Computer Engineering

MS Graduate Handbook

2012 - 2013

ARIZONA STATE UNIVERSITY

MANUAL OF THE MS DEGREE IN COMPUTER ENGINEERING

ARIZONA STATE UNIVERSITY

2012 – 2013

Computer Engineering graduate degrees please contact:

Office of Graduate Programs
School of Computing, Informatics, and Decision Systems Engineering
Arizona State University
PO Box 878809
Tempe, AZ 85287-8809
PHONE: (480) 965-3199

Computer Engineering on the web:
http://cidse.engineering.asu.edu/forstudent/graduate/computer-engineering/
E-mail address: cidse.advising@asu.edu

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I. Introduction to the Computer Engineering Program

Computer Engineering is a multi-disciplinary program that builds on the fundamentals of Computer Science, Electrical Engineering, Industrial Engineering and Applied Mathematics. Graduates of this program will have the knowledge and skills necessary to advance the design, system integration, testing, evaluation and deployment of the state-of-the-art hardware and software for systems that include computing, communications and networking (wired and wireless), control functions, sensing, signal processing and actuation.

The MS degree program is intended for students that want to gain knowledge deeper than that provided at the BS level and sufficient for designing and implementing state-of the-art systems in industrial research and development positions. The program is also appropriate for students contemplating future PhD study and desiring to gain experience in research. MS graduates may work under the direction of PhD scientists and engineers in high tech lab settings assisting in developing innovative products and systems that require strong foundational knowledge in the underlying sciences and the ability to synthesize and analyze engineering principles as they relate to the development of new computer engineering technology.

II. Objective of the handbook

The purpose of this handbook is to provide guidance and information related to admission, degree requirements, and general policies and procedures. Please note that in some cases you will find differences between the Graduate Policies and Procedures and the Computer Engineering Program requirements. In these cases, CE has established higher standards. Students must satisfy both sets of requirements. Please note that policies and procedures are occasionally amended to improve the program. Changes will be communicated to students through email, and posting on paper and online bulletin boards.

III. Student responsibility

All students are expected to become familiar with university and program policies and procedures and abide by the terms set forth. Information is available both online and by hardcopy upon request. Most importantly you should visit the following websites:

- The Graduate College – http://graduate.asu.edu.
- The Graduate Catalog – www.asu.edu/catalog visit the section on policies and procedures.
- The Computer Engineering Program - http://cidse.engineering.asu.edu/forstudent/graduate/computer-engineering/
- The International Student Office – https://global.asu.edu/isso , if applicable.
- The Ira A. Fulton Schools of Engineering – http://engineering.asu.edu

IV. Faculty responsibility

The members of the faculty of Computer Engineering have diverse backgrounds and knowledge. They are available to assist you in your plan of study and your educational

and career goals. We encourage you to take the opportunity to make individual appointments with faculty members with whom you have common interests. Please refer to the list of the faculty names, areas of expertise, and research interest at the end of this handbook.

V. Admission and eligibility to the MS degree programs

The Computer Engineering MS degree requires a background in engineering, sciences or closely related fields. However, in some cases students with non-traditional educational backgrounds will be considered for admission. These students may be required to take foundational courses to better prepare for the graduate coursework. A student is encouraged to contact a graduate advisor in the School of Computing, Informatics, and Decision Systems Engineering Advising Center to obtain advice on their educational pursuits.

Eligibility - Minimum of a bachelor's degree (*or equivalent*) or a graduate degree from a regionally accredited College or University of recognized standing in a related field such as: Computer Engineering, Computer Systems Engineering, Electrical Engineering, and Computer Science.

Application - All students are required to submit an application with the Graduate College and pay the required fee in order to have their application properly processed.

Application deadlines – December 31 for Fall and August 15 for Spring:
To receive full consideration, we ask that you have all the required documents submitted by the deadline.

GRE scores - Students (International and Domestic) are exempt from taking the GRE who have degrees from any ABET accredited program (from US or overseas institutions) and meet the minimum GPA requirements of the academic units. Students, who do not meet these requirements as outlined, will be required to take the GRE.

TOEFL - The University requires all international applicants from a country whose native language is not English to provide the Test of English as a Foreign Languages (TOEFL). **Please note that your application will not be processed until the university receives official TOEFL scores, which are valid two years from the start date of the degree program.** There are some exceptions for students who have been living in the United States and would like to have the TOEFL waived. They should consult the Graduate College. Please address all TOEFL questions to the Graduate College.

Personal statement - Applicant must submit a personal statement that indicates professional goals and reasons for desiring to enroll in the MS program**.**

Letters of recommendation – Computer Engineering requires three (3) letters of recommendation, at least one of which must come from former faculty. There is no

standard form for letters of recommendation. Our current application process allows students to indicate the names and emails of their recommenders. In turn, the Graduate College sends an e-mail to the recommender alerting him or her to go online and submit a recommendation. We encourage letters from people who know you well, such as teachers, professional associates and supervisors. Ask people who can comment on your academic, emotional, intellectual and professional development.

GPA requirement - To be considered for the MS program, we require a minimum of a 3.00 cumulative GPA (scale is 4.0) in the last 60 hours of a student's first bachelor's degree program.

Application evaluation - Several factors are taken into consideration when evaluating a student's application: the student's cumulative GPA, major, institution, personal statement, letters of recommendation, standardized test scores, and performance in individual courses.

Recommended Academic Preparation – Computer Engineering graduate students should have knowledge in the following topics prior to applying for the program at Arizona State University: Computer Architecture & Organization, Algorithms & Data Structures, Digital Signal Processing, Digital VLSI, and Discrete Math.

If admitted to the Computer Engineering graduate program an exam will be administered on the first day of class to gauge knowledge in the topics. There will be one exam in CEN 501 covering Digital Signal Processing, Digital VLSI, and Discrete Math. A second exam will be given in CEN 502 covering Computer Architecture & Organization and Algorithms & Data Structures. The exam will count towards your overall grade in the course, percentile will be determined by the instructor, so it is highly advised that you have taken a related course and use the study guide provided to refresh your knowledge prior to arriving at ASU. Based on the results of the exam it may be recommended that you take the corresponding course at ASU to better prepare you for the Computer Engineering graduate program.

ASU Recommended Course

CSE 230 – Computer Organization and Assembly Language Programming

CSE 310 – Data Structures and Algorithms

EEE 203 – Signals and Systems I

EEE 335 – Analog and Digital Circuits

MATH 243 – Discrete Math Structures

Notice of Admission – Computer Engineering submits its recommendation of admission to the Graduate College and the final notice of admission decision is notified in writing by the Graduate College. You may check your application status on MyASU (my.asu.edu).

Pre-admission credits and Transfer credit – Please refer to the Graduate College policies and procedures.

VI. MS degree requirements

A minimum of 30 credit hours of coursework beyond the bachelor's degree and deficiency courses are required to complete the MS degrees. All Master's students are required to develop and submit a Plan of Study (POS) through online ASU Interactive prior to pre- registering for courses for the upcoming semester. The POS should be developed with the aid of the student's faculty advisor. The CE Graduate Academic Advisor, acting on behalf of the Graduate Program Chair, will initially advise the student. Subsequently, each student should seek out a faculty member in his or her area of study to serve as advisor and committee chair.

a. Degree requirements

There are 6 credit hours required core courses for the MS in Computer Engineering program.

Required Core courses:

Course number & prefix	**Course title**	**Credit hours**
CEN 501	Computer Systems I: Circuits to Architectures	3
CEN 502	Computer Systems II: Fundamentals of Algorithms and Optimization Techniques	3

The combination of CEN501 and CEN502 serves to integrate the required knowledge of electrical engineering and computer science to ensure that all students have the necessary background to pursue advanced study in the areas of computer engineering. CEN501 focuses on circuit and logic design, topics that span the electrical engineering to computer engineering interface. CEN502 begins with computer architecture and focuses on operating systems, compilers, and networking topics that cover the computer science to computer engineering interface. Together this pair of courses provides a common and necessary background for all students in the program to pursue graduate

study in the six areas of the program. As such, these courses must be taken early in the first year of the graduate study.

Elective Courses

Total credits hours for program electives:
Minimum of 18 credit hours (Thesis Option)
Minimum of 24 credit hours (Non-Thesis Option)*

These elective courses in the graduate Computer Engineering program are partitioned into six (6) areas of study, and listed in the table located at the end of this handbook. These courses will be referred to as Computer Engineering Area (CE-Area) courses.

The six (6) areas of study are:

1) VLSI and Architecture
2) Embedded Control Systems
3) Communication and Networks
4) Distributed, Dependable and Secure Systems
5) Multimedia and Signal Processing
6) Systems Optimization

Requirements:

At least 6 credit hours of M* or D* courses cover two (2) of the six (6) areas.

At least 6 credit hours from CE-Area Courses (refer to table at the end of handbook)

At least 6 credit hours of graduate courses in Science, Engineering, or Mathematics (with the approval of the Computer Engineering Graduate Committee).

The combined set of 18 credit hours should be selected to ensure the student has adequate preparation to pursue research in the selected area of the thesis.

*Non Thesis students will take 6 more credit hours towards their area electives.

400-Level Courses and Cross Listed Courses:
No more than 6 hours of 400-level coursework can be included on the graduate student program of study. No more than 12 hours of cross listed courses (4XX/5XX) can be included on the graduate student program of study. No more than a total of 12 hours of a combination of 400-level and cross listed courses (4XX/5XX) can be included on the graduate student program of study.

NAME: _____

Ira A. Fulton Schools of Engineering
ARIZONA STATE UNIVERSITY

ASU ID: _____

Master of Science in Computer Engineering (Computer Systems)

6 Core Credits + 12 Area Credits + 6 Electives Credits+ 6 Elective or Thesis = 30 Credit Hours

6 Credit Hours Core Courses

- ☐ **CEN 501 Computer Systems I**
- ☐ **CEN 502 Computer Systems II**

12 Credit Hours Area Courses

- At least **6 credit hours** of M* or D* courses covering two (2) of the six (6) CE-Areas of Study

  ☐ M* or D* Course _____ Area _____
  ☐ M* or D* Course _____ Area _____

- At least **6 credit hours** from any of the CE-Areas of Study

  ☐ Course _____ Area _____
  ☐ Course _____ Area _____

6 Credit Hours Electives

☐ Course _____
☐ Course _____

6 Credit Hours Electives or Thesis

☐ Course _____
☐ Course _____
or
☐ CEN 599 (3 credits Thesis)
☐ CEN 599 (3 credits Thesis)

CE Areas of Study

VLSI and Architecture – VLSI & A

Distributed, Dependable and Secure Systems – DDSS

Embedded Control Systems – ECS

Multimedia and Signal Processing - MSP

Communications and Networks – CN

Systems Optimization – SO

Overall Credits

- ☐ **30 Credits**
- ☐ **12 Credits CSE**
- ☐ **6 Credits EEE**
- ☐ **CEN 584 Credit Hours (Maximum 2) _____**
- ☐ **No more than 6 credit hours 400 level courses _____**
- ☐ **No more than 12 credits cross listed courses (5XX/4XX) _____**
- ☐ **No more than 12 credits of combined cross listed courses and 400 level course _____**

Please use this sheet as a guide when filling out the iPOS. After electronic submission of the iPOS please turn in this sheet to the Advising Center, BYENG 208.

b. Comprehensive Examination (Non-Thesis Option): Students must achieve a 60% or higher score on the Comprehensive Exam in order to graduate. Comprehensive Examinations are held in once each fall and spring semester. A student must have a cumulative grade-point-average (GPA) of 3.0 over all coursework, 3.0 over all graduate coursework, and 3.0 over all POS courses in order to take the Comprehensive Exam. The written Comprehensive Examination will cover question from the two core classes. The exam will be a closed book two hour exam. Review of comprehensive examination grading is allowed for a two-week period following the posting of results. This will be coordinated through the graduate academic advisor. No review will be allowed after two weeks.

A student who fails the comprehensive examination must petition for re-examination and receive approval from the supervisory committee, CE Program Chair, and the Graduate College Dean before the date of the examination. A student is allowed to retake the examination one time only in the test period immediately following the period in which the examination was failed. If the student's petition for re-examination is not approved or the student fails the re-examination, the department will recommend to the Graduate College to withdraw the student from the MS program.

c. MS Thesis Option: A minimum GPA of 3.0 is required in the first 18 POS hours to pursue the MS thesis option.

MS students writing a thesis require a research advisory committee comprised of at least three faculty members including the committee chair. The two additional members are chosen jointly by the committee chair and the student to facilitate the student's research. A least one additional member should be from the CE faculty. Please refer at the back of the handbook for a list of area faculty and their research.

For MS students, the thesis and a successful oral defense constitute their final examination. A majority pass vote by the student's committee is required. For visa reasons, international students have a maximum of two semesters to finish the thesis after completion of coursework listed in the POS.

d. Steps to Preparing for Your MS Defense:

Prior to defense:

- Obtain a consensus of approval from the committee chair and the committee members to proceed with the oral defense.
- Schedule a date and time with your committee for the oral defense on MyASU.
- Important: Ensure that a minimum of 50% of the official committee be physically present at the defense. If at least 50% of the committee cannot be physically present, the defense must be rescheduled.
- Visit the Graduate College website to familiarize yourself with the dates and deadlines on format approval.

10 days prior to the defense: These steps are required to be complete prior to 10 working days from the date of oral defense.

- Reserve a room with the CIDSE administrative office (Brickyard 5th Floor).
- Submit an electronic version of your abstract with title, full names of your committee members, defense date/time/place, and your name as you want it to appear on the defense announcement to the CIDSE Advising Center front desk (Brickyard Room 208).
- Submit an electronic copy of your completed thesis to the Graduate Program Chair.

On the day of the defense:

- Set-up all your equipment at least one half-hour prior to your presentation to make sure they work properly.

After the defense:

- Your committee will have comments and a discussion with you. At the end, the committee makes a recommendation: Pass, Pass with minor revisions, Pass with major revisions, or Fail.
- Revisions are normal and are expected to be completed within one year period. This includes remaining registered and uploading the finished document on MyASU Format Tools.
- Hand-deliver a copy of your Thesis Defense Report form to the CIDSE Advising Center (BYENG 208).
- Hand-deliver the signed Thesis Defense Report form to the Graduate College.

VII. General Information

a. Research Standards for Publication of Thesis

Graduate research is the study of an issue that is of sufficient breadth and depth to be publishable in CE-related journal. The effort should reflect a minimum of 750 hours of thoughtful work for a thesis (M.S.). The research should follow the 'scientific method' and thus be both objective and reproducible. The thesis should demonstrate independent, original, and creative inquiry. There should be predefined hypotheses or developmental goals and objectives that are measurable and can be tested. The document should demonstrate proficiency with written English and should conform to the Graduate College format guidelines. For more information on format guidelines, please visit the Graduate College web site http://graduate.asu.edu

b. Financial assistance and/or fellowships

There are limited funds for MS students. We encourage students to pursue assistantships outside the CE and not limit their search to CE.

c. Continuous Enrollment and Leave of Absence Policies

Once admitted to a graduate degree program, master and doctoral students must be registered for a minimum of one credit hour (not audit) during all phases of their graduate education. This includes periods when they are engaged in research, working on or defending theses or dissertations, taking comprehensive exams, or in any other way using university facilities or faculty time including the term in which they graduate. This credit must appear on the *Plan of Study* or must be an appropriate graduate-level course (e.g. 595, 695, or 795, Continuing Registration). Courses with grades of "W" and "X" are not considered valid registration for continuous enrollment purposes.

Students planning to discontinue enrollment for a semester or more must request approval for a leave of absence. Students may petition the Graduate College for a leave of absence for a maximum of two semesters during their entire program. A petition for a leave of absence, endorsed by the members of the student's supervisory committee and the head of the academic unit, must be approved by the Graduate College dean. This request must be filed and approved before the anticipated absence.

An approved leave of absence will enable students to re-enter their program without re-applying to the university. Students who do not enroll for a fall or spring semester without an approved leave of absence by the Graduate College are considered withdrawn from the university under the assumption that they have decided to discontinue their program. A student removed for this reason may reapply for admission to resume their degree program; the application will be considered along with all other new applications to the degree program.

A student on leave is not required to pay fees, but in turn is not permitted to place any demands on university faculty or use any university resources.

d. Maximum Time Limit

All work toward a MS degree must be completed within six consecutive years. The six years begins with the semester and year of admission to the program. Graduate courses taken prior to admission that are included on the *Plan of Study* must have been completed within three years of the semester and year of admission to the program.

e. Registration requirements for research assistants (RA) and teaching assistants (TA)

Students awarded an assistantship within the Ira A. Fulton Schools of Engineering are required to be registered for 12 credit hours (no more, no less). Audit credit hours do not count towards the 12 credit hours.

Students who obtain an assistantship outside the Ira A. Fulton Schools of Engineering are required to follow the policy of the unit that hires them.

TAs and RAs are treated as residents for tuition purposes. To be eligible for tuition remission, TAs and RAs must be employed a minimum of 10 hours per week (25 percent Full Time Equivalency {FTE}). TAs/RAs working 10-19 hours per week (25-49 percent FTE)

receive a 50 percent remission of tuition for the semester or summer session of their employment. TAs/RAs working 20 hours per week (50 percent FTE) do not pay tuition during the semester or summer session of their employment. In addition, the university pays the individual's health insurance premium for those TAs and RAs working 20 hours per week (50 percent FTE).

f. Satisfactory Progress, Academic Probation, Progress probation, and Withdrawal from the CE Program: Each semester, the Computer Engineering Program reviews students' files for satisfactory progress towards completion of the degree. All students are placed on one of the four categories:

1. Satisfactory progress
2. Academic Probation
3. Progress Probation
4. Withdrawal from the Computer Engineering Program.

1. Satisfactory progress means that the student does not have any academic and progress probationary issues. In addition to the probationary rules, satisfactory progress includes communication each semester with the student's Committee Chair regarding his or her progress.

2. Academic Probation pertains to grades that might affect Program and University policies including graduation. The following are notices/letters you will receive if one of these pertains to your academics*:*

- GPA below 3.0 in approved POS courses.
- Overall post baccalaureate GPA below 3.0.
- Overall graduate (500 level or above) GPA below 3.0.

3. Progress Probation pertains to issues dealing with making progress towards a degree. The following are notices/letters you will receive if one of these pertains to your academics:

- Failure to pass the Comprehensive Examination.

4. A student is recommended for **withdrawal from the CE Program** if she or he fails to meet the probationary standards placed upon in the semester mentioned in the probationary letter. The student will receive a letter from the Computer Engineering Program explaining the reasons for the withdrawal. The student will have 7 calendar days from the date of the letter to appeal the decision. The Computer Engineering Graduate Affairs Committee (GAC) will review the case and will make the necessary recommendation. The Graduate Program Chair, on behalf of the GAC, will provide a written explanation of the outcome. If the outcome is favorable, the student will have to meet all the outlined requirements at the end of the specified period. The student will be required to sign an agreement acknowledging the recommendations and the consequences if the agreements are not met. If the GAC recommends that the appeal is not

granted in favor of the student, the Graduate Program Chair, on behalf of the GAC, will recommend to the Dean's Academic Affairs to withdraw the student from the CE Program. The student will then have the opportunity to appeal to the Ira A. Fulton Schools Standards Committee which reviews the student's case and makes the final ruling to Associate Dean and the CE Program. If the appeal is not granted in favor of the student, the Dean's Academic and Student Affairs will recommend to the Graduate College to withdraw the student from the CE MS Program. Please refer the Graduate College catalog on policies and procedures or contact the graduate advisor in the CIDSE Advising Center.

g. Academic Integrity

The highest standards of academic integrity are expected of all graduate students, both in the academic coursework and in their related research activities. The failure of any graduate student to meet these standards may result in serious consequences including suspension or expulsion from the university and/or other sanctions as specified in the academic integrity policies of individual colleges as well as the university.

Violations of academic integrity include, but are not limited to: cheating, fabrication, tampering, plagiarism, or aiding and/or facilitating such activities. At the graduate level, it is expected that students are familiar with these issues and each student must take personal responsibility in their work. In addition, graduate students are expected to follow university guidelines related to the Student Code of Conduct. University policies related to academic integrity and code of conduct are available in the Office of Student Life, or at www.asu.edu/studentaffairs/studentlife/judicial.

h. CEN 584 Internship

Graduate Internship is intended as a unique, new learning experience, apart from a regular engineering employment position. Therefore, it is not available to full or part-time workers regularly employed by the company where the internship is proposed. An internship cannot be done if all other class work has been completed, as the Internship Program is designed so that the practical experience gained will enhance the classroom learning experience.

CEN 584 Internship is for one (1 hour) credit hour per semester and typically limited to one semester. In special cases a total of two enrollments with one in Spring or Fall semester and one in summer session will be considered. A student may work full-time (40 hours) in a summer session and part-time (20 hours) in a Fall or Spring semester. Students are advised to consult with their academic advisor when formulating a Plan of Study.

An approved proposal is required before commencing the internship. The request will include a statement from the employer that indicates they understand that the work is to satisfy a degree requirement. A sample letter and other required forms are available from the Graduate Advisor. Students must receive approval from their faculty advisor

and from the Graduate Program Director before registering for CEN 584. In order to register for CEN 584, a student must have a GPA of 3.0. A final Plan of Study must be filed with the Graduate College showing the Internship course before registering for CEN 584. All application materials for an Internship must be completed by the last day of regular registration for any semester. The student must take classes appearing on the Plan of Study the semester following the internship.

A five-page final report is required before a grade and credit is given. The final report must be submitted to the reporting supervisor for comments and then to the faculty advisor for grade assignment.

i. CEN 590 Reading and Conference (Independent Study)

CEN 590 Reading and Conference (Independent Study) is available for MS students. The student must get written approval from the supervising faculty outlining the coverage of the content. The Independent Study form must be approved by the Program Chair and will be placed in the student's file.

j. Engineering Student Organizations

There are dozens of engineering student organizations and teams ranging from honors and professional associations to groups creating underwater robots, concrete canoes and launching rockets. Student organizations are excellent opportunities to learn about career possibilities as many of the student groups operate in conjunction with industry professional societies … get involved today!

Please visit http://studentorgs.engineering.asu.edu/ for a list of Engineering Student Organization.

Computer Engineering Faculty

Surname	Given Name	Rank	Degree	Expertise	Website
Ahn	Gail-Joon	Assoc. Prof	Ph.D.	Network security	
Askin	Ronald	Prof.	Ph.D.	Applied optimization	http://engineering.asu.edu/people/901090
Candan	Kasim (Selcuk)	Prof	Ph.D.	Database systems	http://engineering.asu.edu/people/20861
Cao	Yu (Kevin)	Asst. Prof	Ph.D.	Nanoscale modeling	http://engineering.asu.edu/people/749044
Chakrabarti	Chaitali	Prof	Ph.D.	VLSI architecture	http://engineering.asu.edu/people/22557
Chatha	Karam	Assoc. Prof	Ph.D.	Embedded Systems	http://engineering.asu.edu/people/388446
Baral	Chitta	Prof	Ph.D.	Autonomous agents	
Clark	Larry	Assoc. Prof	Ph.D.	Low power electronics	http://engineering.asu.edu/people/751415
Colbourn	Charles	Prof	Ph.D.	Network reliability	http://engineering.asu.edu/people/384970
Dasgupta	Partha	Assoc. Prof	Ph.D.	Security & Op. systems	http://engineering.asu.edu/people/75201
Vasileska	Dragica	Prof	Ph.D.	Semiconductor Devices	http://engineering.asu.edu/people/106590
Fainekos	Georgios	Asst. Prof	Ph.D.	Cyber physical systems	http://graduate.asu.edu/graduate_faculty/person/Georgios|Fainekos
Fowler	John	Prof.	Ph.D.	Scheduling theory	http://www.fulton.asu.edu/~ie/people/faculty/onepagebios/fowler_j.php
Gel	Esma	Assoc. Prof	Ph.D.	Stochastic modeling	http://engineering.asu.edu/people/257696
Gupta	Sandeep	Prof	Ph.D.	Cyber physical systems	http://engineering.asu.edu/people/313263
Huang	Dijiang	Asst. Prof	Ph.D.	Network security	http://engineering.asu.edu/people/835028
Hui	Joseph	Prof	Ph.D.	Wireless networks	http://engineering.asu.edu/people/230953
Kambhampati	Subbarao	Prof	Ph.D.	Automated planning	http://engineering.asu.edu/people/95646
Karam	Lina	Prof	Ph.D.	Signal/Image processing	http://engineering.asu.edu/people/53561
Kim	Seugnchan	Prof	Ph.D.	Signal Processing	
Tsakalis	Konstantinos	Prof	Ph.D.	System optimization	http://engineering.asu.edu/people/105332
Lee	Yahn-Hang	Prof	Ph.D.	Real-Time systems	http://engineering.asu.edu/people/284224

Li	Baixin	Asst. Prof	Ph.D.	Multimedia processing	http://engineering.asu.edu/people/747601
Li	Jing	Prof	Ph.D.	Statistical modeling	http://engineering.asu.edu/people/356293
Michandani	Pitu	Prof	Ph.D.	Real-time control	https://webapp4.asu.edu/directory/person/1439066
Palais	Joseph	Prof	Ph.D.	Optical communications	http://engineering.asu.edu/people/47394
Panchanathan	Sethuraman	Prof	Ph.D.	Ubiquitous computing	http://engineering.asu.edu/people/88253
Phillips	Stephen	Prof	Ph.D.	Micro electrical systems	http://engineering.asu.edu/people/547474
Reisslein	Martin	Assoc. Prof	Ph.D.	Fiber/wireless networks	http://engineering.asu.edu/people/287028
Richa	Andrea	Assoc. Prof	Ph.D.	Network optimization	http://engineering.asu.edu/people/198256
Runger	George	Prof	Ph.D.	Data mining	http://engineering.asu.edu/people/87655
Sen	Arunabha	Prof	Ph.D.	Network optimization	http://engineering.asu.edu/people/40210
Shrivastava	Aviral	Asst. Prof	Ph.D.	Multicore architecture	http://engineering.asu.edu/people/969623
Si	Jennie	Prof	Ph.D.	Nonlinear dynamic systems	http://engineering.asu.edu/people/48345
Spanias	Andreas	Prof	Ph.D.	Digital signal processing	http://engineering.asu.edu/people/93829
Sundaram	Hari	Assoc. Prof	Ph.D.	Multimedia &databases	http://engineering.asu.edu/people/522896
Syrotiuk	Violet	Assoc. Prof	Ph.D.	Mobile ad hoc networks	http://engineering.asu.edu/people/518662
Tsai	Wei-Tek	Prof	Ph.D.	Software engineering	http://engineering.asu.edu/people/258423
Vrudhula	Sarma	Prof	Ph.D.	VLSI circuit design	http://engineering.asu.edu/people/761142
Wonka	Peter	Asst. Prof	Ph.D.	Computer graphics	http://engineering.asu.edu/people/755237
Xue	Guoliang	Prof	Ph.D.	QoS routing & security	http://engineering.asu.edu/people/378651
Yau	Stephen	Prof	Ph.D.	Network security	http://engineering.asu.edu/people/94570
Zhang	Yanchao	Assoc. Prof	Ph.D.	Cyber security	
Zhang	Junshan	Prof	Ph.D.	Wireless networks	http://engineering.asu.edu/people/284251
Zhang	Muhong	Asst. Prof	Ph.D.	Robust optimization	http://engineering.asu.edu/people/1099666

Computer Engineering Areas of Study

1. VLSI – VLSI and Architecture
2. ECS – Embedded Control Systems
3. CN – Communications and Networks
4. DDSS – Distributed, Dependable Secure Systems
5. MSP – Multimedia and Signal Processing
6. SO – Systems Optimization

M*- Content of course is Master level

D* - Content of course is Doctorate level

Course & Prefix	**Course Title (Credit Hours)**	**VLSI**	**ECS**	**CN**	**DDSS**	**MSP**	**SO**
APM 506	Computational methods (3)						X
APM 523	Optimization (Continuous) (D*) (3)						X
CSE 408/598	Multimedia Information Systems (3)					X	
CSE 412/598	Database Management (3)				X		
CSE 420/598	Computer Architecture I (M*) (3)	X					
CSE 430	Operating Systems (M*) (3)				X		
CSE 434/598	Computer Networks, or (M*) (3)			X			
CSE 440/598	Compiler Construction I (M*) (3)				X		
CSE 445/598	Distributed Software Development (3)				X		
CSE 450/598	Design and Analysis of Algorithms (M*) (3)						X
CSE 468/598	Computer Network Security (3)			X			
CSE 509	Digital Video Processing (D*) (3)					X	
CSE 512	Distributed Database Systems (3)				X		
CSE 515	Multimedia Web Databases (3)					X	
CSE 520	Computer Architecture II (D*) (3)	X					
CSE 522	Real Time Embedded Systems (D*) (3)				X		
CSE 531	Distributed & Multiprocessor Operating Systems (D*) (3)				X		
CSE 534	Advanced Computer Networks (D*) (3)			X			
CSE 535	Mobile Computing (3)			X			
CSE 539	Applied Cryptography (3)				X		
CSE 543	Information Assurance and Security (3)				X		

Course & Prefix	Course Title (Credit Hours)	VLSI	ECS	CN	DDSS	MSP	SO
CSE 545	Software Security (3)				X		
CSE 550	Combinatorial algorithms and intractability (M*) (3)						X
CSE 552	Randomized and Approximation Algorithms (3)						X
CSE 555	Theory of Computation (3)						X
CSE 565	Software Verification, Validation, and Testing (3)				X		
CSE 574	Planning and Learning Methods in AI (3)		X				
CSE 591	Digital Logic Synthesis and Verification Algorithms. (3)	X					
CSE 591	Formal Methods for System Verification (3)	X					
CSE 591	Introduction to Hybrid Systems (D*) (3)		X				
CSE 591	Lower Power Architectures (3)	X					
CSE 591	Machine Learning		X				
CSE 591	VLSI Cad 1 (3)	X					
CSE 598	System-level Hardware/Software Co-design	X					
EEE 404/591	Real-Time Digital Signal Processing (M*) (4)					X	
EEE 407/591	Digital Signal Processing (M*) (4)					X	
EEE 425/591	Digital Circuits and Systems (M*) (4)	X					
EEE 455/591	Communication Systems (M*) (3)			X			
EEE 459/591	Communication Networks (M*) (3)			X			
EEE 480/591	Feedback Systems (M*) (4)		X				
EEE 481/591	Computer Controlled Systems (M*) (3)		X				
EEE 505	Time-Frequency Signal Processing (3)					X	
EEE 507	Multidimensional Signal Processing (3)					X	
EEE 508	Digital Image and Video Processing and Compression (D*) (3)					X	
EEE 509	DSP Algorithms and Software (3)					X	

Course & Prefix	Course Title (Credit Hours)	VLSI	ECS	CN	DDSS	MSP	SO
EEE 511	Artificial Neural Computation (3)		X				
EEE 525	VLSI Design (D*) (3)	X					
EEE 526	VLSI Architectures (3)	X					
EEE 551	Information Theory (D*) (3)			X			
EEE 552	Digital Communications (3)			X			
EEE 553	Coding and Cryptography (3)			X			
EEE 554	Random Signal Theory (D*) (3)					X	
EEE 555	Modeling and Performance Analysis (3)					X	
EEE 557	Broadband Networks (3)			X			
EEE 558	Wireless Communications (3)			X			
EEE 582	Linear System Theory (3)		X				
EEE 585	Digital Control Systems (D*) (3)		X				
EEE 586	Nonlinear Control Systems (3)		X				
EEE 587	Optimal Control (3)		X				
EEE 588	Design of Multivariable Control Systems (3)		X				
EEE 606	Adaptive Signal Processing (3)					X	
EEE 607	Speech Coding for Multimedia Communications (3)			X			
EEE 625	Advanced VLSI Design (3)	X					
EEE 686	Adaptive Control (3)		X				
IEE 533	Scheduling (3)						X
IEE 572	Design of Engineering Experiments (3)						X
IEE 574	Applied Deterministic Operations Res. Methods (3)						X
IEE 575	Applied Stochastic Operations Res. Methods (3)						X
IEE 620	Optimization I (Discrete) (D*) (3)						X
IEE 670	Mathematical Statistics (3)						X

Course Descriptions

APM 506 Computational Methods
Covers interpolation, solution of nonlinear equations and systems, numerical differentiation, numerical integration, numerical solution of ordinary and partial differential equations. Students should be an APM graduate student.

APM 523 Optimization
Linear programming, unconstrained nonlinear minimization, line search algorithms, conjugate gradients, quasi-Newton methods, constrained nonlinear optimization, gradient projection, and penalty methods. Completion of courses in Applied Linear Algebra and Computational Methods is strongly recommended prior to enrollment in this course.

CSE 480 Multimedia Information Systems
Design, use, and applications of multimedia systems. Introduces acquisition, compression, storage, retrieval, and presentation of data from different media such as images, text, voice, and alphanumeric.

CSE 412 Database Management
Introduces DBMS concepts. Data models and languages. Relational database theory. Database security/integrity and concurrency.

CSE 420 Computer Architecture I
Computer architecture. Performance versus cost tradeoffs. Instruction set design. Basic processor implementation and pipelining.

CSE 430 Operating Systems
Operating system structure and services, processor scheduling, concurrent processes, synchronization techniques, memory management, virtual memory, input/output, storage management, and file systems.

CSE 434 Computer Networks
Distributed computing paradigms and technologies, distributed system architectures and design patterns, frameworks for development of distributed software components.

CSE 440 Compiler Construction I
Introduces programming language implementation. Implementation strategies such as compilation, interpretation, and translation. Major compilation phases such as lexical analysis, semantic analysis, optimization, and code generation.

CSE 445 Distributed Software Development
Distributed system architectures and design, service-oriented computing, and frameworks for development of distributed application and software components.

CSE 450 Design and Analysis of Algorithms
Design and analysis of computer algorithms using analytical and empirical methods; complexity measures, design methodologies, and survey of important algorithms.

CSE 509 Digital Video Processing
Concepts of digital video compression, video analysis, video indexing, browsing and retrieval, video transmission over networks, video processors, MPEG 1, 2, 4, and 7 standards.

CSE 512 Distributed Database Systems
Distributed database design, query processing, and transaction processing. Distributed database architectures and interoperability. Emerging technology.

CSE 515 Multimedia and Web Databases
Data models for multimedia and Web data; query processing and optimization for inexact retrieval; advanced indexing, clustering, and search techniques.

CSE 520 Computer Architecture II
Computer architecture description languages, computer arithmetic, memory-hierarchy design, parallel, vector, multiprocessors, and input/output.

CSE 534 Advanced Computer Networks
Advanced network protocols and infrastructure, applications of high-performance networks to distributed systems, high-performance computing and multimedia domains, special features of networks.

CSE 535 Mobile Computing
Mobile networking, mobile information access, adaptive applications, energy-aware systems, location-aware computing, mobile security and privacy.

CSE 539 Applied Cryptography
Uses cryptography for secure protocols over networked systems, including signatures, certificates, timestamps, electrons, digital cash, and other multiparty coordination.

CSE 543 Information Assurance and Security
Comprehensive understanding of information assurance and security problems with the solutions as well as hands-on experiences about applying these solutions.

CSE 545 Software Security
Theories and tools for software security, including secure design, threat analysis and modeling, security testing and coding.

CSE 550 Combinatorial Algorithms and Intractability
Combinatorial algorithms, nondeterministic algorithms, classes P and NP, NP-hard and NP-complete problems, and intractability, Design techniques for fast combinatorial algorithms.

CSE 552 Randomized and Approximation Algorithms
Introduces two important areas of algorithm design for graduate students. A randomized algorithm is allowed to rely on the outcome of a random experiment in deciding on its next step. In may applications, randomized algorithms are simpler than any deterministic algorithms known, but in several cases, they are in fact more powerful or more efficient than any deterministic algorithms. Covers basic paradigms for randomized algorithm design and analysis, as well as for derandomization.

CSE 555 Theory of Computation
Rigorous treatment of regular languages, context-free languages, Turing machines and decidability, reducibility, and other advanced topics in computability theory.

CSE 565 Software Verification, Validation, and Testing
Test planning, requirements-based and code-based testing techniques, tools, reliability models and statistical testing.

CSE 574 Planning and Learning Methods in Al
Reasoning about time and action, plan synthesis and execution, improving planning performance, applications to manufacturing intelligent agents.

CSE 591 Seminar
A small class emphasizing discussion, presentations by students, and written research papers.

CSE 598 Special Topics
Topical courses not offered in regular course rotation – e.g., new courses not in the catalog, courses by visiting faculty, courses on timely topics, highly specialized courses responding to unique student demand.

EEE 404 Real-Time Digital Signal Processing
Digital signal processors, translating signals and systems concepts into real-time multimedia and communications applications, real-time algorithms.

EEE 407- Digital Signal Processing
Time and frequency domain analysis, difference equations, z-transform, FIR and IIR digital filter design, discrete Fourier transform, FFT, and random sequences.

EEE 425 Digital Systems and Circuits
Digital logic gate analysis and design. Propagation delay times, fan out, power dissipation, noise margins. Design of MOS and bipolar logic families, including NMOS, CMOS, standard and advanced TTL, ECL, and BiCMOS. Inverter, combinational and sequential logic circuit design, MOS memories, VLSI circuits. Computer simulations using PSPICE.

EEE 455 Communication Systems
Signal analysis techniques applied to the operation of electrical communication systems. Introduction to and overview of modern digital and analog communications.

EEE 459 communication Networks
Fundamentals of communication networks. Study of Seven-Layer OSI model. Focus on functionality and performance of protocols used in communication networks.

EEE 480 Feedback Systems
Analysis and design of linear feedback systems. Frequency response and root locus techniques, series compensation, and state variable feedback.

EEE 481 Computer-Controlled Systems
Implements computer-based, embedded, control systems using MATLAB xPC Target toolbox. Small-scale, representative projects demonstrate theoretical issues and provide hands-on expertise.

EEE 505 Time-Frequency Signal Processing
Joint time-frequency analysis of time-varying signals and systems; linear and quadratic time-frequency representations; applications in current areas of signal processing.

EEE 507 Multidimensional Signal Processing
Processing and representation of multidimensional signals. Design of systems for processing multidimensional data. Introduces image and array processing issues.

EEE 508 Digital Image and Video Processing and Compression
Fundamentals of digital image perception, representation, processing, and compression. Emphasizes image coding techniques. Signals include still pictures and motion video.

EEE 509 DSP Algorithms and Software
Linear systems review, digital filter design, software aspects, DFT, FFT, random signals, programming aspects, applications projects, MATLAB and Java simulations.

EEE 511 Artificial Neural Computation Systems
Networks for computation, learning function representations from data, learning algorithms and analysis, function approximation and information representation by networks, applications in control systems and signal analysis.

EEE 525 VLSI Design
Analysis and design of Very Large Scale Integrated (VLSI) circuits. Physics of small devices, fabrication, regular structures, and system timing.

EEE 526 VLSI Architectures
High throughput and low-power VLSI architectures for signal processing. Array processor systems; data path design and optimization; memory design; high-level synthesis; low-power design at system level, algorithm level, and architecture level.

EEE 551 Information Theory
Entropy and mutual information, source and channel coding theorems, applications for communication and signal processing.

EEE 552 Digital Communications
Complex signal theory, digital modulation, optimal coherent and incoherent receivers, channel codes, coded modulation, Viterbi algorithm.

EEE 553 Conding and Cryptography
Introduces algebra, block and convolutional codes, decoding algorithms, turbo codes, coded modulation, private and public key cryptography.

EEE 554 Random Signal Theory
Applies statistical techniques to the representation and analysis of electrical signals and to communications systems analysis.

EEE 555 Modeling and Performance Analysis
Modeling and performance analysis of stochastic systems and processes such as network traffic queueing systems and communication channels.

EEE 557 Broadband Networks
Physics of wireless and optical communications. Broadband multiplexing and switching methods. Blocking and queuing analysis. Network optimization, routing, and economics.

EEE 558 Wireless Communications
Cellular systems, path loss, multipath fading channels, modulation and signaling for wireless, diversity, equalization coding, spread spectrum, TDMA/FDMA/CDMA.

EEE 582 Linear System Theory
Controllability, observability, and realization theory for multivariable continuous time systems. Stabilization and asymptotic state estimation. Disturbance decoupling, noninteracting control.

EEE 585 Digital control Systems
Analysis and design of digital and sampled data control systems, including sampling theory, z-transforms, the state transition method, stability, design, and synthesis.

EEE 586 Nonlinear Control Systems
Stability theory, including phase-plane, describing function, Liapunov's method, and frequency domain criteria for continuous and discrete, nonlinear, and time-varying systems.

EEE 587 Optimal Control
Optimal control of systems. Calculus of variations, dynamic programming, linear quadratic regulator, numerical methods, and Pontryagin's principle.

EEE 588 Design of Multivariable Control Systems
Practical tools for designing robust MIMO controllers. State feedback and estimation, model-based compensators, MIMO design methodologies, CAD, real-world applications.

EEE 591 Seminar
A small class emphasizing discussion, presentations by students, and written research papers.

EEE 606 Adaptive Signal Processing
Principles and applications of adaptive signal processing, adaptive linear combiner, Wiener least-squares solution, gradient search, performance surfaces, LMS/RLS algorithms, block time/frequency domain LMS.

EEE 607 Speech Coding for Multimedia Communications
Speech and audio coding algorithms for applications in wireless communications and multimedia computing.

EEE 625 Advanced VLSI Design
Practical industrial techniques, circuits, and architectures appropriate to high-performance and low-power digital VLSI designs such as microprocessors.

EEE 686 Adaptive Control
Main topics covered: adaptive identification, convergence, parametric models, performance and robustness properties of adaptive controllers, persistence of excitation, and stability.

IEE 572 Design Engineering Experiments
Analysis of variance and experimental design. Topics include strategy of experimentation, factorials, blocking and confounding, fractional factorials, response surfaces, nested and split-plot designs. Prerequisite: IEE 380.

IEE 620 Optimization I
First course of the Ph.D. level deterministic course series. This course covers foundations of optimization and linear programming. Prerequisites: MAT 272, 242, and IEE 376.

IEE 670 Mathematical Statistics
This course is an introduction to the field of mathematical statistics at a level intended for first-year Ph.D. students in Industrial Engineering. It builds a solid background in the principles, concepts and techniques of mathematical statistics. The class prepares students for advanced study and research in statistics, and is useful for understanding statistical data analysis techniques and developing statistical thinking. Prerequisites: IEE 380