CONCENTRATIONS WITHIN THE BSEChE PROGRAM
March 2018

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 Dr. Montgomery’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:

Category A: BioPharm Science and Engineering
- CHE 517/ PharmSci 717 Biopharm engineering (3 cr.)
- CHE/Pharm 519 Modern pharmaceutical engr (3 cr.)
- PBIS 601 Principles of pharmacology (3 cr.)
- CHE 496 Solids handling (3 cr.)
- CHE 496/696 Introduction to Synthetic Biology (3 cr.)
- CHE 574 Engr principles in drug delivery and targeting (3 cr.)
- Biochem 415/515 Introductory biochemistry (3 cr.), or Chem 351 (4 cr.), MCDB 310 (3 cr.)
- BME 410 Design & applnts of biomaterials (3 cr.)
- PBIS 621 Translational pharmacology (2 cr.)

Category B: Applied Statistics and Math
- CHE 431 Engineering stats & problem solving (3 cr.)
- Stat 412 Intro to probability and statistics (3 cr.)
- Stat 470 Intro to design of experiments (4 cr. w/ Instructor permission)
- Stat 570 Design of experiments (3 cr.)
- Math 419 Linear spaces and matrix theory (3 cr.)
- IOE 460 Decision analysis (3 cr.)

Category C: Regulatory Science
- BUSABRD 319 Global Immersion: Intell prop law (3 cr.)
- CHE/Pharm 597 Regulatory sci. for sci and engrs (2 cr.)
- BME/HE 588 Global qual syst & regulatory innovat (2 cr.)
- BL 319 Intellectual property law (3 cr.)

Other Relevant Courses
- BME 500 BME Seminar (1 cr.)
- CHE 496/596 Chem Process Safety Risk Manag. (3 cr.)
- IOE 436 Human Factors (3 cr.)
- IOE 813 Provided. better hlthcre thru syst engr (2 cr.)
- Psych 449 Decision processes (3 cr.)

Conc. in Electrical Engr – Electronic Devices
NOTE: EECS students are given priority in enrollments.

Required Courses – 8 credits:
- EECS 215 Introduction to electronic circuits (4 cr.) or ECE 415 Intro to electronic circuits (4 cr.)
- EECS 314 Electrical circuits, systems, & appl’n (4 cr.)
- EECS 320 Intro to semiconductor devices (4 cr.)
- EECS 414 Introduction to MEMS (4 cr.)
- EECS 421 Properties of transistors (4 cr., req. EECS 320)
- EECS 423 Solid-state device laboratory (4 cr.)
- EECS 429 Semiconductor optoelectronic devices (4 cr.)

Technical Electives - 4 credits. Select from:
- EECS 512 Advanced electronics (4 cr., requires EECS 415)
- EECS 527 Advanced semiconductor devices (4 cr., requires EECS 415)
- EECS 531 Advanced semiconductor circuits (4 cr., requires EECS 415)
- EECS 570 Advanced computer systems (4 cr., requires EECS 415)
- EECS 615 Advanced solid-state devices (4 cr., requires EECS 415)
- EECS 621 Advanced semiconductor devices (4 cr., requires EECS 415)
- EECS 631 Advanced electronic computation (4 cr., requires EECS 415)
- EECS 641 Advanced electronic circuits (4 cr., requires EECS 415)
- EECS 651 Advanced electronic circuits (4 cr., requires EECS 415)
- EECS 661 Advanced electronic circuits (4 cr., requires EECS 415)
- EECS 671 Advanced electronic circuits (4 cr., requires EECS 415)
- EECS 681 Advanced electronic circuits (4 cr., requires EECS 415)
- EECS 691 Advanced electronic circuits (4 cr., requires EECS 415)
- EECS 711 Advanced electronic circuits (4 cr., requires EECS 415)
- EECS 721 Advanced electronic circuits (4 cr., requires EECS 415)
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- EECS 891 Advanced electronic circuits (4 cr., requires EECS 415)

Policy/law course – 3 credits. Select from:
- EECS 501 Seminars on energy systems, tech, and policy (3 cr.)
- NRE 475 Environ law (3 cr.)
- EHS 588/Environ 475
- NRE/BE 527 Energy markets and politics (3 cr.)

Concentration in Environmental Engineering

Technical electives - 9 credits. Select from:
(underlined courses are required)
- CEE 265 Sustainable engineering principles (3 cr.)
- CEE 365 Enviro enr principles (3 cr.)
- CEE 366 Enviro enr lab (2 cr. reqs)
- CEE 270 and 365
- CEE 428 Groundwater hydrology (3 cr., requires CEE 265 and CEE 325 or equivalent)
- CEE 465 Enviro 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 Enviro 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 engineering fundamentals (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 595 NRE 595
- CEE 686 Case studies in environ sustainability (2-3 cr., sr std)
- CEE 686-001 Enviro finance (3 cr.)
- CLIMATE 350 Atmospheric thermodynamics (3 cr.)
- CLIMATE 410 Earth system modeling (4 cr.)
- CLIMATE 467/ Biogeochemical cycles (3 cr.)
- CHEM 467
- CLIMATE 475 Earth system interactions (4 cr., sr std)
- Earth 305 Earth’s surface and sediment (4 cr.)
- Earth 313 Geobiology (4 cr.)
- Earth 325 Environ geochemistry (3 cr.)
- Earth 477 Hydrogeology (4 cr.)

PubPol 250 Soc. systems, energy, & pub policy (3 cr.)
PubPol 481 Science, tech, & pub policy (3 cr.)
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tr>
<td>Earth 478</td>
<td>Geochemistry of natural waters</td>
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<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  Growth & 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.)

**Concentration in the Life Sciences**

**Required Course:**
- MCDB 310  Intro biochem (3 cr.), or Chem 351 (4 cr.) or Biochem 415/515 (3 cr.)
- CEE 580  Required Course: (3 cr., sr., std.)
- SPACE 370  Solar terrestrial relations (4 cr.)

**Technical Electives - 8 or 9 credits, for 12 credits total:**
- Biology 205  Developmental biology (3 cr.)
- Biology 207  Intro microbiology (4 cr.)
- Biology 208  Embryology (3 cr.)
- Biology 222  Introduction to neurobiology (3 cr.)
- Biology 225  Principles of animal physiology (3 cr.)
- Biology 305  Genetics (3 cr.)
- BME 418  Quantitative cell biology (3 cr.)
- BME 419  Quantitative physiology (4 cr.)
- BME 476  Biofluid mechanics (4 cr.)
- BME 479/  Biotransport (4 cr.)
- CDB 580  Developmental biology (3 cr.)
- CEE 482  Environmental microbiology (3 cr., requires CEE 325 and 365)
- CHE 517  Biopharm engineering (3 cr.)
- CHE 519  Pharmaceutical eng.. (3 cr., sr. std.)
- CHE 574  Engineering principles in drug delivery & targeting (3 cr.)
- CHE 584  Tissue Engineering (3 cr.)
- CHE 696  Tech innovation, law, & regulation (3 cr.)
- MCDB 411  Protein structure function (3 cr.)
- MCDB 436  Introductory immunology (3 cr.)
- MedAdm 403  The human anatomy (5 cr.)

**Concentration in Materials Science and Engineering**

**Technical Electives - 12 credits. Select from:**
- MSE 242  Physics of materials (4 cr.)
- MSE 335  Kinetics & transport in MSE (4 cr.)
- MSE 350  Structures of materials (4 cr.)
- MSE 400  Electronic, Magnetic and Optical Materials for Modern Device Technology (3 cr.)
- MSE 410  Design & apps of biomaterials (3 cr.)
- MSE 412  Polymeric materials (3 cr.)
- MSE 420  Mechanical behavior of materials (3 cr. requires ME 211)
- MSE 440  Ceramic materials (3 cr.)
- MSE 465  Structural & chemical characterization of materials (3 cr., requires MSE 242, 360)
- MSE 470  Physical metallurgy (3 cr.)
- MSE 511/  Rheology of Polymeric Materials (3 cr.)
- CHE 511/MacroSE 511
- MSE 514  Composite materials (3 cr.)
- MSE 558/9  Foundations of nanotechnology (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 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.)

**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.)

**Conc. in Petroleum and Gas Exploration**

To include 4 lecture courses, composed of at least 3 credits of 300 level or higher EARTH courses and 3 credits of 300 level or higher CEE courses. Only one of Earth 116 or Earth 119 can count toward the concentration

- Earth 116/ Introductory geology (5 cr.)
- Earth 118  Introductory geology laboratory (1 cr.)
- Earth 119  Introductory geology lecture (4 cr.)
- Earth 248  Environmental geology (4 cr.)
- Earth 305  Earth’s surface & sediments (4 cr., requires intro geology course)
- Earth 310  Geochemistry of the solid earth (4 cr. requires intro geology course)
- Earth 314  Global & applied geophysics (4 cr.)
- Earth 351  Earth structure (4 cr.)
- Earth 380  Mineral resources, econ, & the environment (4 cr.)
- Earth 422  Principles of geochemistry (3 cr., requires intro geology course)
- Earth 467  Stratigraphy & basis analysis (4 cr. requires introductory geology course)
- Earth 477  Hydrogeology (4 cr.)
- CEE 345  Geotechnical engineering (4 cr.)
- CEE 428/  Groundwater hydrology (3 cr.)
- Enscen 428
- CEE 446  Engr geology & site characterization (3 cr., requires CEE 345)
- CEE 522  Sediment transport (3 cr.)
- CEE 527  Coastal hydrodynamics (3 cr.)
- CEE 528/  Flow and transport in porous media (3 cr., Enscen 528 requires CEE 428 or equivalent)
- CEE 535  Excavation and tunneling (3 cr.)

Check web for updates at: www.engin.umich.edu/che/undergraduate/program