BIOLOGICAL ENGINEERING SUPPORTING COURSE LISTS

(updated August 2023)

AGRICULTURAL ENGINEERING OPTION SUPPORTING COURSE LISTS

MATH/BASIC SCIENCE COURSES+

AGRO 28	Principles of Crop Management (3) Offered: FA
ANSC 201	Animal Science (4) Offered: FA/SP
BIOL 11	Introductory Biology I (3)
BIOL 110	Biology: Basic Concepts and Biodiversity (4) Offered: FA/SP/SU
BIOL 127	Introduction to Plant Biology (3) Offered: FA
BIOL 141	Introductory Physiology (3) Offered: FA/SP/SU
BMB 211	Elementary Biochemistry (3) Prerequisite: CHEM 202 or CHEM 210. Offered: FA/SP/SU
CHEM 112	Chemical Principles II (3) Prerequisite: CHEM 110 or CHEM 106. Offered: FA/SP/SU
CHEM 202	Fundamentals of Organic Chemistry I (3) Prerequisite: CHEM 101 or CHEM 110 or CHEM 106 or CHEM 130. Offered: FA/SP/SU
GEOSC 1	Physical Geology (3) Offered: FA/SP
HORT 101	Horticultural Science (3) Offered: FA/SP
MATH 220	Matrices (2-3) Prerequisite: MATH 110 or MATH 140 or MATH 140H. Offered: FA/SP/SU
MATH 240	Mathematical Methods for Biology and the Life Sciences (4) Prerequisite: MATH 141B or instructor approval. Offered: FA
MICRB 201	Introductory Microbiology (3) Prerequisite: CHEM 110. Offered: FA/SP
PHYS 213	General Physics: Fluids and Thermal Physics (2) Prerequisite: MATH 140 and PHYS 211; Concurrent: MATH 141. Offered: FA/SP/SU
PHYS 214	General Physics: Wave Motion and Quantum Physics (2) Prerequisite: MATH 141 and PHYS 211 and PHYS 212. Offered: FA/SP/SU
PHYS 237	Introduction to Modern Physics (3) Prerequisite: PHYS 212; Concurrent: PHYS 214. Offered: FA/SP
SOILS 101	Introductory Soil Science (3) Offered: FA/SP

ENGINEERING SCIENCE/DESIGN COURSES+

AE 308	Introduction to Structural Analysis (4) Prerequisite: EMCH 211, EMCH 213. Offered: FA
AE 310	Fundamentals of Heating, Ventilating, and Air Conditioning (3) Prerequisite: ME 201. Prerequisite or concurrent: AE 202. Offered: SP
AE 402	Design of Concrete Structures for Buildings (3) Prerequisite: AE 221, AE 222, AE 308. Offered: FA
AE 403	Advanced Steel Design for Buildings (3) Prerequisite: AE 401, AE 430. Offered: SP
AE 444	Micro CADD Applications for Buildings (3) Prerequisite: AE 222; CMPSC 201 or CMPSC 202. Offered: FA/SP
AE 470	Residential Building Design and Construction (3) Prerequisite: AE 372 or CE 332. Offered: FA
BE 461	Design of Fluid Power Systems (3) Prerequisite: BE 306 or ME 360; and CE 360 or ME 320. Offered: FA
BE 462	Design of Wood Structures (3) Prerequisite: BE 303, AE 308, or CE 340. Offered: FA
BE 463	Design Principles of Mechatronics for Biosystems (3) Prerequisite: BE 305 or EE 210 or EE 211 or EE 212. Offered: SP
BE 464	Bioenergy Systems Engineering (3) Prerequisite: EME 301, ME 201, ME 300, or CHE 220. Prerequisite or concurrent: BE 308, CHE 340, or CE 479. Offered: FA
BE 465	Food and Biological Process Engineering (3) Prerequisite: BE 302. Offered: FA
BE 467	Design of Stormwater and Erosion Control Facilities (3) Prerequisite: BE 307 or CE 461. Offered: FA
BE 468	Microbiological Engineering (3) Prerequisite: BE 308 or both BMB 211 and MICRB 201. Prerequisite or concurrent: BE 302. Offered: SP
BE 477	Land-Based Waste Disposal (3) Prerequisite: BE 307 or CE 370. Offered: FA
BE 487	Watershed Modeling for Water Quality Design (3) Prerequisite: BE 307 or CE 461. Offered: SP
CE 310	Surveying (3) Prerequisite: EDSGN 100, MATH 141. Offered: FA/SP

CE 335 Engineering Mechanics of Soils (3) Prerequisite: EMCH 210 or EMCH 213. Concurrent: GEOSC 1. Offered: FA/SP

CE 340 Structural Analysis (3) Prerequisite: EMCH 210 or EMCH 213. Offered: FA/SP

CE 341 Design of Concrete Structures (3) Prerequisite: CE 340, Prerequisite or concurrent: CE 336. Offered: FA/SP

CE 342 Design of Steel Structures (3) Prerequisite: CE 336, CE 340. Offered: FA/SP

CE 370 Introduction to Environmental Engineering (3) Prerequisite: CHEM 110; MATH 111 or MATH 141. Offered: FA/SP

CE 410 Sustainable Residential Subdivision Design (3) Prerequisite: AE 372 or CE 332. Offered: FA

CE 435 Foundation Engineering (3) Prerequisite: CE 335. Prerequisite or concurrent: CE 341. Offered: FA/SP

CE 461 Water-resource Engineering (3) Prerequisite: CE 360. Offered: FA/SP

CE 462 Open Channel Hydraulics (3) Prerequisite: CE 360. Offered FA/SP

CE 465 Water Resources Capstone Course (3) Prerequisite: CE 461. Prerequisite or concurrent: CE 462. Offered: SP

CE 473 Ecological Design of Regenerative Aquatic Systems (3) Prerequisite: CE 370. Offered: FA

CE 475 Water Quality Chemistry (4) Prerequisite: C E 370, CHEM 110, CHEM 111. Offered: SP

CE 476 Solid and Hazardous Wastes (3) Prerequisite: CE 370, CE 371. Offered: SP

EDSGN 468 Engineering Design and Analysis with CAD (3) Prerequisite: EMCH 210 or EMCH 211. Offered: FA/SP (**only 3 credits can be used toward electives**; Solidworks section recommended)

EDSGN 452 Projects in Humanitarian Engineering (2) Prerequisite: 5th semester standing. Concurrent: EDSGN 453. Offered: SP

EDSGN 453 Design for Developing Communities (1) Prerequisite: 5th semester standing. Offered: SP

EMCH 315 Mechanical Response of Engineering Materials (2) Prerequisite: EMCH 213, EMCH 210H, or EMCH 210. Offered: FA/SP

EMCH 316 Experimental Determination of Mechanical Response of Materials (1) Prerequisite or concurrent: EMCH 315. Offered: FA/SP

EMCH 416 Failure and Failure Analysis of Solids (3) Prerequisite: EMCH 213 or EMCH 210. Offered: SP

IE 312 Product Design and Manufacturing Processes (3) Prerequisite: EMCH 213, EMCH 210H, or EMCH 210; Prerequisite or concurrent: ESC 414M or MATSE 259. Offered: FA/SP/SU

MATSE 259 Properties and Processing of Engineering Materials (3) Prerequisite: EMCH 213 or EMCH 210. Offered: FA/SP/SU

ME 405 Indoor Air Quality Engineering (3) Prerequisite: ME 320 or equivalent. Offered: FA

ME 370 Vibration of Mechanical Systems (3) Prerequisite: EMCH 212, CMPSC 200, MATH 220, MATH 251. Offered: FA/SP

ME 410 Heat Transfer (3) Prerequisite: ME 320 or BME 409, CMPSC 200 or CMPSC 201, MATH 220 or NUCE 309. Offered: FA/SP/SU

ME 431 Internal Combustion Engines (3) Prerequisite: ME 300 and ME 320. Offered: FA

ME 433 Fundamentals of Air Pollution (3) Prerequisite: ME 201 or ME 300. Offered: SP

ME 444 Engineering Optimization (3) Prerequisite: MATH 220; MATH 230 or MATH 231; CMPSC 201 or CMPSC 202 or CMPSC 200. Offered: SP

ME 450 Modeling of Dynamic Systems (3) Prerequisite: ME 370, ME 345. Offered: FA/SP

ME 452 Vehicle Road Dynamics (3) Prerequisite or concurrent: ME 450. Offered: SP

ME 456 (IE 456) Industrial Robot Applications (3) Prerequisite: MATH 220; MATH 250 or MATH 251; IE 305 or ME 360; CMPSC 200 or CMPSC 201. Offered: FA

ME 462 Lubrication in Machine Design (3) Prerequisite: MATH 251, ME 360. Offered: FA

AGRICULTURAL/BIOLOGICAL SCIENCE COURSES[+]

AGRO 28 Principles of Crop Management (3) Offered: FA

AGRO 423 Forage Crop Management (3) Prerequisite: AGRO 28. Offered: FA

AGRO 425 Field Crop Management (3) Prerequisite: AGRO 28. Offered: SP

ANSC 201 Animal Science (4) Offered: FA/SP
ANSC 309 Beef Cattle Production and Management (4) Concurrent: ANSC 201. Offered: SP
ANSC 310 Dairy Cattle Production and Management (3) Prerequisite: AN SC 201. Offered: SP
ANSC 311 Poultry Production and Management (3) Prerequisite: ANSC 100. Offered: FA
ASM 309 (ERM 309) Measurement & Monitoring of Hydrologic Systems (3) Prerequisite: PHYS 211 or PHYS 250, CHEM 110. Offered: FA
ASM 320 Combustion Engines for Mobile Equipment (3) Prerequisite: BE 306 or ASM 310 or ME 360. Offered: SP
ASM 420 Principles of Off-Road Machines (3) Prerequisite: BE 306 or ASM 310 or ME 360. Offered: SP
ASM 424 Precision Agriculture Technology (3) Prerequisite: BE 301 or ME 330 or STAT 240 or STAT 200 or STAT 250. Offered: FA
BIOL 110 Biology: Basic Concepts and Biodiversity (4) Offered: FA/SP/SU
BIOL 141 Introductory Physiology (3) Offered: FA/SP/SU
BIOL 220W Biology: Populations and Communities (4) Prerequisite: BIOL 110. Offered: SP
BIOL 240W Biology: Function and Development of Organisms (4) Prerequisite: BIOL 110, CHEM 110. Offered: SP
BRS 350 Introduction to Life Cycle Assessment (3) Prerequisite: 5th semester standing and (MATH 110 or MATH 140). Offered: FA
BRS 411 Biobased Fiber Science (4) Prerequisite: CHEM 110, BRS 300. Offered: SP
BRS 417 Processing and Manufacturing Systems for Bioproducts (4) Prerequisite: BRS 221 and BRS 300. Offered: SP
BRS 423 Deterioration and Protection of Bioproducts (3) Prerequisite: BRS 300. Concurrent: BRS 411. Offered: SP
BRS 426 Safety and Health in Agriculture and Biorenewable Industries (3) Prerequisite: 5th semester standing or higher. Offered: SP
ERM 402 Foundations of Sustainable Business (3) Prerequisite: AGBM 101 or ECON 102 or ECON 104. Offered: SP
ERM 412 Resource Systems Analysis (3) Prerequisite: BIOL 220W, ERM 151, ERM 300 and STAT 240; MATH 111 or MATH 141. Offered: FA/SP
ERM 430 (PPEM 430) Air Pollution Impacts to Terrestrial Ecosystems (3) Prerequisite: BIOL 220W or FOR 308. Offered: SP
ERM 431 (VBSC 431) Environmental Toxicology (3) Prerequisite: BIOL 110, CHEM 110, CHEM 112. Offered: FA
ERM 435 (WFS 435) Limnology (3) Prerequisite: BIOL 110, BIOL 220W, CHEM 110. Offered: FA
ERM 447 Stream Restoration (3) Prerequisite: ASM 327 or BE 307 or CE 461. Offered: FA
ERM 448 Rural Road Ecology and Maintenance (3) Prerequisite: MATH 140. Prerequisite or concurrent: BE 307 or CE 370. Offered: SP
ERM 450 (WFS 450) Wetland Conservation (3) Prerequisite: ERM 300 or WFS 209. Offered: FA
FOR 455 Remote Sensing and Spatial Data Handling (3) Prerequisite: MATH 110, 3 credits in computer science, 6 credits in ecological and/or geological sciences. Offered: SP
FOR 470 Watershed Management (3) Prerequisite: 3 credits in Soils. Offered: SP
HORT 101 Horticultural Science (3) Offered: FA/SP
HORT 315 Environmental Effects on Horticultural Crops (3) Prerequisite: HORT 101. Offered: SP
HORT 402W Plant Nutrition (3) Prerequisite: (HORT 315 or BIOL 441) and SOILS 101. Offered: FA
HORT 412W Post-Harvest Physiology (3) Prerequisite: HORT 101. Recommended Preparation: HORT 351. Offered: SP
HORT 451 Hydroponics and Aquaponics (3) Prerequisite: HORT 101 or AGRO 28 or AGECO 121. Students without the formal prerequisite should have junior level standing in science or engineering major. Offered: SP
HORT 453 Flower Crop Production and Management (3) Prerequisite: HORT 101. Offered: SP
SOILS 101 Introductory Soil Science (3) Offered: FA/SP
SOILS 401 Soil Composition and Physical Properties (3) Prerequisite: SOILS 101. Offered: SP
SOILS 404 Urban Soils (3) Prerequisite: SOILS 101. Offered: SP
SOILS 416 Soil Genesis, Classification, and Mapping (4) Prerequisite: SOILS 101. Offered: FA

SOILS 418 (AGECO 418, ANSC 418) Nutrient Management in Agricultural Systems (3) Prerequisite: BIOL 110 or (BIOL 11 and BIOL 12) or BIOL 127 or BISC 3. Offered: FA

TURF 235 The Turfgrass (3) Offered: FA

TECHNICAL ELECTIVE COURSES[+]

Any course acceptable as a Math/Basic Science, Engineering Science/Design OR Biological/Agricultural Science Requirement may be taken as a Technical Selection, plus CMPSC 121, CMPSC 131, CMPSC 200, CMPSC 201, ENGR 310, ENGR 407, ENGR 408, ENGR 451, ENGR 455, MGMT 215, GEOSC 452.

BIOLOGICAL ENGINEERING COURSES

BE 461 Design of Fluid Power Systems (3) Prerequisite: BE 306 or ME 360; CE 360 or ME 320. Offered: FA

BE 462 Design of Wood Structures (3) Prerequisite: BE 303, AE 308, or CE 340. Offered: FA

BE 463 Design Principles of Mechatronics for Biosystems (3) Prerequisite: BE 305 or EE 210 or EE 211 or EE 212. Offered: SP

BE 464 Bioenergy Systems Engineering (3) Prerequisite: EME 301, ME 201, ME 300, or CHE 220. Prerequisite or concurrent: BE 308, CHE 340, or CE 479. Offered: SP

BE 465 Food and Biological Process Engineering (3) Prerequisite: BE 302. Offered: FA

BE 467 Design of Stormwater and Erosion Control Facilities (3) Prerequisite: BE 307 or CE 461. Offered: FA

BE 468 Microbiological Engineering (3) Prerequisite: BE 308 or (MICRB 201 and BMB 211). Prerequisite or concurrent: BE 302. Offered: SP

BE 477 Land-Based Waste Disposal (3) Prerequisite: BE 307 or CE 370. Offered: FA

BE 487 Watershed Modeling for Water Quality Design (3) Prerequisite: BE 307 or CE 461. Offered: SP

[+]Other courses may be taken to meet the engineering science/design, agricultural/biological science, and technical requirements if the student submits a petition approved by the Department of Agricultural and Biological Engineering. All petitions must be submitted and approved prior to the student's graduation semester, however earlier is preferred to ensure adequate progress towards completing degree requirements.

Courses in red are new additions to the supporting course lists and will likely require petitions (coursesub.psu.edu) until they are implemented into the LionPATH degree audit

FOOD AND BIOLOGICAL PROCESS ENGINEERING OPTION SUPPORTING COURSE LISTS

EMPHASIS TECHNICAL (BIOLOGICAL/FOOD SCIENCE) COURSES+

ANSC 300	Integrated Animal Biology (3) Concurrent: (BIOL 11 and BIOL 12) or BIOL 110 or at least third-semester standing. Offered: SP
BE 306	Machines for Agricultural and Biological Processing (3) Prerequisite: EMCH 212 and (EMCH 210 or EMCH 213). Offered: SP
BMB 212	Elementary Biochemistry Laboratory (1) Prerequisite or concurrent: BMB 211. Offered: FA/SP
BMB 251	(MICRB 251) Molecular and Cell Biology I (3) Prerequisite: CHEM 112. Offered: FA/SP
BMB 428	Physical Chemistry with Biological Applications (3) Prerequisite: MATH 141 and PHYS 212 and (CHEM 202 or CHEM 210). Offered: FA
BMB 442	Laboratory in Proteins, Nucleic Acids, and Molecular Cloning (3) Prerequisite: BMB 251, BIOL 230W, or MICRB 201; CHEM 202 or CHEM 210. Prerequisite or concurrent: BMB 211 or BMB 401. Offered: FA/SP
BMB 460	(MICRB 460) Cell Growth and Differentiation (3) Prerequisite: BMB 252 or BIOL 230W. Offered: SP
BMB 464	Molecular Medicine (3) Prerequisite: BMB 251 or MICRB 251 or BIOL 230W. Offered: FA
BIOL 110	Biology: Basic Concepts and Biodiversity (4) Offered: FA/SP/SU
BIOL 220W	Biology: Populations and Communities (4) Prerequisite: BIOL 110. Offered: FA
BIOL 222	Genetics (3) Prerequisite: BIOL 110 or MICRB 201 or BIOL 141 or BIOL 133 or BMB 251. Offered: FA
BIOL 230W	Biology: Molecules and Cells (4) Prerequisite: BIOL 110 and CHEM 110. Offered: SP
BIOL 240W	Biology: Function and Development of Organisms (4) Prerequisite: BIOL 110 and CHEM 110. Offered: SP
BIOL 141	Introductory Physiology (3) Offered: FA/SP/SU
BIOL 161	Human Anatomy and Physiology I (3) Offered: FA (only 3 credits from either BIOL 141 or BIOL 161 can be used toward electives)
BIOL 162	Human Anatomy and Physiology I - Laboratory (1) Prerequisite or concurrent: BIOL 161. Offered: FA
BIOL 163	Human Anatomy and Physiology II (3) Prerequisite: BIOL 161. Offered: SP
BIOL 164	Human Anatomy and Physiology II - Laboratory (1) Prerequisite or concurrent: BIOL 163. Offered: SP
BIOTC 416	(MICRB 416) Microbial Biotechnology (3) Prerequisite: MICRB 201, MICRB 202, BMB 442. Offered: FA
BIOTC 459	(HORT 459, BIOL 459) Plant Tissue Culture and Biotechnology (3) Prerequisite: BIOL 230W or (BMB 251 and BMB 252). Offered; SP
BIOTC 479	Methods in Biofermentations (3) Prerequisite: MICRB 201 and MICRB 202 and (BMB 252 or BIOL 230W) and BMB 442. Offered: FA/SP
BIOTC 489	Animal Cell Culture Methods (3) Prerequisite: MICRB 201 and MICRB 202 and (BIOL 230W or BMB 251). Offered: FA
BME 201	Fundamentals of Cells and Molecules (3) Prerequisite: BIOL 141 or BIOL 240W, CHEM 112, MATH 141. Concurrent: PHYS 212, CMPSC 200. Offered: SP
BME 437	Biomedical Data Science for Bioengineers (3). Offered: FA
BME 455	Stem Cell Biology and Therapy (3) Prerequisite: BIOL 230W or BIOL 240W or BME 201 or BMB 251. Offered: FA
BRS 350	Introduction to Life Cycle Assessment (3) Prerequisite: 5th semester standing and (MATH 110 or MATH 140). Offered: FA
CHEM 112	Chemical Principles II (3) Prerequisite: CHEM 110 or CHEM 106. Offered: FA/SP/SU
CHEM 113	Experimental Chemistry II (1) Prerequisite: CHEM 111. Prerequisite or concurrent: CHEM 112. Offered: FA/SP
CHEM 203	Fundamentals of Organic Chemistry II (3) Prerequisite: CHEM 202. Offered: FA/SP
FDSC 200	Introductory Food Science (3) Prerequisite: CHEM 110. Offered: FA/SP
FDSC 207	(ANSC 207) Animal Products Technology (2) Offered: FA

FDSC 208	(ANSC 208) Animal Products Technology Laboratory (1) Prerequisite or concurrent: ANSC 207. Offered: FA
FDSC 400	Food Chemistry and Analysis (I) (3) Prerequisite: FDSC 200 or FDSC 201 or CHEM 202. Concurrent: BMB 211 and BMB 212. Offered: FA
FDSC 404	Sensory Evaluation of Foods (3) Prerequisite: STAT 250, Junior standing. Offered: FA
FDSC 406W	Physiology of Nutrition (3) Prerequisite: BMB 211. Prerequisite or concurrent: FDSC 200, FDSC 201. Offered: SP
FDSC 407	Food Toxins (2) Prerequisite: BMB 211 and 7th semester standing or higher. Offered: FA
FDSC 408	Food Microbiology (3) Prerequisite: MICRB 201. Prerequisite or concurrent: FDSC 200, FDSC 201. Offered: FA
FDSC 409	Laboratory in Food Microbiology (2) Prerequisite: MICRB 202. Concurrent: FDSC 200, FDSC 201, FDSC 408. Offered: FA
FDSC 410	Food Chemistry and Analysis (II) (3) Prerequisite: FDSC 200 and FDSC 201 and FDSC 400 and BMB 212. Offered: SP
FDSC 411	Managing Food Quality (3) Prerequisite: FDSC 200, FDSC 201, FDSC 408, STAT 250. Offered: FA
FDSC 413	Science and Technology of Plant Foods (3) Prerequisite: FDSC 200, FDSC 201, and at least 2 of the following 400 level courses (FDSC 400, FDSC 405, FDSC 408, FDSC 410). Offered: FA
FDSC 414	Science and Technology of Dairy Foods (3) Prerequisite: FDSC 200, FDSC 201, and at least 2 of the following 400 level courses (FDSC 400, FDSC 405, FDSC 408, FDSC 410). Offered: SP
FDSC 415	Science and Technology of Muscle Foods (3) Prerequisite: FDSC 200, FDSC 201, and at least 2 of the following 400 level courses (FDSC 400, FDSC 405, FDSC 408, FDSC 410). Offered: SP
FDSC 417	Food Laws and Regulations (3) Prerequisite: FDSC 200 and FDSC 201 and 6 credits of 400-level FDSC courses. Offered: SP
FDSC 444	Arguing about Food (3) Prerequisite: FDSC 200. Offered: SP
FDSC 450	Food Innovation and Product Design (3) Prerequisite: FDSC 200 and FDSC 201 and 6 credits of 400-level FDSC courses. Offered: FA
HORT 101	Horticultural Science (3) Offered: FA/SP
HORT 402	Plant Nutrition (3) Prerequisite: HORT 315 or BIOL 441, SOILS 101. Offered: SP
HORT 412W	Post-Harvest Physiology (3) Prerequisite: HORT 101. Recommended Preparation: HORT 351. Offered: SP
HORT 420	Plant Growth Regulators (3) Prerequisite: BIOL 110 or HORT 101. Offered: FA
HORT 451	Hydroponics and Aquaponics (3) Prerequisite: HORT 101 or AGRO 28 or AGECO 121. Students without the formal prerequisite should have junior level standing in science or engineering major. Offered: SP
HORT 453	Flower Crop Production and Management (3) Prerequisite: HORT 101. Offered: SP
PPEM 456	Applied Microbial Ecology (3) Prerequisite: MICRB 201 or MICRB 201H. Offered: FA
VBSC 331	Pharmacology I: Drug Actions and Reactions (3) Prerequisite: BIOL 230W. Offered: FA
VBSC 438	Introduction to Molecular Pharmacology (3) Prerequisite: CHEM 202 and CHEM 201(?) and BIOL 110 and (BMB 211 or BIOL 230W or BMB 251). Offered: SP

FDSC 405 (Food Engineering Principles) is not accepted as an elective due to overlap in content with engineering fundamentals and BE 465.

ENGINEERING SCIENCE/DESIGN COURSES+

BE 306	Machines for Agricultural and Biological Processing (3) Prerequisite: EMCH 212; EMCH 210 or EMCH 213. Offered: SP
BE 461	Design of Fluid Power Systems (3) Prerequisite: BE 306 or ME 360; CE 360 or ME 320. Offered: FA
BE 463	Design Principles of Mechatronics for Biosystems (3) Prerequisite: BE 305 or EE 210 or EE 211 or EE 212. Offered: SP
BE 464	Bioenergy Systems Engineering (3) Prerequisite: EME 301, ME 201, ME 300, or CHE

220. Prerequisite or concurrent: BE 308, CHE 340, or CE 479. Offered: SP

BE 477 Land-Based Waste Disposal (3) Prerequisite: BE 307 or CE 370. Offered: FA

BME 406 Medical Imaging (3) Prerequisite: PHYS 212; CMPSC 200 or CMPSC 201. Offered: FA

BME 410 Biomedical Applications of Microfluidics (3) Prerequisite: CHEM 112; PHYS 211. Prerequisite or concurrent: BME 303, ME 320, CHE 330, AERSP 308, or PHYS 213. Offered: FA

BME 413 Mass Transport in Biological Systems (3) Prerequisite: BME 313 or ME 300 or ME 302 or CHE 220 or PHYS 213 and MATH 250 or MATH 251 and BIOL 141 or BIOL 240W. Offered: SP

BME 419 Artificial Organs and Prosthetic Devices (3) Prerequisite: BIOL 141 or BIOL 240W or BIOL 472 and CMPSC 200 or CMPSC 201 or CMPSC 121. Offered: SP

BME 423 Reaction Kinetics of Biological Systems (3) Prerequisite: BIOL 141 or BIOL 240W, CHEM 112, MATH 250 or MATH 251, BME 313 or CHE 210 or ME 300. Concurrent or prerequisite: BME 413 or CHE 410 or BE 302. Offered: SP

BME 433 Drug Delivery (3) Prerequisite: CHEM 112; BME 201 or BIOL 230W or BMB 251; BME 413 or BE 302 or CHE 410. Offered: SP

BME 443 (MATSE 403) Biomedical Materials (3) Prerequisite: MATSE 201 or CHEM 112; MATH 230 or MATH 231. Offered: FA

BME 444 (IL) (MATSE 404) Surfaces and the Biological Response to Materials (3) Prerequisite: CHEM 112 or MATSE 112. Offered: SP

BME 445 Tissue Engineering: Concepts, Calculations and Applications (3) Prerequisite: CHEM 112; BME 201, BIOL 230W, or BMB 251; PHYS 211. Offered: FA

BME 446 Polymers in Biomedical Engineering (3) Prerequisite: CHEM 112, CHEM 113, CHEM 202 or CHEM 210, EMCH 210 or EMCH 211 and EMCH 213. Offered: FA

CHE 340 Introduction to Biomolecular Engineering (3) Prerequisite: CHE 210 with "C" or better, BMB 251, CHEM 212. Offered: FA/SP

CHE 449 Bioseparations (3) Prerequisite: CHE 410. Offered: FA (last offered in 2021)

CHE 455 Drug Delivery, Pharmacokinetics, and Artificial Organs (3) Prerequisite: CHE 350, BME 409, BME 413, or BE 302. Recommended Preparation: CHE 410. Offered: SP

CE 370 Introduction to Environmental Engineering (3) Prerequisite: CHEM 110; MATH 111 or MATH 141. Offered: FA/SP/SU

CE 371 Water and Wastewater Treatment (3) Prerequisite: CE 360, CE 370. Offered: FA/SP/SU (hasn't been offered since 2021/22)

CE 473 Ecological Design of Regenerative Aquatic Systems (3) Prerequisite: CE 370. Offered: FA

EDSGN 452 Projects in Humanitarian Engineering (2) Prerequisite: 5th semester standing. Concurrent: EDSGN 453. Offered: SP

EDSGN 453 Design for Developing Communities (1) Prerequisite: 5th semester standing. Offered: SP

EDSGN 468 Engineering Design and Analysis with CAD (3) Prerequisite: EMCH 210 or EMCH 211. Offered: FA/SP (**only 3 credits can be used toward electives**)

ENVSE 400 Safety Engineering (3) Prerequisite: CHEM 110 and PHYS 211 and MATH 141. Offered: FA

ENVSE 427 Pollution Control in the Process Industries (3) Prerequisite: CHEM 110 and CHEM 112 and MATH 141 and MNPR 301 and (EME 303 or CE 360). Offered: FA

ENVSE 450 Environmental Health and Safety (3) Prerequisite: CHEM 110. Offered: FA

IE 312 Product Design and Manufacturing Processes (3) Prerequisite: EMCH 213, EMCH 210H, or EMCH 210; Prerequisite or concurrent: ESC 414M or MATSE 259. Offered: FA/SP/SU

IE 327 Introduction to Work Design (3) Prerequisite: MATH 141; Concurrent: EMCH 211 or E MCH 210. Offered: FA/SP/SU

IE 405 Deterministic Models in Operations Research (3) Prerequisite: MATH 220. Offered: FA/SP/SU

IE 425 Stochastic Models in Operations Research (3) Prerequisite: MATH 220 and IE 322. Offered: FA/SP/SU

IE 467 Facility Layout and Location (3) Prerequisite: IE 322 and IE 405. Offered: SP

ME 405 Indoor Air Quality Engineering (3) Prerequisite: ME 320. Offered: FA

ME 410 Heat Transfer (3) Prerequisite: ME 320 or BME 409, CMPSC 200 or CMPSC 201,

MATH 220 or NUCE 309. Offered: FA/SP/SU

ME 420 Compressible Flow I (3) Prerequisite: ME 320. Offered: FA

TECHNICAL SELECTION COURSES[+]

Any course acceptable as Engineering/Science Design or Emphasis Technical Elective may be taken as a Technical Elective, plus CMPSC 121, CMPSC 131, CMPSC 200, CMPSC 201, ENGR 310, ENGR 407, ENGR 408, ENGR 451, ENGR 455, ERM 402, MATH 220, MATH 240, MGMT 215, and STAT 319.

[+]Other courses may be taken to meet the engineering science/design, biological/food science, and technical requirements if the student submits a petition approved by the Department of Agricultural and Biological Engineering. All petitions must be submitted and approved prior to the student's graduation semester, however earlier is preferred to ensure adequate progress towards completing degree requirements.

Courses in red are new additions to the supporting course lists and will likely require petitions (coursesub.psu.edu) until they are implemented into the LionPATH degree audit

NATURAL RESOURCES ENGINEERING OPTION SUPPORTING COURSE LISTS

BIOLOGICAL/ENVIRONMENTAL SCIENCE COURSES+

AGRO 28	Principles of Crop Management (3) Offered: FA
BIOL 110	Biology: Basic Concepts and Biodiversity (4) Offered: FA/SP/SU
BIOL 220W	Biology: Populations and Communities (4) Prerequisite: BIOL 110. Offered: FA
BIOL 240W	Biology: Function and Development of Organisms (4) Prerequisite: BIOL 110 and CHEM 110. Offered: SP
BRS 350	Introduction to Life Cycle Assessment (3) Prerequisite: 5th semester standing and (MATH 110 or MATH 140). Offered: FA
CE 370	Introduction to Environmental Engineering (3) Prerequisite: CHEM 110; MATH 111 or MATH 141. Offered: FA/SP/SU
ENT 425	Freshwater Entomology (3) Offered: FA
ERM 402	Foundations of Sustainable Business (3) Prerequisite: AGBM 101 or ECON 102 or ECON 104. Offered: SP
ERM 411	Legal Aspects of Resource Management (3) Prerequisite: ECON 102 or AGBM 101. Prerequisite or concurrent: ERM 151, CED 152, or EBF 200. Offered: FA
ERM 435	(WFS 435) Limnology (3) Prerequisite: BIOL 110, BIOL 220W, CHEM 110. Offered: FA
ERM 447	Stream Restoration (3) Prerequisite: ASM 327 or BE 307 or CE 461. Offered: FA
ERM 448	Rural Road Ecology and Maintenance (3) Prerequisite: MATH 140. Prerequisite or concurrent: BE 307 or CE 370. Offered: SP
ERM 449	Sustainable Water Management: Economics and Policy (3) Prerequisite: MATH 22 or MATH 110 or MATH 140; AGBM 101 or ECON 102. Recommended Preparation: CED 201 or EBF 200. Offered: SP
ERM 450	(WFS 450) Wetland Conservation (3) Prerequisite: ERM 300 or WFS 209. Offered: FA
FOR 203	Field Dendrology (3) Concurrent: FOR 200W or WP 200W and WP 203. Offered: FA
FOR 455	Remote Sensing and Spatial Data Handling (3) Prerequisite: MATH 110, 3 credits in computer science, 6 credits in ecological and/or geological sciences. Offered: SP
GEOSC 1	Physical Geology (3) Offered; FA/SP
GEOSC 452	Hydrogeology (3) Prerequisite: CHEM 112; GEOSC 1, GEOSC 20 or GEOSC 71; MATH 140 or MATH 110. Offered: FA/SP
HORT 101	Horticultural Science (3) Offered: FA/SP
HORT 131	Herbaceous Perennial and Annual Identification (3) Prerequisite: BIOL 127, BIOL 110 or HORT 101. Offered: FA
SOILS 102	Introductory Soil Science Laboratory (1) Prerequisite or concurrent: SOILS 101. Offered: FA/SP
SOILS 401	Soil Composition and Physical Properties (3) Prerequisite: SOILS 101. Offered: SP
SOILS 402	Soil Nutrient Behavior and Management (3) Prerequisite: CHEM 112, SOILS 101. Offered: SP
SOILS 404	Urban Soils (3) Prerequisite: SOILS 101. Offered: SP
SOILS 405	(GEOSC 405) Hydropedology (3) Prerequisite: SOILS 101. Offered: FA
SOILS 416	Soil Genesis, Classification, and Mapping (4) Prerequisite: SOILS 101. Offered: FA
SOILS 418	(AGECO 418, AN SC 418) Nutrient Management in Agricultural Systems (3) Prerequisite: BIOL 110 or (BIOL 11 and BIOL 12) or BISC 3. Offered: FA
SOILS 420	Remediation of Contaminated Soils (3) Prerequisite: SOILS 101. Offered: FA
SOILS 422	Natural Resources Conservation and Community Sustainability (4) Prerequisite: SOILS 101. Offered: SP
SOILS 450	Environmental Geographic Information Systems (3) Prerequisite: SOILS 101. Offered: FA

ENGINEERING SCIENCE/DESIGN COURSES+

AE 444	Micro CADD Applications for Buildings (3) Prerequisite: AE 222; CMPSC 201 or CMPSC 202. Offered: FA/SP
BE 303	Structural Systems in Agriculture (3) Prerequisite: EMCH 210 or EMCH 213. Offered: SP
BE 462	Design of Wood Structures (3) Prerequisite: BE 303, AE 308, or CE 340. Offered: FA

BE 464 Bioenergy Systems Engineering (3) Prerequisite: EME 301, ME 201, ME 300, or CHE 220. Prerequisite or concurrent: BE 308, CHE 340, or CE 479. Offered: SP

BE 468 Microbiological Engineering (3) Prerequisite: BE 308 or both MICRB 201 and BMB 211 Prerequisite or concurrent: BE 302. Offered: SP

CE 310 Surveying (3) Prerequisite: EDSGN 100, MATH 141. Offered: FA/SP

CE 335 Engineering Mechanics of Soils (3) Prerequisite: EMCH 210 or EMCH 213. Concurrent: GEOSC 1. Offered: FA/SP

CE 340 Structural Analysis (3) Prerequisite: EMCH 210 or EMCH 213. Offered: FA/SP

CE 370 Introduction to Environmental Engineering (3) Prerequisite: CHEM 110; MATH 111 or MATH 141. Offered: FA/SP/SU

CE 371 Water and Wastewater Treatment (3) Prerequisite: CE 360, CE 370. Offered: FA/SP/SU (hasn't been offered since 2021/22)

CE 410 Sustainable Residential Subdivision Design (3) Prerequisite: AE 372 or CE 332. Offered: FA

CE 461 Water-resource Engineering (3) Prerequisite: CE 360. Offered: FA/SP

CE 462 Open Channel Hydraulics (3) Prerequisite: E 360. Offered FA/SP

CE 465 Water Resources Capstone Course (3) Prerequisite: CE 461. Prerequisite or concurrent: CE 462. Offered: SP

CE 472 Environmental Engineering Capstone Design (3) Prerequisite: CE 370, CE 371. Offered: SP

CE 473 Ecological Design of Regenerative Aquatic Systems (3) Prerequisite: CE 370. Offered: FA

CE 475 Water Quality Chemistry (4) Prerequisite: CE 370, CHEM 110, CHEM 111. Offered: SP

CE 476 Solid and Hazardous Wastes (3) Prerequisite: CE 370, CE 371. Offered: SP

EDSGN 452 Projects in Humanitarian Engineering (2) Prerequisite: 5th semester standing. Concurrent: EDSGN 453. Offered: SP

EDSGN 453 Design for Developing Communities (1) Prerequisite: 5th semester standing. Offered: SP

EDSGN 468 Engineering Design and Analysis with CAD (3) Prerequisite: EMCH 210 or EMCH 211. Offered: FA/SP (**only 3 credits can be used toward electives**; AutoCAD section recommended)

TECHNICAL ELECTIVE COURSES[+]

Any course acceptable as Engineering/Science Design or Biological/Environmental Science may be taken as a Technical Elective, plus CHEM 112, CHEM 202, CMPSC 121, CMPSC 131, CMPSC 200, CMPSC 201, ENGR 310, ENGR 407, ENGR 408, ENGR 451, ENGR 455, MATH 220, MATH 240, and MGMT 215

[+]Other courses may be taken to meet the engineering science/design, biological/environmental science, and technical requirements if the student submits a petition approved by the Department of Agricultural and Biological Engineering. All petitions must be submitted and approved prior to the student's graduation semester, however earlier is preferred to ensure adequate progress towards completing degree requirements.

Courses in red are new additions to the supporting course lists and will likely require petitions (coursesub.psu.edu) until they are implemented into the LionPATH degree audit