

## BIOMED E BIOTECHNOLOGY CONCENTRATION - F07

MS: 30 total credit hours minimum

**Students last name begins with A - M:** Advisor: Alan J. Hunt, Ph.D. (ajhunt@umich.edu)

**Students last name begins with N - Z:** Advisor: Michael Mayer, Ph.D. (mimayer@umich.edu)

### Biotechnology (one course):

- BIOMED E 410 Design and Application of Biomaterials (4) (I)<sup>1</sup>  
BIOMED E 556 Cellular and Molecular Biomechanics (3) (I)  
BIOMED E 561 Biological Micro and Nanotechnology (3) (II)  
BIOMED E 584 Tissue Engineering (3) (II)

### General:

- BIOMED E 500 Biomedical Engineering Seminar (1) (I,II)  
BIOMED E 550 Ethics and Enterprise (1) (I)

### Biomedical Research and Design (one course):

- BIOMED E 450 Biomedical Engineering Design (4) (II) – for MS only students  
BIOMED E 590 Directed Research (2) (I,II,III)  
BIOMED E 599 - Section 001 Graduate BME Innovative Design Team (2) (I) **AND**  
BIOMED E 599 - Sections 004 and 005 Graduate BME Innovative Design Team (4) (II)<sup>2</sup>

### Mathematics (one course):

- Math 450 Advanced Mathematics for Engineers I (4) (I,II,IIIb)  
Math 454 Boundary Value Problems for Partial Differential Equations (3) (I,II,IIIa)  
Math 462 Mathematical Models (3)<sup>3</sup>  
Math 463 Math Modeling in Biology (3) (I)  
Math 556 Methods of Applied Math I (3) (I)  
Math 563 Advanced Mathematical Methods for the Biological Sciences (3) (II)

ChemE 554/MSE 554

Computational Methods in MSE and ChemE (3) (I)  
ChemE 510 Mathematical Methods in Chemical Engineering (3) (II)

### Bioinstrumentation (one course):

- BIOMED E 458 Biomedical Instrumentation and Design (4) (I,II)  
MCDB 429 Lab in Cell and Molecular Biology (3) (II)  
Biol Chem 516 Intro Biochemistry Lab (3) (I)  
Biophysics 608 Biophysical Principles of Microscopy (3)<sup>4</sup>

### Statistics (one course)<sup>5</sup>:

- IOE 465 Design and Analysis of Experiments (3) (II)  
Statistics 470 Introduction of the Design of Experiments (4) (I)  
Statistics 500 Applied Statistics I (3) (I)  
Statistics 501 Applied Statistics II (3) (II)

### Life Science (two courses):

*At least one of the following:*

- Biol Chem 451<sup>6</sup> Introductory Biochemistry I (Biotechnology only)<sup>7</sup> (4) (I)  
BIOMED E 519 Quantitative Physiology (Tissue Engineering only)<sup>8</sup> (4) (I)

*Other courses:*

- MCDB 427 Molecular Biology (4) (I)<sup>9</sup>  
MCDB 428 Cell Biology (4) (II)<sup>9</sup>  
MCDB 530 Cell Biology (3) (I)<sup>9</sup>  
BIOMED E 418 Quantitative Cell Biology (4) (II)<sup>9</sup>  
BIOMED E 522 Biomembranes: Structure, Transport, and Disease (3) (II)

**Technical Electives:**

At least one graduate<sup>10</sup> level engineering and biology course. For technical electives outside of those listed, you must obtain approval from the biotechnology advisor.

**Sample Course Sequence:**

|               |   |
|---------------|---|
| <b>Fall</b>   | Biol. Chem. 451 or<br>BIOMED E 519,<br>BIOMED E 500,<br>BIOMED E 550, Statistics<br>400, technical elective |
| <b>Winter</b> | BIOMED E 418, MCDB<br>429, BIOMED E 584   |
| <b>Fall</b>   | ChemE 508, BIOMED E<br>590, technical elective  |

**Technical Electives with biotechnology content:**

|               |   |
|---------------|---|
| Biol Chem 550 | Protein Structures & Function (3) (I)                         |
| BIOMED E 410  | Design and Applications of Biomaterials (4) (I)               |
| BIOMED E 476  | Biofluid Mechanics (4) (II)                                   |
| BIOMED E 479  | Biotransport (4) (II)   |
| BIOMED E 584  | Tissue Engineering (3) (II)                                   |
| CDB 683-685   | Organogenesis of Complex Tissues (3) (I)                      |
| ChemE 528     | Chemical Reactor Engineering (3) (I) <sup>11</sup>            |
| ChemE 538     | Statistical and Irreversible Thermodynamics (3) <sup>11</sup> |
| ChemE 542     | Intermediate Transport Phenomena (3) <sup>11</sup>            |

<sup>1</sup> I - fall, II - winter, III - spring-summer, IIIa - spring half, IIIb - summer half.

<sup>2</sup> In order for this course to count toward their degree in BME, students must register for this course in both the fall and winter terms, and they must adhere to the following rules:

a) this course can be counted as a SGUS, terminal MS, or MS/PhD student's 2 credit hour technical elective (fall term) and Biomedical Research and Design requirement (winter term),

b) this course, taken in both terms, can be counted as a technical elective for a student that has already taken BIOMED E 450 or BIOMED E 590,

c) this course can be counted as PhD coursework providing that it has not already been counted as the student's Biomedical Research and Design requirement or technical elective in their MS program, and the student's advisor approves.

<sup>3</sup> Refer to the Mathematics Department for current offering.

<sup>4</sup> Refer to the Biophysics Department for current offering.

<sup>5</sup> Stats 412: Not recommended.

<sup>6</sup> Students that have received their undergraduate degree at U of M and have taken Biol 310 or 311 will not get credit for taking Biol Chem 451.

<sup>7</sup> For students following the Biotechnology track.

<sup>8</sup> For students following the Tissue Engineering track.

<sup>9</sup> These life science courses are not recommended without appropriate prerequisites.

<sup>10</sup> Please see the Horace H. Rackham School of Graduate Studies guidelines.

<sup>11</sup> Refer to the Chemical Engineering Department for current offering.