Barcelona Institute of
Science and Technology

Universitat
Pompeu Fabra
Barcelona

Master of Multidisciplinary Research in Experimental Sciences

Master's Program

Course 2017-2018

Outline

Calendars

Syllabus

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
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OCTOBER						
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DECEMBER						
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JANUARY						
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FEBRUARY						
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MARCH						
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APRIL						
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MAY						
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JUNE						
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AUGUST						
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SEPTEMBER						
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- Holiday
- Welcome
- Bootcamp
- Initial training period (UPF)
- Training days (rotating through 6 BIST centers & DCEXS)
- Research project
- Winter School & Symposium
- Thesis
- Thesis presentations
- Graduation ceremony

Initial Period Training Calendar

SEPTEMBER						
11	12 Welcome	13 Python Bootcamp	14 Python Bootcamp	15 SDA SDA	16	17
18 SAR	19 SDA SDA	20 SAR (11h-13h)	21 SDA SDA	22 SDA SDA	23	24
25 holiday	26 SDA SDA	27 SAR RRSC	28 SDA SDA	29 SDA SDA	30	
OCTOBER						
2 SAR RRSC	3 SDA SDA	4 SAR RRSC	5 SDA SDA	6 SAR SDA	7	8
9 SAR RRSC	10 SDA SDA	11 SAR RRSC	12 holiday	13 holiday	14	15
16 RRSC RRSC	17 SDA SDA	18 SAR RRSC	19 SDA SDA	20 SDA SDA	21	22

SDA	Statistics & Data Analysis	Tue, Thurs & Fri, 10h-12h & 14h-16h
SAR	Seminars in Advanced Research	Mon & Wed 9h-12h
RRSC	Responsible Research and Science Communication	Mon & Wed 14h–16h
Python Bootcamp		9:30-17:30

Syllabus

Scientific Computing Bootcamp

Python for Statistics & Data Analysis

Overview

Dates: 13 and 14 September 2017
Location: UPF

Description

The aim is to give the students a crash course in the programming tools needed to complete the Statistics & Data Analysis course, and an introduction to useful tools for their research projects.

The format will be an intensive 2-day workshop, modelled on and taking advantage of open-source online materials.

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

Timetable

Day 1	Wednesday 13 September	
9:30	**Topic 1:** Anaconda, Jupyter, Spyder, Git & Best Practices	*Justin & Philipp*
11:00	Coffee Break	
11:30	**Topic 2:** Introduction to Python	*Justin Whalley*
13:00	Lunch Break	
14:00	**Topic 3:** Operations, Types, Functions	*Ilario De Toma*
15:30	Coffee Break	
16:00	**Topic 4:** Vectors, Matrices & Dataframes (NumPy & Pandas)	*Ilario De Toma*

Day 2	Thursday 14 September	
9:30	**Topic 5:** Plotting, Data Visualization & Exploration (Matplotlib & Seaborn)	*Alejandro Pozas*
11:00	Coffee Break	
11:30	**Topic 6:** Optimizing Parametric Functions, Integration & ODEs (SciPy & Scikit-learn)	*Alejandro Pozas*
13:00	Lunch Break	
14:00	**Topic 7:** Testing, Profiling & Optimizing Performance	*Philip Germann*
15:30	Coffee Break	
16:00	**Topic 8:** Final Project	*Ilario De Toma*

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.

Other References

- Best Practices in Scientific Computing
- Good Enough Practices in Scientific Computing

Instructors

Justin Whalley: Postdoctoral fellow at the Centro Nacional de Análisis Genómico in the Biomedical Genomics group.
Ilario De Toma: Postdoctoral Researcher at CRG in the Cellular & Systems Neurobiology group**.**
Philipp Germann: Postdoctoral Researcher at CRG in the Molecular Systems Biology group**.** Physicist in biology, photography aficionado and paragliding aerobatics enthusiast. After a bachelor's in astronomy and a master's in theoretical physics I ended up in systems biology where I studied the patterning of limb buds using PDEs for my PhD. Now I am studying cellular behaviour in developmental processes and within lymph nodes employing statistical and agent-based models.
Alejandro Pozas: PhD Fellow at ICFO in the Quantum Information Theory group. Studied Physics at Universidad Complutense de Madrid, and then a Master's in Theoretical Physics at the Perimeter Institute in Canada. Now he is a "la Caixa" PhD Fellow in ICFO working in Quantum Information Theory. In particular, he is interested in developing new tools to distinguish between classical and quantum systems, and in applying machine learning to problems in quantum physics.

Statistics & Data Analysis (5 ECTS)

Description of the subject

Coordinator: Hafid Laayouni
Contact: Rubén Vicente (ruben.vicente@upf.edu)
Teaching staff: Federico Sanchez, Javier Rico, Ramon Miquel and Hafid Laayouni
Code: SDA
ECTS: 5
Workload: 125 hrs.
Term: 1st
Location: UPF

Other references

Groups: 1 single group
Timetables: Taught on Tuesday, Thursday & Friday, 10h-12h & 14h-16h
Building: Dr. Aiguader 80
Classrooms:
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. 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 the first 2 days 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 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

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).

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.

Teaching resources

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

Seminars in Advanced Research (5 ECTS)

Overview

Coordinator: Robert Sewell, ICFO
Contact: robert.sewell@icfo.eu
Teaching staff: Robert Sewell, Rubén Vicente
Code: SAR
Total credits: 5 ECTS
Workload: 125 hrs.
Term: 1st, 2nd and 3rd terms
Teaching language(s): English
Prerequisites: None

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 where possible the invited 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 9 lectures from BIST/DCEXS PIs, and 7 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

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

For the invited speakers, the research seminar will be open to everyone at the hosting institute, and publicly announced. This is followed by 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 group discussion of a research paper. Students will be required to choose and present (max 15min) a research paper on a topic related to the seminar that day, and lead the group in a discussion of the paper and the seminar.

The groups and the assigned training days assigned to each one will be defined during the initial training period.

Calendar

Initial Training Period

Session	Date	Time	Speaker	Center
1	18/09	10-12h	**Salvador Aznar**	IRB Barcelona
2	20/09	11-13h	**Turgut Durduran**	ICFO
3	27/09	10-12h	**David García**	ICN2
4	2/10	10-12h	**Aurelio Juste**	IFAE
5	4/10	10-12h	**Juan Valcárcel**	CRG
6	6/10	10-12h	**Pilar Rivera**	DCEXS, UPF
7	11/10	10-12h	**Alfonso Valencia**	BSC
8	16/10	10-12h	**Pau Gorostiza**	IBEC
9	18/10	10-12h	**Emilio Palomares**	ICIQ

Building: Dr. Aiguader 80
Location: Seminar room 61.109
Time: 10:00 – 12:00 (unless otherwise stated)

Training Days

Session	Date	Location	Speaker	Center
10	01/12	ICFO	**Monika Ritsch-Marte**	Medical University of Innsbruck
11	08/01	ICN2	**Phillip B. Messersmith**	UC Berkeley
12	05/03	DCEXS	**Mauricio Barahona**	Imperial College London
13	09/04	ICIQ	**Serena DeBeer**	Max Planck Institute for Chemical Energy Conversion
14	07/05	CRG	**Luca Giorgetti**	Friedrich Miescher Institute
15	04/06	IRBB	**Ilaria Malanchi**	Francis Crick Institute
16	02/07	IFAE	**Alain Blondel**	CERN, University of Geneva

Location: Various
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 summarising the chosen research article; students must also lead discussion session	40%

Responsible Research and Scientific Communication (5 ECTS)

Overview

Coordinator: Gemma Revuelta, UPF
Contact: Carolina Torres (carolina.llorente@upf.edu); Núria Bayó, (nbayo@bist.eu)
Teaching Staff: Carolina Torres, UPF; Damjana Kastelic, CRG; Dave Filipovic-Carter, Education-Training Ltd; Gavin Lucas, The Paper Mill; Maruxa Martínez, PRBB; Núria Bayó, BIST
Code: RRISC
ECTS: 5
Workload: 125 hrs.
Term: 1st 2nd, 3rd
Location: UPF, Various
Prerequisites: None

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) RRI and public communication
b) Project management
c) 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 seminar is based on the VITAE framework and it is delivered in two full days. The seminar has an experiential learning approach. 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

Session	Format	Title	Timetable	Block
1	2-hour session	Explaining my research: multidisciplinary peers	20/09/2017 15-17h	RRI and public communication
2	2-hour session	Exploring RRI	27/09/2017 14-16h	RRI and public communication
3	2-hour session	Scientific integrity and science ethics	02/10/2017 14-16h	RRI and public communication
4	2-hour session	Other shared values (gender, equality, sustainability, open access/science, justice, inclusiveness)	04/10/2017 14-16h	RRI and public communication
5	2-hour session	Overview of dialogue approach	09/10/2017 14-16h	RRI and public communication
6	2-hour session	Public communication skills. Knowing the public	16/10/2017 14-16h	RRI and public communication
7	2-hour session	Public engagement approach: planning a participatory activity	18/10/2017 14-16h	RRI and public communication
8	2 full days	Effective researcher	2-3/11/2017	Project management
9	3-hour session	Reading effectively	22/12/2017	Scientific communication
10	3-hour session	Preparing a scientific poster	8/1/2018	Scientific communication
11	1 full day	Career planning	5/2/2018	Career Development
12	2-hour session	Planning a participatory dialogue activity: working plan elaboration	5/3/2018	RRI and public communication
13	2-hour session	Planning a participatory dialogue activity: ongoing process	9/04/2018	RRI and public communication
14	2-hour session	Presentation, reflection and evaluation	7/5/2018	RRI and public communication
15	3-hour session	Writing your thesis	4/6/2018	Scientific communication
16	3-hour session	Preparing an oral presentation	2/7/2018	Scientific communication

Assessment

Activity	Sessions	Weight
Block I – RRI and Public Comm.		**40%**
Participation	1-11	20%
Self-assessment	4,10	20%
Plan	7	20%
Oral presentation	11	40%
Block II – Project Management		**30%**
Participation	1-2	40%
Self-assessment	1-2	20%
Peer review	1-2	40%

Activity	Sessions	Weight
Block III – Scientific Comm.		**30%**
Participation	1-4	20%
Plan	1-2	20%
Poster presentation	3	30%
Oral presentation	4	30%

Advanced Techniques in Experimental Sciences (5 ECTS)

Overview

Coordinator: Jordi Arbiol (ICN2)

Contact: Jordi Arbiol (arbiol@icrea.cat), Núria Bayó (nbayo@bist.eu)
Lecturers: Jérémy David (ICN2), Belén Ballesteros (ICN2), Jordi Arbiol (ICN2), Marcos Rosado (ICN2), Sara Martí (ICN2), Julien Colombelli (IRBB), Tino Zimmermann (CRG), María García-Parajo (ICFO), Juan Cortina (IFAE)

ECTS: 5
Workload: 125 hrs.
Term: 2nd
Location: Various
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 2017/2018 will be **Microscopy, Nanoscopy & 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 ICN2 will host the workshop, with input from IRBB, CRG and ICFO 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 (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), Robert Sewell (ICFO), Luciano Di Croce (CRG), Rafel Escribano (IFAE), Pablo Ballester (ICIQ), Arben Merkoçi (ICN2), Raúl Méndez (IRB Barcelona)
ECTS: 20
Workload: 500 hrs.
Term: 1st 2nd & 3rd
Location: Various
Prerequisites: Various

20

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 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 (10 ECTS)

Overview

Coordinator: Rubén Vicente
Contact: Rubén Vicente (ruben.vicente@upf.edu); Núria Bayó (nbayo@bist.eu)
Academic Tutors: Rubén Vincente (UPF), Robert Sewell (ICFO), Luciano Di Croce (CRG), Rafel Escribano (IFAE), Pablo Ballester (ICIQ), Arben Merkoçi (ICN2), Raúl Méndez (IRB Barcelona)
ECTS: 10
Workload: 250 hrs.
Term: 1st & 2nd
Location: Various
Prerequisites: Various

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 (10 ECTS)

Overview

Coordinator: Rubén Vicente
Contact: Rubén Vicente (ruben.vicente@upf.edu); Núria Bayó (nbayo@bist.eu)
Academic Tutors: Rubén Vincente (UPF), Robert Sewell (ICFO), Luciano Di Croce (CRG), Rafel Escribano (IFAE), Pablo Ballester (ICIQ), Arben Merkoçi (ICN2), Raúl Méndez (IRBB)
ECTS: 10
Contact Hours: 250
Term: 3rd
Location: Various
Prerequisites: Various

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 defence	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.