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 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 nine (9) credits must be from the list of CprE electives
- Six (6) credits must be taken from the list of Computational Thinking electives
- Six (6) credits can be taken from the Non-CprE/EE Technical Elective List

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 (9 cr.)

COURSES	DESCRIPTION	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	Com S 311, Stat 330
CprE 414x	Introduction to Software Systmes for Big Data Analytics	4	ComS 363; CprE 315 or 308; Com S 311 or 352
$CprE/SE 416	Software Evolution and Maintenance	3	ComS 309
$CprE/EE 418	High Speed Sys. Engr. Meas. & Test.	4	EE 230, EE 311
$CprE/SE 419	Software Tools for Large Scale Data Analysis	4	CprE 308 or ComS 352, ComS 309
$CprE/SE 421	Software Analysis and Verification for Safety and Security	3	ComS 309; CprE 310 or ComS 230
$CprE/ComS/Math 424	Introduction to High Performance Computing	3	Math 265; Math 207 or Math 317
$CprE/ComS 425	High Performance Computing for S & E Apps	3	ComS 311, Engl 250, SpCm 212
$CprE/ComS 426	Intro to Parallel Algorithms and Program.	4	CprE 308 or ComS 321, CprE 315 or ComS 311
CprE 430/530	Network Protocols and Security	3	CprE 381 or equivalent
CprE 431	Basics of Information Systems Security	3	Cr/E CprE 308 or ComS 352
$CprE/EE 435	Analog VLSI Circuit Design	4	EE 330
$CprE/ComS 444	Introduction to Bioinformatics	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	4	EE 330
$CprE/EE 466	Multidisciplinary Engineering Design	3	Senior within 2 semester of graduation, instructor permission
CprE 480	Graphics Processing and Architecture	4	CprE 381 or ComS 321
CprE 483	Hardware Software Integration	4	CprE 381
CprE 488	Embedded Systems Design	4	CprE 381 or ComS 321
CprE 489	Computer Networking & Data Comm	4	CprE 381 or EE 324
CprE 490	Independent Study	1-2	Only 2 credits of 490 may be used as tech elective, Senior Classification in CprE

COMPUTATIONAL THINKING ELECTIVES (6 cr.)

COURSES	DESCRIPTION	CR	PREREQUISITES (Check latest catalog for complete lists)
ComS 331	Theory of Computing	3	Min of C- in ComS 228, Math 166, & CprE 310 or ComS 230; Engl 250
ComS 342	Principles of Programming Languages	3	Min of C- in ComS 228 & Math 165; Com S 230 or CprE 310
$ComS 350	Number Theory	3	Math 201 or ComS 230
$ComS/SE/CprE 412	Formal Methods in Software Engineering	3	ComS 311; Stat 330
ComS 415	Software System Safety	3	Com S 309 or Com S 11
ComS 418	Intro to Computational Geometry	3	ComS 311 or permission from instructor
ComS 421	Logic for Math & Computer Science	3	Math 301 or 207 or 317 or ComS 230
$ComS/CprE 426	Introduction to Parallel Algorithms and Programming	4	CprE 308 or ComS 321, CprE 315 or ComS 311
ComS 435	Algorithms for Large Data Sets: Theory and Practice	3	Com S 311 or equivalent
ComS 440	Principles & Practices of Compiling	3	ComS 331, ComS 342, Engl 250, SpCm 212
ComS 441	Programming Languages	3	ComS 342 or 440
ComS 455	Simulation: Algorithms & Implementation	3	ComS 311, ComS 230, Stat 330, Engl 150, Sp Cm 212
ComS 472	Principles of Artificial Intelligence	3	Com S 311, Stat 330 or 305, Engl 250, Sp Cm 212
ComS 474	Introduction to Machine Learning	3	Com S 311, Stat 330 or 305, Math 165, Engl 250, Sp Cm 212
$ComS/Math 481	Numerical Mthds for Differential Equations	3	Math 265, Math 266 or 267
EE 224	Signals and Systems I	4	EE 201, Math 267, Phys 222
EE 324	Signals and Systems II	4	EE 224
IE 312	Optimization	3	Credit or Enrollment in Math 267
MATH 301	Abstract Algebra I	3	Math 166, Math 317 or 407, C- in Math 201
MATH 302	Abstract Algebra II	3	Math 301
MATH 304	Combinatorics	3	Math 166; Math 201 or experience with proofs
MATH 314	Graph Theory	3	Math 166; Math 201 or experience with proofs
MATH 317	Theory of Linear Algebra	4	Credit or Enrollment in Math 201
MATH 331	Topology	3	Math 201; Math 301, 317, 414 or 435
MATH 342	Introduction to the Theory of Probability and Statistics II	4	Stat 201 or equivalent; Stat 341; Math 207 or 317
MATH 350	Number Theory	3	Math 201 or Com S 230
MATH 365	Complex Variables with Applications	3	Math 265
MATH 373	Introduction to Scientific Computing	3	Math 265
MATH 385	Introduction to Partial Differential Equations	3	Math 265 and Math 266 or 267
MATH 407	Applied Linear Algebra	3	Math 317 or Math 207 and experience with proofs
MATH 414	Analysis I	3	Min of C- in Math 201
MATH 415	Analysis II	3	Math 414; Math 265; Math 317 or 407
MATH 421	Logic for Mathematics and Computer Science	3	Math 301 or 207 or 317 or ComS 230
MATH 424	Introduction to High Performance Computing	3	Math 265; Math 207 or 317; or permission of the instructor
MATH 435	Geometry I	3	Math 201; Math 207 or 317
MATH 436	Geometry II	3	Math 201; Math 207 or 317
MATH 474	Mathematics of Finance	3	Check catalog for prereqs

TECHNICAL ELECTIVES (6 cr.)

CprE students may select up to six credits of Non-EE/CprE Electives from 300- and 400-level courses in the following areas: Computer Science, Mathematics, Physics, and other Engineering departments (e.g. ConE 380, or Aer E 494X). The courses listed below are approved exceptions to these guidelines.

COURSES	DESCRIPTION	CR	PREREQUISITES (Check latest catalog for complete lists)
AerE 494	M2I	1…3	
ArtIS 408	Principles of 3D Animation	3	ARTIS 308 (see adviser for form)
ArtIS 409	Computer/Video Game Design & Dvmt	3	Permission of Instructor, ComS 227, ComS 228, ComS 229, Artis 230, Artis 208
BME 220	Introduction to Biomedical Engineering	3	See catalog for prereqs
Com S 252	Linux Operating System Essentials	3	CprE or SE 185 or Com S 127 or 207 or 227
Biol 211	Principles of Biology I	3	HS Bio
Biol 211L	Principles of Biology I Lab	1	Credit or enrollment in Biol 211
Biol 212	Principles of Biology II	3	HS Biol; HS Chem or Cr/E in Chem 163 or 177
Biol 212L	Principles of Biology II Lab	1	Credit or enrollment in Biol 212
Chem 331	Organic Chemistry I	3	Chem 178 or Chem 201
Chem 331L	Organic Chemistry I Lab	1	Chem 177L; credit or enrollment in Chem 331
Chem 332	Organic Chemistry II	3	Chem 331
Chem 332L	Organic Chemistry II Lab	1	Chem 331L; credit or enrollment in chem 332
EM 274	Statics of Engineering	3	Cr/E Math 166, Cr/E Phys 221
EM 324	Mechanics of Materials	3	EM 274
EM 327	Mechanics of Materials Laboratory	1	Cr/E EM 324
EM 345	Dynamics	3	EM 274, Cr/E Math 266 or Math 267
MatE 215	Introduction to Materials Science and Engineeering I	3	Math 165 and Chem 177 or 167
*MatE 273	Principles of Materials Science & Engr	3	Chem 167 or 177, Math 165, Soph class
* Math 207	Matrices and Linear Algebra	3	2 semesters of calculus
ME 231	Engineering Thermodynamics I	3	Math 166, Chem 167, Phys 221
Mteor 342	Atmospheric Physics II	3	Mteor 341
Mteor 435	Radar Applications in Meteorology	3	Mteor 341
NS 320	Naval Ship Systems I - Engineering	3	NROTC students only – Phys 221, Sophomore
NS 330	Naval Ship Systems II - Weapons	3	NROTC students only – Phys 221, Sophomore
Stat 231	Probability & Statistical Inference for Engr	4	Cr/E in Math 265
Stat 322	Probabilistic Methods for Elec. Engineers	3	EE 224

The following courses CANNOT be used as a valid technical elective:

BIOL 307	Women in Science and Engineering
BIOL 393	North American Field Trips in Biology
BIOL 393A	North American Field Trips in Biology: Pre-Trip Seminar
BIOL 393B	North American Field Trips in Biology: North American Field Trip
BIOL 394	International Field Trips in Biology
BIOL 394A	International Field Trips in Biology: Pre-Trip Seminar
BIOL 394B	International Field Trips in Biology: Field Trip to International Location
C E 395	Perspectives in Transportation
CH E 391	Foreign Study Orientation
CH E 392	Foreign Study Program
CPR E 332	Cyber Defense Competition
CPR E 370	Toying with Technology
CPR E/E E 467	Multidisciplinary Engineering Design II
E E 442	Introduction to Circuits and Instruments
E E 448	Introduction to AC Circuits and Motors
ENGR 320	International Experience Report
MATH 397	Teaching Secondary Mathematics Using University Mathematics
MATH 497	Teaching Secondary School Mathematics
MAT E 391	Introduction to US Women's Roles in Industry and Preparation for Summer Study
M E 401	Human Centered Design, Pre-Departure Course
M E 402	Field Engineering: Human Centered Design Concepts
M E 484	Technology, Globalization and Culture
PHYS 311	Intermediate Laboraotry
PHYS 311T	Intermediate Laboratory for Secondary Physics Teachers