Imperial College London

Programme Specification (Master's Level)

MSc in Computational Methods in Ecology and Evolution

This document provides a definitive record of the main features of the programme and the learning outcomes that a typical student may reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities provided. This programme specification is intended as a reference point for prospective students, current students, external examiners and academic and support staff involved in delivering the programme and enabling student development and achievement.

Programme Information				
Programme Title	Computational Methods in Ecology and Evolution			
Award(s)	MSc			
Programme Code	C1B2			
Associateship	None			
Awarding Institution	Imperial College London			
Teaching Institution	Imperial College London			
Faculty	Faculty of Natural Sciences			
Department	Department of Life Sciences			
Main Location of Study	South Kensington Campus			
Mode and Period of Study	1 academic year, full-time			
Cohort Entry Points	Annually in October			
Relevant QAA Benchmark Statement(s) and/or other external reference points	Master's Degree Characteristics			
Total Credits	ECTS:	90	CATS:	180
FHEQ Level	Level 7			
EHEA Level	2nd cycle			
External Accreditor(s)	None			
Specification Details				
Student cohorts covered by specification	2021-22 entry			
Person responsible for the specification	Dr Samraat Pawar, Course Director			
Date of introduction of programme	October 2014			

Date of programme specification/revision	August 2021

Programme Overview

Over the past 10–20 years, biology has become increasingly quantitative, and mathematical sciences have in turn been increasingly influenced by biology.

It has been said that “mathematics is biology's next microscope, only better” (Cohen, Plos Biology, 2004) because mathematical, statistical, and computational sciences will continue to reveal unsuspected and entirely new worlds within biology, just as the microscope revealed previously unseen worlds following its invention.

It has also been said that “biology is mathematics' next physics, only better” (Cohen, Plos Biology) because biology will in turn continue to spur major new developments in computation, mathematics and statistics, just as physics has done in past centuries.

In this unique course we teach quantitative methods and biological concepts together, through application of the methods to cutting-edge biological research problems.

This course is suitable for:

- Life scientists wishing to expand their quantitative skills in light of the increasingly quantitative nature of modern biology
- Physical scientists (mathematicians, physicists, statisticians, computer scientists) with a strong interest in biology

The course serves as ideal preparation for either PhD studies or employment in fields of applied quantitative biology, such as resource management and conservation.

Learning Outcomes

The Imperial Graduate Attributes are a set of core competencies which we expect students to achieve through completion of any Imperial College degree programme. The Graduate Attributes are available at: www.imperial.ac.uk/students/academic-support/graduate-attributes

1. Knowledge and Understanding

i. Basic principles of several fields within ecology, evolution, and evolutionary ecology, from a quantitative viewpoint.

ii. An overview of quantitative and modelling methods appropriate for inquiry in these fields.

iii. The nature of the modern interface between biology and mathematics, statistics and computation.

iv. The fundamental role of mathematical models in modern biology. What can and cannot be accomplished with models. Uses and misuses of models.

v. Different modelling frameworks, their strengths and weaknesses, and fundamental problems to which various approaches have been applied.

vi. Research techniques, including study design, information retrieval, computational statistics, sampling, analysis and presentation of results.

vii. Transferable skills including problem definition, project design, teamwork, written and oral reports, scientific publications.

viii. Detailed knowledge and understanding of the essential facts, concepts, principles and theories relevant to the student's chosen area of specialisation.

2. Skills and other Attributes

Intellectual Skills

i. Analyze and solve research problems by using a multidisciplinary approach.

ii. Integrate and quantify biological knowledge and questions into models and testable hypotheses.

iii. Formulate hypotheses, collect appropriate data to test them, and analyse the data appropriately with models and statistics.

iv. Devise and use appropriate modelling and statistical methods to answer specific biological questions.

v. Plan, conduct and write up a programme of original research.

Practical Skills

i. Devise theoretical models for given problems and implement them in equations and computer simulations.

ii. Design a study that will provide data to answer specific biological questions.

iii. Use and/or develop computational tools and packages.

iv. Use a suite of central statistical tools for fitting and otherwise comparing models with data.

v. Analyse scientific results and determine their strength and validity.

vi. Prepare proposals.

vii. Write concisely and effectively for a scientific and a lay audience.

viii. Use the scientific literature effectively.

Transferable Skills

i. Communicate effectively through oral presentation, written reports, and scientific publications.

ii. Apply statistical and modelling skills.

iii. Management skills: decision making, problem definition, project design and evaluation, risk management, teamwork and coordination

iv. Integrate and evaluate information from a variety of sources.

v. Transfer techniques and solutions from one discipline to another.

vi. Use Information and Communications Technology.

vii. Manage resources and time.

viii. Learn independently with open-mindedness and critical enquiry.

ix. Learn effectively for the purpose of continuing professional development.	
Entry Requirements	
Academic Requirement	Normally a 2.1 UK Bachelor's Degree with Honours in a Biological, Ecological, or other Life Sciences subject, or in a Physical Sciences subject (or a comparable qualification recognised by the College). A-level mathematics is also required.
Non-academic Requirements	None
English Language Requirement	Standard requirement IELTS score of 6.5 overall (minimum 6.0 in all elements)
The programme's competency standards document can be found at: http://www.imperial.ac.uk/media/imperial-college/faculty-of-natural-sciences/department-of-life-sciences/public/postgraduate/masters/Life-Sciences-Competence-standards-PG.pdf	
Learning & Teaching Strategy	
Scheduled Learning & Teaching Methods	• Lectures • Primers • Seminars • Workshops
E-learning & Blended Learning Methods	• Computer-based work with cloud-based version control • Online lecture and assessment materials • Online seminar recordings
Project and Placement Learning Methods	• Online lecture and assessment materials • Two mini-projects • Individual research project and dissertation (5 months), which can include placements
Assessment Strategy	
Assessment Methods	• Computing coursework • Mini-project • HPC Long Practical • Seminar Diary • Exams (Two) • Oral presentations • Final Project Report + Presentation • Viva
Academic Feedback Policy	

Coursework is double-marked and comments by the markers annotated directly on the papers (electronically for submissions on blackboard). A summary of the feedback (with tickboxes indicating relative attainment on key dimensions) will be completed, and an indicative grade will be given (actual marks will not be communicated to the students). These papers will then be returned to the students as soon as possible and within two weeks of submission. Generic feedback on exam questions (explaining what contributed good answers, typical features leading to lower marks for each question across the whole class) and indicative grades will be returned following exams. A meeting will be held after the end of the taught component, at which each student will have a one-to-one discussion with the Course Director on progress to date, coursework marks achieved and expectations for the project.

Staff-student meetings are held termly to communicate general feedback between student representatives and the course directors. Additional meetings are held to provide general feedback and guidance e.g. on exam performance and project selection.

Dissertations are marked by supervisor and 2 independent assessors, who provide feedback electronically that is returned automatically to students after the final examiners meeting.

Re-sit Policy

The College's Policy on Re-sits is available at: http://www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/resitting-examinations/

Mitigating Circumstances Policy

The College's Policy on Mitigating Circumstances is available at: http://www.imperial.ac.uk/student-records-and-data/for-current-students/undergraduate-and-taught-postgraduate/exams-assessments-and-regulations/mitigating-circumstances/

Programme Structure

Full-time	Pre-session	Autumn Term	Spring Term	Summer Term	Summer Vacation
Core Modules	0	8	7	0	0
Elective Modules	0	0	0	0	0
Projects	0	0	0	1	

Assessment Dates & Deadlines

Written Examinations	Spring and Summer
Coursework Assessments	Autumn and Spring
Project Deadlines	Summer
Practical Assessments	Spring

Assessment Structure

Marking Scheme

Pass

- The Pass Mark for all postgraduate taught course modules is 50%.
- Students must pass all elements in order to be awarded a degree.

Merit

- In order to be awarded a result of merit, a candidate must obtain an aggregate mark of 60% or greater, *and also in each element*.
- Where appropriate, a Board of Examiners may award a result of merit where a candidate has achieved an aggregate mark of 60% or greater across the programme as a whole (i.e., across all elements) AND has obtained a mark of 60% or greater in each element with the exception of one element AND has obtained a mark of 50% or greater in this latter element.

Distinction

- In order to be awarded a result of distinction, a candidate must obtain an aggregate mark of 70% or greater overall, *and also in each element*.
- Where appropriate, a Board of Examiners may award a result of distinction where a candidate has achieved an aggregate mark of 70% or greater across the programme as a whole (i.e., across all elements) AND has obtained a mark of 70% or greater in each element with the exception of one element AND has obtained a mark of 60% or greater in this latter element.

Module Weightings

Element (% Weighting)	Module	% Module Weighting
Taught (50%)	Foundations of Biological Computing	4.58%
	Biological Computing in Python	9.18%
	Biological Computing in R	4.68%
	Statistics in R	4.58%
	Spatial Analyses & GIS	4.58%
	Genomics and Bioinformatics	4.58%
	High Performance Computing (HPC)	4.58%
	Population Genetics	4.58%
	Generalised Linear Modelling	4.58%
	Maths for Biology	9.18%
	Maximum Likelihood	4.58%

	Bayesian Statistics	4.58%
	Evolutionary Modelling	4.58%
	Ecological Modelling	4.58%
	Biological Data Structures and C	4.58%
	HPC Long Practical	10%
	Miniproject	12%
Research (50%)	Research Project	100%

Indicative Module List											
Code	Title	Core/ Elective	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
	Foundations of Biological Computing	CORE	9.25	20.75	0	30	10	0	90	7	1.2
	Biological Computing in Python	CORE	44.5	68	0	112.5	10	0	90	7	4.5
	Biological Computing in R	CORE	15.5	39.5	0	55	10	0	90	7	2.2
	Statistics in R	CORE	14.15	40.85	0	55	100	0	0	7	2.2
	Spatial Analyses & GIS	CORE	14.5	40.5	0	55	100	0	0	7	2.2
	Genomics and Bioinformatics	CORE	24.5	25.5	0	50	100	0	0	7	2
	High Performance Computing (HPC)	CORE	22	33	0	55	70	0	30	7	2.2
	Population Genetics	CORE	23	32	0	55	100	0	0	7	2.2
	Generalised Linear Modelling	CORE	27	28	0	55	100	0	0	7	2.2
	Maths for Biology	CORE	44.5	68	0	112.5	100	0	0	7	4.5
	Maximum Likelihood	CORE	22	30.5	0	52.5	100	0	0	7	2.1
	Bayesian Statistics	CORE	24	31	0	55	100	0	0	7	2.2
	Evolutionary Modelling	CORE	16	36.5	0	52.5	100	0	0	7	2.1
	Ecological Modelling	CORE	16	36.5	0	52.5	100	0	0	7	2.1

Indicative Module List											
Code	Title	Core/ Elective	L&T Hours	Ind. Study Hours	Place-ment Hours	Total Hours	% Written Exam	% Course-work	% Practical	FHEQ Level	ECTS
	Biological Data Structures and C	CORE	18	34.5	0	52.5	100	0	0	7	2.1
	HPC Long Practical	CORE	4	96	0	100	0	100	0	7	4
	Miniproject	CORE	8	117	0	125	0	100	0	7	5
	Research	CORE	0	1125	0	1125	0	100	0	7	45

Supporting Information
The Programme Handbook is available at: http://www.imperial.ac.uk/life-sciences/postgraduate/masters-courses/computational-methods-in-ecology-and-evolution/
The Module Handbook is available at: http://www.imperial.ac.uk/life-sciences/postgraduate/masters-courses/computational-methods-in-ecology-and-evolution/
The College's entry requirements for postgraduate programmes can be found at: www.imperial.ac.uk/study/pg/apply/requirements
The College's Quality & Enhancement Framework is available at: www.imperial.ac.uk/registry/proceduresandregulations/qualityassurance
The College's Academic and Examination Regulations can be found at: http://www.imperial.ac.uk/about/governance/academic-governance/regulations/
Imperial College is an independent corporation whose legal status derives from a Royal Charter granted under Letters Patent in 1907. In 2007 a Supplemental Charter and Statutes was granted by HM Queen Elizabeth II. This Supplemental Charter, which came into force on the date of the College's Centenary, 8th July 2007, established the College as a University with the name and style of "The Imperial College of Science, Technology and Medicine". http://www.imperial.ac.uk/admin-services/secretariat/college-governance/charters/charter-and-statutes/
Imperial College London is regulated by the Office for Students (OfS) https://www.officeforstudents.org.uk/