APPROVED TECHNICAL ELECTIVES FOR COMPUTER ENGINEERS

Twenty-one (21) semester credit hours of Technical Electives are required. **Courses not on these lists may be counted as Technical Electives only if they have Calculus and Physics or Chemistry prerequisites and are approved by the Curriculum Committee.** A written request must be submitted and approved **before** the course is taken. For 500-level technical elective options, see your academic adviser. A 500-level course is open to "qualified undergraduate students" (students in the upper half of their class). **NO Graduate or Undergraduate Seminars** are allowed for Technical Elective credit. Graduate Special Topics courses require ECpE Curriculum Committee review.

- At least six (6) credits must be from the list of CprE electives
- Three (3) credits must be taken from the list of ComS electives
- Three (3) credits must be taken from the list of Electrical Engineering electives (check CprE Supplemental Focus Areas for Electrical Engineering elective substitution options)
- The remaining nine (9) credits required can be chosen from the lists of CprE, EE, ComS, or technical electives

IMPORTANT NOTATIONS (Please Read):

1. $ Course is cross-listed (same course). Can only apply one towards graduation EE, CprE, SE, or ComS
2. ✓ Will need to check "Schedule of Classes" at http://classes.iastate.edu/ for class availability
3. * Only one course either MatE 273 or MatE 392 may be applied as a technical elective
4. * Only Math 207 or Math 317 can apply towards graduation requirements, not both courses
5. EE 351 and EE 388 may be used to fulfill International Perspective requirements - You must choose if you want the course applied to either a general education or technical elective requirement, but not both
6. ENGR/EE/CprE 467, EE 442 & EE 448 **cannot** be used to fulfill any elective requirements

COMPUTER ENGINEERING ELECTIVES (6 cr.)

The semester the courses are offered may change

COURSES	DESCRIPTION	SEM	CR	PREREQUISITES (Check latest catalog for complete lists)
$CprE/SE 329	Software Project Management	✓	3	ComS 309
$CprE/EE 330	Integrated Electronics	✓	4	EE 201, Cr/E EE 230, CprE 281
$CprE/SE 339	Software Architecture & Design	✓	3	SE 319
CprE 388	Embedded Systems II: Mobile Platforms	✓	4	CprE 288
$ComS/SE/CprE 412	Formal Methods in Software Engineering	✓	3	ComS 330 or CprE 310; Com S 311, Stat 330
$CprE/SE 416	Software Evolution and Maintenance	✓	3	ComS 309
CprE 417				
$CprE/EE 418	High Speed Sys. Engr. Meas. & Test.	F	4	EE 230, EE 311
$CprE/SE 419	Software Tools for Large Scale Data Analysis	✓	4	CprE 308 or ComS 352, ComS 309
$CprE/ComS 425	High Performance Computing for S & E Apps	S	3	ComS 311, ComS 230, Engl 250
$CprE/ComS 426	Introduction to Parallel Algorithms and Programming	F	4	CprE 308 or ComS 321, CprE 315 or ComS 311
CprE 431	Basics of Information Systems Security	S	3	Cr/E CprE 308 or ComS 352
$CprE/EE 435	Analog VLSI Circuit Design	S	4	EE 324, EE 330, EE 332 & either EE 322 or Stat 330
$CprE/ComS 444	Introduction to Bioinformatics	F	4	Math 165 or Stat 401 or equivalent
CprE 450	Distributed Systems & Middleware	✓	3	CprE 308 or ComS 352
$CprE/ComS 454	Distributed & Network Operating Systems	✓	3	ComS 311, ComS 352
CprE 458	Real-Time Systems	✓	3	CprE 308 or ComS 352
$CprE/EE 465	Digital VLSI Design	S	4	EE 330
$CprE/EE 466	Multidisciplinary Engineering Design	F/S	3	Senior within 2 semester of graduation, instructor
CprE 480	Graphics Processing and Architecture	S	4	CpreE 381 or ComS 321
CprE 488	Embedded Systems Design	✓	4	CprE 381 or ComS 321
CprE 489	Computer Networking & Data Comm	F/S	4	CprE 381 or EE 324
CprE 490	Independent Study	F/S/SS	1-2	Only 2 credits of 490 may be used as tech elective, Senior Classification in CprE

COMPUTER SCIENCE ELECTIVES (3 cr.)

The semester the courses are offered may change

COURSES	DESCRIPTION	SEM	CR	PREREQUISITES (Check latest catalog for complete lists)
ComS 252	Linux Operating System Essentials	F	3	ComS 107 or ComS 207 or ComS 227
$ComS/SE 319	Software Construction & User Interface	F	3	ComS 228
ComS 327	Advanced Programming Techniques	F/S	3	ComS 228, Cr/E Math 166
ComS 331	Theory of Computing	F/S	3	Min of C- in ComS 228, Math 166, & CprE 310 or ComS 230; Engl 250
ComS 336	Introduction to Computer Graphics	F	3	ComS 327, CoReq Math 207 or Math 317
ComS 342	Principles of Programming Languages	F/S	3	Min of C- in ComS 228, Com S 330 or CprE 310
$ComS 350	Number Theory	S	3	Math 201 or ComS 230
ComS 362	Object Oriented Analysis & Design	F/S	3	Minimum of C- in ComS 228; Engl 250
ComS 363	Intro to Database Management Systems	F/S	3	Minimum of C- in ComS 228; Engl 250
$ComS/SE 409	Software Requirements Engineering	F	3	ComS 309
$ComS/SE/CprE 412	Formal Methods in Software Engineering	S	3	Com S 230 or CprE 310; ComS 311, Stat 330
$ComS/SE 417	Software Testing	S	3	ComS 309, ComS 230or CprE 310; Engl 250
ComS 418	Intro to Computational Geometry	✓	3	ComS 311 or permission from instructor
ComS 421	Logic for Math & Computer Science	S	3	Math 301 or 207 or 317 or ComS 230
$ComS/CprE 425	High Performance Computing for S&E Apps	S	3	ComS 311, ComS 230; Engl 250
$ComS/CprE 426	Introduction to Parallel Algorithms and Programming	F	4	CprE 308 or ComS 321, CprE 315 or ComS 311
ComS 430	Advanced Programming Tools	F	3	ComS 311, ComS 362 or 363; Engl 250
ComS 437	Computer Game and Media Programming	S	3	Com S 336 or permission of instructor
ComS 440	Principles & Practices of Compiling	✓	3	ComS 331, ComS 342, Engl 250
$ComS/CprE 444	Introduction to Bioinformatics	F	4	Math 165 or Stat 401 or equivalent
$ComS/CprE 454	Distributed & Network Operating Systems	Alt. S	3	ComS 311, ComS 352
ComS 455	Simulation: Algorithms & Implementation	Alt. F	3	ComS 311, ComS 230, Stat 330, Engl 250
ComS 461	Principles/Internals of Database Systems	F	3	ComS 311, Com S 363, Engl 250
ComS 472	Principles of Artificial Intelligence	F	3	ComS 311, ComS 230 or CprE 310, Stat 330, ComS 342 or comparable programming experience, Engl 250
ComS 474	Elements of Neural Computation	Alt. F	3	Com S 311, Com S 230 or CprE 310, Stat 330, Math 165, Com S 342 or comparable programming experience, Engl 250
ComS 477	Prob. Solving Tech. for Applied ComS	Alt. F	3	ComS 228; CprE 310 or ComS 330, Math 166, Math 207 or 317, or consent of instructor
ComS 481	Numerical Mthds for Differential Equations	S	3	Math 265, Math 266 or 267, programming knowledge
ComS 486	Fund. Concepts in Computer Networking	S	3	ComS 352

TECHNICAL ELECTIVES (9 cr.) - *This list PLUS CprE, EE & ComS List

The semester the courses are offered may change

COURSES	DESCRIPTION	SEM	CR	PREREQUISITES (Check latest catalog for complete lists)
ArtIS 408	Principles of 3D Animation	F/S	3	ARTIS 308 (see adviser for form)
ArtIS 409	Computer/Video Game Design & Dvmt	F/S	3	Permission of Instructor, ComS 227, ComS 228, ComS 229, Artis 230, Artis 208 (see adviser for form)
BME 220	Introduction to Biomedical Engineering	S	3	Biol 212, ENGR 160/Equiv, Math 166, Chem 167 or 178, Phys 222
BME 341	BioMEMs and Nanotechnology	✓	3	BME 220
BME 341L	BioMEMs and Nanotechnology Lab	✓	1	BME 220, Concurrent Enrollment in BME 341
BME 352	Molecular, Cellular and Tissue Biomechanics	✓	3	BME 220, EM 324, MatE 273
BME 428	Image Processing with Biomedical Applications	✓	3	EE 324
$BME/ChE 440	Biomecial Applications of Chemical Engineering	✓	3	ChE 210, Math 266, Phys 222
BME/EE 450	Biosensing	✓	3	BME 220
BME 450L	Biosensing Lab	✓	1	BME 220, concurrent Enrollment in BME 3450
BME 456	Biomaterials	F	3	MatE 216 or 273 or 392
Biol 211	Principles of Biology I	F/S	3	HS Bio
Biol 211L	Principles of Biology I Lab	F/S	1	Credit or enrollment in Biol 211
Biol 212	Principles of Biology II	F/S	3	HS Biol; HS Chem or Cr/E in Chem 163 or 177
Biol 212L	Principles of Biology II Lab	F/S	1	Credit or enrollment in Biol 212
CE 326	Principles of Environmental Engineering	F/S	3	Chem 177 or Chem 178, Math 166, Cr/E EM 378
ConE 380	Engineering Law	F/S	3	Junior classification
EM 274	Statics of Engineering	F/S/SS	3	Cr/E Math 166, Cr/E Phys 221
EM 324	Mechanics of Materials	F/S/SS	3	EM 274
EM 327	Mechanics of Materials Laboratory	F/S/SS	1	Cr/E EM 324
EM 345	Dynamics	F/S/SS	3	EM 274, Cr/E Math 266 or Math 267
$EE/ME 451	Engineering Acoustics	Alt. S	3	Phys 221, Math 266 or Math 267
Engr 340	Intro to Wind Energy: Sysm Dsgn & Delvry	F	3	Math 166, Phys 222
IE 305	Engineering Economic Analysis	F/S/SS	3	Math 166
*MatE 273	Principles of Materials Science & Engr	F/S/SS	3	Chem 167 or 177, Math 165, Sophomore class
*MatE 392	Principles of Materials Science & Engr	SS	3	MatE 391, Chem 167 or Chem 177
* Math 207	Matrices and Linear Algebra	F/S/SS	3	2 semesters of calculus
Math 314	Graphs Theories	S	3	Math 166 or 166H, Math 201 or experience with proofs
*Math 317	Theory of Linear Algebra	F/S	4	Math 166, Cr/E Math 201
Math 341	Intro to Theory of Probability & Statistics I	F/S	3	Math 265 or 265H
$Math 350	Number Theory	S	3	201 or ComS 230
Math 365	Complex Variables with Applications	S	3	Math 265
Math 373	Intro to Scientific Computing	F	3	Math 265
Math 385	Intro to Partial Differential Equations	F/S	3	Math 265, Math 266 or Math 267
Math 481	Numerical Mthds for Diff. Eq. & Interpolation	S	3	Math 265, Math 266 or Math 267, programming knowledge
ME 231	Engineering Thermodynamics I	F/S/SS	3	Math 166, Chem 167, Phys 221
ME 332	Engineering Thermodynamics II	F/S/SS	3	ME 231
ME 433	Alternative Energy	F	3	Phys 221/222 & Chem 167
NS 320	Naval Ship Systems I - Engineering	F	3	NROTC students only – Phys 221, Sophomore
NS 330	Naval Ship Systems II - Weapons	S	3	NROTC students only – Phys 221, Sophomore
NucE 401	Nuclear Radiation Theory & Engineering	F	3	Phys 222, Math 266 or Math 267
NucE 402	Nuclear Reactor Engineering	S	3	NucE 401
NucE 405	Radiation Protection and Shielding	✓	3	NucE 401
NucE 410	Nuclear Reactor Theory	F	3	NucE 401
NucE 411	Nuclear Reactor Analysis	S	3	NucE 410

COURSES	DESCRIPTION	SEM	CR	PREREQUISITES (Check latest catalog for complete lists)
NucE 430	Nuclear Energy and Society	Alt. S.	3	NucE 401
NucE 441	Probabilistic Risk Assessment	S	3	Stat 305 or equivalent
NucE 461	Radiation Detection, Measuremt & Simulation	S	3	NucE 401
Phys 321	Intro to Modern Physics I	F	3	Phys 222, Cr/E Math 266
Phys 321L	Introductory Lab in Modern Physics	F	1	Cr/E Phys 321
Phys 322	Intro to Modern Physics II	S	3	Phys 321
Phys 322L	Introductory Lab in Modern Physics II	S	1	Cr/E Phys 322
Stat 231	Probability & Statistical Inference for Engineers	F/S	4	Cr/E in Math 265
Stat 322	Probabilistic Methods for Electrical Engineers	F/S	3	EE 224

ELECTRICAL ENGINEERING ELECTIVES (3 cr.)

The semester the courses are offered may change

COURSES	DESCRIPTION	SEM	CR	PREREQUISITES (Check latest catalog for complete lists)
EE 224	Signals & Systems I	F/S	4	EE 201, Math 267, Phys 222
EE 303	Energy Systems & Power Electronics	F/S	3	Math 267, Phys 222, Cr/E EE 224 and EE 230
EE 311	Electromagnetic Fields & Waves	F/S	4	EE 201, Math 265, Phys 222, Cr/E Math 267
EE 314	Elecromagnetics for non Elec Engineers	✓	3	Phys 222, Phys 112, or equivalent
EE 321	Communications Systems I	F	3	EE 224
EE 322	Probabilistic Methods for Elec Engineers	F/S	3	EE 224
EE 324	Signals & Systems II	F/S	4	EE 224
$EE/CprE 330	Integrated Electronics	✓	4	EE 201, Cr/E EE 230, CprE 281
EE 332	Semiconductor Materials & Devices	S	3	Phys 222, EE 230
EE 336	Biomedical Instrumentation		3	EE 188, 224, 230
EE 351	Analysis of Energy Systems	✓	3	Phys 222
EE 388	Sustainable Engineering & Int'l Devlpmnt	F	3	Junior Classification in Engineering
EE 414	Microwave Engineering	F	4	EE 230, EE 311
EE 417	Electrmgntc Radiation, Antennas, & Prop.	S	4	EE 311
$EE/CprE 418	High Speed Syst Engr Msrmnt & Test	F	4	EE 230, EE 311
EE 422+	Communications Systems II	✓	3	EE 321, C/E EE 423
EE 423+	Communications Systems Laboratory	✓	1	EE 321 & Enrollment in EE 422
EE 424	Intro to Digital Signal Processing	✓	4	EE 224
EE 432	Microelectronics Fabrication Techniques	✓	4	Cr/E EE 332
$EE/CprE 435	Analog VLSI Circuit Design	S	4	EE 324, EE 330, EE 332, EE 322 or Stat 330
EE 438	Optoelectronic Devices & Applications	✓	3	EE 311, EE 332
EE 439	Nanoelectronics	F	3	EE 332 or MatE 334
EE 452	Elec Machines & Pwr Electrnc Drives	S	3	EE 303, EE 324
EE 455	Intro to Energy Distribution Systems	F	3	EE 303, Cr/E EE 324
EE 456	Power System Analysis I	F	3	EE 303, Cr/E EE 324
EE 457	Power System Analysis II	S	3	EE 303, Cr/E EE 324
EE 458	Economic Sys. for Elect. Power Planning	✓	3	EE 303 or Econ 301
EE 459	Electromechanical Wind Energy Conservation and Grid Integration	✓	3	Cr/E EE 452 & EE 456
$EE/CprE 465	Digital VLSI Design	S	4	EE 330
$EE/CprE 466	Multidisciplinary Engineering Design	F/S	3	Must be within 2 semester of graduation and receive instructor permission
EE 475	Automatic Control Systems	F	3	EE 324
EE 476	Control System Simulation	S	3	EE 475
EE 488	Eddy Current Nondestructive Evaluation	F	3	Math 265, MatE 216 or 273 or EE 311 or Phys 364
EE 489	Survey of Remoste Sensing Technologies	S	3	Four Courses in physical or biological seciences or engineering
EE/Phys 496	Modern Optics	S	3	Cr/E Phys 322 & Phys 365 & Phys 480