# MSc Degree in Computational Biology

*Universidad Politécnica de Madrid*
2018 Curriculum

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| RUCT code | 4316260 |
| Academic level | Master *RD* 1393/2007 |
| MECES level | 3 |
| Branch | Sciences |
| Qualifies for regulated profession | No |
| Verification | May 8, 2017 |
| Authorised by *Comunidad de Madrid* | 2941/2018, August, 8 (*BOCM* August, 20) |
| Council of Ministers Agreement | October 5, 2018 |
| BOE publication | December 21, 2018 |
| RENEWED DEGREE ||
| Resolution of November 16, 2021, of the Council of Universities, concerning the renewal of the official MSc Degree in Computational Biology accreditation by the 'Universidad Politécnica de Madrid'. ||

The scientific community and the pharmaceutical-biotech business are increasingly aware of the vast advantages of applying bio-computing tools to their research and production chains. These bioinformatics tools have grown considerably in number and sophistication in recent years. Consequently, today there is a great demand for professionals trained in Computational Biology. The *'Universidad Politécnica de Madrid* (UPM)' has broad experience in these knowledge areas: Computer Science and Biological Sciences, both from an educational and an applied point of view. The MSc Degree in Computational Biology assembles all this experience to bring their students closer to the knowledge of UPM professionals, whose work has international prestige.

The Master is taught at the UPM Campus of Excellence in Montegancedo (a campus with Faculties, Research Centres and Companies) and promotes partnership between entities. In addition, it offers its students solid conceptual training and complementary work experience. For this, the Master comprises internships in companies or research centres in Computer Science, Biotechnology, Health and Plant Breeding, among others.

In short, students will receive excellent training in an area of knowledge in great demand, allowing them to apply for a wide range of job opportunities.

| MODULE 1: "Core Master Topics" | | | | |
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| **CODE** | **COURSES** | Type* | ECTS | Semester |
| 203000021 | STATISTICAL ANALYSIS AND DATA VISUALIZATION | O | 3 | 1S |
| 203000025 | GENOMICS DATA ANALYSES AND VISUALIZATION | B | 6 | 1S |
| 203000023 | MACHINE LEARNING | O | 3 | 1S |
| 203000022 | FAIR DATA MANAGEMENT | O | 3 | 1S |
| 203000024 | BIOINFORMATICS PROGRAMMING CHALLENGES | O | 3 | 1S |

*Core Master Topics* (18 ECTS): Set of basic training courses in Computational Biology. It is recommended that students take at least 9 ECTS and a maximum of 15 ECTS.

| MODULE 2: "Computational And Systems Biology And Genomics" | | | | |
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| CODE | COURSES | Type* | ECTS | Semester |
| 203000160 | BIOCOMPUTING: CHALLENGES, SOLUTIONS AND OPPORTUNITIES | O | 3 | 1S |
| 203000030 | COMPUTATIONAL STRUCTURAL BIOLOGY FOR LEAD DISCOVERY | O | 3 | 1S |
| 203000029 | SYNTHETIC AND SYSTEMS BIOLOGY | O | 3 | 1S |
| 203000027 | COMPUTATIONAL APPROACHES IN EVOLUTIONARY BIOLOGY | O | 3 | 1S |
| 203000026 | GENOMICS ASSISTED BREEDING | O | 3 | 1S |
| 203000028 | MODELIZATION AND SIMULATION OF BIOSYSTEMS | O | 3 | 1S |

**Specific training programme in "Computational-Systems Biology and Genomics"** (0-18 ECTS): This set of courses entitles students to specialise in Computational Biology applied to Biosciences, focusing on aspects of Genomics, Modelling of Biological Systems, Evolutionary Biology, Synthetic Biology and Structural Biology for the finding of drugs or diagnostics of bioeconomic interest. For the intensification of this programme, a minimum of 9 ECTS and up to 18 ECTS should be taken.

| MODULE 3: "Computational Biology And Data Science" | | | | |
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| CODE | COURSES | Type* | ECTS | Semester |
| 203000031 | HEALTH DATA AND KNOWLEDGE MANAGEMENT | O | 3 | 1S |
| 203000033 | KNOWLEDGE REPRESENTATION AND ACQUISITION | O | 3 | 1S |
| 203000032 | SEMANTIC TECHNOLOGIES | O | 3 | 1S |
| 203000034 | PROGRAMMABLE BIOLOGY: DNA COMPUTATION AND BIOCIRCUITS ENGINEERING | O | 3 | 1S |
| 203000035 | BIG DATA ENGINEERING | O | 3 | 1S |

**Specific training programme in "Computational Biology and Data Science"** (0-15 ECTS): This set of courses entitles students to specialise in Computational Biology and Data Analysis, focusing on the newest methods, techniques and algorithms applicable to the analysis of large volumes of data using Artificial Intelligence techniques (Data Science and Big-Data). This promotes a profile more adjusted to Bioinformatics Engineering. This programme covers aspects of Big Data Engineering, Semantic Technologies, Knowledge Representation and Acquisition and Bioinformatics Engineering. For the intensification in this programme a minimum of 9 ECTS and up to a total of 18 ECTS should be taken.

| MODULE 4: "Scientific Seminars" | | | | |
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| CODE | COURSES | Type* | ECTS | Semester |
| 203000039 | SCIENTIFIC SEMINARS | B | 3 | 2S |

*Scientific Seminars* (3 ECTS). Seminars in Computational Biology taught by guest researchers.

| MODULE 5: "Professional Development" | | | | |
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| CODE | COURSES | Type* | ECTS | Semester |
| 203000036 | PROFESSIONAL DEVELOPMENT AND TECHNOLOGY TRANSFER | O | 3 | 2S |
| 203000037 | TECHNOLOGICAL INNOVATION | O | 3 | 2S |

*Professional Development* (*3 ECTS*): It comprises training in Valorisation and Technology Transfer facets and skills for developing a professional career (writing articles/projects, oral presentations, searching for funding, etc.). This training is taught by teaching staff from the departments involved in this MSc Degree, staff from the UPM's CAIT, the Spanish acronym for 'Technological Innovation Support Centre' and professionals in the field.

| MODULE 6: "Internships in Research Companies/Entities (Public or Private)" | | | | |
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| CODE | COURSES | Type* | ECTS | Semester |
| 203000038 | INTERNSHIPS (PROFESSIONAL/RESEARCH-ORIENTED) | O | 9 | IS |

**Internships in Research Companies/Entities (Public or Private)** *(6-9 ECTS).* Under the regulations of the UPM's PAEs (the Spanish acronym for 'Curricular External Academic Internships'). Research Centres/Departments of Universities and OPIs, (the Spanish acronym for 'Public Research Organisms') or companies participate in the PAEs' offer. Among these Centres/Departments are those located at the UPM Montegancedo Campus and the Departments involved in teaching this MSc Degree.

| MODULE 7: "MASTER'S THESIS" | | | | |
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| CODE | COURSES | Type* | ECTS | Semester |
| 203000040 | MASTER'S THESIS | P | 15 | 1S |

*Master's Thesis* (15 ECTS): Students will carry out the Master's Thesis in Research Centres/Departments of Universities (UPM and others) and OPIs (CSIC, INIA ISCII, etc.) or companies. Firms that host students during the curricular internships partake.

| MODULE 8: "Additional Training" | | | | |
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| CODE | COURSES | Type* | ECTS | Semester |
| 203000041 | BIOLOGY FOR COMPUTATIONAL SCIENCE | C | 6 | 1S |
| 203000042 | PROGRAMMING FOR COMPUTATIONAL BIOLOGY | C | 6 | 1S |

**Additional Training** (6 ECTS): According to the student's profile.

Language of the training process: English. Therefore, an English-speaking international student can take the full MSc Degree in English.

All the courses, except those in professional development, are taught in the first semester. The seminars and the Master's Thesis are scheduled for the second semester.

**\*Type of courses:**
B: Compulsory
O: Elective
P: Project (Master's Thesis)
C: Additional Training