	SAR	RRSC	SAR
SDA	SAR	RRSC	RRSC
<b>April 1</b>	<b>May 6</b>	<b>June 3</b>	<b>July 1</b>
SAR	SAR	SAR	SAR
RRSC	RRSC	RRSC	RRSC

## Research Training Period

12 Sep	Welcome Ceremony
13 Sep	Start of Program
22 Oct	Start of Major Project
2 Nov	Deadline for Minor Project assignment
2 Nov	Deadline for Major Project Initial Report
29 Mar	Deadline for Mid-Project Report
28 Jun	Deadline for Final Report
30 Jun	End of Major/Minor Projects
15 Jul	Deadline Master Thesis scientific paper
24-26 July	Oral presentations

## Lab Time

- Major Project: From Oct 22 2018 to June 30 2019
- Minor Projects: 10 weeks (approx.) between Nov 5 2018 and Jun 30 2019
- Master Thesis: From Jul 1 to Jul 26 2019.

# Academic Board

## MMRES Directors



**Dr. Roderic Guigó**  
CRG  
roderic.guigo@crg.eu



**Dr. Robert Sewell**  
ICFO  
robert.sewell@icfo.eu

## MMRES Coordinators



**Dr. Rubén Vicente**  
DCEXS  
Ruben.vicente@upf.edu



**Dr. Núria Bayó**  
BIST  
nbayo@bist.eu



## Academic Officer

**Donna M Ramírez**  
BIST-UPF  
mres@upf.edu

## Course Coordinators



**Dr. Hafid Laayouni**  
Statistics & Data Analysis  
UPF-ESCI  
Hafid.laayouni@upf.edu



**Dr. Carolina Llorente**  
Responsible Research and  
Science Communication  
UPF-ESCI  
carolina.llorente@upf.edu











**Dr. Jordi Arbiol**  
Advanced Techniques in  
Experimental Sciences  
ICREA-ICN2  
Arbiol@icrea.cat



**Dr. Maria García-Parajo**  
Advanced Techniques in  
Experimental Sciences  
ICREA - ICFO  
Maria.garcia-parajo@icfo.eu

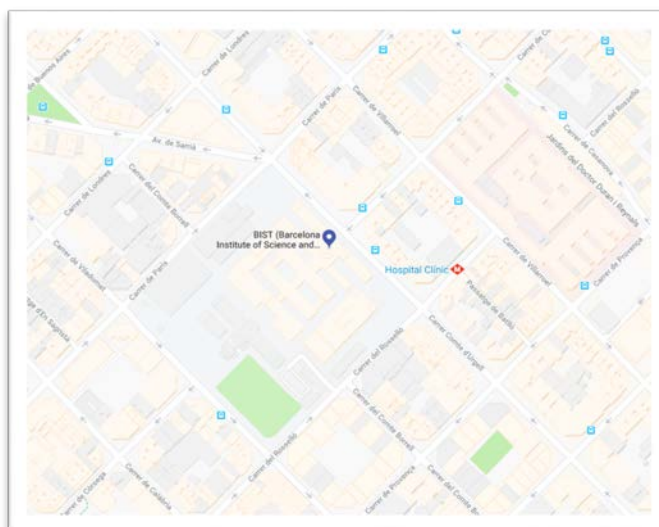


# Directory and Locations

Center	Web	Location	CONTACT	
			Academic Committee	Technical Committee
<b>DCEXS</b>  Universitat Pompeu Fabra Barcelona Departament of Experimental and Health Sciences	upf.edu/web/biomed	Dr. Aiguader 88, 08003, Barcelona	Rubén Vicente Principal Investigator Ruben.vicente@upf.edu	Rubén Vicente Principal Investigator Ruben.vicente@upf.edu
<b>CRG</b>  Centre for Genomic Regulation	Crg.eu	Dr. Aiguader 88, 08003, Barcelona	Luciano Di Croce Group Leader Luciano.DiCroce@crg.eu	Imma Falero Academic Coordinator imma.falero@crg.eu
<b>IBEC</b>  Institute for Biomechanics of Catalonia	ibecbarcelona.eu	C/Baldiri Reixac 10-12, Parc Científic de Barcelona 08028	Samuel Sánchez Group Leader ssanchez@ibecbarcelona.eu	Sergio González Project Manager sgonzalez@ibecbarcelona.eu
<b>ICFO</b> 	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
<b>ICIQ</b>  Institut Català d'Innovació i Recerca en Química Avançada	Iciq.org	Avinguda Països Catalans, 16 43007 de Tarragona	Mónica Pérez-Temprano Group Leader mperez@iciq.es	Noelia Flores Grants Officer nflores@iciq.cat
<b>ICN2</b>  Institut Català de Nanociència i Nanotecnologia	Icn2.cat	Campus de la UAB, Edifici ICN2 de Bellaterra	Arben Merkoçi Group Leader arben.merkoci@icn2.cat	Ainhoa Ayastuy HR Generalist ainhoa.ayastuy@icn2.cat
<b>IFAE</b>  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
<b>IRBB</b>  Institut de Recerca Biomèdica de Barcelona	irbbarcelona.org	C/Baldiri Reixac 10-12, Parc Científic de Barcelona 08028	Roger Gomis Group Leader roger.gomis@irbbarcelona.org	Xenia Villalobos Academic Officer xenia.villalobos@irbbarcelona.org

## BIST (Barcelona Institute of Science and Technology)

Carrer del Comte d'Urgell 187  
 Building 12 (BIST)  
 Barcelona 08036  
 T. +34 938 293 603  
 info@bist.eu



# Syllabus

## Statistics & Data Analysis (SDA, 5 ECTS)

### Overview

**Coordinator:** Hafid Laayouni

**Contact:** Hafid Laayouni (hafid.laayouni@upf.edu)

**Teaching staff:** Marius Costache, Javier Rico, Ramon Miquel, Philipp Germann, Alejandro Pozas, Pablo Latorre, Pablo Villegas and Hafid Laayouni

**ECTS:** 5

**Workload:** 125 hrs.

**Term:** 1<sup>st</sup>, 2<sup>nd</sup>

**Location:** UPF Campus Mar (Dr. Aiguader 80)

**Comments:** Students must bring their laptop for the hands-on sessions

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### 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:**

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

#### **Interpersonal:**

2. Group work
3. Ability to solve by yourself a given problem

#### **Systemic:**

4. Analysis and synthesis abilities
5. 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

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## Calendar

### Initial Training Period

Session	Date	Time	Activity	Lecturer	Room
1	13-Sep	10:30 - 12:30	Introduction	H. Laayouni	61.109
2	13-Sep	14:00 - 17:00	Bootcamp	P. Germann/A. Pozas	61.109
3	14-Sep	10:30 - 12:30	Bootcamp	P. Germann/A. Pozas	61.109
4	14-Sep	14:00 - 17:00	Bootcamp	P. Germann/A. Pozas	61.109
5	18-Sep	10:30 - 12:30	Basic probability density functions	H. Laayouni	61.109
6	18-Sep	14:00 - 17:00	Bootcamp	P. Germann/A. Pozas	61.109
7	20-Sep	10:30 - 12:30	Sampling distribution / Law of large numbers and convergence	H. Laayouni	61.109
8	20-Sep	14:00 - 17:00	Bootcamp	P. Germann/A. Pozas	61.109
9	25-Sep	10:00 - 12:00	Parameter estimation	J. Rico	61.109
10	25-Sep	14:00 - 16:00	Parameter estimation	J. Rico	61.109
11	27-Sep	10:30 - 12:30	Parameter estimation	J. Rico	61.109
12	27-Sep	14:00 - 17:00	Parameter estimation	J. Rico	61.109

11	02-Oct	10:30 - 12:30	Hypothesis testing Introduction t test	H. Laayouni	61.109
14	02-Oct	14:00 - 16:00	Hypothesis testing	H. Laayouni	61.109
15	04-Oct	10:30 - 12:30	Hypothesis testing Categorical data	H. Laayouni	61.109
16	04-Oct	14:00 - 16:00	Hypothesis testing	H. Laayouni	61.109
17	09-Oct	10:30 - 12:30	Hypothesis testing ANOVA I	H. Laayouni	61.109
18	09-Oct	14:00 - 16:00	Hypothesis testing	H. Laayouni	61.109
19	11-Oct	10:30 - 12:30	Hypothesis testing ANOVA II	H. Laayouni	61.109
20	11-Oct	14:00 - 16:00	Hypothesis testing	H. Laayouni	61.109
21	16-Oct	10:30 - 12:30	Hypothesis testing (Regression and Correlation)	H. Laayouni	61.109
22	16-Oct	14:00 - 16:00	Hypothesis testing (Regression and Correlation)	H. Laayouni	61.109
23	18-Oct	10:30 - 12:30	Hypothesis testing	H. Laayouni	61.109
24	18-Oct	14:00 - 16:00	Effect size and Power analysis	H. Laayouni	61.109

### Training Days

Session	Date	Time	Activity	Lecturer	Room
25	03-Dec	10:00-13:00	Exam	H.Laayouni	61.103
26	03-Dec	14:00 - 17:00	Hypothesis testing	M. Costache	61.107
27	04-Dec	10:00 - 12:00	Hypothesis testing	M. Costache	61.109
28	04-Dec	14:00 - 17:00	Hypothesis testing	M. Costache	61.127
29	10-Jan	10:00 - 12:00	Bayesian statistics	R. Miquel	61.127
30	10-Jan	14:00 - 17:00	Bayesian statistics	R. Miquel	61.127
31	11-Jan	14:00 - 17:00	Bayesian statistics	R. Miquel	61.127

### 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.

## Seminars in Advanced Research (SAR, 5 ECTS)

### Overview

**Coordinator:** Robert Sewell, ICFO

**Contact:** robert.sewell@icfo.eu

**Teaching staff:** Robert Sewell, Rubén Vicente

**Total credits:** 5 ECTS

**Workload:** 125 hrs.

**Term:** 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> terms

**Location:** UPF Campus Mar (Dr. Aiguader 80) and BIST Centers + DCEXS

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### 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	17-Sep	10:00-12:00	Laura Lechuga	ICN2	61.109
2	19-Sep	10:00-12:00	Nicholas Stroustrup	CRG	61.109
3	26-Sep	14:00-16:00	Romain Quidant	ICFO	61.109
4	01-Oct	10:00-12:00	Aurelio Juste	IFAE	61.109
5	03-Oct	10:00-12:00	Emilio Palomares	ICIQ	61.109
6	05-Oct	10:00-12:00	Jordi Garcia Ojalvo	DCEXS	61.109
7	10-Oct	10:00-12:00	Xavier Salvatella	IRBB	61.109
8	19-Oct	10:00-12:00	Samuel Sanchez	IBEC	61.109

### Training Days - Group Discussion Sessions

Session	Date	Location	Speaker	Affiliation
9	12-Dec	IRBB	Shalev Itzkovitz	Weizmann Institute of Science
10	11-Jan	DCEXS	tbc	
11	08-Feb	ICFO	tbc	
12	04-Mar	ICN2	Andreas Hierlemann	ETH Zurich
13	01-Apr	IBEC	Ana Pego	Instituto de Engenharia Biomédica
14	06-May	IFAE	Georgi Dvali	NYU Center for Cosmology and Particle Physics
15	03-Jun	CRG	Nicola Iovino	Max Planck Institute of Immunobiology and Epigenetics
16	01-Jul	ICIQ	Luis Liz-Marzan	Center for Cooperative Research in Biomaterials

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**Time:** 10:00 – 13:00 (unless otherwise stated)

### 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%

## Responsible Research and Scientific Communication (RRSC, 5 ECTS)

### Overview

**Coordinator:** Carolina Llorente, UPF

**Contact:** Carolina Llorente (carolina.llorente@upf.edu)

**Teaching Staff:** Carolina Llorente, UPF; Damjana Kastelic, CRG; Gavin Lucas, The Paper Mill; Maruxa Martínez, PRBB

**ECTS:** 5

**Workload:** 125 hrs.

**Term:** 1<sup>st</sup> 2<sup>nd</sup>, 3<sup>rd</sup>

**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 doctoral researchers by providing an opportunity to build their understanding, skills and confidence in basic knowledge of project management and effective communication. It also encourages critical discussions and thorough reflection on the wider impact of concrete research and innovation (R&I). It equips students with knowledge and skills to understand Responsible Research and Innovation (RRI) and to promote and facilitate such discussion and reflection processes, and gives them the opportunity to be part of such activities. The course focuses on two skill sets for scientific communication: how to gather information, and how to communicate science. For the first skill set, the students will learn to gather, /manage and summarise scientific information; and for the second they will develop their abilities in three key channels for scientific communication: poster presentations, scientific articles, and oral presentations.

The course is divided into three different domains:

- a) BLOCK I: RRI and public communication
- b) BLOCK II: Project management
- c) BLOCK III: Scientific communication

### Objectives

On completion of this seminar 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, 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 participants work in up to three multi-disciplinary groups (across function and academic specialism, department or institution) to provide a broad spectrum of experience in a safe and experimental environment. Each session is designed to have a central core of experiential learning activities, time to incorporate lessons learned into ongoing research projects, time to produce a specific derivable and time to receive peer mentoring. This seminar has been designed to improve the student's performance in carrying out the ongoing research projects, organising their research work and collaborating with supervisors and team members.

### Block III: Scientific 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

Session	Day	Time	Block	Activity	Lecturer	Room
1	21-sep	10:00-13:00	RRI and public communication	Explaining my research: multidisciplinary peers	G. Revuelta	61.109
2	21-sep	14:00-16:00	RRI and public communication	Exploring RRI	C. Llorente	61.109
3	26-sep	09:30-13:00	RRI and public communication	Scientific integrity and Science Ethics	M. Martínez	61.106/108
4	03-oct	14:00-16:00	RRI and public communication	Other Shared Values	C. Llorente	21 61.109
5	05-oct	14:00-16:00	RRI and public communication	Overview of dialogue approach	C. Llorente	61.109
6	08-oct	09:30-11:30	Project management	Effective Researcher	D. Kastelic	61.109
7	08-oct	11:30-13:00	Project management	Effective Researcher	D. Kastelic	61.109
8	08-oct	14:00-16:00	Project management	Effective Researcher	D. Kastelic	61.109
9	08-oct	16:00-18:00	Project management	Effective Researcher	D. Kastelic	61.109
10	10-oct	14:00-16:00	RRI and public communication	Public communication skills	C. Llorente	61.109
11	15-oct	09:30-11:30	Project management	Effective Researcher	D. Kastelic	61.109
12	15-oct	11:30-13:00	Project management	Effective Researcher	D. Kastelic	61.109
13	15-oct	14:00-16:00	Project management	Effective Researcher	D. Kastelic	61.109
14	15-oct	16:00-18:00	Project management	Effective Researcher	D. Kastelic	61.109
15	17-oct	10:00-12:00	RRI and public communication	Engagement Approach: Planning a participatory	C. Llorente	61.109
16	17-oct	14:00-19:00	Scientific communication	Reading Effectively	G. Lucas	61.109

### Training Days

Session	Day	Time	Block	Activity	Lecturer	Room
17*	11-Jan	14:00-16:00	Scientific communication	Preparing a Scientific Poster	G. Lucas	tbc
18	12-feb	09:30-11:30	Project management	Career Planning	D. Kastelic	61.107
19	12-feb	11:30-13:00	Project management	Career Planning	D. Kastelic	61.107
20	12-feb	14:00-17:00	Project management	Career Planning	D. Kastelic	61.107
21	04-mar	14:00-16:00	RRI and public communication	RRI Public Engagement	C. Llorente	ICN2
22	01-Apr	14:00-16:00	RRI and public communication	RRI Public Engagement	C. Llorente	IBEC
23	06-may	14:00-16:00	RRI and public communication	RRI Public Engagement	C. Llorente	IFAE
24	03-jun	14:00-17:00	Scientific communication	Writing your thesis	G. Lucas	CRG

25	01-jul	14:00-17:00	Scientific communication	Preparing Oral Presentation	G. Lucas	ICIQ
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### Assessment

Activity	Sessions	Weight	Activity	Sessions	Weight
<b>Block I – RRI and Public Comm.</b>		<b>40%</b>	<b>Block III – Scientific Comm.</b>		<b>30%</b>
Participation	1-11	20%	Participation	1-4	20%
Self-assessment	4,10	20%	Plan	1-2	20%
Plan	7	20%	Poster presentation	3	30%
Oral presentation	11	40%	Oral presentation	4	30%
<b>Block II – Project Management</b>		<b>30%</b>			
Participation	1-2	40%			
Self-assessment	1-2	20%			
Peer review	1-2	40%			

## Advanced Techniques in Experimental Sciences (ATES, 5 ECTS)

### Overview

**Coordinator:** Jordi Arbiol (ICREA & ICN2), Maria García-Parajo (ICREA & ICFO)

**Contact:** Jordi Arbiol ([arbiol@icrea.cat](mailto:arbiol@icrea.cat)), Donna M Ramírez ([dramirez@bist.eu](mailto:dramirez@bist.eu))

**Lecturers:** Belén Ballesteros (ICN2), Marcos Rosado (ICN2), Jordi Fraxedas (ICN2), Cesar Moreno (ICN2), Maria Garcia-Parajo (ICREA & ICFO), Timo Zimmermann (CRG), Julien Colombelli (IRB), Manel Martínez (IFAE), Santi Serrano (Institut de Ciències de l'Espai), Jérémy David (ICN2), Jordi Arbiol (ICREA & ICN2), Sara Martí-Sánchez (ICN2), Neus Domingo (ICN2), Aitor Mugarza (ICREA & ICN2), Oscar Blanch (IFAE), Pablo Loza (ICFO), Sébastien Tosi (IRB), M. Chiara Spadaro (ICN2), Jorge Jiménez (IFAE), Maria Marsal (ICFO), Omar Olarte (ICFO), Jordi Andilla (ICFO)

**ECTS:** 5

**Workload:** 125 hrs.

**Term:** 2<sup>nd</sup>

**Location:** ICN2, ICFO

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### 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 2018/2019 will be **Microscopy & Imaging Science**, covering the following five topics:

- Optical microscopy
- Electron microscopy
- Scanning probe microscopy
- Raman imaging and spectroscopy
- 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 workshop, 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

<b>Task</b>	<b>Description</b>	<b>Weight</b>
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, 20 ECTS)

### Overview

**Coordinator:** Rubén Vicente, Núria Bayó

**Contact:** Rubén Vicente (ruben.vicente@upf.edu); Núria Bayó (nbayo@bist.eu)

**Academic Tutors:** Rubén Vicente (UPF), Samuel Sánchez (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:** 1<sup>st</sup> 2<sup>nd</sup> & 3<sup>rd</sup>

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

### Overview

**Coordinator:** Rubén Vicente, Núria Bayó

**Contact:** Rubén Vicente (ruben.vicente@upf.edu); Núria Bayó (nbayo@bist.eu)

**Academic Tutors:** Rubén Vicente (UPF), Samuel Sánchez (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:** 1<sup>st</sup> & 2<sup>nd</sup>

**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%
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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 (10 ECTS)

## Overview

**Coordinator:** Rubén Vicente, Núria Bayó

**Contact:** Rubén Vicente (ruben.vicente@upf.edu); Núria Bayó (nbayo@bist.eu)

**Academic Tutors:** Rubén Vicente (UPF), Samuel Sánchez (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:** 3<sup>rd</sup>

**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 front of an external committee during the last week of July.

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



The BIST research centres are:



Member institutions of the board:

