**Bachelor of Science – Bioinformatics and Computational Biology Requirements (BINF)**

85‐88 credits

(Updated Sept 2018)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course** | **Name** | **Pre‐requisites** | **Credits** | **Grade** |
| **Biology** | | | 29 |  |
| BIOL 141 | Foundations of Biology I | MATH 150 or higher, or placement in MATH 151 | 4 |  |
| BIOL 142 | Foundations of Biology II | BIOL 141, and MATH 150 or higher, or placement in MATH 151 | 4 |  |
| BIOL 300L | Experimental Biology Lab | MATH 150 or higher, or placement in MATH 151; BIOL 141; BIOL 142; BIOL 302; CHEM 102; and CHEM 102L | 2 |  |
| BIOL 302 | Molecular & General Genetics | MATH 150 or higher, or placement in MATH 151, BIOL 141, BIOL 142; CHEM 101/123, and CHEM 102/124 [CR] | 4 |  |
| BIOL 303 | Cell Biology | MATH 150 or higher, or placement in MATH 151; BIOL 141; BIOL 142; BIOL 302; CHEM 102 | 4 |  |
| BIOL 430 | Biological Chemistry | BIOL 303 and CHEM 351 | 4 |  |
| BIOL 313 | Introduction to Bioinformatics | MATH 151, and BIOL 141 or CMSC 104\* | 3 |  |
| BIOL 495 | Seminar in Bioinformatics + | BIOL 142, BIOL 313, CMSC 202] | 4 |  |
| **Chemistry** | | | 11 |  |
| CHEM 101 | Principles of Chemistry I | MATH 106 or higher | 4 |  |
| CHEM 102 | Principles of Chemistry II | CHEM 101 | 4 |  |
| CHEM 351 | Organic Chemistry I | CHEM 102 | 3 |  |
| **Physics & Math** | | | 19 |  |
| PHYS 121 | Introductory Physics I | MATH 151[CR] | 4 |  |
| MATH 151 | Calculus & Analytical Geometry | MATH 150 | 4 |  |
| MATH 152 | Calculus II | MATH 151 | 4 |  |
| MATH 221 | Linear Algebra | MATH 151 | 3 |  |
| STAT 355 | Intro to Prob & Stats for Sci/Eng | MATH 152 | 4 |  |
| **Computer Sciences** | | | 17 |  |
| CMSC 201 | Computer Science I for Majors | MATH 150 or higher\*\* | 4 |  |
| CMSC 202 | Computer Science II for Majors | CMSC 201; MATH 150 or higher | 4 |  |
| CMSC 203 | Discrete Structures | MATH 151 | 3 |  |
| CMSC 341 | Data Structures | CMSC 202 and CMSC 203 | 3 |  |
| CMSC 461 | Database Management Systems | CMSC 341 | 3 |  |
| **Upper‐level Electives** | | | 9‐12 |  |
| List A Elective | (see List) | (see Catalog) |  |  |
| **List A/B Elective** | (see List) | (see Catalog) |  |  |
| List B Elective | (see List) | (see Catalog) |  |  |

 All courses used to meet the major requirements must be completed with a grade of C or better

 All courses taken as pre‐requisites for other courses must be passed with a C or better.

Semester Legend: F=Fall, S=Spring, Z=Possible Summer (For indicative purposes only. Please check online course availability)

[CR]

Co‐Requirement

\* CMSC 201 can be used to meet the pre‐requirement

\*\* Requires previous programming experience or CMSC 104

**Itinerary**

 A student planning to complete the B.S. in Bioinformatics & Computational Biology should begin a first course in chemistry during the first semester of the freshman year. The mathematics sequence should also be started as soon as possible.

 Transfer students with an interest in Bioinformatics should contact the BINF program director as early as possible upon their arrival to UMBC in order to receive proper advising in degree planning.

 Different career options and optional minors in other disciplines are available to BINF students. Please consult the attached itinerary guidelines. These itineraries are meant only as *illustrative* guidelines of different pathways in the major. They do not define nor constitute strict or fixed pathway requirements for completion of the major.

 On its own, the BINF major *does* *not* satisfy pre‐med / pre‐pharm / pre‐dental requirements.

**Gateway requirements**

Students must complete the courses below with a Grade Point Average (GPA) no lower than 3.0 and with no grade lower than “C” in any of the courses. At least three of these courses must be completed at UMBC. A course may be repeated once to meet gateway requirements, but both grades will be used to compute the gateway GPA. (e.g. a student receiving a grade of “B” in all six gateway courses with one enrollment in each course will have a gateway GPA of 3.0. A student receiving an initial grade of “C” and a repeated grade of “B” in CHEM 101, with a “B” in all other gateway courses, will have a gateway GPA of 2.86).

|  |  |  |  |
| --- | --- | --- | --- |
| **Required Gateway Course** | **Credits** | **Semester taken** | **Grade** |
| BIOL 141 ‐ Foundations of Biology I | 4 |  |  |
| BIOL 302 ‐ Molecular and General Genetics | 4 |  |  |
| CHEM 101 ‐ Principles of Chemistry | 4 |  |  |
| CHEM 102 ‐ Principles of Chemistry II | 4 |  |  |
| CMSC 201 ‐ Computer Science I for Majors | 4 |  |  |
| MATH 151 ‐ Calculus & Analytical Geometry I | 4 |  |  |

Students who do not meet the above criteria (e.g. transfer students who transfer in more than three of the above courses) may petition the BINF steering committee for admission to the program.

Under exceptional circumstances, the Department may waive or alter a BINF degree requirement. Students seeking to petition for a waiver must consult with their academic adviser, then may submit a [Petition for Waiver/Substitution of Program Requirements](https://biology.umbc.edu/undergrad/forms-links/).

**Approved Bioinformatics & Computational Biology Electives**

**List A**

Any List A recommended course or any BIOL 4xx / CHEM 4xx course approved by a BINF advisor.

*Recommended courses*

BIOL 304 ‐ Plant Biology §

BIOL 305 ‐ Comparative Animal Physiology §

BIOL 411 ‐ Bacterial Physiology

BIOL 414 ‐ Eukaryotic Genetics and Molecular Biology

BIOL 418 ‐ Human Molecular Biology

BIOL 426 ‐ Approaches to Molecular Biology

BIOL 428 ‐ Computer Applications in Molecular Biology

BIOL 434 ‐ Microbial Molecular Genetics

BIOL 442 ‐ Developmental Biology

BIOL 444 ‐ Development and Cancer [R] BIOL 442

BIOL 466 ‐ Population and Quantitative Genetics BIOL 483 ‐ Evolution: From Genes to Genomes BIOL 486 ‐ Genome Science

CHEM 301 ‐ Physical Chemistry

CHEM 303 ‐ Physical Chemistry for the Biochemical Sciences

CHEM 352 ‐ Organic Chemistry II

CHEM 420 ‐ Computer Applications in Chemistry [R] CHEM 302/303

CHEM 431 ‐ Chemistry of Proteins [R] CHEM 437/BIOL 430

CHEM 432 ‐ Advanced Biochemistry [R] CHEM 437\* and CHEM 438

CHEM 433 ‐ Biochemistry of Nucleic Acids [R] CHEM 437\*

CHEM 438 ‐ Comprehensive Biochemistry II [R] CHEM 437\*

CHEM 455 ‐ Introduction to Biomedicinal Chemistry [R] CHEM 352

CHEM 444 ‐ Molecular Modeling in Biochemistry [R] CHEM 301/303

and CHEM 437

\*

**List B**

Any List B recommended course or any CMSC 4xx / IS 4xx / MATH 4xx / STAT 4xx course approved by a BINF advisor and the corresponding department/instructor.

*Recommended courses*

CMSC 433 ‐ Scripting Languages

CMSC 441 ‐ Design and Analysis of Algorithms CMSC 442 ‐ Information and Coding Theory CMSC 445 ‐ Software Engineering

CMSC 453 ‐ Applied Combinatorics and Graph Theory

CMSC 455 ‐ Numerical Computations

CMSC 471 ‐ Artificial Intelligence

CMSC 472 ‐ Knowledge ‐ Based Systems [R] CMSC 471

CMSC 473 ‐ Introduction to Natural Language Processing [R] CMSC 331

CMSC 475 ‐ Introduction to Neural Networks

CMSC 476 ‐ Information Retrieval

CMSC 478 ‐ Introduction to Machine Learning [R] CMSC 471

IS 413 ‐ GUI Systems Using JAVA

IS 428 ‐ Data Mining Techniques and Applications formally [R] IS 410

IS 448 ‐ Markup and Scripting Languages

MATH 341 ‐ Computational Methods

STAT 419 ‐ Introduction to Biostatistics [R] STAT 454

STAT 420 ‐ Statistics for Bioinformatics

STAT 432 ‐ Statistical Computer Packages and Their Applications

STAT 433 ‐ Statistical Computing [R] STAT 453

STAT 451 ‐ Introduction to Probability Theory [R] MATH 251

STAT 453 ‐ Introduction to Mathematical Statistics [R] STAT 451

STAT 454 ‐ Applied Statistics

STAT 614 ‐ Environmental Statistics [R] STAT 453

CHEM 437 can be used as a substitute for BIOL 430 when completing the

CHEM 437/438 sequence, but cannot be used as an elective.

§

Only one of these courses BIOL 304 / BIOL 305 may be taken as elective.

[R] Requirement

CHEM 420 or CHEM 444 can be taken as List B electives if taken in conjunction with CHEM 301, CHEM 303 and CHEM 438 in List A.