

CONCENTRATIONS WITHIN THE BSEChE PROGRAM

February 2017

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

At least one course from each category:

Category A: BioPharm Science and Engineering

ChE 517 Biochemical engineering (3 cr.)
 ChE/Pharm 519 Modern pharmaceutical engr (3 cr.)
 PIBS 601 Principles of pharmacology (3 cr.)
 ChE 496 Solids handling (3 cr.)
 ChE 496/696 Industrial & therapeutic biomolecular engineering (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 & applctns of biomaterials (3 cr.)
 Pharm Sci 608 Pharmacokinetic concepts & appl's (4 cr.)
 PIBS 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 436 Human factors (3 cr.)
 IOE 460 Decision analysis (3 cr.)

Category C: Regulatory Science

ChE/Pharm 597 Regulatory sci. for sci and engrs (2 cr.)
 BME/ChE 588 Global quality systems and regulatory innovation (2 cr.)
 ChE/BME 587 Tech innovation, law & regulation (2 cr.)
 Psych 449 Decision processes (3 cr.)
 LHC 319 Intellectual property law (2.25 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
 EECS 314 Electrical circuits, systems, & appl'ns (4 cr.)
 EECS 320 Intro. to semiconductor devices (4 cr.)

Technical Electives - 4 credits. Select from:

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.)

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.)
 ESEng 567
 CHE 496 Hydrogen tech: prod'n & storage (3 cr.)
 CHE 496 Fuel processors and fuel cells (3 cr.)
 ME 432 Combustion (3 cr., req's ME 336, 320)
 ME 433/ Advanced energy solutions (3 cr.,
 AUTO 533 requires ME 235)
 ME 438 Internal combustion engines (4 cr.)
 ME 538 Advanced IC Engines (3 cr.)
 ME 539 Heat transfer physics (3 cr., requires ME 235 and ME 335)
 ME 571/ Energy generation and storage using
 ESENG 505 modern materials (3 cr.)
 NERS 250/ Fundamentals of nuclear energy and
 ENSCEN 211 Radiological sciences (4 cr.)

Policy/law course – 3 credits. Select from:

ESENG 501 Seminars on energy systems, technology, and policy (3 cr.)

NRE 475 / Environmental law (3 cr.)
 EHS 588/ Environ 475
 NRE/ BE 527 Energy markets and politics (3 cr.)
 PubPol 250 Social systems, energy, and public policy (3 cr.)
 PubPol 481 Science, tech, and public policy (3 cr.)

Concentration in Environmental Engineering

Technical electives - 9 credits. Select from: (sustainability-focused courses are underlined)

AOSS 350 Atmospheric thermodynamics (4 cr.)
 AOSS 370 Solar terrestrial relations (4 cr.)
 AOSS 410 Earth system modeling (4 cr.)
 CLIMATE 467/ Biogeochemical cycles (3 cr.)
 CHEM 467
 CLIMATE 475 Earth system interactions (4 cr., sr std)
CEE 265 Sustainable engineering principles (3 cr.)
 CEE 365 Environmental engr principles (4 cr.)
 CEE 366 Environmental 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 Environmental process engr (3 cr., requires CEE 325 and CEE 365)
 CEE 480 Design of environ. engr systems (3 cr.)
 CEE 481 Aquatic chemistry (3 cr.)
 CEE 482 Environmental microbiology (3 cr., requires CEE 325 and 365)
 CEE 501-7 Wind energy development, engr, and 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 environmental engr (3 cr., sr. std.)
 NRE 595
CEE 686 Case studies in environmental sustainability (2-3 cr., sr std)

CEE 686-001	Environmental finance (3 cr.)
Environ 325/ Earth 325	Environmental geochemistry (3 cr.)
Earth 305	Earth's surface and sediment (4 cr.)
Earth 313	Geobiology (4 cr.)
Earth 477	Hydrogeology (4 cr.)
Earth 478	Geochemistry of natural waters
Environ 365	International environmental law (3 cr.)
Environ 475	Environmental Law (3 cr.)
ME 589	Sustainable design of technology systems (3 cr., sr, std.)

Policy/law/economics course - 3 credits. Select from

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

Concentration in the Life Sciences

Required Course:

MCDB 310	Intro biochem (3 cr.), (or Chem 351 (4 cr.) or Biolchem 415/515 (3 cr.)
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Technical Electives - 8 or 9 credits, for 12 credits total:

Biology 205	Developmental biology (3 cr.)
Biology 207	Introductory 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/ CDB 580	Biotransport (4 cr.)
CEE 482	Developmental biology (3 cr.)
CEE 482	Environmental microbiology (3 cr., requires CEE 325 and 365)
ChE 517	Biochemical 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.)
Micrbiol 301	Intro. microbiology (3 cr.)
Micrbiol 405	Medical microbiology & infectious diseases (3 cr.)
Micrbiol 460	Eukaryotic Microbiology (3 cr.)
Physiol 201	Intro to human physiology (4 cr.)
Physiol 502	Human physiology (4 cr.)
Stats 449	Topics in biostatistics (3 cr.)

Conc. in Materials Science and Engineering

Required Course:

MSE 350	Structures of materials (4 cr.)
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Technical Electives - 8 credits. Select from:

MSE 242	Physics of materials (4 cr.)
MSE 335	Kinetics & transport in MSE (4 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 and chemical characterization of materials (3 cr., requires MSE 242, 360)
MSE 470	Physical metallurgy (3 cr.)
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 engineering 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 and 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.)
NERS 441	Nuclear reactor theory I (4 cr. reqs NERS 312 and Math 454)
NERS 471	Introduction to plasmas (3 cr.)
NERS 481	Engr principles of radiation imaging (2 cr.)
NERS 484	Radiological health engr fund (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 284	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, and the environment (4 cr.)
Earth 422	Principles of geochemistry (3 cr., requires intro geology course)
Earth 467	Stratigraphy and basis analysis (4 cr. requires introductory geology course)
Earth 477	Hydrogeology (4 cr.)
CEE 345	Geotechnical engineering (4 cr.)
CEE 428/ Enscen 428	Groundwater hydrology (3 cr.)
CEE 446	Engineering geology & site characterization (3 cr., requires CEE 345)
CEE 522	Sediment transport (3 cr.)
CEE 527	Coastal hydraulics (3 cr.)
CEE 528/ Enscen 528	Flow and transport in porous media (3 cr., requires CEE 428 or equivalent)
CEE 535	Excavation and tunneling (3 cr.)

Check web for updates at:

www.engin.umich.edu/che/undergraduate/program