

Chemical Engineering Technical Electives

Technical Electives: Students must complete at least **6 credits** of technically oriented subject-related courses approved by their advisor. Acceptable topical areas for technical electives include, but are not limited to, biological sciences and engineering; advanced chemistry and physics; electrical engineering; environmental engineering; food processing; materials engineering; and mathematics, statistics, and computing.

- You may **select two courses from one of the groups** listed below or request approval from your advisor for an alternate set of courses.
- **At least one course must include 3 credits of engineering topics**, denoted by superscript “e” in front of the course listing.
- Engineering topics, “e,” courses include courses taught in the College of Engineering as well as some advanced courses taught outside the college.
- You may replace one technical elective with 3 credits of EGR X (internship/co-op course). This must be paired with an “e” course from any category.

BIOLOGICAL SCIENCES AND ENGINEERING

ANTR 350, Human Gross Anatomy for Pre-Health Professionals (p: BS 161) F/S/Su

° **BE 440**, Entrepreneurial Engr. for Innovation in Health & Safety (p: MTH 132; recc: BS 161; jr/sr standing) S

° **BE 444**, Biosensors for Medical Diagnostics (p: BS 161; CEM 151; ECE 345 or approval of dept.) S

° ***CHE 481**, Biochemical Engineering (p: CHE 431; BMB 401 or BMB 461 & BMB 462) F

° **CHE 882**, Advanced Biochemical Engineering (p: CHE 481; approval of instructor) S of EVEN yrs.

° **CHE 883**, Multidisciplinary Bioprocessing Lab (p: CHE 481; approval of instructor) S of ODD yrs.

CSS 350, Introduction to Plant Genetics (p: BS 161 or PLB 105) S

° **EGR 440**, Engineering Entrepreneurship F

° **FSC 211**, Principles of Food Science F/Su

° **FSC 401**, Food Chemistry (p: CEM 352 or BMB 401 or cc) S

FSC 440, Food Microbiology (p: MMG 201 or MMG 301; WRA) F

IBIO 341, Fundamental Genetics (p: BS 161; BS 162) F/S/Su

° **ME 494**, Biofluid Mechanics and Heat Transfer (p: CHE 311 or cc) F

° **ME 495**, Tissue Mechanics (p: ME 222) S

MMG 301, Introductory Microbiology (p: BS 161; CEM 351 or cc) F/S

MMG 409, Eukaryotic Cell Biology (p: BS 161; BMB 401 or cc or BMB 462 or cc) S

MMG 413, Virology (p: BMB 401 or BMB 462 or cc) S

MMG 425, Microbial Ecology (Recc: MMG 301) S

° **MMG 445**, Microbial Biotechnology (p: MMG 301 or BMB 461 or BMB 401; WRA) F/Su

MMG 451, Immunology (p: BS 161; BMB 401 or cc or BMB 461 or cc) F

° **MSE 425**, Biomaterials and Biocompatibility (p: MSE 250 or approval of dept.) F

PHM 350, Introductory Human Pharmacology (p: PSL 250 or PSL 310 or PSL 431 & PSL 432) F/S/Su

PSL 250, Introductory Physiology F/S/Su

° **PSL 425**, Physiological Biophysics (p: PSL 250 or PSL 310 or PSL 431 & PSL 432) F/S

PSL 431, Human Physiology I (p: BS 161; CEM 152) F

PSL 432, Human Physiology II (p: PSL 431; BS 161; CEM 152) S

***Note: Completion of CHE 472 or CHE 481 is a program requirement. Therefore, CHE 472 or CHE 481 taken alone cannot count as both a technical elective and a program requirement.**

If BMB 462 is taken to fulfill major requirements, it will count as a technical elective in biological sciences and engineering but is not an “e” denoted course.

CHEMICAL ENGINEERING

AFRE 829, Economics of Environmental Resources (p: undergraduate intermediate microeconomics, calculus and statistics) S

° **BE 469**, Sustainable Bioenergy Systems (p: CHE 201; CHE 321) S

° **CHE 468**, Biomass Conversion Engineering (p: CHE 321; CHE 431) F

° ***CHE 472**, Composite Materials Processing (p: CHE 311) F

° ***CHE 481**, Biochemical Engineering (p: CHE 431; BMB 401 or BMB 461 & BMB 462) F

° **CHE 483**, Brewing & Distilled Beverage Technology (p: CHE 311; must be 21 yrs; override required) F or S

° **CHE 490**, Independent Study (p: approval of dept.)

° **CHE 882**, Advanced Biochemical Engineering (p: CHE 481; approval of instructor) S of EVEN yrs.

° **CHE 883**, Multidisciplinary Bioprocessing Lab (p: CHE 481; approval of instructor) S of ODD yrs.

° **CSS 467**, BioEnergy Feedstock Production (p: MTH 103 or higher) F

° **EGR 440**, Engineering Entrepreneurship F

° **ME 413**, Cryogenic-Thermal Systems (p: approval of department) S

° **ME 414**, Mechanical Design of Cryogenic Systems (p: approval of department) F

MMG 409, Eukaryotic Cell Biology (p: BS 161; BMB 401 or cc or BMB 462 or cc) S

MMG 421, Prokaryotic Cell Physiology (p: MMG 301; BMB 461 or cc or BMB 401 or cc) F

MMG 431, Microbial Genetics (p: BMB 461 or cc or BMB 401 or cc) F

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ADVANCED CHEMISTRY AND PHYSICS

CEM 411, Advanced Inorganic Chemistry (p: CEM 311 or CEM 384 or CEM 483) F

° **CEM 444**, Chemical Safety (p: CEM 152; CEM 352) F, 1 credit

***CEM 483**, Quantum Chemistry (p: MTH 235; PHY 184; CEM 152) F

° ***CEM 484**, Molecular Thermodynamics (p: MTH 235; CEM 152) S

CEM 485, Modern Nuclear Chemistry (p: CEM 152; PHY 184) S of EVEN yrs.

PHY 215, Thermodynamics and Modern Physics (p: PHY 184; MTH 234 or cc) F/S

PHY 321, Classical Mechanics I (p: PHY 215 or cc; MTH 235 or cc) F/S

PHY 422, Classical Mechanics II (p: PHY 321) F

° **PHY 480**, Computational Physics (Recc: CSE 231) S

**Note: Completion of CEM 483 or CEM 484 is a program requirement. Therefore, CEM 483 or CEM 484 taken alone cannot count as both a technical elective and a program requirement.*

ELECTRICAL ENGINEERING

° **CSE 231**, Programming I (Python) (p: MTH 132 or cc) F/S/Su

° **CSE 232**, Programming II (C++) (p: CSE 231; MTH 132) F/S/Su

° **CSE 260**, Discrete Structures in Computer Science (p: MTH 133) F/S/Su

° **ECE 201**, Circuits and Systems I (p: CSE 231 or cc or CSE 220 or cc or EGR 102 or cc; MTH 234 or cc) F/S

° **ECE 202**, Circuits and Systems II (p: ECE 201; MTH 235 or cc) F/S

° **ECE 230**, Digital Logic Fundamentals (p: CSE 231 or cc or CSE 220 or cc) F/S

° **ECE 280**, Electrical Engineering Analysis (p: MTH 234; ECE 201 or cc) F/S

° **ECE 345**, Electronic Instrumentation and Systems (p: MTH 234 or cc; PHY 184; WRA) F/S/Su

° **EGR 440**, Engineering Entrepreneurship F

ENVIRONMENTAL ENGINEERING

AFRE 265, Ecological Economics (p: EC 201 or cc or EC 202 or cc) F/S

AFRE 360, Environmental Economics (p: AFRE 265; AFRE 203) S

ANS 407, Food and Animal Toxicology (p: BS 161) S

CSS 210, Fundamentals of Soil Science (Recc: CEM 151) F/S

CSUS 465, Environmental and Natural Resource Law (p: CSUS 200 or EEM 255) F

- ° **EGR 440**, Engineering Entrepreneurship F
- ° **ENE 280**, Principles of Environmental Engineering and Science (p: CEM 151; MTH 132 or cc) F/S
- ° **ENE 481**, Environmental Chemistry: Equilibrium Concepts (p: CEM 151; CEM 152; ENE 280 or BE 230 or GLG 201 or GLG 301 or approval of dept.) F
- ° **ENE 483**, Water and Wastewater Engineering (p: ENE 280 or BE 230; CHE 311) F
- ° **ENE 487**, Microbiology for Environmental Science and Engineering (p: ENE 280) S
- ° **ENE 489**, Air Pollution: Science and Engineering (p: CEM 151; MTH 133; ENE 280 or BE 230; CHE 311) S
- IBIO 446**, Environmental Issues and Public Policy F

FOOD PROCESSING

- ° **BE 477**, Food Engineering: Fluids (p: BE 350; BE 351; BE 360) F ***Override granted to senior CHE students.**
- ° **BE 478**, Food Engineering: Solids (p: BE 350; BE 351; BE 360) S
- CEM 482**, Science and Technology of Wine Production (p: CEM 351; must be 21 yrs; override required) F
- ° **CHE 483**, Brewing and Distilled Beverage Technology (p: CHE 311; must be 21 yrs; override required) F or S
- ° **FSC 211**, Principles of Food Science F/Su
- FSC 325**, Food Processing: Unit Operations (p: FSC 211 or ANS 201 or approval of dept.) S
- ° **FSC 342**, Food Safety and Hazard Analysis Critical Control Point Program (p: FSC 211 or cc or HNF 150 or cc or course in MMG, CEM, or BS) F
- ° **FSC 401**, Food Chemistry (p: CEM 352 or BMB 401 or cc) S
- FSC 421**, Food Laws and Regulations (p: HNF 150 or FSC 211 or ABM 100) S of ODD yrs./Su of EVEN yrs.
- ° **FSC 430**, Food Processing: Fruits and Vegetables (p: FSC 211; FSC 325 or BE 350) F
- ° **FSC 431**, Food Processing: Cereals (p: FSC 211; FSC 325 or BE 350) S
- ° **FSC 432**, Food Processing: Dairy Foods (p: FSC 211; FSC 325 or BE 350) F
- ° **FSC 433**, Food Processing: Muscle Foods (p: FSC 211; FSC 325 or BE 350) S
- ° **FSC 440**, Food Microbiology (p: MMG 201 or MMG 301; WRA) F
- FSC 455**, Food and Nutrition Laboratory (p: BMB 401 or cc or BMB 461 or cc; WRA) F
- ° **FSC 470**, Food Production Development, (p: FSC 401; FSC 310; FSC 440) S
- FSC 481**, Fermented Beverages, (p: must be 21 yrs.; override required) F
- MMG 301**, Introductory Microbiology (p: BS 161; CEM 351 or cc) F/S

MATERIALS ENGINEERING

- ° **CE 221**, Statics (p: PHY 183; MTH 234 or cc) F/S/Su
- ° **CHE 472**, Composite Materials Processing (p: CHE 311) F
- ° **EGR 440**, Engineering Entrepreneurship F
- ° **ME 222**, Mechanics of Deformable Solids (p: CE 221; MTH 234) F/S/Su
- ° **ME 361**, Dynamics (p: CE 221; MTH 235) F/S
- ° **ME 413**, Cryogenic-Thermal Systems (p: approval of department) S
- ° **ME 414**, Mechanical Design of Cryogenic Systems (p: approval of department) F
- ° **ME 495**, Tissue Mechanics (p: ME 222) S
- ° **MSE 250**, Materials Science and Engineering (p: CEM 151) F/S/Su
- ° **MSE 260**, Electronic, Magnetic, Thermal and Optical Properties of Materials (p: MSE 250; PHY 184 or cc) S
- ° **MSE 370**, Synthesis and Processing of Materials (p: MSE 250; CHE 321) S
- ° **MSE 425**, Biomaterials and Biocompatibility (p: MSE 250 or approval of dept.) F
- ° **PKG 221**, Packaging with Glass and Metal (p: CEM 151; PHY 183; PKG 102 or cc or approval of dept.) F/S
- ° **PKG 323**, Packaging with Plastics (p: CEM 351; STT 351 or STT 200 or STT 201 or STT 315; MTH 133; PKG 101; PKG 221 or cc or approval of dept.) F/S

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MATHEMATICS, STATISTICS, AND COMPUTING

- MTH 309**, Linear Algebra I (p: MTH 133; WRA; MTH 299 or approval of dept.) F/S/Su
MTH 314, Matrix Algebra with Applications (p: MTH 133) F/S/Su
MTH 320, Analysis I (p: MTH 133; MTH 299 or approval of dept.) F/S/Su
MTH 414, Linear Algebra II (p: MTH 309) F
° **MTH 415**, Applied Linear Algebra (p: MTH 235; MTH 309 or MTH 314) F/S/Su
° **MTH 421**, Analysis II (p: MTH 320; MTH 234) F/S
° **MTH 451**, Numerical Analysis I (p: CSE 231; MTH 235) F
° **STT 351**, Probability and Statistics for Engineering (p: MTH 234) F/S/Su
° **CSE 231**, Programming I (Python) (p: MTH 132 or cc) F/S/Su
° **CSE 232**, Programming II (C++) (p: CSE 231; MTH 132) F/S/Su
° **CSE 260**, Discrete Structures in Computer Science (p: MTH 133) F/S/Su