CONCENTRATIONS WITHIN THE BSEChE PROGRAM
June 2020

All concentrations consist of 12 credits and must include at least one 300 or 400 level course. Only engineering and general electives can be used as part of a concentration. Up to three research credits in a related area can count toward a concentration with Brittany Smith’s approval. Contact her for approval of any other courses. Courses taken for a concentration cannot be taken Pass/Fail. Concentrations are not available to students pursuing dual degrees or SUGS masters in the same area. Student must earn a C- or better in all courses counting towards a concentration and must earn a 2.0 or above overall concentration GPA.

### Conc. In BioPharmaceutical Engineering

12 credits total, including at least 1 course each from categories A, B, & C:

<table>
<thead>
<tr>
<th>Category A: BioPharm Science and Engineering</th>
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<tbody>
<tr>
<td>ChE 517/PharmSci 717 Biopharm engineering (3 cr.)</td>
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<tr>
<td>ChE/Pharm 519 Modern pharmaceutical engr (3 cr.)</td>
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<tr>
<td>PIBS 601 Principles of pharmacology (3 cr.)</td>
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<tr>
<td>ChE 497 Solids handing (3 cr.)</td>
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<tr>
<td>ChE/Chem 496/966 Introduction to Synthetic Biology (3 cr.)</td>
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<tr>
<td>ChE 696 Principles &amp; Predictions of Drug Distribution (3 cr.)</td>
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<tr>
<td>ChE 574 Engr principles in drug delivery and targeting (3 cr.)</td>
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<tr>
<td>Biochem 415/515 Introductory biochemistry (3 cr.), or Chem 351 (4 cr.), MCDB 310 (3 cr.)</td>
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<tr>
<td>BME 410 Design &amp; applcns of biomaterials (3 cr.)</td>
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<tr>
<td>Pharm Sci 608 Pharmacokinetic concepts &amp; appln's (4 cr.)</td>
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<tr>
<td>PIBS 621 Translational pharmacology (2 cr.)</td>
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<tr>
<th>Category B: Applied Statistics and Math</th>
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<tr>
<td>Che 431 Engineering stats &amp; problem solving (3 cr.)</td>
</tr>
<tr>
<td>Stat 412 Intro to probability and statistics (3 cr.)</td>
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<tr>
<td>Stat 470 Intro to design of experiments (4 cr. w/ Instructor permission)</td>
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<tr>
<td>Stat 570 Design of experiments (3 cr.)</td>
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<tr>
<td>Math 419 Linear spaces and matrix theory (3 cr.)</td>
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<tr>
<td>Math 217 Linear Algebra (4 cr alternative-Math 419)</td>
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<td>IOE 460 Decision analysis (3 cr.)</td>
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<tr>
<th>Category C: Regulatory Science</th>
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<tbody>
<tr>
<td>ChE/Pharm 597 Regulatory sci. for sci and engrs (2 cr.)</td>
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<tr>
<td>BME/Chem 588 Globl qual syst &amp; regulatory innovat (2 cr.)</td>
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<td>BL 319 Intellectual property law (3 cr.)</td>
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### Concentration in Electrical Engineering

NOTE: EECS students are given priority in enrollments.

**Required Courses – 4 credits:**

- EECS 215 Intro to electronic circuits (4 cr. preferred) or EECS 314 Electrical circuits, systems, & appl'n's (4 cr.)

**Technical Electives - 8 credits.**

**Process Controls:**

- EECS 216 Intro to Signals & Systems (4cr.)
- EECS 460 Control Systems Analysis & Design (4cr.)
- EECS 461 Embedded Control Systems (4cr.)

**Electronic Devices:**

- EECS 320 Intro to semiconductor devices (4 cr.)
- EECS 414 Introduction to MEMS (4 cr.)
- EECS 421 Properties of transistors (4 cr.)
- EECS 423 Solid-state device laboratory (4 cr.)
- EECS 429 Semiconductor optoelectronic devices (4 cr.)

**Concentration in Energy Systems Engineering**

**Technical Electives - 9 credits. Select from:**

- AERO 533/ Combustion processes
- ENSCEN 533 (3 cr., requires AEROSP 225)
- CEE 567/ Energy infrastructure systems (3 cr.)

**Electrical Engineering:**

- ChE 496 Hydrogen tech: prod'n & storage (3 cr.)
- ChE 496 Fuel processors & fuel cells (3 cr.)
- ChE 496 Solar Energy Conversion (3 cr.)
- ME 432 Combustion (3 cr., req's ME 336, 320)
- ME 433/ Adv. energy solutions (3 cr., req. ME 235)

**Technical Electives - 9 credits. Select from:**

- AUTO 533 Energy generation & storage using Environ. systems (3 cr., req. ME 325 and 335)
- ME 438 Advanced IC Engines (3 cr.)
- ME 539 Heat transfer physics (3 cr., req. ME 235 and 335)
- ME 571 Intro to T&D & advanced materials (4 cr.)

**Concentration in Environmental Engineering**

**Technical electives - 9 credits. Select from:**

(sustainability-focused courses are underlined)

- CEE 265 Sustainable engineering principles (3 cr.)
- CEE 365 Environ engr principles (4 cr.)
- CEE 366 Environ engr lab (2 cr. reqs)
- CEE 270 and 365
- CEE 428 Groundwater hydrology (3 cr., requires CEE 265 and CEE 325 or equivalent)
- CEE 465 Environ process engr (3 cr., requires CEE 325 and CEE 365)
- CEE 480 Design of enviro. engr systems (3 cr.)
- CEE 481 Aquatic chemistry (3 cr.)
- CEE 482 Environ microbiology (3 cr., requires CEE 325 and 365)
- CEE 501-7 Wind energy development, engr, & construction
- CEE 501-14 Greenhouse gas control (3 cr.)
- CEE 526 Design of hydraulic systems (3 cr., requires CEE 325 or equivalent)
- CEE 563 Air quality control (3 cr.)
- CEE 586 Industrial ecology (3 - 4 cr., sr. std.)
- CEE 589/ Risk and benefit analysis in enviro engr (3 cr., sr. std.)
- CEE 686 Case studies in environ sustainability (2-3 cr., sr std)
- CEE 686-001 Environ finance (3 cr.)
### Concentration in the Life Sciences

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<tr>
<th>Course</th>
<th>Credits</th>
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<tr>
<td>CLIMATE 350</td>
<td>Atmospheric thermodynamics (3 cr.)</td>
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<tr>
<td>CLIMATE 410</td>
<td>Earth system modeling (4 cr.)</td>
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<tr>
<td>CLIMATE 467/ CHEM 467</td>
<td>Biogeochemical cycles (3 cr.)</td>
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<tr>
<td>CLIMATE 475</td>
<td>Earth system interactions (4 cr., sr std)</td>
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<tr>
<td>Earth 305</td>
<td>Earth's surface and sediment (4 cr.)</td>
</tr>
<tr>
<td>Earth 313</td>
<td>Geobiology (4 cr.)</td>
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<tr>
<td>Earth 325</td>
<td>Environ geochemistry (3 cr.)</td>
</tr>
<tr>
<td>Earth 477</td>
<td>Hydrogeology (4 cr.)</td>
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<tr>
<td>Earth 478</td>
<td>Geochimistry of natural waters</td>
</tr>
<tr>
<td>ME 589</td>
<td>Sustainable design of technology systems (3 cr., sr std.)</td>
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<tr>
<td>SPACE 370</td>
<td>Solar terrestrial relations (4 cr.)</td>
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#### Policy/law/economics course - 3 credits. Select from:

- **BE 562** Gwnt & Stabilization in the Macro Econ (2.25 cr.)
- **CEE 587** Water resource policy (3 cr., sr, std.)
- **CEE 589** Risk & benefit analysis in environmental engineering (3 cr. sr std.)
- **Earth 380** Mineral resources, economics, & the environment (4 cr.)
- **Econ 370/ Environ 375** Environ & resource econ (3 cr.)
- **Environ 235** Natural Resources & Environ Econ (3 cr.)
- **Environ 312** Envirol politics and policy (3 cr.)
- **Polsci 380**
- **Environ 365** International environmental law (3 cr.)
- **Environ 412** Environ values in public policy (3 cr.)
- **PubPol 412**
- **NRE 475/ENR 475** Environmental law (3 cr.)
- **EHS 588/Environ 475**
- **NRE/BE 527** Energy markets and energy politics (3 cr)
- **PubPol 481** Science, tech, and public policy (3 cr.)

### Concentration in Mechanical Engineering

#### Required Courses:

- **ME 211** Intro to solid mechanics (4 cr.)
- **ME 240** Intro to dynamics and vibrations (4 cr.)

#### Technical Electives - 4 credits. Select from:

- **ME 311** Strength of materials (3 cr.)
- **ME 350** Design and manufacturing II (4 cr. requires ME 211, 240 and 250)
- **ME 382** Mechanical Behavior of Materials (4 cr. - requires ME 211)
- **ME 400** Mechanical engr analysis (3 cr.)
- **ME 401** Statistical quality control & design (3 cr.)
- **ME 420** Fluid mechanics II (3 cr., requires ME 320)
- **ME 432** Combustion (3 cr., reqs ME 336 & 320)
- **ME 440** Intermediate dynamics & vibrations (4 cr.)
- **ME 476** Biofluid Mechanics (4 cr. requires ME 320)

### Concentration in Materials Science and Engineering

#### Technical Electives - 12 credits. Select from:

- **MSE 242** Physics of materials (4 cr.)
- **Any 300, 400, 500 level MSE course**

### Concentration in Nuclear Engineering

#### Required Courses:

- **NERS 250** Fundamentals of NERS (4 cr.)
- **NERS 311** Elements of NERS I (3 cr.)
- **NERS 312** Elements of NERS II (3 cr.)

At least 2 additional credits, which require the above 3 courses. Choose from:

- **NERS 421** Nuclear engineering materials (3 cr.)
- **NERS 425** Applications of radiation (4 cr.)
- **NERS 441** Nuclear reactor theory I (4 cr. reqs NERS 312 and Math 454)

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**Check web for updates at:**

[www.engin.umich.edu/che/undergraduate/program](http://www.engin.umich.edu/che/undergraduate/program)