Chemical Engineering
Technical Electives 2015

**Technical Electives:** Students must complete at least **6 credits** of technically-oriented subject-related courses approved by his or her advisor. Acceptable subjects include, but are not limited to the following: composites processing or biochemical engineering, electronic materials, environment, advanced mathematics, transport phenomena, advanced chemistry, food, legal and regulatory issues, advanced materials, statistics, biomedical engineering, and polymers.

- You may **select two courses from one of the group** 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 subscript “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.

### BIOLOGICAL SCIENCES AND ENGINEERING

**CHE 481**, Biochemical Engineering (CHE 431; BMB 401 or BMB 461 & 462) F  
**CHE 882**, Advance Biochemical Engineering (p: CHE 481) S of EVEN yrs.  
**CHE 883**, Multidisciplinary Bioprocessing Lab (p: CHE 481) S of ODD yrs.  
**CSS 350**, Introduction to Plant Genetics (p: BS 161 or PLB 105) S  
**FSC 211**, Principles of Food Science F/S  
**FSC 401**, Food Chemistry (p: CEM 352 or BMB 401 or cc) S  
**MMG/FSC 440**, Food Microbiology (p: MMG 201 or MMG 301; WRA) S  
**ME 494**, Biofluid Mechanics and Heat Transfer (p: ME 410 or cc) or (CHE 311 or cc) or (BE 350 or cc) F  
**ME 495**, Tissue Mechanics (p: ME 222) S  
**MMG 301**, Intro. Microbiology (p: BS 161; CEM 251 or cc or CEM 143 or cc) F/S  
**MMG 409**, Eukaryotic Cell Biology (p: BS 161; BMB 401 or cc or BMB 462 or cc) S  
**MMG 425**, Microbial Microbiology (RB: MMG 301) S  
**MMG 451**, Immunology (p: BS 161; BMB 401 or cc or BMB 461 or cc) F  
**MSE 425**, Biomaterials and Biocompatibility (p: MSE 250) S  
**PHM 350**, Introductory Human Pharmacology (p: PSL 250 or PSL 431 and 432) F/S/Su  
**PSL 250**, Introductory Physiology (p: none) F/S/Su  
**PSL 425**, Physiological Biophysics (p: PSL 250 or PSL 310 or PSL 431 and PSL 432) F/S  
**PSL 431**, Human Physiology I (p: BS 161; CEM 142 or 152) F  
**PSL 432**, Human Physiology II (p: PSL 431; BS 161; CEM 142 or 152) S  
**ZOL 341**, Fundamental Genetics (BS 161) F/S/Su

*Note: Completion of CHE 472 or CHE 481 is a program requirement. Therefore, CHE 472 or CHE 481 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)  
**CHE 468**, Biomass Conversion Engineering (p: BE 351 or CHE 321) and (BE 360 or CHE 431) F  
**BE 469**, Sustainable Bioenergy Systems (p: BE 230 or CHE 201) S  
**CHE 472**, Composite Materials Processing (p: CHE 311) S  
**CHE 481**, Biochemical Engineering (CHE 431; BMB 401 or BMB 461 & 462) F  
**CHE 490**, Independent Study
CHE 483, Brewing & Distilled Beverage Technology (p: CHE 311 or BE 350 or ME 410 or FSC 325 or cc or BE/FSC 429 or cc; must be 21 yrs.) S
CHE 883, Multidisciplinary Bioprocessing Lab (p: CHE 481) S of ODD yrs.
CHE 882, Advance Biochemical Engineering (p: CHE 481) S of EVEN yrs.
CSS 467, BioEnergy Feedstock Production (p: MTH 103 or higher) F
MMG 409, Eukaryotic Cell Biology (p: BS 161; MMB 401 or cc or MMB 462 or cc) S
MMG 421, Prokaryotic Cell Physiology (p: MMG 301 and (MB 461 or concurrently)) or (MMG 301 and (MB 401 or concurrently)) F
MMG 431, Microbial Genetics (p: BMB 461 or concurrently) or (BMB 401 or concurrently) F

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ADVANCED CHEMISTRY AND PHYSICS
CEM 411, Inorganic Chemistry (p: CEM 311 or CEM 384 or CEM 483) S
CEM 444, Chemical Safety (p: CEM 142; CEM 252; override needed) F, I credit
CEM 483, Quantum Chemistry (p: MTH 235; PHY 184; CEM 142 or 152) F
CEM 484, Molecular Thermodynamics (p: MTH 235 and CEM 142 or 152) S
CEM 485, Modern Nuclear Chemistry (p: CEM 142 or CEM 152; PHY 184) S of even yrs.
PHY 215, Thermodynamics and Modern Physics (p: PHY 184 or cc; MTH 234 or cc) F/S
PHY 321, Classical Mechanics I (p: PHY 184, MTH 234 or cc) S/Su
PHY 422, Classical Mechanics II (p: PHY 321) F
PHY 480, Computational Physics (RB: CSE 131 or 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
ECE 201, Circuits and Systems I (p: CSE 131 or cc or CSE 231 or cc or EGR 102 or cc or CSE 220 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 131 or 231 or or CSE 220 or EGR 102) F/S
ECE 280, Electrical Engineering Analysis (p: MTH 234; ECE 201 or cc) F/S
ECE 345, Electronic Instrumentation and Systems (p: MTH 235, PHY 184; WRA) F/S
ECE 231, Programming I (Python) (p: MTH 132 or cc) F/S
ECE 232, Programming II (Python) (p: CSE 231; MTH 132) F/S
ECE 260, Discrete Structures in Computer Science (p: MTH 133) F/S

ENVIRONMENTAL ENGINEERING
ANS 407, Food and Animal Toxicology (p: BS 161) F
CSUS 465, Environmental and Natural Resource Law (p: CSUS (ESA) 200 or EEP 255) F
ECE 280, Principles of Environmental Engineering and Science (p: CEM 141 or CEM 151; MTH 132 or cc) F/S
ECE 481, Environmental Chemistry; Equilibrium Concepts (p: CEM 151 and 152;, ENE 280 or Be 230 or GLG 201 or GLG 301 or approval of dept.) F
ECE 483, Water & Wastewater in Environmental Engineering (p: ENE 280 and CE 312) F
ECE 487, Microbiology for Environmental Science and Engineering (p: ENE 280) S
ECE 489, Air Pollution Science Engineering (p: (CEM 141 or CEM 151 or LB 171) and (MTH 133 or MTH 153H or LB 119) and (ENE 280 or BE 230) and (CE 321 or CHE 311) S
CSS 210, Fundamentals of Soil Science F
EEP 255, Ecological Economics F/S
EEP 320, Environmental Economics (p: EEP 255 and EC 201) S
EEP 405, Corporate Environmental Management (p: EEP 255 or ABM 332 or MGT 315 or MGT 325) S
ZOL 446, Environmental Issues and Public Policy F

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**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 and BE 351 and BE 360) S
- **CEM 482**, Science and Technology of Wine Production (p: CEM 143 or CEM 251 or CEM 351; must be 21 yrs.) F
- **CHE 483**, Fermented Beverage Technology (p: CHE 311 or BE 350 or ME 410 or FSC 325 or cc or BE/FSC 429 or cc; must be 21 yrs.) S
- **FSC 211**, Principles of Food Science F/S
- **FSC 325**, Food Processing: Unit Operations (p: FSC 211 or ANS 201) S
- **FSC 342**, Food Safety and Hazard Analysis Critical Control Point Program (p: FSC 211 or HNF 150 or cc or HNF 160 or cc or cc 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 HNF 260 or ABM 100) S
- **FSC 430**, Food Processing: Fruits and Vegetables (p: FS 211) F
- **FSC 431**, Food Processing: Cereals (p: FSC 211) S
- **FSC 432**, Food Processing: Dairy Foods (p: FSC 211 or ANS 201) S
- **FSC 433**, Food Processing: Muscle Foods (p: FSC 211 or ANS 201) S
- **FSC 440**, Food Microbiology (p: MMG 201 or MMG 301: WRA) F
- **FSC 455**, Food and Nutrition Laboratory (p: (BMB 200 or concurrently) or (BMB 401 or concurrently) or (BMB 461 or concurrently)) and completion of Tier I writing requirement) F
- **FSC 470**, Food Production Development, (p:(FSC 401 and FSC 410) and (FSC 440 or concurrently) S
- **MMG 301**, Intro. Microbiology (p: BS 161; CEM 251 or cc or 351 or cc or CEM 143 or cc) F/S

**MATERIALS ENGINEERING**

- **CHE 472**, Composite Materials Processing (p: CHE 311 or ME 332 or CE 321) F
- **CE 221**, Statics (p: PHY 183, MTH 234, or cc) F/S/Su
- **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 495**, Tissue Mechanics (p: ME 222) S
- **MSE 250**, Introduction to Materials Science (p: CEM 141 or CEM 151) F/S/Su
- **MSE 260**, Electronic Structure and Properties of Materials (p: MSE 250, PHY 184 or cc; CEM 141 or CEM 151) S
- **MSE 370**, Physical Processing of Materials (p: MSE 250 and CHE 321 or ME 201 or PHY 215 or MSE 410) S
- **MSE 425**, Biomaterials and Biocompatibility (p: MSE 250) S
- **PKG 221**, Packaging with Glass & Metal (p: CEM 141 or 151; PHY 183 or PHY231; PKG 101 or cc) F/S
- **PKG 323**, Packaging with Plastics (p: PKG 101; PKG 221 or cc; CEM 351 or CEM 251 or CEM 143; STT 351 or STT 200 or STT 201; MTH 132 or MTH 124) F/S

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**MATHEMATICS, STATISTICS, AND COMPUTING**

- **MTH 309**, Linear Algebra I (p: MTH133 and (MTH 299 or approval of dept.; WRA) F/S/Su
- **MTH 314**, Matrix Algebra with Applications (p: MTH133) F/S/Su
- **MTH 320**, Analysis I (p: MTH133 and (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 and MTH 234) F/S/Su
- **MTH 451**, Numerical Analysis I (p: CSE 131 or CSE 231; MTH 309 or 314 or 415; MTH 235) F
- **STT 351**, Probability and Statistics for Engineering (p: MTH 234) F/S/Su
- **CSE 231**, Programming I (Python) (p: MTH 124 or cc or MTH 132 or cc) F/S/Su
- **CSE 323**, Programming II (Python) (p: CSE 231; MTH 124 or cc or MTH 132) F/S/Su
- **CSE 260**, Discrete Structures in Computer Science (p: MTH 133) F/S