**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/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
*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
*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.

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
*EC 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
*EC 202, Circuits and Systems II (p: ECE 201; MTH 235 or cc) F/S
*EC 230, Digital Logic Fundamentals (p: CSE 231 or cc or CSE 220 or cc) F/S
*EC 280, Electrical Engineering Analysis (p: MTH 234; ECE 201 or cc) F/S
*EC 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
Updated 6/2022
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

*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.*

**MATHEMATICS, STATISTICS, AND COMPUTING**

Updated 6/2022
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