­­­­­­BME Undergraduate Tracking Document

Student: Biomaterials Sample Rev: March 26, 2021

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| 13/3 Units | | | | | | | | |  | | 2/3 Units | | | | | |
| **MATH / BASIC SCIENCE / SUPPLEMENTAL SCIENCE** | | | | | | | | |  | **SOCIAL SCIENCE** | | | | | | |
| Math | | | | Biology | | | Chemistry | |  | ECON 1110 | | | | ID 2050 | | |
| (2 Units) | | | | (2/3 Units; at least one at 2000+) | | | (2/3 Units) | |  | [courses](http://www.wpi.edu/academics/ssps/ugrad-courses.html) & ID2050 (for global IQP) | | | | | | |
| MA 1021: Calculus I | | | | BB 2550: Cell Biol. | | | CH 1010: Chem I | |  | 6/3 Units | | | | | | |
| MA 1022: Calculus II | | | | BB 1035: Biotech | | | CH 1020: Chem II | |  | **HUMANITIES REQ’MENT** | | | | | | |
| MA 1023: Calculus III | | | | Physics | | | Suppl. Science  (1/3 Units; any level)  (BB, PH, CH, MA, CS, FY) | |  | Hu | | | Hu | | Hu | |
| MA 1024: Calculus IV | | | | (2/3 Units) | | |  | Hu | | | Hu | | InqSem | |
| MA 2051: Diff. Equat. | | | | PH 1110: Mechanics | | |  | Click for [HU Requirement](https://www.wpi.edu/academics/undergraduate/humanities-arts-requirement) | | | | | | |
| MA 2610: Statistics I | | | | PH 1120: Electricity | | | CH2310: Orgo | |  | 3/3 Unit | | | | | | |
|  | | | |  | | | | |  | **IQP** | | | | | | |
| **COMPUTER PROGRAMMING** (1/3 Unit) | | | | | | | BME1004 | |  | Away | | | Away | | Away | |
|  | | | | |  |  | | |  | To find an IQP click [link](https://www.wpi.edu/academics/undergraduate/interactive-qualifying-project) | | | | | | |
| 1/3 Unit | | | | |  | 2/3 Units | | |  | 3/3 Unit | | | | | | |
| **PHYSICAL EDUCATION** | | | | |  | **FREE ELECTIVES** | | |  | **MQP** | | | | | | |
| 1/12 | 1/12 | 1/12 | 1/12 | |  | PQP/BME 4300 | | ES1310 |  | 1/6 A | | 1/3 B | | 1/3 C | | 1/6 D |

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| 14/3 Units | | | | | |
| **ENGINEERING** | | | | | |
| **Distribution requirement**  (or higher level, or equivalent) | **Example Courses** | | | \*Sub-specialties within the Biomaterials Track | |
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| **Biomaterials\*** | **Drug Delivery\*** | **Tissue Engineering\*** | These are BME CORE | |
| **Equivalences** | |
| Biomechanics | ES 2501 | | | - Consult the Biomedical Engineering Program Chart in the Undergraduate catalog for courses that count towards these requirements.  - Students that entered Fall 2020 and after:  You can only receive ENGR distribution credit for one of BME2502 or ES2502.  You can only receive ENGR distribution credit for one of BME2001 or ES2001.  - We do not recommend you take both BME2210 and ECE2010. | |
| Biomaterials | BME 2001 | | |
| Bioinstrumentation | BME 2210 | | |
| BME Analysis | BME 2211 – Analysis/Prog | | |
| ENGR 2000+ | BME 2610 – Introduction to Bioprocess Engineering | | | **Notes** | |
| ENGR 2000+ | ME 2820 | ES 3001 | | ENGR can be BME (except BME 1001, BME 1004, BME 3110, BME 532, BME 560, BME 562, BME 564, and BME 593; BME 595 requires departmental approval), CE, CHE, ECE, RBE, ME, and ES courses at the 2000-level or above (except RBE 3100). | Extra suggested courses  Suppl Sci.:  BB 2950, BB 3101, CH 2320  Free Elective:  BME 1001, ME 1800, ME 2820  ENGR:  ES 3001, ES 3002,  ES 3004 |
| ENGR 2000+ | BME 3111 – Physiol and Eng | | |
| Engr Design | BME 3300 – BME Design | | |
| BME Lab #1 (1/6 unit) | BME 3811 Biomaterials lab | | |
| BME Lab #2 (1/6 unit) | BME 3505 Solid Biomechanics I lab | | |
| BME Lab #3 (1/6 unit) | BME 3012 Biomedical Sensors lab | | |
| BME Lab #4 (1/6 unit) | BME 3605 | | BME 3813 |
| ENGR 3000+ | ES 3001 | CHE 3301 | BME 4701 |
| ENGR 3000+ | BME 3610 - Transport Analysis | | |
| BME 4000 | BME 4814 Biomaterials | | | 4000+ in specialization area – 4814, 4828, 4831, 4701 | |
| BME 4000+ | BME 4828 | BME 4831 | BME 4828 |

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| **SELF AUDIT** (check Banner/WorkDay to assure your courses are assigned correctly) |
| * 1/3 units Stats (MA 2610, MA 2611) (y/n)?\_\_\_\_\_\_\_ |
| * 1/3 unit Prog (BME 1004) (y/n)?\_\_\_\_\_\_\_ |
| * 14/3 units Engineering (y/n)?\_\_\_\_\_\_\_ with 9/3 units BME (y/n)?\_\_\_\_\_\_\_ |
| * 3/3 units ENG 2000+ level (y/n)?\_\_\_\_\_\_\_ (note that the green highlighted rows may bin in this category) * 2/3 units ENG 3000+ level (y/n)?\_\_\_\_\_\_\_ |
| * BME Labs (4 x 1/6 unit) (y/n)?\_\_\_\_\_\_\_ * Living Systems Laboratory requirement (BME 3111, BME 3012, BME 3503, or BME 3813) (y/n)?\_\_\_\_\_ * 2/3 units BME 4000+ (y/n)? \_\_\_\_\_\_\_\_ (Note: 1/3 unit **AT** BME 4000 level) * 1/3 unit BME design (BME 3300 or equiv) (y/n)? \_\_\_\_\_\_ * Capstone Design in BME (must be checked off by BME program MQP advisor) (y/n)?\_\_\_\_\_\_\_ |

Note that all required courses above will equal 45/3 Units, i.e., you have an additional 3/3 units free to equal 48/3 in 4 years.

**Biomaterials general specialization**

Biomaterials is a specialization within biomedical engineering that involves the application of biomaterials for therapeutic and diagnostic purposes.

**Definition from BMES: Biomaterials** - includes both living tissue and artificial materials used for implantation. Understanding the properties and behavior of living material is vital in the design of implant materials. The selection of an appropriate material to place in the human body may be one of the most difficult tasks faced by the biomedical engineer. Certain metal alloys, ceramics, polymers, and composites have been used as implantable materials. Biomaterials must be non-toxic, non-carcinogenic, chemically inert, stable, and mechanically strong enough to withstand the repeated forces of a lifetime. Newer biomaterials even incorporate living cells in order to provide a true biological and mechanical match for the living tissue. From <<http://www.bmes.org/content.asp?contentid=140>>

**Biomaterials: Drug delivery – sub-specialty**

This area involves biomaterials development for applications in drug therapeutics specifically focused on drug delivery systems providing sufficient competency in bioprocesses related to drug delivery.

**Biomaterials: Tissue engineering – sub-specialty**

This area involves biomaterial development for applications in tissue development, regenerative medicine, cell engineering, and cell manufacturing providing sufficient competency in biology related to tissue engineering.

Potential jobs in (where text is in parenthesis, the noted sub-specialty is of particular relevance):

* Implantable medical devices development (Biomat)
* Biomaterial formulation
* Materials, component, and device testing to meet development and regulatory requirements
  + Designing, developing, and implementing test methods and equipment
* In vitro and in vivo characterization (Biomat and TE)
* Disease modeling (TE)
* Tissue engineering (TE)
* Design of drug delivery systems (DD)

Graduate school – these areas allow for sufficient competency for continued education at the graduate level (research-based, project-based, course-based graduate programs).

Minors have been identified for each sub-specialization to allow for a more distinguished WPI experience.

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| **Sub-specialization** | **Biomaterials** | **Drug Delivery** | **Tissue Engineering** |
| *Minor* | *Materials* | *Chemistry* | *Biology* |
| Double Count courses | CH 2310 | CH 1010 | BB 1035 |
| ME 2820 | CH 2310 | BB 2550 |
| BME 4814 |  | BB 2950 |
| Additional courses to fulfill the minor | CH 2320 | CH 2320 | BB 2903 (1/6) |
| ES 2001 | CH 4110 | BB 3512 (1/6) |
| ME 4821 | CH 4130 or CH 4140 | BB 3620 |
|  | CH 4150 | BB 4550 |

**Can double count up to 3/3 units towards minor and major (that means you must take at least an additional 3/3 units for the minor).**