MASTER OF SCIENCE IN COMPUTER ENGINEERING AND ELECTRICAL ENGINEERING

The purpose of the Master of Science in Computer Engineering and Electrical Engineering dual degree (M.S.CP.E/E.E.) is to prepare students for advanced study and/or research, or for industry in the fields of both computer and electrical engineering. The M.S.CP.E./E.E. program provides for a strong foundation in all aspects of the design and development of computer systems, and also offers several areas of study within electrical engineering. There is also an option to pursue thesis research under the guidance of a faculty adviser.

There is a growing need for engineers with a strong educational background in both computer engineering and electrical engineering. In the M.S.CP.E./E.E. program, students will be introduced to topics important to the computer engineering field, such as computer hardware design, computer networks, and software engineering, as well as topics in electrical engineering, such as communications and signal processing, electronics and electromagnetics, and power and control systems. The program of study includes a minimum of 45 credit hours of acceptable graduate coursework in both computer engineering and electrical engineering. M.S.CP.E./E.E. degree requirements are described in the section below. Requirements for the M.S.CP.E./E.E. fully satisfy the existing requirements for an M.S. in Computer Engineering and an M.S. in Electrical Engineering. The program is usually completed in four semesters of full-time study.

Admission requirements for the M.S.CP.E./E.E. are the same as those for admission to the Master of Science in Computer Engineering or Electrical Engineering. Students whose accredited B.S. degree is not in computer and/or electrical engineering may pursue the CP.E./E.E. degree provided that they demonstrate proficiency in the material contained in the following undergraduate courses:

ECE 211	Circuit Analysis I	3
ECE 213	Circuit Analysis II	4
ECE 218	Digital Systems	4
ECE 242	Digital Computers and Computing	3
or CS 350	Computer Organization and Assembly Language Programming	
ECE 307	Electrodynamics	4
ECE 308	Signals and Systems	3
ECE 311	Engineering Electronics	4
CS 201	Accelerated Introduction to Computer Science [1]	4
CS 401	Introduction to Advanced Studies I	3
MATH 251	Multivariate and Vector Calculus	4
MATH 252	Introduction to Differential Equations	4

[1] i.e. CS 115 and CS 116 combined

A student may demonstrate proficiency by successfully completing the courses or by demonstrating satisfactory performance in one or more special examinations administered by the department.

In addition to all university requirements for a master of science degree, the M.S.CP.E./E.E. degree has the following requirements:

1. A minimum of 45 credit hours of graduate-level coursework including the following:
   a. Two core courses and two elective courses in a CPE major area, chosen from among the CPE areas of concentration
   b. One core course from each of the two remaining areas of CPE concentration
   c. Four (or more) courses within an EE major area, chosen from among the EE areas of concentration
   d. A minimum of two courses chosen from either or both of the remaining EE areas of concentration
   e. Additional coursework approved by the academic adviser
2. A GPA of at least 3.0/4.0 (excluding prerequisites and proficiencies)

The CPE/EE program is subject to the following restrictions: a minimum of 30 credit hours coursework at the 500-level or higher; at least 30 credit hours of ECE courses, excluding short courses; no more than six credit hours of ECE short courses; six to eight credit hours of research work (ECE 591) leading to an M.S. dissertation may be included with the approval of a thesis adviser.

Each regular (matriculated) graduate student is assigned an academic adviser, indicated in their formal letter of admission to the master's program.

Master of Science in Computer Engineering and Electrical Engineering (Coursework Only Option)

Requirement	Credits
Minimum Credits Required	45
Minimum 500-Level Credit	30
Minimum ECE Credit	30
Maximum 700-Level Credit	6

Code	Title	Credit Hours
Computer Engineering Major Courses		**(12-15)**
Select two core courses from the chosen CPE area of concentration from the lists below (p. 3)		6-7
Select two elective courses from the chosen CPE area of concentration from the lists below (p. 3)		6-8
Computer Engineering Elective Courses		**(6-8)**
Select one course from each of the two remaining CPE areas of concentration from the lists below (p. 3)		6-8
Electrical Engineering Major Courses		**(12-16)**
Select four courses from the chosen EE area of concentration from the lists below (p. 4)		12-16
Electrical Engineering Minor Electives		**(6-8)**
Select two courses from either or both of the remaining EE areas of concentration (p. 4)		6-8
General Electives		**(0-9)**
Select zero to nine credit hours of general ECE electives		0-9

Master of Science in Computer Engineering and Electrical Engineering (Thesis Option)

Requirement	Credits
Minimum Credits Required	45
Minimum 500-Level Credit	30
Minimum ECE Credit	30
Maximum 700-Level Credit	6

Code	Title	Credit Hours
Computer Engineering Major Courses		**(12-15)**
Select two core courses from the chosen CPE area of concentration from the lists below (p. 3)		6-7
Select two elective courses from the chosen CPE area of concentration from the lists below (p. 3)		6-8
Computer Engineering Elective Courses		**(6-8)**
Select one course from each of the two remaining CPE areas of concentration from the lists below (p. 3)		6-8
Electrical Engineering Major Courses		**(12-16)**
Select four courses from the chosen EE area of concentration from the lists below (p. 4)		12-16
Electrical Engineering Minor Electives		**(6-8)**
Select two courses from either or both of the remaining EE areas of concentration (p. 4)		6-8
General Electives		**(0-3)**
Select zero to three credit hours of general ECE electives		0-3
Thesis Research		**(6-8)**
ECE 591	Research and Thesis for Masters Degree	6-8

[1] Students pursuing the thesis option must complete six to eight credit hours of research work (ECE 591) leading to an M.S. dissertation with the approval of a thesis adviser.

CPE Areas of Concentration

Computer Hardware Design

Code	Title	Credit Hours
Core Courses		**(6-7)**
ECE 529	Advanced VLSI Systems Design	3-4
or ECE 429	Introduction to VLSI Design	
ECE 585	Computer Organization and Design	3
Elective Courses		**(48)**
ECE 425	Analysis and Design of Integrated Circuits	3
ECE 429	Introduction to VLSI Design	4
ECE 430	Fundamentals of Semiconductor Devices	3
ECE 441	Smart and Connected Embedded System Design	4
ECE 446	Advanced Logic Design	4
ECE 485	Computer Organization and Design	3
ECE 529	Advanced VLSI Systems Design	3
ECE 530	High Performance VLSI IC Systems	3
ECE 583	High Speed Computer Arithmetic	3
ECE 584	VLSI Architecture for Signal Processing and Communication Systems	3
ECE 585	Computer Organization and Design	3
ECE 586	Hardware Security and Advanced Computer Architectures	3
ECE 587	Hardware/Software Codesign	3
ECE 588	Hardware Acceleration for Machine Learning	3
ECE 589	Computer-Aided Design of Analog IC	3

Computer Systems Software

Code	Title	Credit Hours
Core Courses		**(6)**
CS 550	Advanced Operating Systems	3
CS 551	Operating System Design and Implementation	3
Elective Courses		**(36)**
ECE 449	Object-Oriented Programming and Machine Learning	3
ECE 587	Hardware/Software Codesign	3
CS 487	Software Engineering I	3
CS 545	Distributed Computing Landscape	3
CS 546	Parallel and Distributed Processing	3
CS 550	Advanced Operating Systems	3
CS 551	Operating System Design and Implementation	3
CS 555	Analytic Models and Simulation of Computer Systems	3
CS 586	Software Systems Architectures	3
CS 587	Software Project Management	3
CS 588	Advanced Software Engineering Development	3
CS 589	Software Testing and Analysis	3

Networks and Telecommunications

Code	Title	Credit Hours
Core Courses		**(7)**
ECE 407	Introduction to Computer Networks with Laboratory	4
or ECE 408	Introduction to Computer Networks	
ECE 541	Communications Networks Performance Analysis	3
or ECE 545	Modern Internet Technologies	
Elective Courses		**(74)**

ECE 407	Introduction to Computer Networks with Laboratory	4
ECE 408	Introduction to Computer Networks	3
ECE 443	Introduction to Computer Cyber Security	4
ECE 504	Wireless Communication System Design	3
ECE 508	Video Communications	3
ECE 511	Analysis of Random Signals	3
ECE 513	Communication Engineering Fundamentals	3
ECE 514	Digital Communication Principles	3
ECE 515	Modern Digital Communications	3
ECE 516	Coding for Distributed Storage Systems	3
ECE 517	Modern Wireless Network Protocols and Standards	3
ECE 519	Coding for Reliable Communications	3
ECE 520	Information Theory and Applications	3
ECE 541	Communications Networks Performance Analysis	3
ECE 542	Design and Optimization of Computer Networks	3
ECE 543	Computer Network Security	3
ECE 544	Wireless and Mobile Networks	3
ECE 545	Modern Internet Technologies	3
ECE 546	Wireless Network Security	3
ECE 547		3
ECE 570	Fiber-Optic Communication Systems	3
ECE 584	VLSI Architecture for Signal Processing and Communication Systems	3
CS 455	Data Communications	3
CS 544	Computer Networks II: Network Services	3

EE Areas of Concentration

Communications and Signal Processing

Code	Title	Credit Hours
ECE 401	Communication Electronics	3
ECE 403	Digital and Data Communication Systems	3
ECE 405	Digital and Data Communication Systems with Laboratory	4
ECE 406	Wireless Communications Systems	3
ECE 421	Microwave Circuits and Systems	3
ECE 423	Microwave Circuits and Systems with Laboratory	4
ECE 436	Digital Signal Processing I with Laboratory	4
ECE 437	Digital Signal Processing I	3
ECE 481	Image Processing	3
ECE 504	Wireless Communication System Design	3
ECE 507	Imaging Theory & Applications	3
ECE 508	Video Communications	3
ECE 509	Electromagnetic Field Theory	3
ECE 511	Analysis of Random Signals	3
ECE 513	Communication Engineering Fundamentals	3
ECE 514	Digital Communication Principles	3
ECE 515	Modern Digital Communications	3
ECE 516	Coding for Distributed Storage Systems	3
ECE 519	Coding for Reliable Communications	3
ECE 520	Information Theory and Applications	3
ECE 522	Electromagnetic Compatibility	3
ECE 565	Computer Vision and Image Processing	3
ECE 566	Machine and Deep Learning	3
ECE 567	Statistical Signal Processing	3

ECE 568	Digital Speech Processing	3
ECE 569	Digital Signal Processing II	3
ECE 570	Fiber-Optic Communication Systems	3
ECE 576	Antenna Theory	3
ECE 578	Microwave Theory	3

Computers and Microelectronics

Code	Title	Credit Hours
ECE 407	Introduction to Computer Networks with Laboratory	4
ECE 408	Introduction to Computer Networks	3
ECE 425	Analysis and Design of Integrated Circuits	3
ECE 429	Introduction to VLSI Design	4
ECE 430	Fundamentals of Semiconductor Devices	3
ECE 441	Smart and Connected Embedded System Design	4
ECE 443	Introduction to Computer Cyber Security	4
ECE 446	Advanced Logic Design	4
ECE 449	Object-Oriented Programming and Machine Learning	3
ECE 485	Computer Organization and Design	3
ECE 502	Basic Network Theory	3
ECE 517	Modern Wireless Network Protocols and Standards	3
ECE 521	Quantum Electronics	3
ECE 524	Advanced Electronic Circuit Design	3
ECE 525	RF Integrated Circuit Design	3
ECE 526	Active Filter Design	3
ECE 527	Performance Analysis of RF Integrated Circuits	3
ECE 529	Advanced VLSI Systems Design	3
ECE 530	High Performance VLSI IC Systems	3
ECE 541	Communications Networks Performance Analysis	3
ECE 542	Design and Optimization of Computer Networks	3
ECE 543	Computer Network Security	3
ECE 544	Wireless and Mobile Networks	3
ECE 545	Modern Internet Technologies	3
ECE 546	Wireless Network Security	3
ECE 547		3
ECE 571	Nanodevices and Technology	3
ECE 575	Electron Devices	3
ECE 583	High Speed Computer Arithmetic	3
ECE 584	VLSI Architecture for Signal Processing and Communication Systems	3
ECE 585	Computer Organization and Design	3
ECE 586	Hardware Security and Advanced Computer Architectures	3
ECE 587	Hardware/Software Codesign	3
ECE 588	Hardware Acceleration for Machine Learning	3
ECE 589	Computer-Aided Design of Analog IC	3

Power and Control

Code	Title	Credit Hours
ECE 411	Power Electronics	4
ECE 412	Hybrid Electric Vehicle Drives	4
ECE 417	Power Distribution Engineering	3
ECE 418	Power System Analysis	3
ECE 419	Power Systems Analysis with Laboratory	4
ECE 420	Analytical Methods for Power System Economics and Cybersecurity	3
ECE 438	Control Systems	3

ECE 505	Applied Optimization for Engineers	3
ECE 506	Analysis of Nonlinear Systems	3
ECE 531	Linear System Theory	3
ECE 533	Robust Control	3
ECE 535	Discrete Time Systems	3
ECE 538	Renewable Energies	3
ECE 539	Computer Aided Design of Electric Machines	3
ECE 540	Reliability Theory and System Implementation	3
ECE 548	Energy Harvesting	3
ECE 549	Motion Control Systems Dynamics	3
ECE 550	Power Electronic Dynamics and Control	3
ECE 551	Advanced Power Electronics	3
ECE 552	Adjustable Speed Drives	3
ECE 553	Power System Planning	3
ECE 554	Power System Relaying	3
ECE 555	Power Market Operations	3
ECE 556	Power Market Economics and Security	3
ECE 557	Fault-Tolerant Power Systems	3
ECE 558	Power System Reliability	3
ECE 559	High Voltage Power Transmission	3
ECE 560	Power Systems Dynamics and Stability	3
ECE 561	Deregulated Power Systems	3
ECE 562	Power System Transaction Management	3
ECE 563	Artificial Intelligence in Smart Grid	3
ECE 564	Control and Operation of Electric Power Systems	3
ECE 579	Operations and Planning and Distributed Power Grid	3
ECE 580	Elements of Sustainable Energy	3
ECE 581	Elements of Smart Grid	3
ECE 582	Microgrid Design and Operation	3