New Program Proposal: Graduate Degree Program

Form 2B

Version 2016-10-13

This form should be used to seek SUNY's approval and New York State Education Department's (SED) registration of a proposed new academic program leading to master's or doctoral degree. Approval and registration are both required before a proposed program can be promoted or advertised, or can enroll students. The campus Chief Executive or Chief Academic Officer should send a signed cover letter and this completed form (unless a different form applies[1]), which should include appended items that may be required for Sections 1 through 6, 9 and 10 and MPA-1 of this form, to the SUNY Provost at *program.review@suny.edu*. The completed form and appended items should be sent as a single, continuously paginated document.[2] If Sections 7 and 8 of this form apply, External Evaluation Reports and a single Institutional Response should also be sent, but in a separate electronic document. Guidance on academic program planning is available here.

Table of Contents

NOTE: Please update this Table of Contents automatically after the form has been completed. *To do this, put the cursor anywhere over the Table of Contents, right click, and, on the pop-up menus, select "Update Field" and then "Update Page Numbers Only." The last item in the Table of Contents is the List of Appended and/or Accompanying Items, but the actual appended items should continue the pagination.*

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[1] Use a different form if the proposed new program will lead to a graduate degree or any credit-bearing certificate; be a combination of existing registered programs (i.e. for a multi-award or multi-institution program); be a breakout of a registered track or option in an existing registered program; or **lead to certification as a classroom teacher, school or district leader, or pupil personnel services professional** (e.g., school counselor).

[2] This email address limits attachments to 25 MB. If a file with the proposal and appended materials exceeds that limit, it should be emailed in parts.

Section 1. General Information		
a) Institutional Information	Date of Proposal:	January 11, 2018 (updated)
	Institution's 6-digit SED Code:	210500
	Institution's Name:	The University at Albany
	Address:	1400 Washington Avenue, Albany, NY 12222
	Dept of Labor/Regent's Region:	Capital Region
b) Program Locations	List each campus where the entire program will be offered (with each institutional or branch campus 6-digit SED Code):	
	List the name and address of off-campus locations (i.e., extension sites or extension centers) where courses will offered, **or check here [ ] if not applicable**:	
c) Proposed Program Information	Program Title:	Electrical and Computer Engineering
	Award(s) (e.g., M.A., Ph.D.):	Ph.D.
	Number of Required Credits:	Minimum [75] If tracks or options, largest minimum [ ]
	Proposed HEGIS Code:	0901
	Proposed 6-digit CIP 2010 Code:	14.0901
	If the program will be accredited, list the accrediting agency and expected date of accreditation:	
	If applicable, list the SED professional licensure title(s)[3] to which the program leads:	
d) Campus Contact	Name and title: Jonathan Bartow, Vice-Dean of Graduate Education Telephone: 518-437-5062 E-mail: jbartow@albany.edu	
e) Chief Executive or Chief Academic Officer Approval	**Signature affirms that the proposal has met all applicable campus administrative and shared governance procedures for consultation, and the institution's commitment to support the proposed program.** ***E-signatures are acceptable.*** Name and title: James Stellar, Ph. D. Executive Vice-President and Provost Signature and date: [signature] 1/12/18	
	If the program will be registered jointly[4] with one or more other institutions, provide the following information for each institution:	
	Partner institution's name and 6-digit SED Code: Name, title, and signature of partner institution's CEO (or **append** a signed letter indicating approval of this proposal):	

[3] If the proposed program leads to a professional license, a specialized form for the specific profession may need to accompany this proposal.
[4] If the partner institution is non-degree-granting, see SED's CEO Memo 94-04.

Attestation and Assurances

On behalf of the institution, I hereby attest to the following:

That all educational activities offered as part of this proposed curriculum are aligned with the institutions' goals and objectives and meet all statutory and regulatory requirements, including but not limited to Parts 50, 52, 53 and 54 of the Rules of the Board of Regents and the following specific requirements:

That credit for study in the proposed program will be granted consistent with the requirements in §50.1(o).

That, consistent with §52.1(b)(3), a reviewing system has been devised to estimate the success of students and faculty in achieving the goals and objectives of the program, including the use of data to inform program improvements.[5]

That, consistent with §52.2(a), the institution possesses the financial resources necessary to accomplish its mission and the purposes of each registered program, provides classrooms and other necessary facilities and equipment as described in §52.2(a)(2) and (3), sufficient for the programs dependent on their use, and provides libraries and library resources and maintains collections sufficient to support the institution and each registered curriculum as provided in §52.2(a)(4), including for the program proposed in this application.

That, consistent with 52.2(b), the information provided in this application demonstrates that the institution is in compliance with the requirements of §52.2(b), relating to faculty.

That all curriculum and courses are offered and all credits are awarded, consistent with the requirements of §52.2(c).

That admissions decisions are made consistent with the requirements of §52.2(d)(1) and (2) of the Regulations of the Commissioner of Education.

That, consistent with §52.2(e) of the Regulations of the Commissioner of Education: overall educational policy and its implementation are the responsibility of the institution's faculty and academic officers, that the institution establishes, publishes and enforces explicit policies as required by §52.2(e)(3), that academic policies applicable to each course as required by §52.2(e)(4), including learning objectives and methods of assessing student achievement, are made explicit by the instructor at the beginning of each term; that the institution provides academic advice to students as required by §52.2(e)(5), that the institution maintains and provides student records as required by §52.2(e)(6).

That, consistent with §52.2(f)(2) of the Regulations of the Commissioner of Education, the institution provides adequate academic support services and that all educational activities offered as part of a registered curriculum meet the requirements established by state, the Rules of the Board of Regents and Part 52 of the Commissioner's regulations.

CHIEF ADMINISTRATIVE or ACADEMIC OFFICER/ PROVOST	
Signature: [signature]	Date 1/12/18
Type or print the name and title of signatory James R. Stellar, Senior Vice President for Academic Affairs & Provost	Phone Number 518-956-8030

[5] The NY State Education Department reserves the right to request this data at any time and to use such data as part of its evaluation of future program registration applications submitted by the institution.

Section 2. Program Information

2.1. Program Format

Check all SED-defined formats, mode and other program features that apply to the **entire program**.

a) Format(s): [ ]Day [ ]Evening [ ]Weekend [ ]Evening/Weekend [ ]Not Full-Time

b) Modes: [ ]Standard [ ]Independent Study [ ]External [ ]Accelerated [ ]Distance Education
NOTE: *If the program is designed to enable students to complete 50% or more of the course requirements through distance education, check Distance Education, see Section 10, and append a Distance Education Format Proposal.*

c) Other: [ ] Bilingual [ ] Language Other Than English [ ] Upper Division [ ] Cooperative [ ] 4.5 year [ ] 5 year

2.2. Related Degree Program

NOTE: *This section is not applicable to a program leading to a graduate degree.*

2.3. Program Description, Purposes and Planning

a) What is the description of the program as it will appear in the institution's catalog?

Electrical and Computer Engineering (ECE) is the creative application of engineering principles and methods to the design and development of hardware and software systems. The Ph.D. ECE program encompasses the design, development, testing, and evaluation of hardware and software components, as well as integrated systems and networks. Research in Electrical and Computer Engineering strives to achieve innovative functionality and higher performance in computing systems and components. The research portion of the Ph.D.. ECE program, is focused in four concentration areas: 1) Communications and Networking, 2) Signal and Information Processing, 3) Computer Engineering and 4) Electronic Circuits and Systems.

b) What are the program's educational and, if appropriate, career objectives, and the program's primary student learning outcomes (SLOs)? ***NOTE:*** *SLOs are defined by the Middle States Commission on Higher Education in the Characteristics of Excellence in Higher Education (2006) as "clearly articulated written statements, expressed in observable terms, of key learning outcomes: the knowledge, skills and competencies that students are expected to exhibit upon completion of the program."*

Our objectives and outcomes have been developed to adhere to the guidelines established by ABET Engineering and Accreditation Commission, the accreditation agency for engineering programs. From http://www.abet.org/network-of-experts/for-current-abet-experts/refresher-training/module-4-quality-improvement-of-student-learning/, program educational objectives are defined as "broad statements that describe what graduates are expected to attain within a few years after graduation" and student outcomes "describe what students are expected to know and be able to do by the time of graduation".

Program Educational Objectives

Graduates of the Ph.D. program in ECE will be prepared to:

1. Succeed in academic or industrial positions in Electrical and Computer Engineering or related disciplines;
2. Apply their depth of knowledge, analytical skills and problem-solving ability to address real world problems of societal significance; and

3. Continue to learn and develop their skills, becoming leaders who shape the future of this dynamic field of engineering.

Student Learning Outcomes

After successfully completing the Ph.D. degree in Electrical and Computer Engineering, students will be able to:

1. Demonstrate extensive knowledge in one area of Electrical and Computer Engineering;
2. Study an issue, identify and evaluate alternative actions, propose a course of action, implement a solution, and defend conclusions; and
3. Present technical information in a variety of formats, including written reports and oral presentations.

c) How does the program relate to the institution's and SUNY's mission and strategic goals and priorities? What is the program's importance to the institution, and its relationship to existing and/or projected programs and its expected impact on them? As applicable, how does the program reflect diversity and/or international perspectives? For doctoral programs, what is this program's potential to achieve national and/or international prominence and distinction?

The University has established the creation of new academic programs to meet the high-demand employment needs of the regional, state and national economy as one of its primary goals. The Electrical and Computer Engineering programs, combined with the existing and emerging programs in the College of Engineering and Applied Sciences, will service this directive and continue to transform the University into a highly–ranked public research institution in the Capital Region. The creation of a world–class engineering school is critical to this directive. The addition of Master's and Doctoral degrees in Electrical and Computer Engineering (ECE) will support the growth of high–impact research and high–quality engineering education. Currently, the Department of Electrical and Computer Engineering offers the B.S. in Computer Engineering (B.S. CE approved summer 2016). Transitioning to the future, we plan to expand our program offerings to include a B.S. in Electrical and Computer Engineering (B.S. ECE in development), a M.S. in Electrical and Computer Engineering (M.S.ECE, parallel application), and the Ph.D. in Electrical and Computer Engineering (Ph.D. ECE, this application). The Department will become one of a set of engineering departments in the College of Engineering and Applied Sciences that conducts world-class scholarship funded by extramural research grants and offers rigorous undergraduate and graduate curricula. UAlbany's goals align well with those of the other SUNY campus centers, focused on high-impact research and high quality undergraduate and graduate engineering education.

The Ph.D. ECE program is necessary to enable long–term and significant synergistic collaborations with existing departments at the University at Albany, both in education and research. It is also indispensable for attracting industrial collaborations and research that will provide students with a unique skill set and numerous career development opportunities. Fruitful collaborations with the Computer Science Department will result in multiple cross–listed, innovative courses and high impact research awards that address key societal problems (e.g. preventive medicine, emergency preparedness, social welfare, education, among various others). Toward this endeavor, cross–college/school collaborations (e.g. School of Public Health, School of Social Welfare, College of Emergency Preparedness, Homeland Security and Cyber-security) will bring together experts from diverse fields leading to high–impact research collaborations and unique educational experiences for students. The expertise brought in by the University's various research centers such as the Atmospheric Sciences Research Center, the Center for Elimination of Minority Health Disparities, Center for Public Health Preparedness, Child Welfare, Drug Abuse and initiatives such as the Mesonet will also complement and strengthen ECE research collaborations.

The Ph. D. ECE program has the potential to invite healthy cross–campus collaborations within the SUNY system. Working with our partners at our University Centers, state operated campuses and our neighbor SUNY Polytechnic, will allow us to come together to advance research in critical areas such as VLSI, Signal and Information Processing and Communications, Network Communications and Cyber Physical

Systems. Our nodal location within Tech Valley and many Fortune 500 companies will facilitate the development of new public-private collaborations strengthening ties with industrial partners through high–impact, high–risk research while enabling students to gain valuable experience through internships. This arrangement will secure opportunities for faculty to enjoy deeper–in–depth collaborations and secure long-term commitment to the University through high–risk, high–reward research programs.

An in–depth interdisciplinary research environment is a crucial ingredient to foster a successful Ph.D. program in engineering. It is expected that collaborative faculty research will encompass VLSI, Electronics, Electromagnetics, Probability Theory, Stochastic Processes, Game Theory, Statistics and other topics in applied Physics and applied mathematics. Faculty and students from the Mathematics and Physics departments who are interested in applying their theoretical foundation to these ECE–related applications can collaborate with the ECE faculty and discover challenges and eventually make new theoretical contributions.

The Ph.D. ECE program is a necessary step for establishing an esteemed graduate teaching/research presence in engineering within the University. The Ph.D. ECE program will complete the institution's academic offerings from a B.S. CE and B.S. ECE to an M.S. ECE, and ultimately to the Ph. D. ECE while supporting faculty research. It will allow them to conduct and fulfill long–term research goals with motivated and experienced doctoral students. These research initiatives will create a rich environment for students and provide them unique research development opportunities to follow careers in both industry and academia.

Doctoral programs attain distinction through the research achievements of their faculty. The University has invested in building an engineering college, enabling the Electrical and Computer Engineering department to hire 13 tenured/tenure track faculty, including a few senior faculty who have an excellent track record of research accomplishment and have attained prominence in their field and a larger group of excellent junior faculty who have recently come from programs at top research universities and have outstanding early-career track records. This foundation for an outstanding faculty makes it highly likely that the Ph.D. ECE program will grow in prominence and attain national and international distinction.

d) How were faculty involved in the program's design? Describe input by external partners, if any (e.g., employers and institutions offering further education?

Faculty and staff have been meeting regularly since summer, 2016 to develop and define the curriculum necessary for the Ph.D. ECE program, and to match outcomes of the program to its objectives. Building on the interaction and foundations established by the interdisciplinary committee established for the B.S. CE program development with consultants, industry Partners, and a review of our peer institution's curricula, the essential intellectual and technical tools required for a 21st century Ph.D. electrical and computer engineer were determined. Then, leveraging the experience of our faculty with inputs on curriculum organization and implementation from personal faculty contacts and discussions at a range of top-ranked universities around the country, including:

- University of Illinois, Urbana-Champaign: http://www.ece.illinois.edu/
- Rensselaer Polytechnic Institute: https://ecse.rpi.edu/
- Virginia Tech: https://ece.vt.edu/
- The Ohio State University: https://ece.osu.edu/
- Purdue University: https://engineering.purdue.edu/ECE

the ECE department faculty modeled our program and curriculum structure around these examples. We then tailored specific concentration and focus areas based on the unique interests and skills of our faculty and the needs of industries in the surrounding community, such as Global Foundries, GE, Lockheed Martin and IBM.

e) How did input, if any, from external partners (e.g., educational institutions and employers) or standards influence the program's design? If the program is designed to meet specialized accreditation or other external standards, such as the educational requirements in Commissioner's Regulations for the profession, append a side-by-side chart to show how the program's components meet those external standards. If SED's Office of the Professions requires a specialized form for the profession to which the proposed program leads, append a completed form at the end of this document.

The faculty adapted key curriculum and engaged learning model features identified by the team of consultants (Dr. William Sanders, Interim Department Head from the Department of Electrical and Computer Engineering at The University of Illinois, Urbana-Champaign, Dr. Allen Downey, Professor of Computer Science from Olin College of Engineering and Professor David Soldan, from the Electrical & Computer Engineering Department in the College of Engineering at Kansas State University) ,who had been brought in to provide guidance and advice in formulating our B.S. CE, M.S. ECE, and Ph.D. ECE programs.

f) Enter anticipated enrollments for Years 1 through 5 in the table below. How were they determined, and what assumptions were used? What contingencies exist if anticipated enrollments are not achieved?

Year	Anticipated Headcount Enrollment			Estimated FTE
	Full-time	Part-time	Total	
1	10	1	11	10
2	12	1	13	12
3	18	2	20	19
4	24	3	27	25
5	30	3	33	31

These anticipated enrollments are based on a typical ratio of Ph.D. students per faculty member in a research active ECE department such as ours, although set a little low initially to allow for our high proportion of junior faculty and the need to promote the program. It is also consistent with typical graduate-undergraduate proportions for an ECE department in a public research university, scaling off our anticipated undergraduate enrollments. In addition, to graduates of B. S. and M.S. programs in Computer, Electrical, and Electrical and Computer Engineering, some graduates of Computer Science and Physics programs are candidates for the Ph.D. in ECE. These numbers accurately reflect the typical ratio of Ph.D. students per faculty member, along with the projected interest of those enrolled in the aforementioned B.S. and M.S. programs.

The headcounts represent the total number of students in the program for that year, using the assumption that students entering with a bachelor's degree will remain in the program for 5 years. The part-time numbers are conservative and will be exceeded once the public is aware of the existence of our program. Graduates who entered the workforce directly after college and have recognized the need for an advanced degree will see our program as a way to advance their careers. Part-time students are counted as 1/3 FTE.

g) Outline all curricular requirements for the proposed program, including prerequisite, core, specialization (track, concentration), internship, capstone, and any other relevant component requirements, but do not list each General Education course.

The course work for each area of concentration consists of a set of required core courses and a set of elective courses in the areas of electrical engineering, computer engineering, computer science, mathematics, physics, and other related fields as appropriate which provide master's degree students with both a depth and breadth of technical topics across the 4 concentrations areas of the ECE department: 1) Communications and Networking, 2) Signal and Information Processing, 3) Computer Engineering, and 4) Electronic Circuits and Systems.

The table below shows the Ph.D. program requirements for a student starting with a Bachelor of Science degree in Computer, Electrical, or Electrical and Computer Engineering.

Topic	Credit Requirement
Depth – Courses in a selected Concentration Area	15
Breadth – Courses outside the selected Concentration Area	6
Math/Physics	6
Technical Electives	6
Electives	6
Thesis	36 (minimum)
Total for Ph.D. ECE	75 (minimum)

The course categories are:

- Depth Courses: 15 credit hours (5 courses) selected from a single concentration area. Courses are chosen from the list of concentration areas and their associated core courses that is maintained by the department. The list is shown below.
- Breadth Courses: 6 credit hours (2 courses) from the list of concentration areas but chosen from outside the student's depth concentration area. The two courses must be chosen from different concentration areas. If a course is listed in the student's depth concentration area as well as another area, it can only be used to satisfy the depth concentration course requirement.
- Math/Physics Electives: 6 credit hours (2 courses) of courses in mathematics (A MAT) or physics (A PHY).
- Technical Electives: 6 credit hours (2 courses) of courses within the College of Engineering and Applied Sciences (CEAS), mathematics (A MAT) or physics (A PHY). These credit hours can be used to gain additional breadth outside of ECE or for additional ECE courses.
- Electives: 6 credit hours (2 courses) taken in any college. Prior approval by the student's advisor and the Graduate Program Coordinator are required for these courses. These credit hours can be used to gain additional breadth outside of engineering and the sciences or for additional technical courses. It is expected that the courses will be relevant to or complement the student's area of study.
- Thesis: 36 credit hours (minimum) of thesis.

Students must submit an advisor-approved Ph.D. plan of study to the ECE Graduate Program Coordinator by the end of the first semester. The Graduate Program Coordinator must approve the plan of study. If a student deviates from the initial plan of study, a revised plan should be submitted in a timely manner so that the department has an approved up-to-date version. It is expected that one or more revised plans of study may be submitted during a student's doctoral studies.

The table below lists the current and currently planned courses for each of the Concentration Areas and the Project Courses. It is anticipated that this course list will expand as the department faculty grows, with courses being added to each area and the addition of new Concentration Areas.

Course Number	Course Title	Credit Hours	Notes
ECE 510	Antenna Engineering	3	CONCENTRATION AREA 1 Communications and Networking
ECE 571	Advanced Digital Communications	3	
ECE 572	Radiowave Propagation and Remote Sensing	3	
CSI 516	Computer Communication Networks	3	
MAT 575	Optimization Theory	3	
ECE 671	Probability and Random Processes	3	
ECE 672	Detection and Estimation Theory	3	
CSI 616	Computer Communication Networks II	3	
ECE 673	Information Theory	3	

ECE 674	Error Control Coding	3	
ECE 675	Mobile and Wireless Networking	3	
ECE 676	Wireless Communication	3	
ECE 561	Digital Image Processing	3	CONCENTRATION AREA 2 Signal and Information Processing
ECE 580	Linear Control Theory	3	
ECE 661	Mathematical Methods of Signal Processing	3	
ECE 662	Advanced Digital Signal Processing	3	
CSI 671	Computer Vision	3	
ECE 664	Statistical Pattern Recognition	3	
ECE 671	Probability and Random Processes	3	
ECE 680	Advanced Linear Control Theory	3	
ECE 681	Nonlinear and Adaptive Control	3	
ECE 500	Advanced Electronic Circuits	3	CONCENTRATION AREA 3 Electronic Circuits and Systems
ECE 510	Antenna Engineering	3	
ECE 511	Microwave Engineering	3	
ECE 520	Introduction to VLSI	3	
ECE 521	Digital ASIC Design	3	
ECE 522	Integrated Circuit Devices	3	
PHY 587	Solid State Physics I	3	
PHY 588	Solid State Physics II	3	
ECE 620	Mixed-Signal IC Design	3	
ECE 621	Radio Frequency IC Design	3	
ECE 531	FPGA-Based Data Acquisition and Real-Time Processing	3	CONCENTRATION AREA 4 Computer Engineering
ECE 540	Parallel Programming for GPU’s	3	
ECE 550	Robotics	3	
CSI 535	Artificial Intelligence I	3	
CSI 536	Machine Learning	3	
CSI 635	Artificial Intelligence II	3	
ECE 630	Advanced Computer Architecture	3	
CSI 671	Computer Vision	3	
ECE 650	Introduction to Neural Networks	3	
ECE 669	Projects in Signal and Information Processing	3	PROJECT COURSES
ECE 679	Projects in Communications and Networking	3	
ECE 629	Projects in Electronic Circuits and Systems	3	
ECE 659	Projects in Computer Engineering	3	
ECE 697	Independent Study and Research	1-3	
ECE 899	Doctoral Thesis	1-12	

The course requirements for the Ph.D. degree shown above will be adjusted for those who enter the program with a Master’s degree. For students with a MSECE degree from UAlbany, the courses taken as part of the MS program will be directly applied to the course requirements for the Ph.D. MS thesis credits will not be counted. Note that additional credit hours may be required for students who change concentration area between their Master's and doctoral programs.

For students entering with a Master's degree from another institution or from another (non-ECE) program at UAlbany, the course credit requirements will be adjusted based on an evaluation of the coursework taken during their Master's program. The Graduate Program Coordinator, in consultation with the student's advisor, will determine which courses will be credited towards the Ph.D. degree and to which course category they are assigned. The primary goal of the process of assigning credit for courses will be to ensure that the student will attain the depth and breadth of the Ph.D. program as described above.

h) Program Impact on SUNY and New York State

(1) ***Need:*** What is the need for the proposed program in terms of the clientele it will serve and the educational and/or economic needs of the area and New York State? How was need determined? Why are similar programs, if any, not meeting the need?

Apart from the recently approved B.S. in Computer Engineering at UAlbany, undergraduate engineering degrees in the Capital Region are available only at private institutions (Rensselaer Polytechnic Institute and Union College), with *annual tuition alone approximating $50,000*. Graduate engineering degrees are only available locally at Rensselaer Polytechnic Institute and Clarkson Graduate School. Again, these are expensive private programs. Additionally, Rensselaer Polytechnic Institute discourages part-time study, meaning that the local market of engineers with a B.S. degree who wish to obtain a graduate degree part-time while employed is poorly served. Students who cannot afford private tuition choose to leave the area to access a public education in engineering. Many of those students may never return to our region, causing a regional drain of talent and expertise. Given these fiscal realities, there is no question that this program will attract a substantial number of students. Moreover, there is simply no way those two institutions can meet the growing demand for engineers at all degree levels in the region. This program will provide access to an affordable graduate electrical and computer engineering degree in the Capital Region.

In addition to providing an affordable Ph.D. ECE pathway for students in the region, the new program will attract New York State students from outside the region, other U.S. students, and international students. Upon graduation, some of these students will find jobs with local industry and stay in the region. By increasing the number of well-educated engineers with advanced degrees in the region, this program will increase the pool of candidates for research and advanced technology leadership and management positions in local industry.

Along with the benefits it brings to the graduates of the program and the industry that employs them, the research undertaken as part of this graduate program will lead to new discoveries, raise the national and international profile of the University, bring in substantial extramural resources, and foster the creation of new businesses through technical entrepreneurship. Most of this growth can be expected to occur locally, bringing the notion of "Tech Valley" to greater fruition.

The tables on the next two pages show New York State Department of Labor (NYS DOL) employment projection data for both New York State and Capital Region. The data covers occupations that are within the Electrical and Computer Engineering field. Although the data does not apply solely to advanced degrees, it shows the need for graduates in ECE to meet expected employer demand and students who obtain graduate degrees will contribute to filling this need.

New York State Department of Labor

Statewide Long-Term Occupational Employment Projections, 2014-2024

SOC Code[1]	Title	Employment		Change		Annual Average Openings		
		2014	2024	Net	Percent	Total	Growth	Replacement
17-2061	Computer Hardware Engineers	1,350	1,470	120	8.9%	40	12	28
17-2071	Electrical Engineers	11,450	12,590	1,140	10.0%	366	114	252
17-2072	Electronics Engineers, Except Computer	4,090	4,290	200	4.9%	110	20	90
15-1121	Computer Systems Analysts	37,560	48,860	11,300	30.1%	1,613	1,130	483
15-1122	Information Security Analysts	4,990	5,850	860	17.2%	150	86	64
15-1132	Software Developers, Applications	46,960	60,710	13,750	29.3%	2,046	1,375	671
15-1133	Software Developers, Systems Software	18,680	23,690	5,010	26.8%	768	501	267
15-1143	Computer Network Architects	7,180	8,170	990	13.8%	191	99	92

SOC Code[1]	Title	Annual Wages ($) - 2016[2]			
		Mean	Median	Entry[3]	Experienced[4]
17-2061	Computer Hardware Engineers	$108,490	$106,850	$72,890	$126,290
17-2071	Electrical Engineers	$99,860	$96,480	$69,530	$115,020
17-2072	Electronics Engineers, Except Computer	$100,860	$99,680	$63,770	$119,410
15-1121	Computer Systems Analysts	$98,400	$91,040	$59,600	$117,810
15-1122	Information Security Analysts	$112,790	$109,240	$68,320	$135,020
15-1132	Software Developers, Applications	$112,130	$106,650	$69,040	$133,680
15-1133	Software Developers, Systems Software	$111,980	$107,740	$71,030	$132,460
15-1143	Computer Network Architects	$115,910	$110,560	$71,640	$138,040

Capital Region Long-Term Occupational Employment Projections, 2012-2022

SOC Code[1]	Title	Employment		Change		Annual Average Openings		
		2012	2022	Net	Percent	Total	Growth	Replacement
17-2061	Computer Hardware Engineers	80	90	10	12.5%	0	0	0
17-2071	Electrical Engineers	1,130	1,810	680	60.2%	100	70	30
17-2072	Electronics Engineers, Except Computer	160	190	30	18.8%	0	0	0
15-1121	Computer Systems Analysts	3,440	4,090	650	18.9%	120	70	50
15-1122	Information Security Analysts	220	280	60	27.3%	10	10	0
15-1132	Software Developers, Applications	1,960	2,580	620	31.6%	90	60	30
15-1133	Software Developers, Systems Software	640	850	210	32.8%	30	20	10
15-1143	Computer Network Architects	490	570	80	16.3%	20	10	10

SOC Code[1]	Title	Annual Wages ($) - 2016[2]			
		Mean	Median	Entry[3]	Experienced[4]
17-2061	Computer Hardware Engineers	$94,650	$88,070	$67,470	$108,230
17-2071	Electrical Engineers	$105,810	$100,490	$68,550	$124,440
17-2072	Electronics Engineers, Except Computer	$93,750	$90,010	$63,610	$108,810
15-1121	Computer Systems Analysts	$77,880	$77,850	$56,310	$88,670
15-1122	Information Security Analysts	$92,370	$92,220	$60,690	$108,210
15-1132	Software Developers, Applications	$82,580	$78,320	$50,660	$98,540
15-1133	Software Developers, Systems Software	$102,170	$94,540	$70,250	$118,120
15-1143	Computer Network Architects	$97,000	$94,950	$70,430	$110,290

[1] Occupational codes are based on the SOC 2010 coding structure. Detailed information regarding the structure can be found at http://www.bls.gov/soc/

[2] Employment and wage data by occupation are based on the Occupational Employment Statistics (OES) survey, which collects information from approximately 52,000 businesses. Data were collected in 2012, 2013, 2014 and 2015 and then updated to the first quarter of 2016 by making cost-of-living adjustments. These estimated wages reflect a minimum wage of $9.00 per hour, which was the minimum wage in effect at the time the estimates were prepared. Occupational employment and wages technical documentation is found at http://labor.ny.gov/stats/lstechoes.shtm.

[3] *Entry wage*: The mean (average) of the bottom third of wages in an occupation.

[4] *Experienced wage*: The mean (average) of the top two-thirds of wages in an occupation.

Among the other SUNY campuses, similar graduate programs are found at the University Centers. Stony Brook offers separate graduate degrees in computer engineering and electrical engineering within a single ECE Department; Buffalo offers a graduate degree in computer science and engineering in a CSE Department, and a graduate degree in electrical engineering in an EE Department. Among the University Centers, only Binghamton offers graduate degrees in ECE within a single ECE Department, as we intend to do. Nevertheless, based on the number of degrees granted (table below) as compared to the demand shown in the NYS Labor data, it is clear that SUNY is not producing engineering talent at a rate sufficient to sustain the growing high-technology economy in the State and Region and move it forward.

Number of degrees conferred 2015-2016*						
Programs	**UAlbany**	**Binghamton**	**UBuffalo**	**Stony Brook**		**Notes**
Computer Engineering						
BS		59	37	32		
MS			0	23		
Ph.D			0	3		
Electrical and Electronics Engineering						
BS		58	85	60[d]		[d]*offered as a distance ed program*
MS			171	23		*Buffalo offers a CSE graduate program*
Ph.D			9	72		
Electrical & Computer Engineering						
BS						
MS		72				
Ph.D		7				

*IPEDS DATA: https://nces.ed.gov/collegenavigator/

Although other SUNY campuses provide similar graduate degrees, there is no other public university available in or near the Capital Region offering graduate degrees in ECE. The Stony Brook program offers separate EE and CE degrees, while ours is a combined approach; Buffalo's two degrees are distinct and housed in different departments, while we gain breadth and efficiency with a common degree in a single department; Binghamton's approach is most like ours, but is organized around slightly different focus areas.

Our program will attract local students, improving the retention of advanced engineering talent in the Region and thereby supporting *and stimulating* growth in the local technology industry. The graduate students we produce, whether originally from the local region or from out-of-state, will fill many research and engineering management positions requiring advanced degrees. Local, quality, public engineering graduate programs are essential to creating a virtuous cycle to address the regional brain drain. Increased numbers of well-educated engineers holding advanced degrees in the local workforce will attract (and spawn) more technology firms to (in) the Region and that, in turn, will create more opportunity and more incentive for talented local students to study and remain in the Region.

This program will also provide an affordable option for a growing local technology sector: a program of affordable quality to provide their engineers with studies leading to advanced degrees and expanded capabilities. The only local possibilities at present are Rensselaer Polytechnic Institute (RPI) and Clarkson Graduate School, but the companies find RPI to be cost-prohibitive (the Dean knows this from his own prior experience as Head of the Department of Electrical, Computer, and Systems Engineering at RPI; the companies stayed away and told us why.) and Clarkson has only a satellite campus locally and many courses are only offered through distance learning. Only Clarkson supports and encourages part-time graduate study in engineering. A high quality, affordable, program in the Region will be extremely attractive to local companies. In fact, we have already received multiple inquiries from local technology firms, both large and small. With this program, we will greatly improve the ability of the Capital Region to retain existing technology companies and/or units thereof.

The term Electrical and Computer Engineering covers a range of technical expertise from software to hardware design, communications and control theory, sensors and signal analysis, electromagnetics, antennas, power systems, electronics, devices, materials, and more. It is arguably the most broadly based of scientific disciplines. With that backdrop, only the largest programs in the country attempt to cover it all with equal depth. Beyond the necessary grounding in the fundamentals, programs generally identify key focus areas, usually related to their faculty strengths and the needs of their constituencies, and concentrate their resources accordingly. This is especially true of graduate programs, where substantial depth is required. For example, the UAlbany Computer Engineering B.S. program addresses content across the continuum of digital hardware, architecture, and software design, leveraging a strong association with the Computer Science offerings here at the College. We will build the ECE graduate program on a set of four concentration areas: 1) Communications and Networking, 2) Signal and Information Processing, 3) Computer Engineering, and 4) Electronic Circuits and Systems. These concentrations have been selected to match the needs of the region, state, and nation, and are well supported by the research and teaching strengths of our faculty. Over time, as the size of the program and faculty grow, we will likely expand into new, additional concentration areas.

The availability of graduate programs in the department will realize a number of benefits and address a number of concerns:

- The department's visibility and reputation will be enhanced, and its academic ranking will be improved. This will, in turn, attract a stronger group of students from across the Region and beyond, and make all of our graduates (at all degree levels) more attractive in the marketplace.
- Only with active, research-based graduate programs will we be able to attract and retain the best faculty.
- Graduate students are the lifeblood of any university's research portfolio. Without a strong graduate program to attract strong graduate students, faculty efforts to secure extramural research funding from the National Science Foundation, DARPA, and other Federal agencies, and the benefits that accrue from those funds, will be seriously impaired – or worse.
- The research to be undertaken by the faculty and students in this program will address problems of societal significance in consumer products, health and medicine, energy and environment, national security and defense, and more. Demand for highly qualified engineers in these areas continues to grow.

Graduates from this program will be prepared to take positions with many different job titles. Additionally, the job titles in the industry tend to vary over time, along with the demand for skills. This breadth is reflected in the list of titles, all of which represent positions that could be filled by graduates of this program, shown in the NYS DOL Employment Projection tables shown earlier. It is also important to note that the data presented in these tables are for BS level engineering positions (the only data available); engineers with Masters degrees will command greater starting salaries, and will generally see a more rewarding career path owing to the greater range of research and engineering management opportunities available to them. *By any measure, those tables show a very strong, sustained job market for electrical and computer engineers across the State and Region*. Nationally, the growth (BS level) is not quite as strong (BLS: 3% computer, slight electrical), but simply replacing the large numbers of engineers now entering retirement will create substantial, sustained demand.

The UAlbany Ph.D. ECE curriculum has been designed to prepare our graduates for a dynamic, fluid, multidisciplinary career environment. This degree program will put graduates on a pathway to postdoctoral fellowships, industrial research positions, and, in some cases, academic positions. They will be exceptionally well educated, fully capable of competing for jobs at the most prestigious companies and universities. The Ph.D ECE will imbue its holder with the background, skills and mindset to create significant new knowledge in his or her field. They will be prepared to be front line researchers advancing the field of electrical and computer engineering and producing advances that can potentially have significant impact on New York State and the country.

Lastly, the United States graduates relatively few students, proportionally, in the STEM disciplines as compared to our global economic competitors. Those economies with a greater proportion of engineers in the workforce do better economically; our developing competitors recognize this and are working hard to catch up. Dean Boyer studied this phenomenon as a Jefferson Science Fellow at the US Department of State, where he served as Senior Science Advisor to Dr. Thomas Shannon, then Assistant Secretary of State for Western Hemisphere Affairs. A scatter plot of national *per-capita* engineers and scientists versus GDP *per capita* reveals a very high correlation. This is also true at a regional scale, as can be seen by considering, for example, the California Bay Area, greater Boston, and the NC Research Triangle; this program will help to position Tech Valley among that group. *Once an economy moves beyond manufacturing, the only sustainable driver of economic growth is innovation. Engineers are the professional innovators who build the national (and regional) wealth; graduate-degreed engineers are the leaders among those innovators.*

(2) ***Employment:*** For programs designed to prepare graduates for immediate employment, use the table below to list potential employers of graduates that have requested establishment of the program and state their specific number of positions needed. If letters from employers support the program, they may be **appended** at the end of this form.

Employer	***Need: Projected positions***	
	In initial year	**In fifth year**
Kitware	15	30
IEEE GlobalSpec, Inc.	4	9
GLOBALFOUNDRIES	See letter of support	

(3) ***Similar Programs:*** Use the table below to list similar programs at other institutions, public and independent, in the service area, region and state, as appropriate. Expand the table as needed. ***NOTE:*** *Detailed program-level information for SUNY institutions is available in the Academic Program Enterprise System (APES) or Academic Program Dashboards. Institutional research and information security officers at your campus should be able to help provide access to these password-protected sites. For non-SUNY programs, program titles and degree information – but no enrollment data – is available from SED's Inventory of Registered Programs.*

Institution	Program Title	Degree	Enrollment
SUNY Binghamton	Electrical & Computer Engineering	Ph.D.	71
SUNY Buffalo	Electrical Engineering	Ph.D.	97
SUNY Stonybrook	Electrical Engineering	Ph.D.	64
SUNY Stonybrook	Computer Engineering	Ph.D.	14
Rensselaer Poly. Inst.	Electrical Engineering	Ph.D.	93
Rensselaer Poly. Inst.	Computer & Systems Engineering	Ph.D.	16
Clarkson University Capital Region Campus	Electrical Engineering	Ph.D.	Unknown

(4) ***Collaboration:*** Did this program's design benefit from consultation with other SUNY campuses? If so, what was that consultation and its result?

An evaluation, review, and consideration of doctoral programs at other University Centers was used in crafting the Ph.D. ECE program.

(5) ***Concerns or Objections:*** If concerns and/or objections were raised by other SUNY campuses, how were they resolved?

There were no objections or recommendations submitted during the required comment period for this degree.

2.4. Admissions

a) What are all admission requirements for students in this program? Please note those that differ from the institution's minimum admissions requirements and explain why they differ.

Program Admission Requirements

1) In addition to the general University requirements, applicants are expected to have a B.S. or M.S. degree in Computer Engineering, Electrical Engineering, or Electrical and Computer Engineering but applicants from other areas will be considered on a case by case basis. The ECE Graduate Admissions Committee will verify that each student entering the program has completed an appropriate set of post-secondary educational and professional experiences, using as a guide the student outcomes defined in of Criterion 3 of the general ABET Engineering Accreditation Commission criteria for baccalaureate level engineering programs, and Criterion 6 for curriculum requirements: (http://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2017-2018/) .

2) Prospective students should specify their career goals and research interests in the Statement of Purpose.

3) All international applicants are required to submit the results of the TOEFL or IELTS, and meet the university's minimum requirement. TOEFL or IELTS scores are not required for students who submit official transcripts showing the successful completion (B or better average) of at least two full-time semesters of academic courses (not including English language preparatory programs) at a college or university in countries where English is the dominant language. Waiver of the score submission requirement is subject to review by the Office of Graduate Admissions. To be considered for a Teaching Assistantship, international graduate students must have a TOEFL score of 600 or above on the paper version; 250 or above on the computer version; or 100 or above on the IBT Internet based test and also be certified by the department chairperson as competent to conduct classroom discussion before they can be authorized to teach classes or laboratories where the language of instruction is English.

b) What is the process for evaluating exceptions to those requirements?

Requests for exceptions to the general University at Albany admission policies listed above in item 3) should be directed in writing to the Graduate Admissions Committee. Requests for exceptions to the Ph.D. ECE specific requirement in item 1) above, should be directed in writing to the Department Chair of Electrical and Computer Engineering. Each request will be assessed by the review committee of each office and a response with information on compliance requirements will be sent to the student.

c) How will the institution encourage enrollment in this program by persons from groups historically underrepresented in the institution, discipline or occupation?

Connections will be established with several engineering organizations. These include The Society of Women Engineers, The National Society of Black Engineers, The NYS Society of Professional Engineers, The University at Albany College of Computing Women in Technology program, The National Association of Multicultural Engineering Program Advocates, and the Two Year Engineering Science Association. By participating in faculty training in the areas of diversity and multicultural students, and participating in targeted events through the aforementioned networks, such as high school engineering competitions, a recruitment pipeline will be created specifically for women and students of color typically underrepresented in computing professions.

d) What is the expected student body in terms of geographic origins (i.e., same county, same Regents Region, New York State, and out-of-state); academic origins; proportions of women and minority group members; and students for whom English is a second language?

In preparing our projections, we reviewed data from the other University – Binghamton University, University at Buffalo, and Stonybrook University – as well as national data from the American Society for Engineering Education (ASEE).

At the University Centers, the average undergraduate/graduate student ratio is 2:1 and 70.2% of the graduate students are from out-of-state. For Ph.D. programs, the percentage of out-of-state students is approximately 82%, higher than that for Master's programs. The American Society for Engineering Education (ASEE) in 2016 found that engineering doctoral programs nationwide typically graduate 23.3% women and 10.1% underrepresented minorities, approximately. Electrical (16.4%), Computer (17.5%) and Electrical/Computer (15.4%) engineering doctoral programs graduate percentages of women that are all slightly below the overall percentage for engineering. (https://www.asee.org/documents/papers-and-publications/publications/college-profiles/16Profile-Front-Section.pdf). Many of the students in engineering graduate programs (more than half) come from abroad, and include a higher proportion of women than undergraduate programs dominated by domestic students.

A number distinctive features of UAlbany and the region, impact our estimates. Because we have attracted a far higher than normal fraction of women to our faculty (roughly half), and because the UAlbany student population includes approximately 40% underrepresented minorities, we are optimistic that we can do better than the national norms in attracting highly qualified American women and underrepresented minority students to the program. Women and minority students will be courted through admissions events, connections with professional organizations and campus activities including support to attend Grace Hopper events locally and nationally. Our location in "Tech Valley" with its concentration of technology-focused companies along with our ability to offer a high-quality Ph.D. program at much lower cost than the other local options, make us believe that we will have a higher fraction of in-state students than the other University Centers.

Based on the above reasoning, we anticipate the following:

- approximately 15% of our Ph.D. student body will be comprised of underrepresented minorities
- approximately 28% of our Ph.D student body will be women
- approximately 75% of the Ph.D. student body will be those for whom English is a second language.
- approximately 25% of the Ph.D. student body will be from in-state.

2.5. Academic and Other Support Services

a) Summarize the academic advising and support services available to help students succeed in the program.

To ensure student success, a Graduate Program Coordinator will be appointed and will oversee the graduate program and students. The role of this Graduate Program Coordinator is to 1) supervise and coordinate the administration and governance of graduate studies within the graduate program for which he or she is responsible. 2) Serve as the liaison to the departmental faculty-at large and all administrative offices at the University at Albany. 3) Provide written criteria to each student, upon entry, of what constitutes acceptable progress through the program and the grounds for the student's termination from it. 4) Receive, arrange for the review of, and monitor the progress of student applications and petitions. 5) Orient and counsel graduate students with respect to program and degree requirements until a permanent adviser is selected and assist in that selection as necessary. 6) Identify areas of deficiency for students entering and make course recommendations to ensure a successful transition to the graduate program. 7) Work with the Graduate

Dean and the Office of Graduate Education to comply with all University requirements for the doctoral degree.

b) Describe types, amounts and sources of student financial support anticipated. Indicate the proportion of the student body receiving each type of support, including those receiving no support.

Financial support is available in the form of:

- Graduate Teaching Assistantships – Graduate Assistantships are funded via state support with department TA's factored into the central financial plan and allocated accordingly.
- Research Assistantships (funded primarily from faculty grants but could be from department indirects and IFR)
- External Fellowships – Our exceptional graduate students will be highly encouraged to pursue and apply for external fellowships including but not limited to SMART, NSF, DoD, NDSEG, etc.

We anticipate the following with regards to the proportion of the Ph.D. students receiving support and the sources:

- 5% self-funded (or funded by their employers)
- 75% on research grants
- 15% TAs
- 5% fellowships

2.6. Prior Learning Assessment

If this program will grant credit based on Prior Learning Assessment, describe the methods of evaluating the learning and the maximum number of credits allowed, **or check here [X] if not applicable**.

2.7. Program Assessment and Improvement

Describe how this program's achievement of its objectives will be assessed, in accordance with *SUNY policy*, including the date of the program's initial assessment and the length (in years) of the assessment cycle. Explain plans for assessing achievement of students learning outcomes during the program and success after completion of the program. **Append** at the end of this form, **a plan or curriculum map** showing the courses in which the program's educational and, if appropriate, career objectives – from Item 2.3(b) of this form – will be taught and assessed. ***NOTE:*** *The University Faculty Senate's Guide for the Evaluation of Undergraduate Programs is a helpful reference.*

The ECE department will follow the assessment and review process that is in place for all programs at the University at Albany which has many features in common with the ABET accreditation process. See http://www.albany.edu/assessment/prog_review.html. For the University at Albany process, each academic program develops a self-study and undergoes an external review process on a seven-year cycle. The self-study will identify strengths in the department, and areas that need attention and improvement. It will provide an opportunity for reflection on the missions of the programs within the department and the College of Engineering and Applied Sciences, and for examination of the departmental role in the University at Albany community. This process will include input and the involvement of program faculty, professional staff, and students, as appropriate at each phase. The first review of this program will take place during the 2022 – 2023 academic year, the scheduled full review for all program in the College of Engineering and Applied Sciences.

The above describes the periodic, externally-vetted review of the program. Additionally, regular internal reviews of student outcome attainment will be performed as part of a continuous improvement process. The direct measurement of student outcome attainment will be based on student performance in courses and their thesis work. The mapping of student outcomes to the assessment measures is provided in Appendix II.

Section 3. Program Schedule and Curriculum

Complete the **SUNY Graduate Program Schedule** to show how a typical student may progress through the program. This is the registered curriculum, so please be precise. Enter required courses where applicable, and enter generic course types for electives or options. Either complete the blank Schedule that appears in this section, or complete an Excel equivalent that computes all sums for you, found here. Rows for terms that are not required can be deleted.

NOTES: *The **Graduate Schedule** must include all curriculum requirements and demonstrate that expectations from in*
Regulation 52.2 http://www.highered.nysed.gov/ocue/lrp/rules.htm are met.

Special Cases for the Program Schedules:

- *For a program with multiple tracks, or with multiple schedule options (such as full-time and part-time options), use one Program Schedule for each track or schedule option. Note that licensure qualifying and non-licensure qualifying*
  options cannot be tracks; they must be separate programs.
- *When this form is used for a multi-award and/or multi-institution program that is not based entirely on existing programs, use the schedule to show how a sample student can complete the proposed program. **NOTE:** Form 3A, Changes to an Existing Program, should be used for new multi-award and/or multi-institution programs that are based entirely on existing programs. SUNY policy governs the awarding of two degrees at the same level.*

a) If the program will be offered through a nontraditional schedule (i.e., not on a semester calendar), what is the schedule and how does it impact financial aid eligibility? ***NOTE:*** *Consult with your campus financial aid administrator for information about nontraditional schedules and financial aid eligibility.*

N/A – The program will be offered via a traditional schedule.

b) For each existing course that is part of the proposed graduate program, **append** a catalog description at the end of this document.

c) For each new course in the graduate program, **append** a syllabus at the end of this document. ***NOTE:*** *Syllabi for all courses should be available upon request. Each syllabus should show that all work for credit is graduate level and of the appropriate rigor. Syllabi generally include a course description, prerequisites and corequisites, the number of lecture and/or other contact hours per week, credits allocated (consistent with SUNY policy on credit/contact hours), general course requirements, and expected student learning outcomes.*

d) If the program requires external instruction, such as clinical or field experience, agency placement, an internship, fieldwork, or cooperative education, **append** a completed External Instruction form at the end of this document

SUNY Graduate Program Schedule (***OPTION:*** ***You can insert an Excel version of this schedule AFTER this line, and delete the rest of this page.)***

Program/Track Title and Award:____

a) Indicate **academic calendar** type: [ ] Semester [ ] Quarter [ ] Trimester [ ] Other (describe):
b) **Label each term in sequence**, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)
c) Use the table to show **how a typical student may progress through the program**; copy/expand the table as needed.
d) Complete the last row to show program totals and comprehensive, culminating elements. **Complete all columns that apply to a course. New**: X if new course **Prerequisite(s)**: list prerequisite(s) for the listed courses

SUNY Graduate Sample Program Schedule

Campus Name	**University at Albany**
Program/Track Title and Award	**Electrical and Computer Engineering/PhD**

	Semester	Quarter	Trimester	Other
Calendar Type	x			

(Label each term in sequence, consistent with the institution's academic calendar (e.g., Fall 1, Spring 1, Fall 2)

Use the table to show how a typical student may progress through the program. Check all columns that apply to a course or enter credits where applicable. New: X if a new course. Co/Prerequisite(s): list prerequisite(s) for the noted courses.

Term 1:				**Term 2:**			
Course Number & Title	**Credits**	**New (X)**	**Co/Prerequisites**	**Course Number & Title**	**Credits**	**New (X)**	**Co/Prerequisites**
Depth Course 1	3			Depth Course 3	3		
Breadth Course 1	3			Depth Course 4	3		
Depth Course 2	3			Math/Physics Elective 1	3		
Term credit total:	**9.0**			**Term credit total:**	**9.0**		
Term 3:				**Term 4:**			
Course Number & Title	**Credits**	**New (X)**	**Co/Prerequisites**	**Course Number & Title**	**Credits**	**New (X)**	**Co/Prerequisites**
Technical Elective 1	3			Breadth Course 2	3		
ECE 899 Doctoral Thesis	6	X		Elective 1			
Breadth Course 2	3			ECE 899 Doctoral Thesis	3	X	
Term credit total:	**12.0**			**Term credit total:**	**6.0**		
Term 5:				**Term 6:**			
Course Number & Title	**Credits**	**New (X)**	**Co/Prerequisites**	**Course Number & Title**	**Credits**	**New (X)**	**Co/Prerequisites**
Depth Course 5	3			Technical Elective 2	3		
ECE 899 Doctoral Thesis	6	X		ECE 899 Doctoral Thesis	6	X	
Term credit total:	**9.0**			**Term credit total:**	**9.0**		
Term 7:				**Term 8:**			
Course Number & Title	**Credits**	**New (X)**	**Co/Prerequisites**	**Course Number & Title**	**Credits**	**New (X)**	**Co/Prerequisites**
Math/Physics Elective 2	3			Elective 2	3		
ECE 899 Doctoral Thesis	6	X		ECE 899 Doctoral Thesis	9	X	
Term credit total:	**9.0**			**Term credit total:**	**12.0**		
Program Total:	**75.0**						

Identify the required comprehensive, culminating element(s), such as a thesis or examination, including course number(s), if applicable:

ECE 899 Doctoral Thesis - 36 Credits

Section 4. Faculty

a) Complete the **SUNY Faculty Table** on the next page to describe current faculty and to-be-hired (TBH) faculty.

b) **Append** at the end of this document position descriptions or announcements for each to-be-hired faculty member.

NOTE: *CVs for all faculty should be available upon request. Faculty CVs should include rank and employment status, educational and employment background, professional affiliations and activities, important awards and recognition, publications (noting refereed journal articles), and brief descriptions of research and other externally funded projects. New York State's requirements for faculty qualifications are in in Regulation 52.2* *http://www.highered.nysed.gov/ocue/lrp/rules.htm*

c) What is the institution's definition of "full-time" faculty?

A full time faculty member is one who holds an appointment with a 100% time commitment.

SUNY Faculty Table

Provide information on current and prospective faculty members (identifying those at off-campus locations) who will be expected to teach any course in the graduate program. Expand the table as needed. Use a separate Faculty Table for each institution if the program is a multi-institution program.

Faculty Member Name and Title/Rank (Include and identify Program Director with an asterisk)	**% of Time Dedicated to This Program**	**Program Courses Which May Be Taught (Number and Title)**	**Highest and Other Applicable Earned Degrees (include College or University)**	**Discipline(s) of Highest and Other Applicable Earned Degrees**	**Additional Qualifications: List related certifications, licenses and professional experience in field**
PART 1. Full-Time Faculty					
Kim L. Boyer Professor and Dean	5%	Concentration Areas 1, 2 and 4 ECE 659 *(Projects in Computer Engineering)* ECE 679 *(Projects in Communications and Networking)*	PhD, Purdue	Electrical Engineering	Fellow IEEE, Fellow IAPR, Jefferson Science Fellow
			MSEE, Purdue	Electrical Engineering	~ 40 years' experience, Officer IEEE, President IAPR, >100 publications, 7 books
			BSEE, Purdue	Electrical Engineering	Ohio State, RPI, Bell Labs
Gary Saulnier Professor and Chair*	100%	Concentration Areas 1, 2 and 3 ECE 500 (*Advanced Electronic Circuits*)	PhD, Rensselaer Polytechnic Institute	Electrical Engineering	Professor of the Electrical, Computer, and Systems Engineering

		ECE 571 (*Advanced Digital Communications)* ECE 629 *(Projects in Electronic Circuits and Systems)* ECE 679 *(Projects in Communications and Networking)*			department at Rensselaer Polytechnic Institute
			ME, Rensselaer Polytechnic Institute	Electrical Engineering	Associate Head for Undergraduate Studies at Rensselaer Polytechnic Institute
			BS, Rensselaer Polytechnic Institute	Electrical Engineering	Electrical Engineer at General Electric Corporate Research and Development Center, Schenectady, NY
Mei Chen Associate Professor	100%	Concentration Areas 2 and 4: ECE 550 *(Robotics)* ECE 561 *(Digital Image Processing)* CSI 671 *(Computer Vision)* ECE 650 (*Introduction to Neural Networks*) ECE 659 *(Projects in Computer Engineering)* ECE 664 *(Statistical Pattern Recognition)* ECE 669 *(Projects in Signal and Information Processing)*	PhD, Carnegie-Mellon	Robotics, Computer Science	
			MS, Tsinghua (China)	Electrical and Computer Engineering	15 years' experience as a CompE research scientist
			BS, Tsinghua (China)	Electrical and Computer Engineering	(HP, Sarnoff, Intel)
Hany Elgala Assistant Professor	100%	Concentration Areas 1, 3 and 4: ECE 531 *(FPGA-Based Data Acquisition and Real-Time Processing)* ECE 571 (*Advanced Digital Communications)*	PhD, Jacobs University (Germany)	Electrical Engineering	3 years' postdoc, Boston U, 1 year Research Prof., BU
			BSc, Ain-Shams University (Egypt)	Electrical Engineering	

		ECE 662 *(Advanced Digital Signal Processing)* ECE 674 *(Error Control Coding)* ECE 675 *(Mobile and Wireless Networking)* ECE 676 *(Wireless Communications)* ECE 679 *(Projects in Communications and Networking)*			
Yelin Kim Assistant Professor	100%	Concentration Area 2: ECE 561 *(Digital Image Processing)* ECE 661 *(Mathematical Methods of Signal Processing)* ECE 662 *(Advanced Digital Signal Processing)* ECE 669 *(Projects in Signal and Information Processing)* ECE 671 *(Probability and Random Processes)* ECE 672 *(Detection and Estimation Theory)* ECE 673 *(Information Theory)* CSI 535 *(Artificial Intelligence I)* MAT 575 *(Optimization Theory)*	PhD, University of Michigan	Electrical Engineering	GE Global Research
			MS, University of Michigan	Electrical Engineering	Infosys Technologies
			BS, Seoul National University (Korea)	Electrical Engineering	
Tolga Soyata Associate Professor	100%	Concentration Areas 3 and 4: ECE 520 *(Introduction to VLSI)* ECE 521 *(Digital ASIC Design)* ECE 522 *(Integrated Circuit Devices)* ECE 531 *(FPGA-Based Data Acquisition and Real-Time Processing)* ECE 540 *(Parallel Programming for GPUs)* ECE 561 *(Digital Image Processing)*	PhD, University of Rochester	Electrical and Computer Engineering	Research Assistant Professor, U of Rochester
			MS, Johns Hopkins University	Electrical and Computer Engineering	Soyata Computers, successful startup - sold to Just Solutions
			BS, Istanbul Technical University (Turkey)	Electrical and Computer Engineering	

		ECE 580 *(Linear Control Theory)* ECE 620 *(Mixed-Signal IC Design)* ECE 630 *(Advanced Computer Architecture)* ECE 621 *(VLSI RFIC Design)* ECE 629 *(Projects in Electronic Circuits and Systems)*			
Ming-Ching Chang Assistant Professor	100%	Concentration Areas 3 and 4: ECE 540 *(Parallel Programming for GPUs)* ECE 550 *(Robotics)* ECE 561 *(Digital Image Processing)* ECE 580 *(Linear Control Theory)* ECE 630 *(Advanced Computer Architecture)* ECE 650 (*Introduction to Neural Networks*) ECE 659 *(Projects in Computer Engineering)* ECE 664 *(Statistical Pattern Recognition)* CSI 535 *(Artificial Intelligence I)* CSI 635 *(Artificial Intelligence II)*	PhD, Brown University	Engineering	Lead Computer Scientist, Computer Vision Lab, GE Global Research, Niskayuna
			MS, National Taiwan University (Taiwan)	Computer Science and Information Engineering	Adjunct Professor, Computer Science, UAlbany
			BS, National Taiwan University (Taiwan)	Civil Engineering	
Daphney Zois Assistant Professor	100%	Concentration Areas 1 and 2: ECE 571 (*Advanced Digital Communications)* ECE 580 *(Linear Control Theory)* ECE 661 *(Mathematical Methods of Signal Processing)* ECE 662 *(Advanced Digital Signal Processing)* ECE 664 *(Statistical Pattern Recognition)*	PhD, University of Southern California	Electrical Engineering	Postdoctoral researcher, University of Illinois
			MS, University of Southern California	Electrical Engineering	Systems Administrator, U of Patras
			B Eng, University of Patras (Greece)	Computer Engineering and Computer Science	

		ECE 669 *(Projects in Signal and Information Processing)* ECE 671 *(Probability and Random Processes)* ECE 672 *(Detection and Estimation Theory)* ECE 673 *(Information Theory)* ECE 674 *(Error Control Coding)* ECE 679 *(Projects in Communications and Networking)* ECE 680 *(Advanced Linear Control Theory)* ECE 681 *(Nonlinear and Adaptive Control)* MAT 575 *(Optimization Theory)*			
James Moulic Professor and Associate Dean for Applied Learning and Cooperative Education, Acting Chair of Computer Science	20%	Concentration Areas 3 and 4: ECE 520 (Introduction to VLSI) ECE 521 *(Digital ASIC Design)* ECE 522 *(Integrated Circuit Devices)* ECE 531 *(FPGA-Based Data Acquisition and Real-Time Processing)* ECE 540 *(Parallel Programming for GPUs)* ECE 620 *(Mixed-Signal IC Design)* ECE 629 *(Projects in Electronic Circuits and Systems)* ECE 630 *(Advanced Computer Architecture)* ECE 659 *(Projects in Computer Engineering)* PHY 587 *(Solid State Physics I)* PHY 588 *(Solid State Physics II)*	PhD, NYU Poly	Electrical Engineering	IEEE Fellow, Professor of Electrical and Computer Engineering, University of Alaska - Anchorage
			MS, University of Illinois	Electrical Engineering	Senior Manager, IBM TJ Watson Research Center, Yorktown Heights
			BS, University of Illinois	Electrical Engineering	IBM liaison to RPI's capstone design program
					ABET Program Evaluator
Weifu Wang Assistant Professor		Concentration Area 4 ECE 550 *(Robotics)*	PhD, Dartmouth College	Computer Science	

	100%	ECE 561 *(Digital Image Processing)* ECE 650 (*Introduction to Neural Networks*) ECE 659 *(Projects in Computer Engineering)* ECE 661 *(Mathematical Methods of Signal Processing)* ECE 664 *(Statistical Pattern Recognition)* ECE 671 *(Probability and Random Processes)* CSI 535 *(Artificial Intelligence I)* CSI 536 *(Machine Learning)* CSI 635 *(Artificial Intelligence II)* MAT 575 *(Optimization Theory)*	BS, Nanjing University	Software Engineering	Minor, Business Administration and Management
Dola Saha Assistant Professor	100%	Concentration Areas 1 and 2 ECE 571 (*Advanced Digital Communications)* ECE 630 *(Advanced Computer Architecture)* ECE 662 *(Advanced Digital Signal Processing)* ECE 669 *(Projects in Signal and Information Processing)* ECE 675 *(Mobile and Wireless Networking)* ECE 676 *(Wireless Communications)* ECE 679 *(Projects in Communications and Networking)* CSI 516 *(Computer Communications Networks)* CSI 616 *(Computer Communications Networks II)*	PhD, University of Colorado	Computer Science	Research Assistant Professor, Rutgers University WINLAB, Dept. of Electrical and Computer Engineering
			MS, University of Colorado	Computer Science	Researcher, NEC Laboratories
			BTech, Kalyani University (India)	Information Technology	
Aveek Dutta Assistant Professor		Concentration Areas 1 and 4	PhD, University of Colorado	Electrical Engineering	Assistant Professor of Electrical

	100%	ECE 531 *(FPGA-Based Data Acquisition and Real-Time Processing)* ECE 571 *(Advanced Digital Communications)* ECE 580 *(Linear Control Theory)* ECE 630 *(Advanced Computer Architecture)* ECE 659 *(Projects in Computer Engineering)* ECE 662 *(Advanced Digital Signal Processing)* ECE 671 *(Probability and Random Processes)* ECE 672 *(Detection and Estimation Theory)* ECE 674 *(Error Control Coding)* ECE 675 *(Mobile and Wireless Networking)* ECE 676 *(Wireless Communications)* ECE 679 *(Projects in Communications and Networking)* ECE 680 *(Advanced Linear Control Theory)* CSI 516 *(Computer Communications Networks)* CSI 616 *(Computer Communications Networks II)*			Engineering and Computer Science, University of Kansas
			MS, University of Colorado	Electrical Engineering	Postdoctoral researcher, Princeton University
			BTech, Kalyani University (India)	Electronics & Telecommunications	
Mustafa Aksoy Assistant Professor	100%	Concentration Areas 1 and 3 ECE 510 *(Antenna Engineering)* ECE 572 *(Radiowave Propagation and Remote Sensing)* ECE 511 *(Microwave Engineering)* ECE 629 *(Projects in Electronic Circuits and Systems)*	PhD, Ohio State University	Electrical and Computer Engineering	Post-Doctoral Research Associate, NASA Goddard Space Flight Center
			MS, Ohio State University	Electrical and Computer Engineering	
			BS, Bilkent University	Electrical and Electronics Engineering	

Guy Cortesi Professor of Practice	100%	Concentration Areas 3 and 4 ECE 531 *(FPGA-Based Data Acquisition and Real-Time Processing)* ECE 629 *(Projects in Electronic Circuits and Systems)* ECE 659 *(Projects in Computer Engineering)*	PhD, University at Albany	Information Science	Extensive industrial R&D experience
			MS, Clarkson	Electrical and Computer Engineering	Successful entrepreneurial activities
			BS, Clarkson	Electrical and Computer Engineering	
Jonathan Muckell Professor of Practice	100%	Concentration Area 4 ECE 531 *(FPGA-Based Data Acquisition and Realtime Systems)*	PhD, University at Albany	Information Science	Experience with NYS
			MS, Rensselaer Polytechnic Institute	Computer and Systems Engineering	Chief Technology Officer
			BS, St. Lawrence	Electrical and Computer Engineering	
To Be Hired Open Rank (ECE)	100%				

All of the faculty listed above should additionally be considered eligible to direct Independent Study ECE697, Master's Thesis ECE699 and Doctoral Dissertation ECE899 "courses."

Section 5. Financial Resources and Instructional Facilities

a) What is the resource plan for ensuring the success of the proposed program over time? Summarize the instructional facilities and equipment committed to ensure the success of the program. Please explain new and/or reallocated resources over the first five years for operations, including faculty and other personnel, the library, equipment, laboratories, and supplies. Also include resources for capital projects and other expenses.

New instructional facilities are not needed for the program, since virtually all of the graduate courses will be taught in pre-existing standard lecture-hall classrooms. There will be minimal need for additional teaching lab facilities distinct from those in the existing undergraduate courses. To support the recent introduction of the B.S. Computer Engineering, the library has already expanded its journal collection, including adding a subscription to IEEE Xplore Digital Library, and computing services has obtained licenses to MATLAB. Licenses for Cadence Designs tools, which are needed to support electronic design at both the graduate and undergraduate level, will be added soon.

Graduate student research is funded through grants and faculty start-up funding, including equipment purchases. All faculty are provided laboratory space for their work in addition to significant start-up funding that can be used to support graduate students, purchase laboratory equipment or software, travel, etc. New laboratories and equipment, therefore, will be added as new faculty are hired and will support the research area(s) and students of these faculty.

We currently have the faculty expertise needed to offer the proposed courses and to supervise students' thesis and project work. As undergraduate and graduate enrollments increase, the revenue generated will allow the addition of new faculty. Initial hires will likely be teaching faculty who will assume a greater portion of the undergraduate teaching responsibilities, particularly for lower-division courses, and allow regular, research-active faculty to focus more heavily on upper-division undergraduate and graduate teaching and research.

Capital projects, as needed, will be covered in the Campus Financial Plan. Within 4 years, it is expected that the College of Engineering and Applied Sciences will move into its own building on the UAlbany Downtown Campus. A $60M renovation project is currently underway to prepare the building for CEAS. This new building will bring new laboratory, office and instructional space to the department.

b) Complete the five-year SUNY Program Expenses Table, below, consistent with the resource plan summary. Enter the anticipated academic years in the top row of this table. List all resources that will be engaged specifically as a result of the proposed program (e.g., a new faculty position or additional library resources). If they represent a continuing cost, new resources for a given year should be included in the subsequent year(s), with adjustments for inflation or negotiated compensation. Include explanatory notes as needed.

SUNY Program Expenses Table

(OPTION: You can paste an Excel version of this schedule AFTER this sentence, and delete the table below.)

PROGRAM EXPENSES CATEGORIES	Expenses (in dollars)					
	Before Start	Academic Year 2018	Academic Year 2019	Academic Year 2020	Academic Year 2021	Academic Year 2022
(a) Personnel (including faculty and all others	$ 1,525,307	$ 1,657,813	$ 1,690,969	$ 1,724,789	$ 1,759,285	$ 1,794,470
(b) Library						
(c) Equipment/Furniture	$ -	$ -	$ -	$ -	$ -	$ -
(d) Laboratories	$ -	$ -	$ -	$ -	$ -	$ -
(e) Supplies	$ 13,500	$ 13,500	$ 13,500	$ 13,500	$ 13,500	$ 13,500
(f) Capital Expenses						
(g) Student Stipends and scholarships	$ -	$ 98,298	$ 200,528	$ 306,808	$ 417,258	$ 532,005
(h) Other (specify): Search Expenses and Department set up	$ -	$ -	$ -	$ -	$ -	$ -
Sum of Rows Above	$ 1,538,807	$ 1,769,611	$ 1,904,997	$ 2,045,097	$ 2,190,043	$ 2,339,975

Section 6. Library Resources

a) Summarize the analysis of library collection resources and needs *for this program* by the collection librarian and program faculty. Include an assessment of existing library resources and accessibility to those resources for students enrolled in the program in all formats, including the institution's implementation of SUNY Connect, the SUNY-wide electronic library program.

The University Libraries collects, houses, and provides access to all types of published materials in support of the research and teaching of the schools, colleges, and academic departments of the University. This evaluation considers those portions of the libraries' collections and services that would support a graduate degree in Electrical and Computer Engineering. Many of these resources were recently supplemented in support of the new B.S. degree in Computer Engineering.

Library Collections

The University Libraries are among the top 115 research libraries in the country. The University Library, The Science Library, and the Dewey Graduate Library contain more than two million volumes and over 2.9 Million microforms. The Libraries provide access to more 75,000 online journals and over 117,000 online books.

Whenever possible, current subscriptions are available online. Additionally, the Libraries serve as a selective depository for U.S. Government publications and house collections of software and media. The Science Library, which opened in September 1999, occupies 61,124 square feet on four floors. The Science Library serves the entire University at Albany community, but contains collections supporting the departments of Atmospheric and Environmental Sciences, Biological Sciences, Chemistry, Computer Science, Mathematics and Statistics, Physics, Psychology, Electrical and Computer Engineering, and the College of Nanoscale Science and Engineering. Approximately 600,000 volumes in the science and technology subject areas (Q-TP of the Library of Congress classification scheme) are housed in this library. Online resources (journals, databases, e-books, digital libraries) are available on and off campus, all hours of the day.

Books

Currently, it is estimated that there are over 20,000 books in those portions of the Library of Congress (LC) classification scheme which relate to computing and computer science; specifically, in LC classes QA 76 (computer science), Q 327 (pattern recognition), Q 335-336 (artificial intelligence), QA 267-268 (machine theory), TA 1630-1650 (image processing), TK 5105 (computer networks), and TK 7880-7895 (computer electronics and hardware). To assess to strength of the book collection in computer science, a study was conducted in 2008. The University Libraries book holdings were compared to the listing in the "Computing" chapter of *RCL:Resources for College Libraries* (volume 5: *Science and Technology*) on pages 335 to 349 (Chicago: American Library Association, 2007). The study showed that the University Libraries have 180 of 231(77.9%) of the books listed, which indicates a strong collection.

The books in the current collection will support both the computer science and electrical and computer engineering courses in the curriculum.

Reference Collection

The Science Library reference collection houses many reference resources for computing, computer science, computer engineering, and electrical and computer engineering. These include guides to the literature, dictionaries, encyclopedias, biographical sources, handbooks, and style guides.

Journals and Magazines

The University Libraries' subscriptions to the *ACM (Association for Computing Machinery) Digital Library, IEEE Xplore Digital Library,* Elsevier *(ScienceDirect),* Springer, and Wiley. Furthermore, the University Libraries provide access to many more computing magazines through its subscriptions to full text aggregator databases like *Applied Sciences and Technology Source, Computer Source, Academic Search Complete,* and *Academic OneFile*.
No additional magazine resources are required.

Conference Proceedings

Conferences are an important means for communicating the latest developments in electrical and computer engineering. Major associations sponsor numerous conferences each year. Those associations include the IEEE, the Association For Computing Machinery (ACM), the British Computer Society, and the IET (Institution of Engineering and Technology). Several databases, which are described below, index Conference proceedings. The University Libraries subscribe to the *ACM Digital Library* and *IEEE Xplore*. These collections include the conferences proceedings of the ACM, the IEEE, and related organizations. The University Libraries also subscribe to the *Springer Computer Science E-book Collection*. Many of the dozens of new e-books added to this collection each month are conference proceedings from around the world. The British Computer Society conference proceedings (and workshops) are open access and are available in a resource called *Electronic Workshops in Computing (eWiC).* Conference proceedings published by the IET and other publishers can be selected for purchase by the librarian. No new resources are required.

Databases and Digital Collections

The University Libraries currently subscribes to many databases and digital collections that are important to electrical and computer Engineering. The databases include, IEEE/IET Electronic Library (IEL), ACM Digital Library, Scopus, INSPEC, SPIE Digital Library, and Springer Computer Science eBook Collection. Those databases are listed and described below. Comprehensive Databases Published by the Institution of Engineering and Technology (IET), INSPEC provides comprehensive indexing of the world's scientific literature for engineering, physics and computer science. It covers journal articles, conference proceedings, reports, dissertations, and books. The *(ACM) Guide to Computing Literature* is a comprehensive database that contains citations from the major English language publishers in computing. Coverage, which dates as far back as 1947, includes books, journal articles, conference proceedings, doctoral dissertations, master's theses, and technical reports.

Digital Collections/Full Text Databases

The IEEE Xplore Digital Library is a full-text database that provides access to IEEE journals, transactions, and magazines, including early access documents; IEEE conference proceedings; IET journals, IET conference proceedings, IEEE published standards, IEEE Standards Dictionary Online, etc. It is important to note that IEL contains almost one-third of the world's current literature in electrical engineering, communications, and computer science. The *ACM (Association for Computing Machinery) Digital Library* is a full text database that provides access to all of the association's journals, magazines, special interest group newsletters, and conference proceedings. The *IEEE Computer Society Digital Library* is a full text database that contains the scholarly journals, magazines, and conference proceedings and workshops published by the IEEE Computer Society. *Applied Science and Technology Source* provides access to the full text from more than 1,400 journals and magazines, including scholarly journals, trade magazines, professional society journals, and conference proceedings. Three of the broad subjects covered are engineering, computing, and information technology. Providing access to nearly 300 full text academic journals, magazines, and trade publications, *Computer Source* covers subjects like information systems and robotics. An additional 150 periodicals are also indexed and abstracted.

Related Databases

Web of Science indexes the core journals for all science and technology subjects, including computer engineering. Besides keyword and author searching, one of its key features is the ability to track an author's citation and determine who has cited that work. *MathSciNet* is a comprehensive database for pure and applied mathematics, and indexes important resources in engineering mathematics.

At this time, no new databases are recommended. However, as engineering grows and research expands at the University, it may become necessary to subscribe to *Compendex*, a comprehensive database that covers engineering disciplines.

Patents

U.S. patents and patent applications are freely available from the United States Patent and Trademark Office (USPTO) Website as well as several other patent Websites. Patents from other countries and international organizations are also freely available on the Web. No resources are recommended.

Standards

Engineers depend on industrial standards for their work. Currently, the University Libraries rely on the New York State Library for standards, which has a large collection along with related publications. This includes standards from the American National Standards Institute (ANSI), the National Institute of Standards and Technology (NIST), and the International Organization for Standardization (ISO). The websites of these organizations and others provide free standards searching capabilities. IEEE Xplore Digital Library provides access to IEEE standards. No resources are recommended. As the program grows, the University Libraries may need to revisit the acquisition of standards for electrical and computer engineering, if the need exists. A purchase on demand model may work best.

Technical Reports

Published by academic departments, companies, and government agencies, technical reports describe successful and unsuccessful research. They are intended for rapid dissemination before being presented at conferences or published in scholarly journals. Most organizations make their technical reports available on their Websites. However, the "technical report system" is changing. Many technical reports are being migrated to institutional repositories or subject repositories like the *Computing Research Repository CoRR)* (http://arxiv.org/corr/home). Therefore, search engines are needed to track down older as well as current reports. *Google* and *Google Scholar* are often very helpful. In addition, *TRAIL: The Technical Report Archive & Image* Library http://technicalreports.org/), *National Technical Information Service (NTIS)* (http://ntis.gov/), *NCSTRL: Networked Computer Science Technical Reports Library*

(http://csetechrep.ucsd.edu/Dienst/htdocs/Welcome.html), and the Google custom search engine (http://www.opendoar.org/search.php) at *OpenDOAR* (Directory of Open Access Repositories) are useful.

No resources are recommended.

Interlibrary Loan and Delivery Services

The University Libraries' Interlibrary Loan (ILL) Department borrows books and microforms, and obtains digital copies of journal articles and other materials not owned by the Libraries from sources locally, statewide, nationally, and internationally. ILL services are available at no cost to the user for faculty, staff, and students currently enrolled at the University at Albany. Users can manage their requests through the use of ILLiad, the University Libraries' automated interlibrary loan system, which is available through a web interface at https://illiad.albany.edu/.

The University Libraries also provide delivery services for books and articles housed in any of the three libraries. Books can be delivered to one of the libraries or for faculty, to departmental addresses. Articles are scanned and delivered electronically via email. The Libraries also provide free delivery services to the home addresses of online learners and people with disabilities. Delivery services are managed through ILLiad as well.

Access to Research Collections

Library memberships provide access to many other libraries in the Capital District region, in New York State, and throughout the United States and Canada. In the Capital District, the Capital District Library Council (CDLC) sponsors the Direct Access Program (DAP). Upon presentation of a CDLC DAP card, students and faculty may borrow from or use 47 academic, public, law, medical, and technology libraries, including the Rensselaer Polytechnic Institute Libraries, which has excellent science and technology collections. Students and faculty may also use the collections of the New York State Library. Statewide, students and faculty may use and borrow materials from most of the SUNY-affiliated institutions.

Summary

The University Libraries have been committed to build and maintain collections in support of electrical and computer engineering. Many resources purchased for computer science, other science/technology subjects, and computer engineering will also support the electrical and computer engineering program.

b) Describe the institution's response to identified collection needs and its plan for library development.

No new resources are needed.

Section 7. External Evaluation

SUNY and SED require external evaluation of all proposed graduate degree programs. List below all SUNY-approved evaluators who conducted evaluations (adding rows as needed), and **append at the end of this document** each original, signed *External Evaluation Report.* ***NOTE:*** *To select external evaluators, a campus sends 3-5 proposed evaluators' names, titles and CVs to the assigned SUNY Program Reviewer, expresses its preferences and requests approval.*

Evaluator #1	**Evaluator #2**
Name: Scott F. Midkiff Title: Vice-President for Information Technology and Chief Information Officer, Professor of Electrical and Computer Engineering Institution: Virginia Polytechnic Institute and State University (Virginia Tech).	Name: Joanne Bechta Dugan Title: Professor of Electrical and Computer Engineering and the Director of the Computer Engineering Programs Institution: University of Virginia

Section 8. Institutional Response to External Evaluator Reports

Append at the end of this document a single *Institutional Response* to all *External Evaluation Reports.*

Section 9. SUNY Undergraduate Transfer

NOTE: *SUNY Undergraduate Transfer policy does not apply to graduate programs.*

Section 10. Application for Distance Education

a) Does the program's design enable students to complete 50% or more of the course requirements through distance education? [X] No [ ] Yes. If yes, **append** a completed *SUNY Distance Education Format Proposal* at the end of this proposal to apply for the program to be registered for the distance education format.

b) Does the program's design enable students to complete 100% of the course requirements through distance education? [X] No [ ] Yes

Section MPA-1. Need for Master Plan Amendment and/or Degree Authorization

a) Based on guidance on Master Plan Amendments, please indicate if this proposal requires a Master Plan Amendment.
[X] No [ ] Yes, a completed *Master Plan Amendment Form* is **appended** at the end of this proposal.

b) Based on *SUNY Guidance on Degree Authorizations* (below), please indicate if this proposal requires degree authorization.

[X] No [ ] Yes, once the program is approved by the SUNY Provost, the campus will work with its Campus Reviewer to draft a resolution that the SUNY Chancellor will recommend to the SUNY Board of Trustees.

SUNY Guidance on Degree Authorization. *Degree authorization is required when a proposed program will lead to a new degree (e.g., B.F.A., M.P.H.) at an existing level of study (i.e., associate, baccalaureate, first-professional, master's, and doctoral) in an existing disciplinary area at an institution. Disciplinary areas are defined by the New York State Taxonomy of Academic Programs. Degree authorization requires approval by the SUNY Provost, the SUNY Board of Trustees and the Board of Regents.*

List of Appended Items

Appended Items: Materials required in selected items in Sections 1 through 10 and MPA-1 of this form should be appended after this page, with continued pagination. In the first column of the chart below, please number the appended items, and append them in number order.

Number	Appended Items	Reference Items
N/A	*For multi-institution programs*, a letter of approval from partner institution(s)	Section 1, Item (e)
N/A	*For programs leading to professional licensure*, a side-by-side chart showing how the program's components meet the requirements of specialized accreditation, Commissioner's Regulations for the Profession, or other applicable external standards	Section 2.3, Item (e)
N/A	*For programs leading to licensure in selected professions for which the SED Office of Professions (OP) requires a specialized form*, a completed version of that form	Section 2.3, Item (e)
I	*OPTIONAL: For programs leading directly to employment*, letters of support from employers, if available	Section 2, Item 2.3 (h)(2)
II	*For all programs*, a plan or curriculum map showing the courses in which the program's educational and (if appropriate) career objectives will be taught and assessed	Section 2, Item 7
III	*For all programs*, a catalog description for each existing course that is part of the proposed graduate major program	Section 3, Item (b)
IV	*For all programs with new courses*, syllabi for all new courses in a proposed graduate program	Section 3, Item (c)
N/A	*For programs requiring external instruction*, a completed *External Instruction Form* and documentation required on that form	Section 3, Item (d)
V	*For programs that will depend on new faculty*, position descriptions or announcements for faculty to-be-hired	Section 4, Item (b)
VI	*For all programs*, original, signed External Evaluation Reports from SUNY-approved evaluators	Section 7
VII	*For all programs*, a single Institutional Response to External Evaluators' Reports	Section 8
N/A	*For programs designed to enable students to complete at least 50% of the course requirements at a distance*, a *Distance Education Format Proposal*	Section 10
N/A	*For programs requiring an MPA*, a *Master Plan Amendment form*	Section MPA-1

Appendix I: Letters of support from employers [Section 2, Item 2.3 (h)(2)]

1. **Kitware**
2. **IEEE GlobalSpec**
3. **Global Foundries**

28 Corporate Drive
Clifton Park, NY 12065 USA
Phone/Fax: (518) 371-3971
www.kitware.com

Dr. Anthony Hoogs
Senior Director of Computer Vision
Kitware, Inc.
28 Corporate Drive
Clifton Park, NY 12065
(518) 881-4910
anthony.hoogs@kitware.com
www.kitware.com/company/team/hoogs.html

December 14, 2016

Ann Marie Murray, Ph.D.
Associate Provost for Program Development and Service Professor
University at Albany, State University of New York
University Hall 308
1400 Washington Avenue
Albany, New York 12222

Re: Support of the University at Albany Computer Engineering Graduate Program

Dear Dr. Murray:

I'm writing in support of the Computer Engineering Doctoral Program at the University of Albany. As the Senior Director of Computer Vision at Kitware, I recognize the strong need for MS and PhD graduates trained in both the software and the hardware end of computer technology. The planned graduate curriculum offers students the qualifications and skills to serve the research employment needs in companies such as Kitware.

Kitware is a leader in the creation and support of open-source software and state of the art research in computer vision, visualization and medical imaging. By fostering extended, collaborative communities, Kitware is able to perform cost-effective visualization, computer vision, data analytics and medical imaging research in collaboration with a variety of academic and government institutions and private corporations worldwide. Our employees are trained computer professionals, with a majority holding graduate degrees and one third with PhD. Many are internationally recognized in their fields.

The employment forecast for computer and software engineering researchers is very positive. Computer engineers can serve industries like Kitware in many ways and are desirable employees. It is expected that within the next year we will hire more than fifteen employees, most with graduate degrees in CS, ECE or EE, and we expect in five years that there will be at least thirty openings here at Kitware, some of which can be filled by applicants who possess the skills and training commensurate with those developed through the computer engineering program at the University.

Kitware

Leaders in Visualization Technology

28 Corporate Drive
Clifton Park, NY 12065 USA
Phone/Fax: (518) 371-3971
www.kitware.com

Kitware collaborates with dozens of universities, mostly in the USA but also world-wide. We recently began our first collaboration with the University on the DARPA Media Forensics program, which has been progressing well. We look forward to expanding our relationship as the University adds high-quality faculty, and the graduate students they will attract, in research areas relevant to Kitware such as computer vision, machine learning, robotics, data analytics, scientific visualization and medical image analysis.. We will consider internships or co-ops for upper level students to work with our talented staff as our needs dictate. This will provide us the opportunity to stay connected to the University and benefit from the pool of trained students who may be available for a career with Kitware.

We wish you great success in expanding the graduate program at the new College of Engineering and Applied Science at the University. The presence of local public higher education degrees in computer engineering and computer science is important for many reasons. It will serve our industries and our communities in meeting the demands of the workforce while retaining skilled professionals in our region. We look forward to the implementation of the computer engineering graduate program.

Sincerely,

Dr. Anthony Hoogs
Senior Director of Computer Vision
Kitware, Inc.

IEEE GlobalSpec

Patrick D. Mahoney
President & Chief Executive Officer

12 January 2017

Ann Marie Murray, Ph.D.
Associate Provost for Program Development and Service Professor
University at Albany, State University of New York
University Hall 308
1400 Washington Avenue
Albany, New York 12222

Re: University at Albany Computer Engineering Graduate Program

Dear Dr. Murray:

On behalf of IEEE GlobalSpec, I write to you today in full support of the proposed Masters and Doctoral programs in Electrical and Computer Engineering (ECE) at University at Albany's College of Engineering and Applied Science.

GlobalSpec was created in 1996 by three GE engineers who sought to convert the tedious process of component search from manual to online entry, thus significantly accelerating the research and design process for device and system engineering. From those early days, GlobalSpec grew into a component search warehouse and a business-to-business ("B2B") digital publisher. Today, IEEE GlobalSpec employs 150+ people, primarily in the Albany area, with plans for significant growth in the coming years. In fact, one of our employees is a current full-time Computer Engineering major at University at Albany, who we promoted from a summer internship partly in recognition of his technical training.

Given the broad nature of the markets and customers we serve, companies like ours place a significant value on engineers with exposure to a broad technical curriculum as outlined for your ECE program. Our future employment plans pivot on our ability to attract top engineering talent, one of the reasons I am delighted with University at Albany's plans for advanced degree training in ECE. Beyond that, we have a continuing need for summer interns to help us with both research and the operational aspects of our business.

30 Tech Valley Drive, Ste. 102 | East Greenbush, New York 12061 | USA
Tel: +1 518 880-0200 | Toll Free: +1 866 773 2448

Patrick D. Mahoney
President & Chief Executive Officer

Our technical recruiting needs are as diverse as our customer base. Over the next five years, we envision adding 12-15 engineers to our payroll with potentially 60% of them coming from ECE disciplines. We currently recruit engineers from engineering schools across the nation, and we would be delighted to hire locally because such ability serves to instill confidence in the regional economy as well as the reputation of IEEE GlobalSpec.

It is my hope that this letter of endorsement helps to provide confidence in the direction the University at Albany is taking by expanding the graduate degree program in University at Albany's College of Engineering and Applied Science at the University. Best of luck in the creation and launch of these exciting advance degree programs.

Very truly yours,

Patrick D. Mahoney

30 Tech Valley Drive, Ste. 102 | East Greenbush, New York 12061 | USA
Tel: +1 518 880-0200 | Toll Free: +1 866 773 2448

16 February 2017

Anne Marie Murray, PhD
Associate Provost for Program Development and Service Professor
University at Albany, State University of New York
University Hall 308
1400 Washington Avenue
Albany, NY 12222

Re: University at Albany Electrical & Computer Engineering Programs

Dear Dr. Murray,

Please accept this letter in support of University at Albany's proposed graduate degree programs in electrical and computer engineering to be housed at its College of Engineering and Applied Sciences (CEAS).

As a manufacturer of the world's most advanced semiconductor technologies, GLOBALFOUNDRIES depends on the availability of a skilled local workforce to ensure our continued success and the sustainability of the region. Our advanced node production facility in Malta, NY, known as Fab 8, represents a $15 billion investment and employs thousands of workers to support its operations, approximately one-third of which hold engineering degrees. To thrive in a highly competitive global marketplace, we depend on the local education ecosystem to prepare students for careers in advanced manufacturing and support our future talent pipeline. We are confident that University at Albany's proposed graduate programs in electrical and computer engineering will do just that.

GLOBALFOUNDRIES sees University at Albany as an important partner in delivering much-needed education and training to its employees and the ecosystem at large. We support the University at Albany's efforts to expand its electrical and computer engineering programs to meet the needs of advanced manufacturers, such as GLOBALFOUNDRIES, and look forward to our continued partnership.

Sincerely,

Mike Russo
Director & Corporate Lead
U.S. Government Relations & Regulatory Affairs

400 Stonebreak Road Extension, Malta, NY 12020 - Ph: (518) 305-9023 - Fx: (518) 305-9173 - mike.russo@globalfoundries.com

Appendix- II: [A plan or curriculum map] Section 2, Item 7

Following an ABET-like approach, only the attainment of the Student Learning Outcomes will be assessed. This approach is largely due to the difficulty in obtaining direct measurement for the attainment of Educational Objectives since they concern student achievement after graduation. The table below shows the assessment measures that will be used.

Student Learning Outcome	Assessment Measures
a. Demonstrate extensive knowledge in one area of Electrical and Computer Engineering	Student grades in their depth courses.
b. Study an issue, identify and evaluate alternative actions, propose a course of action, implement a solution, and defend conclusions	Evaluation of student performance in their thesis research.
c. Present technical information in a variety of formats, including written reports and oral presentations	Evaluation of the written presentation components of students' theses. Evaluation of the oral presentation of students' theses.

Faculty who are supervising doctoral students or who are serving on doctoral committees will complete a form assessing performance for Student Learning Outcomes 2 and 3 for each student as part of the student's Thesis Defense. These forms, as well as a selection of theses and reports will be reviewed by the ECE Assessment Committee on a biennial basis in evaluating the overall attainment of Student Learning Outcomes. The committee will report the results to the Graduate Studies Committee who will then provide a report to the faculty as a whole along with recommended actions.

Appendix III: Catalog description for each existing course

CSI 516 Computer Communications Networks I (3)

Introduction to computer communication networks. Equal emphasis on all layers of the ISO reference model and the TCP/IP protocol suite. Topics include physical networks, sliding window protocols, remote procedure call, routing, naming and addressing, security, authentication, performance, and applications. Prerequisites: CSI 333 (formerly CSI 202), CSI 310, and MAT 367.

CSI 535 Artificial Intelligence I (3)

A first course in artificial intelligence (AI) introducing basic concepts and techniques. Topics include problem representation, production systems, heuristic search, predicate logic, and structured representation of knowledge. Techniques of sample search and sample problem solving systems are represented. Exercises in a selected AI programming language. Prerequisites: CSI 310, departmental examination in discrete mathematics.

CSI 536 Machine Learning (3)

Machine learning is an important and rapid growing branch of artificial intelligence. The aim of machine learning is to design algorithm that can extract information from environment automatically and improve its ability to perform the intended task. Currently, machine learning has been applied in various fields including engineering, bioinformatics, data mining and neurosciences, to name a few. This course provides a broad introduction to machine learning. Specifically, topics that will be covered in the class may include: numerical optimization methods that are essential for machine learning algorithms dimension reduction methods: principal component analysis & ISOMAP classification methods: linear discriminant analysis, k-nearest neighbor classifier, and logistic regression regression methods: least squares regression, ridge regression, and l1 regularized least squares regression (LASSO) clustering methods: k-means clustering and EM algorithm neural networks support vector machines for classification and regression. Prerequisites: basic knowledge of Linear Algebra (AMAT 220 or equivalent), Multivariate calculus (AMAT 214 or equivalent), Discrete probability (AMAT 367 or equivalent), Numerical methods (CSI 401 or equivalent).

CSI 616 Computer Communication Networks II (3)

Survey of current trends in computer communication networks. Topics include transaction oriented protocols, bulk data transfer protocols, high speed networks, routing, protocol performance and efficiency, security, and authentication. Prerequisite: CSI 516.

CSI 635 Artificial Intelligence II (3)

A continuation of the materials introduced in CSI 535. Prerequisite: CSI 535.

CSI 671 (Inf 671) Computer Vision (3)

Billions of images are hosted publicly on the web - how can you find one that "looks like" some image you are interested in? How can a robot identify objects in complex environments, or navigate uncharted territory? How can a video camera in the operating room help a surgeon plan a procedure more safely, or assist a radiologist in more efficiently detecting a tumor? Computer vision is at the heart of many such questions: the goal is to develop methods that enable a machine to "understand" or analyze images and videos, so that information can be derived from raw pixel values to support various applications. In this course, through lectures, paper presentations, and projects, we will explore fundamental topics including image formation, feature detection, segmentation, recognition and learning, and motion and tracking. We will treat computer vision as a process of inference from noisy and uncertain data and emphasize probabilistic, statistical, and data-driven approaches. Prerequisites: This course requires familiarity with calculus, basic probability theory and linear algebra, and some programming experience. Previous experience with image processing and machine learning will be useful but is not assumed. MATLAB, the language of choice for the programming assignments will be covered as part of the introduction to the course.

MAT 575 Optimization Theory (3)

Introduction to optimization. Constrained optimization and Lagrange multipliers. Convex sets, convex functions and conjugate functions. Fenchel duality, convex optimization, Lagrange duality, non-linear programming. Karush-Tucker conditions and calculus of variations. Prerequisites: MAT 214 and 220.

PHY 587 Solid State Physics 1 (3)

A broad survey of the phenomena of solid state physics. Symmetries of crystals and diffraction from periodic structures; vibrational states and electronic band structures in crystalline metals, semiconductors, and insulators; thermal, transport and optical properties of solids. Prerequisites: PHY 517 and PHY 547.

PHY 588 Solid State Physics II (3)

A broad survey of the phenomena of solid state physics (continuation of Solid State Physics I). Superconductivity; magnetic and dielectric properties of materials; spectroscopy with photons and electrons; point and line defects; surfaces and interfaces; alloys; noncrystalline solids. Prerequisite: PHY 587.

Appendix IV: Syllabi for all new courses

University at Albany / Electrical and Computer Engineering

Advanced Electronic Circuits

ECE 500 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Gary J. Saulnier
Instructor Title	Professor, ECE
Office Location	Li84A
Office hours	TBD
E-mail Address	gsaulnier@albany.edu
TA's / Peer Educators	TBD
Prepared By	Gary J. Saulnier

Textbooks:

Design with Operational Amplifiers and Analog Integrated Circuits, 4th Edition by Sergio Franco

COURSE DESCRIPTION / OVERVIEW:

Linear and non-linear applications of operational amplifiers, with an emphasis on circuit design. Non-ideal operational amplifier behavior, including both static and dynamic characteristics. Amplifier stability and frequency compensation techniques. Operational amplifier based oscillators. Circuit noise.

PREREQUISITES:

CEN 380 Introduction to Digital Electronics or equivalent

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: After completing the course, students will be able to:

- Analyze and design linear op amp circuits
- Determine the error introduced by non-ideal op amp characteristics
- Determine the noise at the output of a circuit containing op amps
- Apply frequency compensation to stabilize op amp circuits
- Analyze and design non-linear op amp circuits

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained.

ASSESSMENT AND POLICIES:

Exams: Three exams will be given.

Projects / Assignments: Weekly homework will be assigned based on the material covered during previous week.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

- Homework - 15% (lowest grade dropped)
- Exams - 75% (25% each)
- Attendance - 10%

Attendance/Lateness/Use of Computers in class

Students are expected to *attend every class and to arrive on time*. Please DO NOT disrupt the class by entering late or leaving early without instructor approval. Attendance will be taken at every class meeting. Each unexcused absence (one approved by either instructor prior to class) will result in a 1-point deduction from your class participation grade. Computers may be used during class for note taking as long as the use is not disruptive or distracting. Also see http://www.albany.edu/health_center/medicalexcuse.shtml.

Responsible Computing

Students are required to read the University at Albany Policy for the Responsible Use of Information Technology (http://www.albany.edu/its/policies_responsible_use_of_IT.htm). Students will be expected to apply the policies discussed in this document to all computing and electronic communications in the course.

Students With Disabilities

Reasonable accommodations will be provided for students with documented physical, sensory, systemic, cognitive, learning and psychiatric disabilities. If you believe you have a disability requiring accommodation in this class, please notify the Director of the Disability Resource Center (Campus Center 137, 442-5490). That office will provide the course instructor with verification of your disability, and will recommend appropriate accommodations. For further information refer to the University's Disclosure Statement regarding Reasonable Accommodation found at the bottom of the document at the following website: http://www.albany.edu/disability/docs/RAP.doc. This website can be reached by following the link under "Reasonable Accommodation Policy" at the following webpage

http://www.albany.edu/disability/faculty-staff.shtml.

Academic Honesty and Overall Regulations

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(http://www.albany.edu/undergraduate_bulletin/regulations.html).

COURSE OUTLINE AND READINGS:

Classes	Topic	Readings	Notes
1 – 4	Ch 1: Op Amp Fundamentals	Chapter 1	
5 - 7	Ch 2: Circuits with Resistive Feedback	Chapter 2	
8 - 9	Ch 5: Static Op Amp Limitations	Ch 5: 5.1 – 5.4	
10	Exam 1: Ch 1 & Ch 2		
11 - 12	Ch 5: Static Op Amp Limitations (continued)	Ch :, 5.5 – 5.8	
13 - 15	Ch 6: Dynamic Op Amp Limitations	Ch 6: 6.1 – 6.4	
16 - 17	Ch 7: Noise	Ch 7: 7.1 – 7.4	
18 - 19	Ch 8: Stability	Ch 8: 8.1 – 8.2	
20	Exam 2: Ch 5, Ch 6, & Ch 7		
21 - 22	Ch 8: Stability (continued)	Ch 8: 8.4, 8.5	

23 - 25	Ch 9: Nonlinear Circuits	Ch 9: 9.1 -9.4, 9.6, 9.7	
26 - 28	Ch 10: Oscillators		
	Exam 3: Ch 8, Ch 9, & Ch 10		

University at Albany / Electrical and Computer Engineering

Antenna Engineering

ECE 510

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Mustafa Aksoy
Instructor Title	Assistant Professor, ECE
Office Location	Li 91A
Office hours	TBD
E-mail Address	maksoy@albany.edu
TA's / Peer Educators	TBD
Prepared By	Mustafa Aksoy

Textbook (representative):

Antenna Theory: Analysis and Design, 4th Edition, Constantine Balanis, Wiley

COURSE DESCRIPTION / OVERVIEW

The fundamental principles of antenna theory and the application of these fundamental principles to the analysis, design and measurement of antennas. Practical antenna design examples (dipoles, loops, patches, arrays and other antennas) will be examined to introduce antenna engineering for communications.

PREREQUISITES

APHY 150 - Physics II: Electromagnetism and APHY 155 - Physics Lab II, or Graduate Student standing in Engineering

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- understand basic antenna parameters, including radiation resistance, input impedance, gain and directivity
- learn antenna radiation properties, propagation (Friis transmission formula) and wireless point to point communication connectivity requirements
- be shown elementary antennas and their radiation properties
- be exposed to impedance matching techniques, and mutual coupling
- understand antenna arrays and array design methods.
- be introduced to commonly used wideband antennas such as spirals and log-periodics
- be introduced to aperture antennas such as horns and reflectors

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed with quizzes and exams.

Exams: There will a mid-term exam and a final exam.

Quizzes: Eight quizzes will be given throughout the semester.

Grading

A final grade will be determined as a weighted average of the exam and quiz scores using the following weights:

Quizzes: 40% (Eight quizzes, each counts 5%)

Mid-term Exam: 25%
Final Exam: 35%

Grading Scale

A: 100-95 points	**A-**: 94-90 points	
B+: 89-87 points	**B**: 86-84 points	**B-**: 83-80 points
C+: 79-77 points	**C**: 76-73 points	**C-**: 72-70 points
D: 69-60 points		
E: 59 points and below		

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. The scale is a template for the "minimum" final grade and the instructor may modify the scale slightly based on the grade distribution in the class. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

Students are expected to attend every class and to arrive on time. However, attendance will not be included in the grading, because it will be implicitly factored into the student grade. Computers may be used during class for note taking as long as the use is not disruptive or distracting. Also see

http://www.albany.edu/health_center/medicalexcuse.shtml.

Responsible Computing

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Students with Disabilities

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(http://www.albany.edu/undergraduate_bulletin/regulations.html).

COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided on Blackboard. Students are expected to have read the listed material in the textbook before it is covered in class.

Class	Topic	Readings	Notes
	Fundamentals of Electromagnetics		
1-2	Maxwell's Equations and Boundary Conditions		
3	Complex Poynting Vector, Real and Reactive Power		
4	Potentials and Radiation Integral		
	Introduction to Antennas and Antenna Parameters		
5	Radiation from Antennas		
6-7	Radiation Resistance, Radiation Intensity, Directivity and Gain, Effective Aperture, Far-zone and Fresnel Regions		
	Elementary Antennas: Dipoles, Linear Wires, and Loops		
8-9	Dipole Antennas		
10-11	Linear Wire Antennas		
12-13	Loop Antennas		
	Antenna Array Theory		
14-16	Linear and Planar Arrays		
17-18	Phased Arrays		
19-20	Array Design Techniques		
	Antenna Examples		
21-24	Microstrip Antennas		
25-28	Aperture Antennas		

University at Albany / Electrical and Computer Engineering

Microwave Engineering

ECE 511

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Mustafa Aksoy
Instructor Title	Assistant Professor, ECE
Office Location	Li 91A
Office hours	TBD
E-mail Address	maksoy@albany.edu
TA's / Peer Educators	TBD
Prepared By	Mustafa Aksoy

Textbook (representative):

Microwave Engineering, 4th Edition, David Pozar, Wiley

COURSE DESCRIPTION / OVERVIEW

In this course the high frequency behavior of circuit and network elements will be introduced, and passive microwave devices (power dividers, couplers, resonators etc.) will be studied.

PREREQUISITES

APHY 150 - Physics II: Electromagnetism and APHY 155 - Physics Lab II, or Graduate Student standing in Engineering

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- be given a comprehensive introduction to microwave circuit design which provides practical design theories for the design and synthesis of passive microwave circuits.
- be able to use CAD tools to verify the microwave circuits designed, account for real world implementation effects, and optimize the microwave circuits designed.
- be exposed to the measurements of microwave circuits using a network analyzer
- be involved in a team oriented design project where they design, fabricate, and test a microwave circuit and present their results to the class.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed with quizzes, exams and a design project.

Exams: There will a mid-term exam and a final exam.

Quizzes: Five quizzes will be given throughout the semester.

Design Project: Each student will design, fabricate (fabrication will be handled by the department) and test a passive microwave device of their choice and present their efforts to the class.

Grading

A final grade will be determined as a weighted average of the exam and quiz scores using the following weights:

Quizzes: 25% (Five quizzes, each counts 5%)

Mid-term Exam: 25%

Final Exam: 30%

Design Project: 20%

Grading Scale

A: 100-95 points	**A-**: 94-90 points	
B+: 89-87 points	**B**: 86-84 points	**B-**: 83-80 points
C+: 79-77 points	**C**: 76-73 points	**C-**: 72-70 points
D: 69-60 points		
E: 59 points and below		

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. The scale is a template for the "minimum" final grade and the instructor may modify the scale slightly based on the grade distribution in the class. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

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(http://www.albany.edu/undergraduate_bulletin/regulations.html).

COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided on Blackboard. Students are expected to have read the listed material in the textbook before it is covered in class.

Class	Topic	Readings	Notes
	Fundamentals of Electromagnetics		
1-2	Maxwell's Equations and Boundary Conditions		
3	Complex Poynting Vector, Real and Reactive Power, Potentials		
	Transmission Line Theory		
4-5	Lumped-Element Circuit Model for Transmission Lines		
6-8	Field Analysis of Transmission Lines		
9	The Smith Chart		
	Waveguides and Transmission Lines		
10-13	TEM, TE and TM Waves		
14-15	Parallel Plate, Rectangular and Circular Waveguides		
16-17	Coaxial Line, Stripline and Microstrip		
	Microwave Network Analysis		
18	Impedance, Admittance, Scattering and Transmission Matrices		
19	Signal Flow Graphs		
	Impedance Matching and Tuning		
20-21	Matching with Lumped Elements		
22-23	Single-Stub and Double-Stub Tunings and the Quarter Wave Transformer		
	Passive Microwave Circuit Elements		
24	Resonators, Design Project Presentations		
25-26	Power Dividers and Couplers, Design Project Presentations		
27-28	Filters, Design Project Presentations		

University at Albany / Electrical and Computer Engineering

Introduction to VLSI

ECE 520

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Tolga Soyata
Instructor Title	Associate Professor, ECE
Office Location	DR 116
Office hours	TBD
E-mail Address	tsoyata@albany.edu
TA's / Peer Educators	TBD
Prepared By	Tolga Soyata

Textbooks (required):

TBD

COURSE DESCRIPTION / OVERVIEW

An introduction to Very Large Scale Integrated (VLSI) circuit design. The device, circuit, and system aspects of VLSI design are covered in an integrated fashion. Emphasis is placed on NMOS, PMOS and CMOS technology. Using transistors, simple gates such as XOR, AND, OR, AOI, OAI, and flip flops, are constructed and simulated using Cadence tools. Verilog-A is used to provide input vectors and test the correctness of the output.

PREREQUISITES

CEN 380 Introduction to Digital Circuits or equivalent

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- Learn how to use multiple Cadence tools to draw/analyze ICs;
- learn how to use a technology library in Cadence, such as 0.5 µm, or 0.13 µm. etc.
- understand how to make logical gates inside an IC by using NMOS and PMOS transistors;
- learn the Cadence schematic drawing tool to draw the circuit representation of an IC;
- learn Hspice-based circuit analysis tool to simulate and plan their IC;
- learn Verilog-A to design input vectors that are applied to the inputs of the IC;
- learn the layout design tool to draw the layout of their IC;
- learn layout-vs-schematic, design-rule verification tools to check the validity of their design;
- learn the difference between combinatorial vs. synchronous IC design
- learn how to test their entire design for validity; cycle-accurate simulation for synchronous circuits and latency/clock frequency analysis for both types of circuits.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

Since it is too difficult to post most of the Cadence examples, the Unix server directory structure will be used for students to get sample designs and to post their designs.

ASSESSMENT AND POLICIES:

The course will have five individual design projects and a final project. The students are required to work on individual projects alone, but are required to work on the final project in groups of two or three (depending on the class size). Individual projects contribute to 70% of the grade and the final project contributes to 30% of the grade.

Exams: There will be no exams for this course

Projects / Labs / Assignment: There will be 7 labs as part of the course; although they will not be graded, most of them will form the basis for the five individual projects by extending the lab and submitting the finished lab as an individual project.

Final Project: The students will be broken down into multiple groups, each group consisting of two or three students. The students will be given 2-3 options for the final project and will discuss it with their teammate for a period of a week. Before the final project, each group will present a brief "action plan" for their final project. This plan will be discussed and revised in a lecture session to help the students.

Grading

The grade of the class will be determined by five individual projects and a final project:

Labs	0%	although the labs lead to individual projects, so, implicitly included

Individual Project	70% the break-down for five projects is 10-10-15-15-20 and the complexity of the individual projects increase in time, as reflected by the grading.
Final Project	30%
Class Participation:	0% although participation helps student performance in individual projects

Grading Scale

A: 100-95 points	**A-** : 94-90 points	
B+: 89-87 points	**B** : 86-84 points	**B-** : 83-80 points
C+: 79-77 points	**C** : 76-73 points	**C-** : 72-70 points
D: 69-60 points		
E: 59 points and below		

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. The scale is a template for the "minimum" final grade and the instructor may modify the scale slightly based on the grade distribution in the class. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

Students are expected to *attend every class and to arrive on time*. However, attendance will not be included in the grading, because it will be implicitly factored into the student grade. Computers may be used during class for note taking as long as the use is not disruptive or distracting. Also see http://www.albany.edu/health_center/medicalexcuse.shtml.

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction to CMOS VLSI-based design		
1	Introduction, course structure, Cadence directory structure		
2	CMOS design using Cadence: NMOS and PMOS transistors		
3	Drawing your circuit (schematic tool)		
4-5	Simulating your circuit (Hspice tool)		
	Designing combinatorial Gates using NMOS, PMOS		
6	Layout principles: Cadence layout tool		
7	Analog gates: transmission gate		
8	Inverter, tri-state inverter, buffer		
9	NAND, NOR, XNOR , AND, OR, XOR		
10	AOI, OAI, and multi-input gates		
11	Flip flop		
12	Half adder, full adder		
	Synchronous and Combinatorial IC Design		
12	Design principles: clock speed, latency		
13-14	Verilog-A for Analog circuit simulation		
15	Pipelining, clock speed improvement		
16	Layout vs. schematic , parasitic extraction		
17-18	Combinatorial design examples		
19-20	Synchronous design examples		
	Final Project		
21	Final project introduction, student grouping		
22	Final Project proposal by student groups		
23-27	Work on the final project		

University at Albany / Electrical and Computer Engineering

Digital ASIC Design

ECE 521

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Tolga Soyata
Instructor Title	Associate Professor, ECE
Office Location	DR 116
Office hours	TBD
E-mail Address	tsoyata@albany.edu
TA's / Peer Educators	TBD
Prepared By	Tolga Soyata

Textbooks (required):

TBD

COURSE DESCRIPTION

The design of complex digital Application Specific Integrated Circuits (ASICs). Standard cell libraries and the Verilog language are used to build complex digital synchronous circuits using Cadence layout synthesis tools. Interconnect delay estimation, clock tree synthesis, repeater and pipeline stage design are introduced. A synchronous digital circuit utilizing 100s of flip flops and digital gates is designed as a final project and sent to MOSIS for fabrication.

PREREQUISITES

ECE 420/520 Introduction to VLSI

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- Learn how to use multiple Cadence tools to design sophisticated digital synchronous ICs consisting of 100s of gates and flip-flops;
- Learn the Verilog HDL to describe their circuits,
- learn how to use a standard cell library and automated Cadence synthesis tools,
- learn how to design repeaters, buffers, and clock trees to handle interconnect and clock tree issues.
- learn the layout tool to use LVS, DRC, and QRC on circuits that are synthesized automatically;
- learn the Hspice-based circuit analysis tool to check for the validity of the timing/power consumption of their IC;
- apply Verilog-A - that was introduced in the Intro to VLSI - to design input vectors that are applied to the inputs of the IC;
- Perform cycle-by-cycle analysis of their synchronous operation.
- Learn how to use "design rule constraints" to direct the compiler towards desired design priorities, i.e., power, area, path delay.
- Learn how to "tape out" an IC through MOSIS fabrication.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

Since it is too difficult to post most of the Cadence examples, the Unix server directory structure will be used for students to get sample designs and to post their designs.

ASSESSMENT AND POLICIES:

The course will have five individual design projects and a final project. The students are required to work on individual projects alone, but are required to work on the final project in groups of two or three (depending on the class size). Individual projects contribute to 70% of the grade and the final project contributes to 30% of the grade.

Exams: There will be no exams for this course

Projects / Labs / Assignment: There will be 7 labs as part of the course; although they will not be graded, most of them will form the basis for the five individual projects by extending the lab and submitting the finished lab as an individual project.

Final Project: The students will be broken down into multiple groups, each group consisting of two or three students. The students will be given 2-3 options for the final project and will discuss it with their teammate for a period of a week. Before the final project, each group will present a brief "action plan" for their final project. This plan will be discussed and revised in a lecture session to help the students.

Grading

The grade of the class will be determined by five individual projects and a final project:

Labs	0%	although the labs lead to individual projects, so, implicitly included
Individual Project	70%	generally, the break-down for five projects is 10-10-15-15-20 and the complexity of the individual projects increase in time, as reflected by the grading.
Final Project	30%	
Class Participation:	0%	although participation helps student performance in individual projects

Grading Scale

A: 100-95 points	**A-** : 94-90 points	
B+: 89-87 points	**B** : 86-84 points	**B-** : 83-80 points
C+: 79-77 points	**C** : 76-73 points	**C-** : 72-70 points
D: 69-60 points		
E: 59 points and below		

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. The scale is a template for the "minimum" final grade and the instructor may modify the scale slightly based on the grade distribution in the class. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

Students are expected to *attend every class and to arrive on time*. However, attendance will not be included in the grading, because it will be implicitly factored into the student grade. Computers may be used during class for note taking as long as the use is not disruptive or distracting. Also see http://www.albany.edu/health_center/medicalexcuse.shtml.

Responsible Computing

Students are required to read the University at Albany Policy for the Responsible Use of Information Technology (http://www.albany.edu/its/policies_responsible_use_of_IT.htm). Students will be expected to apply the policies discussed in this document to all computing and electronic communications in the course.

Students With Disabilities

Reasonable accommodations will be provided for students with documented physical, sensory, systemic, cognitive, learning and psychiatric disabilities. If you believe you have a disability requiring accommodation in this class, please notify the Director of the Disability Resource Center (Campus Center 137, 442-5490). That office will provide the course instructor with verification of your disability, and will recommend appropriate accommodations. For further information refer to the University's Disclosure Statement regarding Reasonable Accommodation found at the bottom of the document at the following website: http://www.albany.edu/disability/docs/RAP.doc. This website can be reached by following the link under “Reasonable Accommodation Policy” at the following webpage http://www.albany.edu/disability/faculty-staff.shtml.

Academic Honesty and Overall Regulations

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction to CMOS standard cell-based design		
1	Introduction, course structure, Cadence directory structure		
2	CMOS design using standard cells		
3	Interconnect delays, repeaters, buffers		
4	Flip flops, clocking, buffering, clock tree		
	Verilog language and Cycle-by-cycle analysis/simulation		
5	Hardware description of digital circuits using Verilog		
6	Cycle-by-cycle analysis		
7	Pipelining, clock frequency, latency		
8	Synthesis of a layout		
9	NMOS, PMOS Transistor sizing		
10	Test benches : Testing the circuit using Verilog-A input vectors		
	Synchronous/combinatorial circuit synthesis examples		
11	Adder structures		
12	Multiplier structures		
13	Divider structures		
14-15	CORDIC		
16-17	ALU, FPU design		
18-20	MIPS 2000 CPU Design		
	Final Project		
21	Final project introduction, student grouping		
22	Final Project proposal by student groups		
23-27	Work on the final project		

University at Albany / Electrical and Computer Engineering

Integrated Circuit Devices

ECE 522

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	James (Randy) Moulic
Instructor Title	Professor, ECE
Office Location	DR 112
Office hours	TBD
E-mail Address	jmoulic@albany.edu
TA's / Peer Educators	TBD
Prepared By	Gary J. Saulnier

Textbooks (required):

Semiconductor Device Fundamentals, Robert F. Pierret, ISBN-13: 978-0201543933

COURSE DESCRIPTION / OVERVIEW

Modern solid state devices and their operational principles. Solid state physics fundamentals, such as carriers and their mobility, band structures, doping concentrations and PN junctions. The operation of PN diodes, PIN diodes, and Schottky diodes, as well as three terminal devices, such as BJTs, JFETs, SCRs, MESFETs and MOSFETs. Device modelling and behavior.

PREREQUISITES

CEN 280 Introduction to Circuits or equivalent.

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- Have a background on semiconductor physics, P-N junctions, P and N type materials and the concept of “doping.”
- Understand the characterization of two terminal and three terminal semiconductor devices.
- Be able to use SPICE models for these devices and test/measure them using Cadence.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

Exams: There will midterm and final exams

Homework: Homework will be assigned weekly

Final Project: The students will be broken down into multiple groups, each group consisting of two or three students. The students will be given 2-3 options for the final project and will discuss it with their teammate for a period of a week. Before the final project, each group will present a brief “action plan” for their final project. This plan will be discussed and revised in a lecture session to help the students.

Grading

The grade for the class will be determined using the following percentages:

Midterm Exam	30%
Final Exam	30%
Homework	10%
Final Project	30%

Grading Scale

A: 100-95 points	**A-** : 94-90 points	
B+: 89-87 points	**B** : 86-84 points	**B-** : 83-80 points
C+: 79-77 points	**C** : 76-73 points	**C-** : 72-70 points
D: 69-60 points		
E: 59 points and below		

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. The scale is a template for the "minimum" final grade and the instructor may modify the scale slightly based on the grade distribution in the class. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	**Topic**	**Readings**	**Notes**
	Introduction to Semiconductor Physics		
1	Free electrons, electron mobility		
2	Band structure		
3	Non-equilibrium in semiconductors		
4	P-N Junctions		
	Semiconductor Devices		
5	P-N Diodes		
6	PIN Diodes		
7	Schottky Diodes		
8	BJT Transistors		
9	FET Power Transistors		
10	MOSFET Power Transistors		
	Experimental Modeling and Characterization		
11	Modeling P-N Diodes		
12-13	P-N Diode based circuits		
14	Modeling BJTs		
15-16	BJT-based circuits		
17	Modeling FETs		
18-19	FET based circuits		
20	Power MOSFET circuits		
	Final Project		
21	Final project introduction, student grouping		
22	Final Project proposal by student groups		
23-27	Work on the final project		

University at Albany / Electrical and Computer Engineering

FPGA-based Data Acquisition and Real-Time Processing

ECE 531

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Jonathan Muckell
Instructor Title	Professor of Practice, ECE
Office Location	Li 81
Office hours	TBD
E-mail Address	jmuckell@albany.edu
TA's / Peer Educators	TBD
Prepared By	Tolga Soyata

Textbooks (required):

"Advanced Digital Design With the Verilog HDL", Michael D. Ciletti, Xilinx Design Series,
ISBN 0-13-089161-4

COURSE DESCRIPTION / OVERVIEW

In this graduate level course, the students will be required to use a Hardware Description Language (HDL) to build a real-time data acquisition and processing system that utilizes an advanced FPGA, such as Xilinx XUOV5 or Zynq 7000. In order to achieve this goal, the students will be first taught the inner-workings of embedded signals, such as RS232, LCD, DVI, VGA, and I^2C. They will be required to write code in Verilog HDL to acquire a video signal, perform Digital Image Processing in real time and output the processed signal to a monitor.

PREREQUISITES

CEN 380 Introduction to Digital Circuits or equivalent

COREQUISITES

None.

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- Learn how to use Xilinx development tool, Vivado, which allows them to compile their Verilog code and write it into an FPGA board.
- They will learn the inner-workings of an advanced FPGA board and how to program it using a compiler and a development system.
- They will have a detailed knowledge of the way embedded signals, such as RS232, LCD, DVI, VGA, and I^2C, work and how to generate them using the Verilog HDL.
- They will learn how to interface an FPGA board to other peripherals, such as a video monitor, a mouse, keyboard, and a USB flash drive.
- They will learn how to apply their knowledge in Digital Image Processing to a High Performance real-time processing platform, such as the Xilinx Zynq 7000.
- They will learn about how to design timing sequences to coordinate multiple real-time events.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The course will have five individual design projects and a final project. The students are required to work on individual projects alone, but are required to work on the final project in groups of two or three (depending on the class size). Individual projects contribute to 70% of the grade and the final project contributes to 30% of the grade.

Exams: There will be no exams for this course

Projects / Labs / Assignment: There will be 7 labs as part of the course; although they will not be graded, most of them will form the basis for the five individual projects by extending the lab and submitting the finished lab as an individual project.

Final Project: The students will be broken down into multiple groups, each group consisting of two or three students. The students will be given 2-3 options for the final project and will discuss it with their teammate for a period of a week. Before the final project, each group will present a brief “action plan” for their final project. This plan will be discussed and revised in a lecture session to help the students.

Grading

The grade of the class will be determined by five individual projects and a final project:

Labs	0%	although the labs lead to individual projects, so, implicitly included

Individual Project	70% the break-down for five projects is 10-10-15-15-20 and the complexity of the individual projects increase in time, as reflected by the grading.
Final Project	30%
Class Participation:	0% although participation helps student performance in individual projects

Grading Scale

A: 100-95 points	**A-** : 94-90 points	
B+: 89-87 points	**B** : 86-84 points	**B-** : 83-80 points
C+: 79-77 points	**C** : 76-73 points	**C-** : 72-70 points
D: 69-60 points		
E: 59 points and below		

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. The scale is a template for the "minimum" final grade and the instructor may modify the scale slightly based on the grade distribution in the class. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Design Using Verilog		
1	Introduction, course structure, first project		
2-3	Get first project to work, learn GPIO		
4	State Machines and how to create them in Verilog		
5	Analysis: First Project with a state machine		
	Generating / Controlling Embedded Signals		
6-7	RS232, and UART		
8-9	PS2 keyboard and mouse signals		
10	LCD and the LCD Controller/Commands		
11	Hardware and Software Debouncing		
12-13	DVI Output and IIC Bus		
14	VGA Camera Input and BRAM Memory		
	DSP and Advanced Project Development		
15	BRAM and Other Memory Types		
16	Floating Point Units, Core Generator		
17	Digital Image Processing (DIP)		
18-19	Hardware Design for DIP		
20	Ethernet		
	Final Project		
21	Final project introduction, student grouping		
22	Final Project proposal by student groups		
23-27	Work on the final project		

University at Albany / Electrical and Computer Engineering

Parallel Programming for GPUs

ECE 540

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Tolga Soyata
Instructor Title	Associate Professor, ECE
Office Location	DR 116
Office hours	TBD
E-mail Address	tsoyata@albany.edu
TA's / Peer Educators	TBD
Prepared By	Tolga Soyata

Textbooks (required):

TBD

COURSE DESCRIPTION / OVERVIEW

An introduction to massively-parallel programming using Graphics Processing Units (GPUs). The fundamentals of multi-threading using Pthreads (POSIX Threads) and the GPU architecture. Nvidia CUDA programming language is used as the main tool to develop GPU programs. A GPU Cluster is used run parallelized computational tasks.

PREREQUISITES

CEN/CSI 400 Operating Systems, or equivalent

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- Understand the basic concepts of parallel programming;
- Know good design of a parallel program;
- Able to use several tools to code parallel program on different platforms;
- Know good parallel algorithms;
- Know how to analyze a parallel program;

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The course will have coding labs and final project. The students are required to work on individual coding labs alone, but are encouraged to work on final project in groups. The labs will be graded and constitute 60% of the final grade.

Exams: There will be no exams for this course

Projects / Labs / Assignment: Projects / labs / assignments will be assigned and will be conducted both out of class and during lab period. They will be graded on a 5-point scale and will be totaled together to account for 45% of the final grade.

Final Project: A final project will be required. The requirements for this assignment will be fully described in a Blackboard later in the course.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

Labs/projects/assignments (8) 60%

Final Project 35%

Class Participation: 5%

Grading Scale

A: 100-95 points A-: 94-90 points
B+: 89-87 points B: 84-86 points B-: 80-83 points
C+: 79-76 points C: 75-70 points
D: 69-60 points
E: 59 points and below
Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end

of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

Students are expected to *attend every class and to arrive on time*. Please DO NOT disrupt the class or labs by entering late or leaving early without instructor approval. Attendance will be taken at several class meetings. Each unexcused absence (one approved by either instructor prior to class) will result in a 1-point deduction from your class participation grade. Computers may be used during class for note taking as long as the use is not disruptive or distracting. Also see http://www.albany.edu/health_center/medicalexcuse.shtml.

Responsible Computing

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction to Parallel Programming		
1	Introduction, course structure		
2	What is parallel programming, and why?		
3	Platforms for parallel programming and difference		
	P-threads and MP/MPI		
4	p-threads		
5	p-threads (continue)		
6	p-threads (continue) and MP / MPI		
7	MP / MPI		
8	P-threads and MP		
	Design principles and patterns for parallel programs		
9	Design principles and patterns		
10	Design principles and patterns		
11	Parallel programming algorithms		
12	Parallel programming algorithms		
13	Project Proposal		
	CUDA and cell programming		
14	CUDA and GPU		
15	CUDA and GPU (continue)		
16	Cell programming and playstation		
17	Cell Programming and playstation (continue)		
	Case study		
18	Case study 1		
19	Case study 1 (continue)		
20	Case study 2		
21	Case study 2 (continue)		
22	Case study 3		
23	Case study 3 (continue)		
24	Case study 4		
25	Case study 4 (continue)		
26	Final project presentation		
27	Final project presentation		

University at Albany / Electrical and Computer Engineering

Robotics

ECE 550

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Weifu Wang
Instructor Title	Assistant Professor, ECE
Office Location	Li 91B
Office hours	TBD
E-mail Address	Wwang8@albany.edu
TA's / Peer Educators	TBD
Prepared By	Weifu Wang

Textbooks (required):

Introduction to Robotics: Mechanics and Control
John J. Craig (Author)
ISBN-13: 978-0201543612 3rd Edition

COURSE DESCRIPTION / OVERVIEW

An introduction to the fundamentals of robotics, including configuration space, transformation matrix, kinematics, motion planning, and a brief introduction to robot manipulation. In addition to simulation environments, the course uses robot arms and small drones as hardware platforms for students to practice programming and test algorithms. Current final projects include navigating drones through a small field of obstacles and the use of a robot arm to pick up objects.

Apart from simulation environments, the course will use robot arms and small drones as programming platforms for students to practice programming, and test different algorithms. After taking the course, the students should be familiar with the fundamental concepts of robotics, and should be able to use established algorithms to solve simple robotic problems.

The course will combine written exams and labs (projects) to evaluate students. Current of the final projects includes navigating drones through small field of obstacles, and use robot arm to pick up objects.

PREREQUISITES

A MAT 220 Linear algebra and permission of the instructor

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- Understand the fundamental tools and terms often used in Robotics;
- Able to understand the Robotics framework, and the Sense-Plan-Act loop;
- Familiar with Configuration space coordinates, dimensions, and transformations;
- Understand, and able to compute forward kinematics;
- Understand inverse kinematics, why is it important, and able to compute simple inverse kinematics;
- Understand what is motion planning, able to implement simple motion planning algorithms to solve naïve motion planning problems, from simple point robot, to Reed-sheep car;
- Understand the basics of robot arm, and understand fundamental concepts about robot manipulation, able to analyze simple manipulation problems;

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The course will have a mix of written assignments, and coding labs. The students are required to work on written assignments alone, but are encouraged to work on labs in groups. The assignments and labs will be graded and constitute 45% of the final grade. The class will contain one mid-term exam, no final exam but a final project.

Exams: One midterm will be given, a review session will follow the exam. The exam will account for 15% of the final grade.

Projects / Labs / Assignment: Projects / labs / assignments will be assigned and will be conducted both out of class and during lab period. They will be graded on a 5-point scale and will be totaled together to account for 45% of the final grade.

Final Project: A final project will be required. The requirements for this assignment will be fully described in a Blackboard later in the course.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

Exams (1) 20%
Labs/projects/assignments (8) 45%
Final Project 30%
Class Participation: 5%

Grading Scale

A: 100-95 points A-: 94-90 points
B+: 89-87 points B: 84-86 points B-: 80-83 points
C+: 79-76 points C: 75-70 points
D: 69-60 points
E: 59 points and below

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

Students are expected to *attend every class and to arrive on time*. Please DO NOT disrupt the class or labs by entering late or leaving early without instructor approval. Attendance will be taken at several class meetings. Each unexcused absence (one approved by either instructor prior to class) will result in a 1-point deduction from your class participation grade. Computers may be used during class for note taking as long as the use is not disruptive or distracting. Also see http://www.albany.edu/health_center/medicalexcuse.shtml.

Responsible Computing

Students are required to read the University at Albany Policy for the Responsible Use of Information Technology (http://www.albany.edu/its/policies_responsible_use_of_IT.htm). Students will be expected to apply the policies discussed in this document to all computing and electronic communications in the course.

Students With Disabilities

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Academic Honesty and Overall Regulations

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction to Robotics		
1	First class, introductions		
2	Sense-Act-Plan		
3	Current Robot development		
	Configuration space and transformation		
4	Configuration space		
5	C-space obstacle, cell decomposition, curse of dimensionality		
6	Transform between frames		
7	Transform as the result of motion, combine transformations		
8	Program Roomba, see the result of transformation		
	Kinematics		
9	Forward kinematics		
10	Applications of forward kinematics		
11	Inverse kinematics		
12	Inverse kinematics (continue)		
	Mid-term		
	Motion Planning		
13	Complete methods, cell decomposition		
14	Visibility graph, voronoi diagram, geometrical algorithms		
15	Sampling based algorithms		
16	Sampling based algorithm (continue), practice		
17	Non-holomonic planning		

18	Walking, planning with design		
19	Planning for quadcopters		
20	Practice with quadcopters		
	Manipulation		
21	Caging		
22	Immobilization		
23	Pick and place		
24			
25	Final Project competition		
26	Final Project competition		
27	Final Project Presentations Last Class / Wrap-up		Final Projects Due

University at Albany / Electrical and Computer Engineering

Digital Image Processing

ECE 561 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Ming-Ching Chang
Instructor Title	Assistant Professor, ECE
Office Location	Li 90A
Office hours	TBD
E-mail Address	Mchang2@albany.edu
TA's / Peer Educators	TBD
Prepared By	Ming-Ching Chang

Textbooks (required):

Introduction to Video and Image Processing
Moeslund, Thomas B. (Author)
ISBN-13: 978-1-4471-2503-7 (2012)

COURSE DESCRIPTION / OVERVIEW

This course introduces students to Digital Image and Video Processing. The course starts with an introduction of digital image processing. It continues with fundamentals of video processing, and covers closely related topics in computer vision. The course focuses on both the theory and the practical application of digital image and video processing. Students will learn hands-on programming implementation using Python, Matlab, or C++.

PREREQUISITES

AMAT 220 Linear Algebra, CEN 200 C Programming for Engineers or permission of the Department Chair

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- Gain an understanding of Digital Image and Video Processing basics, theory and applications of the following core topics: image acquisition, color representation, filtering, morphology, geometric transformation, camera calibration, segmentation, registration, optical flow, and tracking.
- Understanding and build up fundamentals for advanced areas including computer vision, computer graphics, multimedia, and robotics.
- Gain hands-on experience programming and implementing practical image/video processing systems using Python, Matlab, or C++.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools for digital image and video processing in a combination of team and individual assignments and tests.

Exams: Two exams plus a final will be given. A portion of the class period preceding each exam will be utilized for a review session.

Projects / Assignments: Projects / assignments will be assigned and will be completed out of class. They will be graded on a 10-point scale and will be totaled together to account for 40% of the final grade.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

Exams (2) 30% (15 points each)

Final Exam 25% (25 points)

Projects/assignments (4) 40% (10 points each)

Class Participation: 5%

Total possible points = 100

Grading Scale

A: 100-95 points A-: 94-90 points
B+: 89-87 points B: 84-86 points B-: 80-83 points
C+: 79-76 points C: 75-70 points
D: 69-60 points
E: 59 points and below

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction to Digital Image and Video Processing		
1	Intro to Course Intro to Image/Video Processing		
2			
3	Introduction	Chapter 1	
4			
5	Image Acquisition	Chapter 2	
6			
7	Color Images	Chapter 3	Proj./Assignment 1 Due
8			
9	Point Processing	Chapter 4	
1 0			Proj./Assignment 2 Due
11	Neighborhood Processing	Chapter 5	
12			
13	Test 1		
14	Morphology	Chapter 6	
15			
16	Blob Analysis	Chapter 7	
17			Proj./Assignment 3 Due
18	Segmentation in Video Data	Chapter 8	
19			
20	Tracking	Chapter 9	

21			Proj./Assignment 4 Due
22	Geometric Transformations	Chapter 10	
23			
24	Test 2		
25	Visual Effects	Chapter 11	
26			
27	Applications / Summary	Chapter 12	
	Final Exam		

University at Albany / Electrical and Computer Engineering

Advanced Digital Communications

ECE 571 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Aveek Dutta
Instructor Title	Assistant Professor, ECE
Office Location	Li 89A
Office hours	TBD
E-mail Address	adutta@albany.edu
TA's / Peer Educators	TBD
Prepared By	Aveek Dutta

Textbooks:

Digital Communications, 5th Edition 5th Edition by John Proakis, Masoud Salehi

COURSE DESCRIPTION / OVERVIEW:

This course is a graduate level introduction to the basic principles of digital communication systems. The course focuses on the building blocks of a digital communication system that takes a stream of bits and converts it to a waveform to be transmitted over a channel. The course gives the mathematical foundations of the commonly used algorithms involved in designing digital communication systems. The course would be beneficial particularly to students who are interested in doing research in fields related to communications, networks, and signal processing. The materials of this course forms the basis of further studies in Wireless Communications, Coding Theory and Wireless Networks.

PREREQUISITES:

CEN 350 Signals and Systems and A MAT 370 Probability and Statistics for Engineering and the Sciences or equivalent

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will:

- Analyze analog communication systems
- Analyze basic digital communication systems
- Describe the connection and understand differences between analog and digital representation and transmission of information
- Understand and describe the concept of "noise" in analog and digital communication systems
- Understand and be able to make trade-offs (in terms of bandwidth, power, and complexity requirements) between basic analog and digital communication systems
- Design basic analog or digital communication systems to solve a given communications problem

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

Exams: A mid-term and final exam will be given.

Projects / Assignments: Weekly homework will be assigned based on the material covered during previous week.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

- Homework - 25%
- Midterm - 25%
- Final Exam - 40%
- Attendance and class participation - 10%

Attendance/Lateness/Use of Computers in class

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Computers may be used during class for note taking as long as the use is not disruptive or distracting. Also see http://www.albany.edu/health_center/medicalexcuse.shtml.

Responsible Computing

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Students With Disabilities

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(http://www.albany.edu/undergraduate_bulletin/regulations.html).

COURSE OUTLINE AND READINGS:

Class	Topic	Readings	Notes
	Introduction		
1	Building blocks of Digital Communication systems		
2			
	Communication Sources		
3	Source coding and Compression		

4			
5			
6	Sampling and Quantization		
7			
8			
	Channels, modulation and Demodulation		
9	Constellation, Intersymbol Interference, Eye diagram, pulse shaping, adaptive equalization, partial response signaling		
10			
11			
12			
	Optimal Receiver Design		
13	Matched filter, bit error rate, coherent and noncoherent receivers, Synchronization		
14			
15			
16			
	Midterm Exam		
	Random processes and noise		
17	Baseband and Passband representation of noise, Signal to noise ratio, Stationarity		
18			
19			
20			
	Channel coding		
21	Channel coding theorem, Block codes, Convolution Codes, Viterbi decoder.		
22			
23			
	Wireless Digital Communications and Networks		
24			

25	Wireless channels and Waveforms. Multicarrier Communication		
26	Wireless Networks - from link to network		
27			
28	Final Exam Review		
	Final Exam		

University at Albany / Electrical and Computer Engineering

Radio Wave Propagation and Remote Sensing

ECE 572

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Mustafa Aksoy
Instructor Title	Assistant Professor, ECE
Office Location	Li 91A
Office hours	TBD
E-mail Address	maksoy@albany.edu
TA's / Peer Educators	TBD
Prepared By	Mustafa Aksoy

Textbook (representative):

Radiowave Propagation: Physics and Applications, Levis, Johnson and Teixeira, Wiley

COURSE DESCRIPTION / OVERVIEW

In this course the basic physical mechanisms of electromagnetic wave propagation in the troposphere and ionosphere, and the fundamentals of microwave remote sensing will be studied. Theoretical and empirical models which describe several propagation mechanisms will be discussed to understand the design and analysis of communications and remote sensing (radar and radiometer) systems.

PREREQUISITES

APHY 150 - Physics II: Electromagnetism and APHY 155 - Physics Lab II, or equivalent

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- master analytical and empirical methods for predicting the propagation of electromagnetic waves in the atmosphere over a wide range of frequencies
- understand the basic remote sensing concepts and systems
- learn operation and tradeoffs of radar and radiometer systems

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed with quizzes and exams.

Exams: There will a mid-term exam and a final exam.

Quizzes: Eight quizzes will be given throughout the semester.

Grading

A final grade will be determined as a weighted average of the exam and quiz scores using the following weights:

Quizzes: 40% (Eight quizzes, each counts 5%)
Mid-term Exam: 25%
Final Exam: 35%

Grading Scale

A: 100-95 points	**A-**: 94-90 points	
B+: 89-87 points	**B**: 86-84 points	**B-**: 83-80 points
C+: 79-77 points	**C**: 76-73 points	**C-**: 72-70 points
D: 69-60 points		
E: 59 points and below		

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. The scale is a template for the "minimum" final grade and the instructor may modify the scale slightly based on the grade distribution in the class. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

Students are expected to attend every class and to arrive on time. However, attendance will not be included in the grading, because it will be implicitly factored into the student grade. Computers may be used during class for note taking as long as the use is not disruptive or distracting. Also see

http://www.albany.edu/health_center/medicalexcuse.shtml.

Responsible Computing

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided on Blackboard. Students are expected to have read the listed material in the textbook before it is covered in class.

Class	Topic	Readings	Notes
	Fundamentals of Electromagnetics		
1-2	Maxwell's Equations and Boundary Conditions		
3	Plane Waves and Antenna Properties		
	Direct Transmission		
4	Friis Transmission Formula		
5	Attenuation due to Atmospheric Gases		
6	Attenuation due to Rain		
	Reflection and Refraction		
7	Reflection from a Planar Interface		
8	Refraction in a Stratified Medium and over a Spherical Earth		
9	Ducting and Ray Tracing		
	Path Loss and Fading Models		
10-11	Empirical Path Loss Models		
12-13	Signal fading		
	Groundwave Propagation		
14-15	Planar Earth Groundwaves		
16-17	Spherical Earth Groundwaves		
	Ionospheric Propagation		
18-19	Ionospheric Basics		
20-21	Vertical and Oblique Ionospheric Propagation		
	Remote Sensing Ststems		
22-24	Radar Remote Sensing		
25-27	Microwave Radiometry		

University at Albany / Electrical and Computer Engineering

Linear Control Theory

ECE 580 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Daphney-Stavroula Zois
Instructor Title	Assistant Professor, ECE
Office Location	Li 88A
Office hours	TBD
E-mail Address	dzois@albany.edu
TA's / Peer Educators	TBD
Prepared By	Daphney-Stavroula Zois

Textbooks:

Modern Control Systems **(required)**

Richard C. Dorf, Robert H. Bishop

12th Edition. Upper Saddle River, NJ: Prentice-Hall

ISBN: 978-0-136-02458-3

COURSE DESCRIPTION / OVERVIEW:

An introduction to the analysis and design of linear control systems. Mathematical models, including state variable models. Feedback control, and stability. Root locus and frequency response compensation methods.

PREREQUISITES:

CEN 350 Signals and Systems or equivalent

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will:

- Be able to analyze linear control systems
- Model various problems as continuous and sampled-data systems
- Use and evaluate various stability criteria
- Use root locus compensation techniques whenever necessary

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools of Linear Control Theory in a combination of individual assignments and exams.

Exams: One midterm exam plus a final exam will be given. A portion of the class period preceding each exam will be utilized for a review session.

Projects / Assignments: Homework assignments will be assigned and will be completed out of class. It is highly recommended that computer assignments be done in Matlab - however, other programming languages (e.g. C/C++, Python) may also be acceptable with the permission of the instructor. A project will be assigned at the beginning of the course and will need to be completed by the end of the course.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

10% Homeworks
40% Midterm Exam
45% Final Exam
5% Class Participation

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of coursework to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable._Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction		
1	Perspective, Examples of typical control problems		
2	Laplace transformation models		
	Feedback systems		
3	Feedback system characteristics (sensitivity reduction, transient response control, noise attenuation, steady-state error improvement, definitions, examples)		Homework 1 Due
4	Feedback system performance specifications (steady-state, transient response, parameter variation tolerance, noise tolerance, compromise design)		
	Two-dominant-pole Model		
5	Damping ratio, Natural frequency, Relationships of pole locations to transient spec, Model order reduction by partial fraction expansion, Justification of the two-dominant-pole assumption		Homework 2 Due
	Miscellaneous		
6	Steady-state error, final-value theorem, performance indices, Introduction to the concept of stability		
	Stability		
7	Relation to pole location, Routh-Hurwitz stability criterion		Homework 3 Due
	Root locus		

8	The concept of root-locus, Relation to open-loop pole-zero plot, Phase angle and magnitude conditions.		
9	Asymptotic behavior for large and small gain, Behavior on real axis		Homework 4 Due
10	Root locus behavior at break-away points		
11	Sketching examples		Homework 5 Due
12	Parameter variation analysis, Root sensitivity		
	Frequency response model		
13	Relation to open-loop pole-zero plot		Homework 6 Due
14	Procedures for sketching Bode plot given the pole-zero plot, Determination of transfer function from Bode plot		
15	Concepts of minimum and non-minimum phase systems, Two-dominant-pole system, Resonant peak and resonant frequency, Relation to damping ratio and natural frequency		Homework 7 Due
16	Midterm Exam		
	Performance specs in the frequency domain		
17	Determination of transient properties (rise-time, etc.) from a closed-loop frequency response, Determination of steady-state error from open-loop frequency response		Homework 8 Due
	Nyquist stability criterion		
18	Cauchy's "principle of the argument" and the proof of the Nyquist criterion		
19	Procedures for handling imaginary-axis poles		Homework 9 Due
	Gain and phase margin		
20	Definition and interpretation, Relation to damping ratio of dominant closed-loop poles		
	M-circles		

21	Derivation, Relation to damping ratio of dominant closed-loop poles, Nichols' chart		Homework 10 Due
	Compensation		
22	Root-locus approach		
23	Frequency response approaches using Bode plot and Nichols' chart		Homework 11 Due
24	Examples		
25	Examples		Homework 12 Due
	Robust Control Systems		
26	Uncertain models and parameter variation, QFT, Small gain theorem		
27	H-infinity optimal loop-shaping		Homework 13 Due
28	Review		
	Final Exam		

University at Albany / Electrical and Computer Engineering

Mixed-Signal IC Design

ECE 620

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Tolga Soyata
Instructor Title	Associate Professor, ECE
Office Location	DR 116
Office hours	TBD
E-mail Address	tsoyata@albany.edu
TA’s / Peer Educators	TBD
Prepared By	Tolga Soyata

Textbooks (required):

TBD

COURSE DESCRIPTION / OVERVIEW

The implementation of digital and analog circuits together on a single integrated circuit. The design of analog integrated circuits such as operational amplifiers, operational transconductance amplifiers, and bandgap voltage references. Analog and digital IC design concepts are combined to develop a user-programmable Video Graphics Array (VGA) controller IC that stores user-selected digital values in its internal registers. A final project requires the design of a VGA controller that reads its screen contents from an external SRAM.

PREREQUISITES

ECE 421/521 Digital ASIC Design.

COREQUISITES

None.

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- Learn how to use multiple Cadence tools to design sophisticated mixed-signal analog/digital ICs consisting of 1000s or more transistors;
- learn how to design analog IC design structures, such as OPAMPs, OTAs, bandgap voltage references, analog transmission gates, cascode, differential amplifiers.
- learn how to incorporate Analog design structures and digital design structures that were taught in Digital ASIC Design.
- learn how to read/write an SRAM memory; CAS, RAS signal timing, linear vs. 2D addressing.
- learn the mixed signal design paradigm within the framework of a VGA controller. This controller will produce a VGA signal from a screen memory.
- Learn the concept of a "register" in a programmable IC, such as the one being designed.
- Learn shift register structures to store "user preferences" as found in a standard programmable IC. Use multiple registers to store the screen resolution, polarity, bit depth.
- Learn how to "tape out" this IC through MOSIS fabrication.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

Since it is too difficult to post most of the Cadence examples, the Unix server directory structure will be used for students to get sample designs and to post their designs.

ASSESSMENT AND POLICIES:

The course will have five individual design projects and a final project. The students are required to work on individual projects alone, but are required to work on the final project in groups of two or three (depending on the class size). Individual projects contribute to 70% of the grade and the final project contributes to 30% of the grade.

Exams: There will be no exams for this course

Projects / Labs / Assignment: There will be 7 labs as part of the course; although they will not be graded, most of them will form the basis for the five individual projects by extending the lab and submitting the finished lab as an individual project.

Final Project: The students will be broken down into multiple groups, each group consisting of two or three students. The students will be given 2-3 options for the final project and will discuss it with their teammate for a period of a week. Before the final project, each group will present a brief "action plan" for their final project. This plan will be discussed and revised in a lecture session to help the students.

Grading

The grade of the class will be determined by five individual projects and a final project:

Labs	0%	although the labs lead to individual projects, so, implicitly included
Individual Project	70%	the break-down for five projects is 10-10-15-15-20 and the complexity of the individual projects increase in time, as reflected by the grading.
Final Project	30%	
Class Participation:	0%	although participation helps student performance in individual projects

Grading Scale

A: 100-95 points	**A-** : 94-90 points	
B+: 89-87 points	**B** : 86-84 points	**B-** : 83-80 points
C+: 79-77 points	**C** : 76-73 points	**C-** : 72-70 points
D: 69-60 points		
E: 59 points and below		

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. The scale is a template for the "minimum" final grade and the instructor may modify the scale slightly based on the grade distribution in the class. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

Students are expected to *attend every class and to arrive on time*. However, attendance will not be included in the grading, because it will be implicitly factored into the student grade. Computers may be used during class for note taking as long as the use is not disruptive or distracting. Also see http://www.albany.edu/health_center/medicalexcuse.shtml.

Responsible Computing

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction to mixed-signal CMOS IC Design		
1	Introduction, course structure, Cadence directory structure		
2	Programmable IC design; internal "registers"		
3	SRAM timing; designing an SRAM controller		
4	VGA timing and voltage levels		
	Analog design constructs		
5	Differential amplifier		
6	Cascode amplifier		
7	Operational amplifier (OPAMP)		
8	Operational Trans-conductance amplifier (OTA)		
9	Bandgap voltage reference		
10-11	Design examples, application to VGA controller		
	VGA controller design		
11	Screen memory, 1D linear and 2D addressing		
12	VGA analog signal creation		
13	Analog multiplexing, multi-output		
14	Storing user preferences		
15-20	Continue design		
	Final Project		
21	Final project introduction, student grouping		
22	Final Project proposal by student groups		
23-27	Work on the final project		

University at Albany / Electrical and Computer Engineering

Radio Frequency IC Design

ECE 621

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Tolga Soyata
Instructor Title	Associate Professor, ECE
Office Location	DR 116
Office hours	TBD
E-mail Address	tsoyata@albany.edu
TA’s / Peer Educators	TBD
Prepared By	Tolga Soyata

Textbooks (required):

RF Circuit Design Techniques for MF-UHF Applications,

ISBN

COURSE DESCRIPTION / OVERVIEW

The design, simulation, and implemention of RF/microwave integrated circuit components and devices for applications within the medium frequency (MF) to ultrahigh frequency (UHF) range. System and design concepts are taught through the example of the Radio Frequency Identification (RFID) system. A final project requires the design of an RFID integrated circuit to operate at 433 MHz. Designs are built using the MOSIS 0.5 µm process

PREREQUISITES

ECE 420/520 Introduction to VLSI

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- Learn how to use multiple Cadence tools to design sophisticated RF ICs consisting of about 100 transistors;
- They learn about the RFID standard.
- They learn different modulation techniques and communication protocols
- Learn how to "tape out" an IC through MOSIS fabrication.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

Since it is too difficult to post most of the Cadence examples, the Unix server directory structure will be used for students to get sample designs and to post their designs.

ASSESSMENT AND POLICIES:

The course will have five individual design projects and a final project. The students are required to work on individual projects alone, but are required to work on the final project in groups of two or three (depending on the class size). Individual projects contribute to 70% of the grade and the final project contributes to 30% of the grade.

Exams: There will be no exams for this course

Projects / Labs / Assignment: There will be 7 labs as part of the course; although they will not be graded, most of them will form the basis for the five individual projects by extending the lab and submitting the finished lab as an individual project.

Final Project: The students will be broken down into multiple groups, each group consisting of two or three students. The students will be given 2-3 options for the final project and will discuss it with their teammate for a period of a week. Before the final project, each group will present a brief "action plan" for their final project. This plan will be discussed and revised in a lecture session to help the students.

Grading

The grade of the class will be determined by five individual projects and a final project:

Labs	0%	although the labs lead to individual projects, so, implicitly included
Individual Project	70%	the break-down for five projects is 10-10-15-15-20 and the complexity of the individual projects increase in time, as reflected by the grading.

Final Project 30%

Class Participation: 0% although participation helps student performance in individual projects

Grading Scale

A: 100-95 points	**A-** : 94-90 points	
B+: 89-87 points	**B** : 86-84 points	**B-** : 83-80 points
C+: 79-77 points	**C** : 76-73 points	**C-** : 72-70 points
D: 69-60 points		
E: 59 points and below		

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. The scale is a template for the "minimum" final grade and the instructor may modify the scale slightly based on the grade distribution in the class. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction to RFIC Design		
1	RF Spectrum: from LF to UHF		
2	RFID Standard		
3	RFID IC Building Blocks		
4	Modulation Techniques: ASK, OOK, PSK, FSK		
	IC Design for RF		
5-6	Introduction to Cadence – RF Design		
7-8	Designing Inductors		
9-10	Designing Capacitors		
11-12	Designing the Digital Processor		
13-14	Designing the Harvester		
15-16	Designing the Modulator		
17-20	Testing		
	Final Project		
21	Final project introduction, student grouping		
22	Final Project proposal by student groups		
23-27	Work on the final project		

University at Albany / Electrical and Computer Engineering

Projects in Electronic Circuits and Systems

ECE 629 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Gary J. Saulnier
Instructor Title	Professor, ECE
Office Location	Li 84A
Office hours	TBD
E-mail Address	gsaulnier@albany.edu
TA's / Peer Educators	TBD
Prepared By	Gary J. Saulnier

Textbooks:

None. Students will utilize recent publications in the Electronic Circuits and Systems area in addition to material from previous courses.

COURSE DESCRIPTION / OVERVIEW:

Supervised projects in Electronic Circuits and Systems. Students investigate the state-of-the-art in Electronic Circuits and Systems through the study of current publications, class discussions, student presentations, and a major project.

PREREQUISITES:

Students must have completed at least 3 courses within the Electronic Circuits and Systems Concentration Area.

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES:

Upon successful completion of this course, students will be able to:

1. Discuss issues related to one or more current topics in Electronic Circuits and Systems
2. Apply their knowledge of science, mathematics and engineering disciplines to solve problems in Electronic Circuits and Systems.
3. Read, interpret, and utilize information in the published literature in Electronic Circuits and Systems.
4. Present technical information in a variety of formats, including written reports and oral presentations.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, class presentation schedules, and due dates. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

Assessment will be based on the quality of in-class presentations, written reports, and class attendance and participation. Students are expected to attend all presentations and actively participate in discussions and peer review tasks.

Exams: None.

Projects / Assignments:

1. Literature Search: Investigate a current topic in Electronic Circuits and Systems using the published literature, including peer-reviewed journal papers. Summarize findings in a written report and class presentation.
2. Project: Use analysis, simulation, and/or implementation to apply Electronic Circuits and Systems techniques to a problem of interest. This project could be an extension of the literature search or address a different topic.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

1. Literature Search Written Report: 15%
2. Literature Search Presentation: 10%
3. Project Progress Presentation: 10%
4. Project Written Report: 35%
5. Project Final Presentation: 20%
6. Class Attendance/Participation: 10%

Attendance/Lateness/Use of Computers in class

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(http://www.albany.edu/undergraduate_bulletin/regulations.html).

COURSE OUTLINE AND READINGS:

Week	Discussion Topic	Assignment
Week 1	Course structure and policies. Overview of topics in the field with discussion.	Select a topic for literature search, submit a one paragraph summary of the topic, including references to one or more papers that will be studied.
Week 2	Overview of topics in the field with discussion.	Study papers, work on report and presentation
Week 3	Overview of topics in the field with discussion.	
Week 4	Class presentations reporting on literature search	Submit literature search report
Week 5	Class presentations reporting on literature search	Submit 1 page project proposal
Week 6	TBD*	Work on project
Week 7	TBD	Work on project
Week 8	TBD	Work on project

Week 9	TBD	Prepare progress report for the class
Week 10	Project Progress Reports	Work on project
Week 11	Project Progress Reports	Work on project
Week 12	TBD	Work on project
Week 13	TBD	Work on project
Week 14	Project Final Presentations	Work on project
Week 15	Project Final Presentations	Submit Project Report

* TBD class meetings will vary depending on the specific needs of the class at that time. Lectures on topics related to student projects, tutorials on the use of simulation and analysis tools, general help sessions, class discussions, etc. are all possible.

University at Albany / Electrical and Computer Engineering

Advanced Computer Architecture

ECE 630

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Ming-Ching Chang
Instructor Title	Assistant Professor, ECE
Office Location	Li 90A
Office hours	TBD
E-mail Address	Mchang2@albany.edu
TA's / Peer Educators	TBD
Prepared By	Ming-Ching Chang

Textbooks (required): Computer Architecture, A Quantitative Approach, 5th Edition,

Hennessy, J. and Patterson, D. (Authors)

ISBN-13: 978-0123838728 Morgan Kaufmann, San Francisco, CA. (2012).

COURSE DESCRIPTION / OVERVIEW

A quantitative approach to computer architecture and parallelism, which addresses both software and hardware aspects of parallelism in modern computing systems. Specific emphasis will be placed on benchmarking tools and methods, instruction-level, thread level, data-level, task/request-level parallelism; CPU pipeline resource efficiencies, multi-core performance, development of parallel application code in assembler and high-level languages and extensions for systems such as multi-core (OpenMP), native SIMD accelerators (Intel SSE), hybrid accelerator systems using GPUs (Cuda, OpenCL), Message Passing Interface (MPI), and MapReduce/Hadoop for "big data" applications.

PREREQUISITES

CEN 333 Computer Organization and Assembly Programming or equivalent

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES:

At the completion of the course students will:

- Demonstrate an understanding of fundamental principles of parallel system hardware and software architectures.
- Create practical applications of parallel system software and performance optimization.
- Identify, explain and map specific application needs for parallelism to the best-suited parallel system hardware and computing model or models.
- Write, debug, test and run parallel assembly and high level, parallel Assignments, Quizzes, Exams, Projects enabled languages, exploiting multiple parallel programming models using computer system design software development tools and a hybrid - GPU server cluster.
- Design parallel hardware and software systems and parallel applications.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools for signals and systems in a combination of team and individual assignments and tests.

Exams: Two exams plus a final will be given. A portion of the class period preceding each exam will be utilized for a review session.

Projects / Labs / Assignment: Projects / labs / assignments will be assigned and will be conducted both out of class and during lab period. They will be graded on a 5-point scale and will be totaled together to account for 40% of the final grade.

Final Project: A final project will be required. The requirements for this assignment will be fully described in a Blackboard later in the course.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

Exams (2) 30% (15 points each)
Labs/projects/assignments (8) 40% (5 points each)
Final Project 25% (15 for written portion / 10 points for oral portion)

Class Participation: 5%
Total possible points = 100

Grading Scale

A: 100-95 points A-: 94-90 points
B+: 89-87 points B: 84-86 points B-: 80-83 points
C+: 79-76 points C: 75-70 points
D: 69-60 points
E: 59 points and below

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Quantitative Compuer Design & Instruction Set Principles	Chapter 1	
1	Memory Hierarchy Design and Performance Optimizations	Chapter 2	
2	Advanced Optimizations for Cache Performance		Assignment 1 Due
3	Memory Technologies and System Optimizations		
4	Virtual Memory and Virtual Machines		Assignment 2 Due
	Instruction Level Parallelism (ILP)	Chapter 3	
5	Instruction level parallelism and pipelining concepts		
6	Compiler Techniques for exposing and leveraging ILP		Assignment 3 Due
7	Branch Prediction, Data Hazards, Speculation and Multi-Issue Microachitectures		
8	Test 1		
	Data Level Parallelism	Chapter 4	
9	Vector Co-processor Architectures		Assignment 4 Due
10	Single-instruction, multi-data (SIMD) Extensions for Data Parallel Applications		
11	Graphics Processing Units (GPUs)		
12	Detecting an Exploiting Loop-level Parallelism		Assignment 5 Due
13	Hybrid CPU-GPU Architectures and Applications		
14	X86-Linux/Windows Clusters		
15			
	Thread Level and Massive Parallelism		
16	Centralized, Shared-Memory Architectures	Chapter 5	Assignment 6 Due
17	Performance of Symmetric Shared Memory Multiprocessors		

18	Optimizations and Trade-offs / Assembling digital components		
19	Distributed, Shared Memory Systems		Assignment 7 Due
20	Programming Models and Workloads for Massively Parallel Server Systems	Chapter 6	
21	Physical Hardware Infrastructure for Massively Parallel Servers		
22	Improving System Application Performance Using Parallelism		Assignment 8 Due
23			
24	Test 2		
25	Final Project Presentations		
26	Final Project Presentations		
27	Final Project Presentations Last Class / Wrap-up		Final Projects Due

University at Albany / Electrical and Computer Engineering

Introduction to Neural Networks

ECE 650

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Mei Chen
Instructor Title	Associate Professor, ECE
Office Location	Li 88B
Office hours	TBD
E-mail Address	meichen@albany.edu
TA's / Peer Educators	TBD
Prepared By	Mei Chen

Textbooks:

Text book:

Simon Haykin, Neural Networks: a comprehensive foundation, Third Edition, ISBN-10: 0131471392, ISBN-13: 978-0131471399, Prentice-Hall, 2008.

Reference materials:

Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
Tom M. Mitchell, Machine Learning, McGraw-Hill, ISBN: 0-07-042807-7, 1997.
Christopher M. Bishop, Neural Network for Pattern Recognition, ISBN: 0198538642, Oxford University Press, 1996.
Research papers

COURSE DESCRIPTION / OVERVIEW:

This is an entry level course for students to understand the principles of neural networks, how does a neural network work, and gain hands-on experiences in designing/implementing neural networks to solve real-world problems through a self-proposed class project.

PREREQUISITES:

- Permission of the instructor
- Familiarity with linear algebra, multivariate calculus, and probability theory
- Knowledge of a programming language (MATLAB® recommended)

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES:

On completion of this course, a student should be able to:

- Understand the learning and generalization issue in neural computation.
- Understand the basic ideas behind most common learning algorithms.
- Implement common learning algorithms using an existing package.
- Apply neural networks to problems in the format of a self proposed class project.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools of neural networks in a combination of individual assignments, a midterm exam, and a final class project.

Exams: One midterm exams will be given. A portion of the class period preceding the exam will be utilized for a review session. It is highly recommended that computer assignments be done in Matlab - however, other programming languages (e.g. C/C++, Python) may also be acceptable with the permission of the instructor.

Assignments: Homework assignments will be assigned and will be completed out of class.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

40% Assignments (handed in the end of every week, 80% must be completed)

20% Midterm Exam
30% Class Project
10% Class Attendance and Participation

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of coursework to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable._Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

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Responsible Computing

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Students With Disabilities

Reasonable accommodations will be provided for students with documented physical, sensory, systemic, cognitive, learning and psychiatric disabilities. If you believe you have a disability requiring accommodation in this class, please notify the Director of the Disability Resource Center (Campus Center 137, 442-5490). That office will provide the course instructor with verification of your disability, and will recommend appropriate accommodations. For further information refer to the University's Disclosure Statement regarding Reasonable Accommodation found at the bottom of the document at the following website: http://www.albany.edu/disability/docs/RAP.doc. This website can be reached by following the link under "Reasonable Accommodation Policy" at the following webpage

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Academic Honesty and Overall Regulations

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(http://www.albany.edu/undergraduate_bulletin/regulations.html).

COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction		
1	What are neural networks and machine learning		
2	Linear regression		
	Perceptron learning		
3	Binary linear classification		
4	The perceptron learning algorithm		
	Backpropagation		
5	Learning in a single neuron		
6	Backpropagation		
	Neural language models and optimization		
7	Neural language models		
8	Optimization methods		
	Recurrent neural networks		
9	Recurrent neural networks		
10	Training recurrent neural networks		
	Convolutional neural networks		
11	Convolutional neural networks		

12	Recent advances in convolutional neural networks		
13	Class Project Proposal Presentation		
	Generalization		
14	Improving generalization		
15			
16	Midterm Exam		
	Probabilistic models		
17	Learning probabilistic models		
18	Mixture models		
	Boltzmann machines		
19	Hopfield nets and Boltzmann machines		
20	Learning Boltzmann machines		
21	Class Project Progress Presentation		
	Bayesian neural networks		
22	Bayesian neural networks		
23	Bayesian optimization		
	Reinforcement learning		
24	Q-learning		
25	Policy gradient		
	RBF network and SVM		
26	Radial Basis Function Networks		
27	Support Vector Machines		
28	Class Project Final Presentation		

University at Albany / Electrical and Computer Engineering

Projects in Computer Engineering

ECE 659 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Weifu Wang
Instructor Title	Assistant Professor, ECE
Office Location	Li 91B
Office hours	TBD
E-mail Address	Wwang8@albany.edu
TA's / Peer Educators	TBD
Prepared By	Gary J. Saulnier

Textbooks:

None. Students will utilize recent publications in the Computer Engineering area in addition to material from previous courses.

COURSE DESCRIPTION / OVERVIEW:

Supervised projects in Computer Engineering. Students investigate the state-of-the-art in Computer Engineering through the study of current publications, class discussions, student presentations, and a major project.

PREREQUISITES:

Students must have completed at least 3 courses within the Computer Engineering Concentration Area.

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES:

Upon successful completion of this course, students will be able to:

1. Discuss issues related to one or more current topics in Computer Engineering
2. Apply their knowledge of science, mathematics and engineering disciplines to solve problems in Computer Engineering.
3. Read, interpret, and utilize information in the published literature in Computer Engineering.
4. Present technical information in a variety of formats, including written reports and oral presentations.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, class presentation schedules, and due dates. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

Assessment will be based on the quality of in-class presentations, written reports, and class attendance and participation. Students are expected to attend all presentations and actively participate in discussions and peer review tasks.

Exams: None.

Projects / Assignments:

1. Literature Search: Investigate a current topic in Computer Engineering using the published literature, including peer-reviewed journal papers. Summarize findings in a written report and class presentation.
2. Project: Use analysis, simulation, and/or implementation to apply Computer Engineering techniques to a problem of interest. This project could be an extension of the literature search or address a different topic.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

1. Literature Search Written Report: 15%
2. Literature Search Presentation: 10%
3. Project Progress Presentation: 10%
4. Project Written Report: 35%
5. Project Final Presentation: 20%
6. Class Attendance/Participation: 10%

Attendance/Lateness/Use of Computers in class

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Responsible Computing

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Students With Disabilities

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COURSE OUTLINE AND READINGS:

<table>
<tr><th>Week</th><th>Discussion Topic</th><th>Assignment</th></tr>
<tr><td>Week 1</td><td>Course structure and policies. Overview of topics in the field with discussion.</td><td>Select a topic for literature search, submit a one paragraph summary of the topic, including references to one or more papers that will be studied.</td></tr>
<tr><td>Week 2</td><td>Overview of topics in the field with discussion.</td><td rowspan="2">Study papers, work on report and presentation</td></tr>
<tr><td>Week 3</td><td>Overview of topics in the field with discussion.</td></tr>
</table>

Week 4	Class presentations reporting on literature search	Submit literature search report
Week 5	Class presentations reporting on literature search	Submit 1 page project proposal
Week 6	TBD*	Work on project
Week 7	TBD	Work on project
Week 8	TBD	Work on project
Week 9	TBD	Prepare progress report for the class
Week 10	Project Progress Reports	Work on project
Week 11	Project Progress Reports	Work on project
Week 12	TBD	Work on project

Week 13	TBD	Work on project
Week 14	Project Final Presentations	Work on project
Week 15	Project Final Presentations	Submit Project Report

* TBD class meetings will vary depending on the specific needs of the class at that time. Lectures on topics related to student projects, tutorials on the use of simulation and analysis tools, general help sessions, class discussions, etc. are all possible.

University at Albany / Electrical and Computer Engineering

Mathematical Methods of Signal Processing

ECE 661 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Weifu Wang
Instructor Title	Assistant Professor, ECE
Office Location	Li 91B
Office hours	TBD
E-mail Address	Wwang8@albany.edu
TA's / Peer Educators	TBD
Prepared By	Weifu Wang

Textbooks:

Linear Algebra and Its Applications **(required)**
Gilbert Strang
4th Edition, Thomson
ISBN: 978-0-030-10567-8

Matrix Analysis and Applied Linear Algebra **(optional)**
Carl D. Meyer
SIAM: Society for Industrial and Applied Mathematics, 2001
ISBN: 978-0-898-71454-8

COURSE DESCRIPTION / OVERVIEW:

This course introduces students to Linear Algebra by teaching them basic concepts on this field. Relevant topics are:

- Solving linear equations
- Vector spaces and subspaces
- Matrices and determinants
- Linear independence and bases
- Eigenvalues and eigenvectors
- Similarity of matrices
- Special matrices
- Orthogonality of vectors
- Orthogonalization and orthonormalization
- Bilinear and Quadratic forms
- Hermitian and unitary matrices
- Diagonalization
- Applications of Linear Algebra

PREREQUISITES:

A MAT 214 Calculus III and CEN 200 Programming for Engineers or equivalent

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will:

- Gain a good understanding of the concepts and methods of linear algebra
- Develop the ability to solve problems using linear algebra.
- Connect linear algebra to other fields both within and without mathematics.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools of Linear Algebra in a combination of individual assignments and exams.

Exams: Two midterm exams plus a final exam will be given. A portion of the class period preceding each exam will be utilized for a review session. It is highly recommended that computer assignments be done in Matlab - however, other programming languages (e.g. C/C++, Python) may also be acceptable with the permission of the instructor. A project will be assigned at the beginning of the course and will need to be completed by the end of the course.

Projects / Assignments: Homework assignments will be assigned and will be completed out of class.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

5% Assignments (handed in the end of every week, 80% must be completed)
25% Midterm Exam 1
25% Midterm Exam 2
40% Final Exam
5% Class Participation

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of coursework to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable._Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

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(http://www.albany.edu/undergraduate_bulletin/regulations.html).

COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Solving Simultaneous Linear Equations I		
1	Elementary Row Operations, Gauss Elimination, by Determinants		
2			
	Vector Spaces		
3	Vectors in 2 and 3 dimensions, Real Vector Spaces, Abstract Vector Spaces		Homework 1 Due
4			
	Subspaces		
5	Subspaces in general, The important subspaces of a linear transformation		Homework 2 Due
6			
	Matrices and Determinants		
7	Rules of Matrix Algebra and Determinant Calculation, Relation to Linear Transformations		Homework 3 Due
8			

	Linear Independence and Bases		
9	Matrices in the solution of linear systems, dimension, all bases for the same vector space have the same cardinality		Homework 4 Due
10			
	Eigenvalues and Eigenvectors		
11	Definition, significance, and calculation of eigenvalues and eigenvectors		Homework 5 Due
12			
13	Midterm Exam 1		
	Similarity of Matrices		
14	Definition, properties, and consequences of similarities, invariants with respect to similarity transformation, similarity classes		Homework 6 Due
15			
	Special Matrices. Orthogonality Vectors		
16	Symmetric, Skew Symmetric, Orthogonal, Hermitian, Skew Hermitian, Unitary, Stochastic, Hadamard, Positive Definite, etc, Normed Vector Spaces, and orthogonality		Homework 7 Due
17			
	Singular Value Decomposition		
18	SVDs, pseudo-inverses, Principal Component Analysis		Homework 8 Due
18			
	Orthogonalization and Orthonormalization. The JCF.		
17	The Gram-Schmidt Process, Linear Functionals, dual spaces, dual bases, The Jordan Canonical Form for similarity classes		Homework 9 Due
18			
	Vector Spaces and Matrices over Finite Fields. Bilinear and Quadratic Forms		
19	Sizes and Numbers of Subspaces, Number of bases of subspaces, Similarity and its invariants over finite fields, Bilinear and Quadratic Forms, applications to error-correcting codes (Hamming metric, basic coding theory)		Homework 10 Due
20			
21			Homework 11 Due
22	Midterm Exam 2		

	Theory of Hermitian and Unitary Matrices		
23	Diagonalization of Hermitian by Unitary Matrices, Theorem on real eigenvalues, Examples		Homework 12 Due
24			
	Solving simultaneous linear equations II		
25	Iterative methods, conjugate gradient, preconditioning, sparse, diagonally-dominant systems		Homework 13 Due
	Least squares		
26	Orthogonal projections and least-squares fitting, applications to data analysis		
	Other topics and applications		
27	Clustering and Cheeger's inequality, Spectral graph analysis, Perron-Frobenius Theory		Homework 14 Due
28			
	Final Exam		

University at Albany / Electrical and Computer Engineering

Advanced Digital Signal Processing

ECE 662 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Hany Elgala
Instructor Title	Assistant Professor, ECE
Office Location	Li 86
Office hours	TBD
E-mail Address	helgala@albany.edu
TA's / Peer Educators	TBD
Prepared By	Hany Elgala

Textbooks:

M. Vetterli, J. Kovacevic, and V. K. Goyal, "Foundations of Signal Processing", Cambridge University Press, 2014.

Monson H. Hayes, Statistical Digital Signal Processing and Modeling, Wiley, 1996

Digital Signal Processing (4th Edition) by John G. Proakis, Dimitris K Manolakis, 2006.

COURSE DESCRIPTION / OVERVIEW:

This course builds on the undergraduate level digital signal processing course by focusing on multirate systems, digital filter design and adaptive filtering. The course will cover introductory background material on discrete time representation of signals, z-transform and frequency domain analysis of digital signals.

PREREQUISITES:

ICEN 370 Digital Signal Processing and AMAT 370 Probability and Statistics for Engineering and the Sciences or equivalent

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will:

- Understand and describe multirate systems.
- Design digital filters and mathematically describe their operation.
- Perform adaptive filtering.
- Understand and employ array processing principles.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

Exams: A mid-term and final exam will be given.

Projects / Assignments: Weekly homework will be assigned based on the material covered during previous week. A term project will be assigned on digital filter design.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

1. Homework - 20%
2. Midterm - 25%
3. Term Project - 15%
4. Final Exam - 30%
5. Attendance and class participation - 10%

Attendance/Lateness/Use of Computers in class

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(http://www.albany.edu/undergraduate_bulletin/regulations.html).

COURSE OUTLINE AND READINGS:

Class	Topic	Readings	Notes
	Introduction		
1	Discrete-time complex exponential		
2			
	Hilbert Space		
3	Hilbert spaces; approximation and projections; bases and frames		
4			
5			
6			
	Sequences and discrete-time systems		
7	Discrete-domain signals and systems; DTFT z-transform; DFT;		
8			

9			
10			
	Multirate systems		
11	Sampling rate conversion, Polyphase structures, QMF banks		
12			
13			
14			
15	Mid-term Exam		
	Design of Digital Filters		
16	Design of FIR filter, Design of IIR from FIR		
17			
18			
19			
	Linear prediction and Adaptive filters		
20	Wiener filters, Linear predictors, LMS algorithm, RLS, Lattice structures		
21			
22			
23			
	Array Processing		
24	Beamforming, MUSIC,ESPRIT, Applications to localization (LOS and NLOS)		
25			
26			
27			
28	Final Exam Review		
	Final Exam		

University at Albany / Electrical and Computer Engineering

Statistical Pattern Recognition

ECE 664 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Mei Chen
Instructor Title	Associate Professor, ECE
Office Location	Li 88B
Office hours	TBD
E-mail Address	meichen@albany.edu
TA's / Peer Educators	TBD
Prepared By	Mei Chen

Textbooks:

Pattern Classification **(required)**
R. O. Duda, P. E. Hart, and D. G. Stork
Wiley-Interscience, John Wiley and Sons, Inc.
2nd Edition, New York, 2001
ISBN: 978-0-471-70350-1

Computer Manual in MATLAB to accompany Pattern Classification **(required)**
David G. Stork and Elad Yom-Tov
Wiley-Interscience, 2004
ISBN: 978-0-471-42977-7

Neural Networks for Pattern Recognition **(optional)**
C. M. Bishop
Oxford University Press, Oxford, 1995
ISBN: 978-0-198-53864-6

Pattern Recognition and Machine Learning **(optional)**
C. M. Bishop
Springer, 2006
ISBN: 978-0-387-31073-2

COURSE DESCRIPTION / OVERVIEW:

This course introduces students to Statistical Pattern Recognition by teaching them basic concepts on this field. Relevant topics are:

- Bayesian decision theory
- Maximum-Likelihood and Bayesian Parameter Estimation
- Nonparametric Techniques
- Linear Discriminant Functions
- Multilayer Neural Networks
- Stochastic Methods
- Nonmetric Methods
- Algorithm-Independent Machine Learning
- Unsupervised Learning and Clustering
- Big data classification

PREREQUISITES:

ECE 661 Mathematical Models for Signal Processing, ECE 671 Probability and Random Processes, and CEN 200 Programming for Engineers or equivalent

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will:

- Formulate and solve Bayesian decision problems
- Perform Maximum-Likelihood and Bayesian estimation
- Use nonparametric techniques to estimate density functions
- Use neural networks to formulate and solve various problems
- Use stochastic and nonmetric methods for search and decision-making
- Use unsupervised learning and clustering methods to solve various problems
- Use classification methods to solve big data problems

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools of Statistical Pattern Recognition in a combination of individual assignments, a project and exams.

Exams: One midterm exam plus a final exam will be given. A portion of the class period preceding each exam will be utilized for a review session.

Projects / Assignments: Homework assignments will be assigned and will be completed out of class. It is highly recommended that computer assignments be done in Matlab - however, other programming languages (e.g. C/C++, Python) may also be acceptable with the permission of the instructor. A project will be assigned at the beginning of the course and will need to be completed by the end of the course.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

20% Homeworks
20% Project
25 % Midterm Exam
30% Final Exam
5% Class Participation

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of coursework to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable._Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

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Responsible Computing

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Students With Disabilities

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction		
1	Basic concepts in pattern recognition, A paradigm for pattern recognition, Pattern recognition systems		
2	The design cycle, Learning and adaptation		
	Bayesian Decision Theory		
3	Introduction, Minimum error-rate classification (Minimax criterion, Neyman-Pearson criterion), Classifiers, Discriminant functions, decision surfaces, The Normal density		Homework 1 Due

4	Discriminant functions for the Normal density, Error probabilities and bounds, Continuous and discrete features, Missing and noisy features		
	Maximum-Likelihood and Bayesian Parameter Estimation		
5	Maximum-likelihood estimation, Bayesian estimation, Bayesian parameter estimation, Sufficient statistics		Homework 2 Due
6	Problems of dimensionality, Component analysis and discriminants, Expectation-maximization, Hidden Markov models		
	Nonparametric Techniques		
7	Density estimation, Parzen windows, Nearest neighbor estimation		Homework 3 Due
8	Nearest neighbor rule, metrics and nearest-neighbor classification, Fuzzy classification		
	Linear discriminant functions		
9	Linear discriminant functions and decision surfaces, Generalized linear discriminant functions, The two-category linearly separable case, Minimizing the Perceptron criterion function		Homework 4 Due
10	Relaxation procedures, Nonseparable behavior, Minimum squared-error procedures		
11	The Ho-Kashyap procedures, Linear programming algorithms, Support vector machines, Multicategory generalizations		Homework 5 Due
	Multilayer neural networks		
12	Feedforward operation and classification, Backpropagation algorithm, error surfaces		
13	Backpropagation as feature mapping, Backpropagation, Bayes theory and probability, practical techniques and additional networks		Homework 6 Due
14	Midterm Exam		
	Feature selection and reduction		
15	Subset selection, optimality criteria, structure learning		

	Minimum-redundancy-maximum-relevance (mRMR) feature selection, Correlation feature selection, Regularized trees		Homework 7 Due
	Stochastic methods		
17	Stochastic search, Boltzman learning		
18	Boltzman networks and graphical models, evolutionary methods, genetic programming		Homework 8 Due
	Nonmetric methods		
19	Decision trees, CART, Other tree methods		
20	Recognition with strings, Grammatical methods, Rule-based methods		Homework 9
	Unsupervised learning and clustering		
21	Mixture densities and identifiability, Maximum likelihood estimates, application to Normal mixtures		
22	Unsupervised Bayesian learning, Data description and clustering, Criterion functions for clustering, Iterative optimization		Homework 10
23	Hierarchical clustering, Online clustering, Component analysis, Low-dimensional representations and multi-dimensional scaling		
	Algorithm-independent machine learning		
24	Lack of inherent superiority of any classifier, bias and variance, resampling for estimating statistics		Homework 11 Due
25	Resampling for classifier design, estimating and comparing classifiers, combining classifiers		
	Big data classification		
26	Large-scale big data streams, Big-data classification, Scale-up on a single-machine, Scale-up by parallelism		Homework 12 Due
27	Text classification, Multimedia classification, Time-series data classification		
28	Discrete-sequence classification, collective classification of network data, uncertain data classification		Project Due
	Final Exam		

University at Albany / Electrical and Computer Engineering

Projects in Signal and Information Processing

ECE 669 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Hany Elgala
Instructor Title	Assistant Professor, ECE
Office Location	Li 86
Office hours	TBD
E-mail Address	helgala@albany.edu
TA's / Peer Educators	TBD
Prepared By	Gary J. Saulnier

Textbooks:

None. Students will utilize recent publications in the Signal and Information Processing area in addition to material from previous courses.

COURSE DESCRIPTION / OVERVIEW:

Supervised projects in Signal and Information Processing. Students investigate the state-of-the-art in Signal and Information Processing through the study of current publications, class discussions, student presentations, and a major project.

PREREQUISITES:

Students must have completed at least 3 courses within the Signal and Information Processing Concentration Area.

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES:

Upon successful completion of this course, students will be able to:

1. Discuss issues related to one or more current topics in Signal and Information Processing
2. Apply their knowledge of science, mathematics and engineering disciplines to solve problems in Signal and Information Processing.
3. Read, interpret, and utilize information in the published literature in Signal and Information Processing.
4. Present technical information in a variety of formats, including written reports and oral presentations.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, class presentation schedules, and due dates. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

Assessment will be based on the quality of in-class presentations, written reports, and class attendance and participation. Students are expected to attend all presentations and actively participate in discussions and peer review tasks.

Exams: None.

Projects / Assignments:

1. Literature Search: Investigate a current topic in Signal and Information Processing using the published literature, including peer-reviewed journal papers. Summarize findings in a written report and class presentation.
2. Project: Use analysis, simulation, and/or implementation to apply Signal and Information Processing techniques to a problem of interest. This project could be an extension of the literature search or address a different topic.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

1. Literature Search Written Report: 15%
2. Literature Search Presentation: 10%
3. Project Progress Presentation: 10%
4. Project Written Report: 35%
5. Project Final Presentation: 20%
6. Class Attendance/Participation: 10%

Attendance/Lateness/Use of Computers in class

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Responsible Computing

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Academic Honesty and Overall Regulations

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COURSE OUTLINE AND READINGS:

Week	Discussion Topic	Assignment
Week 1		Select a topic for literature search, submit a one paragraph summary of

	Course structure and policies. Overview of topics in the field with discussion.	the topic, including references to one or more papers that will be studied.
Week 2	Overview of topics in the field with discussion.	Study papers, work on report and presentation
Week 3	Overview of topics in the field with discussion.	
Week 4	Class presentations reporting on literature search	Submit literature search report
Week 5	Class presentations reporting on literature search	Submit 1 page project proposal
Week 6	TBD*	Work on project
Week 7	TBD	Work on project
Week 8	TBD	Work on project
Week 9	TBD	Prepare progress report for the class
	Project Progress Reports	Work on project

Week 10		
Week 11	Project Progress Reports	Work on project
Week 12	TBD	Work on project
Week 13	TBD	Work on project
Week 14	Project Final Presentations	Work on project
Week 15	Project Final Presentations	Submit Project Report

* TBD class meetings will vary depending on the specific needs of the class at that time. Lectures on topics related to student projects, tutorials on the use of simulation and analysis tools, general help sessions, class discussions, etc. are all possible.

University at Albany / Electrical and Computer Engineering

Probability and Random Processes

ECE 671 Section XXXX

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Yelin Kim
Instructor Title	Assistant Professor, ECE
Office Location	Li 90B
Office hours	TBD
E-mail Address	yelinkim@albany.edu
TA's / Peer Educators	TBD
Prepared By	Yelin Kim

Textbooks (required): Introduction to Probability by Dimitri P. Bertsekas and John N. Tsitsiklis, Athena Scientific (2008)

COURSE DESCRIPTION / OVERVIEW

A foundation in the theory and applications of probability and stochastic processes with an emphasis on applications within the broad areas of electrical and computer engineering such as signal processing, detection, estimation, and communications. Fundamental probabilistic results such as the axioms of probability, random variables, distribution functions, functions and sequences of random variables, stochastic processes, and representations of random processes and their application in electrical and computer engineering.

PREREQUISITES

A MAT 370 Probability and Statistics for Engineering and the Sciences or equivalent

COREQUISITES

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will:

- Gain an understanding of random phenomena both qualitatively and mathematically
- Understand how to manipulate those descriptions to solve engineering problems.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools for probability and random probabilities in a combination of team and individual assignments and tests.

Exams: Two exams plus a final will be given. A portion of the class period preceding each exam will be utilized for a review session.

Projects / Assignments: Projects / assignments will be assigned and will be completed out of class. They will be graded on a 10-point scale and will be totaled together to account for 40% of the final grade.

Grading

Homework: 15%
Midterm: 35%
Final: 50%
Exam 3: 25%

The final grade will be set on a curve, with the median grade as a B.

Total possible points = 100

Grading Scale

A: 100-95 points A-: 94-90 points
B+: 89-87 points B: 84-86 points B-: 80-83 points
C+: 79-76 points C: 75-70 points
D: 69-60 points
E: 59 points and below

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction to Probability and Random Processes		
1	Intro to Course Intro to signals and Systems	Chapter 0	
2			
	Basics of Probability		
3	Combinatorial Analysis	Chapter 1.6	
4			
5	Axioms of Probability	Chapter 1.1-1.2	Assignment 1 Due
6			
7	Conditional Probability	Chapter 1.3-1.5	
8			
	Random Variables		
9	Discrete Random Variables	Chapter 2	
10			Assignment 2 Due
11	Properties of Expectation	Chapter 2	
12			
13	Test 1		
14	Continuous Random Variables	Chapter 3	
15			
16	Further Topics on Random Variables	Chapter 4	Assignment 3 Due
17			

	Limit Theorems and Random Processes		
18	Limit Theorems	Chapter 5	
19			
20	Bernoulli and Poisson Processes	Chapter 6	
21			Assignment 4 Due
	Markov Chains		
22	Discrete-Time Markov Chains	Chapter 7.1-7.4	
23	Review		
24	Test 2		
25	Continuous-Time Markov Chains	Chapter 7.5	
26			
27	ntro to Bayesian Statistical Inference / Summary	Chapter 8	
	Final Exam		

University at Albany / Electrical and Computer Engineering

Detection and Estimation Theory

ECE 672 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Daphney-Stavroula Zois
Instructor Title	Assistant Professor, ECE
Office Location	Li 88A
Office hours	TBD
E-mail Address	dzois@albany.edu
TA's / Peer Educators	TBD
Prepared By	Daphney-Stavroula Zois

Textbooks:

Lessons in Estimation Theory for Signal Processing, Communications and Control **(required)**
J. M. Mendel
Prentice-Hall, New Jersey, 1995.
ISBN: 978-0-131-20981-7

Detection, Estimation and Modulation Theory, Part I: Detection, Estimation, and Filtering Theory **(required)**
Harry L. Van Trees, Christine L. Bell and Zhi Tian
Wiley, 2nd Edition, 2013
ISBN: 978-0-470-54296-5

Some material will be taken from

- Harry L. Van Trees and Christine L. Bell, “Bayesian Bounds for Parameter Estimation and Nonlinear Filtering/Tracking,” Wiley-IEEE Press, 2007 (978-0-470-12095-8).
- S. J. Julier and K. J. Uhlmann, “Unscented Filtering and Nonlinear Estimation,” IEEE Proc., vol. 92, pp. 401-422, March 2004.
- E. A. Wan and R. van der Merwe, “The Unscented Kalman Filter,” in Kalman Filtering and Neural Networks, S. Haykin (Ed.), pp. 221-280, John Wiley, 2001
- S. J. Julier and K. J. Uhlmann, “A General Method for Approximating Nonlinear Transformations of Probability Distributions,” Tech. Report RRG, Dept. of Engineering Science, Univ. of Oxford, Nov. 1996.
- Zhe Chen, “Bayesian Filtering: From Kalman Filters to Particle Filters, and Beyond,” 2003.

and from handouts provided during the course.

COURSE DESCRIPTION / OVERVIEW:

The fundamentals of detection and estimation theory for signal processing, communications, and control. Topics covered include: classical statistical decision theory, decision criteria, binary and composite hypothesis tests. receiver operating characteristics and error probability. Bayesian and nonrandom parameter estimation. Non-Bayesian parameter estimation. Covariance inequality bounds. Sufficient statistics. Expectation-maximization algorithm. Kalman prediction, filtering and smoothing. Approximate nonlinear filtering (extended Kalman filtering, unscented Kalman filtering, particle filtering). Parameter estimation in linear dynamical systems. General Bayesian tracking. Higher-order statistics.

PREREQUISITES:

ECE 671 Probability and Random Processes or permission of the instructor

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will:

- Formulate and solve Bayesian/non-Bayesian decision problems.
- Formulate and solve Bayesian/non-Bayesian parameter estimation problems.
- Compute various type of bounds.
- Perform linear and nonlinear exact and approximate filtering.
- Perform general Bayesian tracking.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools of Detection and Estimation Theory in a combination of individual assignments, a project and exams.

Exams: One midterm exam plus a final exam will be given. A portion of the class period preceding each exam will be utilized for a review session.

Projects / Assignments: Homework assignments will be assigned and will be completed out of class. It is highly recommended that computer assignments be done in Matlab - however, other programming languages (e.g. C/C++, Python) may also be acceptable with the permission of the instructor. A project will be assigned at the beginning of the course and will need to be completed by the end of the course.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

30% Homeworks and Project
30% Midterm Exam
35% Final Exam
5% Class Participation

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of coursework to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable._Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
1	Introduction, Coverage, and Philosophy		
	Classical Detection Theory		
2	Hypothesis Testing, Performance Bounds and Approximations, Monte Carlo Simulation, Neyman-Pearson test		
3			
4	Optimal Signal Detection		Homework 1 Due
5			
	Classical Parameter Estimation		
6	The Linear Model, Covariance Inequality Bounds, Properties of Estimators		Homework 2 Due
7			
8	Least-Squares Estimation		Homework 3 Due
9			

10	Elements of Multivariate Gaussian Random Variables, Sufficient Statistics, Elements of Multivariate Gaussian Random Variables		Homework 4 Due
11			
	State Estimation		
12	Elements of Discrete-Time Gauss-Markov Random Processes		Homework 5 Due
13	Prediction, Filtering (Kalman Filter), Filtering Examples, State Smoothing		
14			
15	Midterm Exam		
16	State Estimation for the Not-So-Basic State-Variable Model		Homework 6 Due
17	Linearization and Discretization of Nonlinear Systems		
18	Iterated Least Squares and Extended Kalman Filtering		Homework 7 Due
19	Unscented Kalman Filtering, Particle Filtering		
20			
21	Steady-State Kalman Filter and its Relationship to a Digital Wiener Filter		Homework 8 Due
22	Singular Value Decomposition and Computation of LSE's		
23	Properties of Least-Squares Estimators		Homework 9 Due
24	Best Linear Unbiased Estimation		
25	Maximum-Likelihood Estimation, Maximum A Posteriori Estimation of Random Parameters, Expectation Maximization (EM) algorithm		Homework 10 Due
26			
27	Maximum Likelihood State and Parameter Estimation		Homework 11 Due
28	Higher-order statistics		Project Due
	Final Exam		

University at Albany / Electrical and Computer Engineering

Information Theory

ECE 673 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Yelin Kim
Instructor Title	Assistant Professor, ECE
Office Location	Li 90B
Office hours	TBD
E-mail Address	yelinkim@albany.edu
TA's / Peer Educators	TBD
Prepared By	Yelin Kim

Textbooks (required):

Elements of Information Theory
T. M. Cover and J. A. Thomas
2nd Edition, Wiley
ISBN: 978-0-471-24195-9

Some material will be taken from

- "Applied Digital Information Theory I," J. L. Massey, Lectures Notes
  http://www.isiweb.ee.ethz.ch/archive/massey_scr/adit1.pdf
- "Applied Digital Information Theory II," J. L. Massey, Lectures Notes
  http://www.isiweb.ee.ethz.ch/archive/massey_scr/adit2.pdf

and handouts provided during the course.

COURSE DESCRIPTION / OVERVIEW:

This course introduces students to Information Theory by teaching them basic concepts on this field. Relevant topics are:

- Discrete probability, entropy, mutual information, inequalities
- Typical sequences and sets
- Data compression, Huffman codes, Tunstall codes, universal source coding
- Discrete memoryless channels, capacity, cost, coding
- Differential entropy, Gaussian channels, spectral efficiency, modulation
- Rate distortion theory
- Basic multiuser theory

PREREQUISITES:

AMAT 524 Advanced Linear Algebra, ECE 671 Probability and Random Processes or permission of the instructor

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will:

- Gain an understanding of Information Theory important concepts such as Entropy, Mutual Information and various inequalities
- Understand data compression techniques and codes
- Understand the notion of capacity and
- Gain a basic understanding on multi-user information theory

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools of Information Theory in a combination of individual assignments and exams.

Exams: One midterm exam plus a final exam will be given. A portion of the class period preceding each exam will be utilized for a review session.

Projects / Assignments: Homework assignments will be assigned and will be completed out of class.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

10% Assignments (handed in the end of every week, 80% must be completed)
30% Midterm Exam
55% Final Exam
5% Class Participation

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of coursework to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable._Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
1	Probability, Entropy, Mutual Information, Inequalities		
2			
3	Typical Sequences and Sets, Data Compression		Assignment 1 Due
4			
5	Kraft Inequality, Shannon-Fano Codes		Assignment 2 Due
6			
7	Huffman Codes		Assignment 3 Due
8			
9	Tunstall Codes, Sources with Memory		Assignment 4 Due
10			
11	Coding Sources with Memory		Assignment 5 Due
12			
14	Channel Coding, Capacity, Cost		Assignment 6 Due
15			
16	Codes for the Binary Erasure Channel		Assignment 7 Due
17			
19	Midterm Exam		
20	Differential Entropy, Gaussian Channels		

21			
22	Spectral Efficiency, Modulation		Assignment 8 Due
23			
24	Rate Distortion Theory		Assignment 9 Due
25			
26	Multi-User Information Theory, Models		Assignment 10 Due
27			
28	Multi-Access Channels, Broadcast Channels		Assignment 11 Due
	Final Exam		

University at Albany / Electrical and Computer Engineering

Error Control Coding

ECE 674 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Hany Elgala
Instructor Title	Assistant Professor, ECE
Office Location	Li 86
Office hours	TBD
E-mail Address	helgala@albany.edu
TA's / Peer Educators	TBD
Prepared By	Hany Elgala

Textbooks:

Error Control Coding (2nd Edition) 2nd Edition by Shu Lin, Daniel J. Costello

COURSE DESCRIPTION / OVERVIEW:

Error control techniques for digital data are widely used in applications in our everyday life. They are used in digital transmission systems to eliminate transmission errors and in magnetic, optical, and semiconductor storage devices as hard disks, DVDs, or flash memory to cancel read and write errors. Topics covered in class include algebraic codes (cyclic codes, BCH codes, Reed-Solomon codes), convolutional codes, and modern graph based codes (Turbo-Codes and LDPC codes). Most codes will be discussed in the context of channel coding.

PREREQUISITES:

CEN 370 Digital Signal Processing, A MAT 370 Probability and Statistics for Engineering and the Sciences or equivalent

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: After completing this course the students should be able to:

- Understand Block Codes and Maximum Likelihood Decoding.
- Understand Decoding Tables, Hamming Weight and Distance and Error Correction versus Detection.
- Understand Generator Matrix, Parity-Check Matrix and Error-Correcting Capability of a Linear Code.
- Design an error detecting and correcting system for semiconductor memory system to meet given system specification.
- Understand Binary Cyclic Codes, encoding with (n-k)-Stage Shift Register and Syndrome Calculations and Error Detection.
- Design an error detecting and correcting system for magnetic storage device to meet given system specification.
- Understand Error Trapping Decoding for Cyclic Codes.
- Understand BCH Codes and the encoding and decoding techniques.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

Exams: A mid-term and final exam will be given.

Projects / Assignments: Weekly homework will be assigned based on the material covered during previous week.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

Homework - 25%
Midterm - 25%
Final Exam - 40%
Attendance and class participation - 10%

Attendance/Lateness/Use of Computers in class

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COURSE OUTLINE AND READINGS:

Class	Topic	Readings	Notes
	Introduction and Overview		
1	What is a Code? How are Codes Used and Judged Modulo *m* Computations		
2			
	Finite Fields		
3	Groups, Rings, Fields		

4	Properties of Finite Fields Extension Fields, Polynomials over Finite Fields Minimal Polynomials, Conjugates		
5			
6			
	Introduction to Linear Block Codes		
7	Generator and Parity Check Matrices Minimum Distance Standard Array and Syndrome Decoding Weight Distribution Probability of Error Modified Linear Block Codes		
8			
9			
10			
	Convolutional Codes		
11	Convolutional Encoders Structural Properties of Convolutional Codes Trellis Diagrams Viterbi Algorithm Performance Analysis		
12			
13			
14			
15	Mid-term Exam		
	Cyclic Codes		
16	General Theory Shift Register Implementations Shortened Cyclic Codes, CRCs for Error Detection		
17			
18			
19			
	BCH and RS Codes		
20	BCH and RS Codes: Algebraic Description BCH and RS Codes: Frequency Domain Description Decoding Algorithms for BCH and RS Codes		
21			
22			
23			
	Soft-Decision and Iterative Decoding		
24	Soft-Decision Decoding for Linear Block Codes Optimum Decoding of Convolutional Codes Turbo Coding		
25			

26	Low-Density Parity-Check Codes		
27			
28	Final Exam Review		
	Final Exam		

University at Albany / Electrical and Computer Engineering

Mobile And Wireless Networking

ECE 675 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Dola Saha
Instructor Title	Assistant Professor, ECE
Office Location	Li 89B
Office hours	TBD
E-mail Address	dsaha@albany.edu
TA's / Peer Educators	TBD
Prepared By	Dola Saha

Textbooks (required):

1. Mobile Communications; Authors: Jochen H. Schiller; Published by: Addison-Wesley; ISBN-13: 978-0321123817; ISBN-10: 0321123816
2. (additional, not required) Computer Networking: A top-down approach featuring the Internet; Authors: James F. Kurose and Keith W. Ross; Published by: Addison-Wesley; ISBN-13 978-0136079675; ISBN-10 0136079679

COURSE DESCRIPTION / OVERVIEW

Building on students' basic knowledge of wired computer networks, this course will explore mobile wireless networks. Working individually students will learn about current protocols and technologies in mobile networks. Through hands-on exercises students will gain experience in wireless networks operation and configuration. Successful completion of the course will require detailed prior understanding of network-based communications, Internet protocol operations, strong systems programming skills and familiarity with UNIX.

PREREQUISITES
I CEN 400 Operating Systems and I CEN 416 Computer Communication Networks

COREQUISITES
None

LEARNING OBJECTIVES / OUTCOMES:

Recent projections on Internet traffic demand predict that the Internet traffic generated in 2018 alone will be larger than that of the period from 1984 to 2013 combined. A majority of this traffic will originate from mobile devices. A plethora of technologies provide wireless connectivity for mobile devices. This course will provide an in-depth understanding of modern mobile technologies.

The specific characteristics of mobile networks make traditional wired networks protocol infeasible for wireless networks. This course will start by introducing wireless network specifics that require custom protocol design. It will then cover different approaches toward mobile wireless networking as well as applications that make use of mobile networks.

At the completion of the course the student will:

- Be able to demonstrate a thorough understanding of the mobile networking protocol stack, technologies and applications.
- Be able to utilize mobile network monitoring and analysis tools for wireless network performance and evaluation
- Be able to complete network programming tasks that include performance evaluation in real-world wireless network deployments
- Be able to compose and develop a research article and give an oral presentation on a topic related to mobile network technologies.

COURSE WEBSITE AND BLACKBOARD:
Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools for engineering design in a combination of team and individual assignments/projects and tests.

Exams: Two exams will be given – a midterm and final. A portion of the class period preceding each exam will be utilized for a review session.

Project/Assignment: Projects/assignments will be assigned and will be conducted out of class. They will be graded on a 100-point scale and will be totaled together to account for 50% of the final grade.

Final Project: A final project will not be required.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

Exams (2) 45% (20 points midterm and 25 points final)
Labs/ assignments (5) 50% (10 points each)
Class Participation: 5% (5v points)
Total possible points = 100

Grading Scale

A: 100-95 points A-: 94-90 points
B+: 89-87 points B: 84-86 points B-: 80-83 points
C+: 79-76 points C: 75-70 points
D: 69-60 points
E: 59 points and below

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of course work to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable. Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Notes
	Class overview; Introduction to mobile networking	
1	Schiller, Chapter 1	
2	Schiller, Chapter 1	
	Wireless transmission	
3	Schiller, Chapter 2	
4	Schiller, Chapter 2	Assignment 1 Due
5	Schiller, Chapter 2	
	Wireless Medium Access Control	
6	Schiller, Chapter 3	
7	Schiller, Chapter 3	
8	Kurose and Ross, Chapter 6.3; Schiller, Chapter 7	
9	Schiller, Chapter 7	
	Telecommunication systems	
10	Schiller, Chapter 4	Assignment 2 Due
11	Schiller, Chapter 4	
12	**Satellite Systems:** Schiller, Chapter 5	
13	Review	
14	Midterm	
15	**Broadcast systems:** Schiller, Chapter 6	
	Mobile Network Layer	
16	Schiller, Chapter 8	
17	Schiller, Chapter 8	Assignment 3 Due
18	Schiller, Chapter 8	

	Mobile Transport Layer	
19	Schiller, Chapter 9	
20	Schiller, Chapter 9	
21	Schiller, Chapter 9	
	Support for Mobility	
22	Schiller, Chapter 10	Assignment 4 Due
23	Schiller, Chapter 10	
24	Students research paper presentation	
25	Students research paper presentation	
26	Final Review	Assignment 5 Due
27	Final exam	

University at Albany / Electrical and Computer Engineering

Wireless Communications

ECE 676 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Aveek Dutta
Instructor Title	Assistant Professor, ECE
Office Location	Li 89A
Office hours	TBD
E-mail Address	adutta@albany.edu
TA's / Peer Educators	TBD
Prepared By	Aveek Dutta

Textbooks:

Wireless Communications **(required)**
Andrea Goldsmith
Cambridge University Press
ISBN: 9780521837163

Wireless Communications **(optional)**
Andreas Molisch
WILEY
ISBN: 978-0-470-74186-3

COURSE DESCRIPTION / OVERVIEW:

This course introduces students to design, analysis and fundamental limits of wireless communication systems. Topics that will be covered in this course include: wireless channel models, fading and diversity, mmWave propagation, multiple-antenna and MIMO systems; space-time codes and decoding algorithms; multiple-access techniques and multiuser detection; broadcast codes and precoding; cellular and ad-hoc network topologies; OFDM and ultrawideband systems; and architectural issues.

PREREQUISITES:

ECE 571 Advanced Digital Communications or permission of the instructor

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will:

- Gain a good understanding of the wireless channel and its effects on communication
- Develop the ability to solve problems in the wireless communication domain
- Gain in-depth knowledge of modern wireless systems, including MIMO and Millimeter wave communication

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools of Linear Algebra in a combination of individual assignments and exams.

Exams: One midterm exams plus a final exam will be given. A portion of the class period preceding each exam will be utilized for a review session. It is highly recommended that computer assignments be done in Matlab - however, other programming languages (e.g. C/C++, Python) may also be acceptable with the permission of the instructor.

Assignments: Homework assignments will be assigned and will be completed out of class.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

25% Assignments (handed in the end of every week, 80% must be completed)
25% Midterm Exam
40% Final Exam
10% Class Attendance and Participation

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of coursework to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable._Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

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COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction		
1	Overview of Wireless Communications		
2			
	Wireless Channel Models		
3	Path loss and Shadowing Models		
4			
5	Millimeter wave Propagation		
6			
7	Statistical Fading Models, Narrowband Fading		
8			
9	Wideband Fading Models		
	Impact of Fading and ISI		
10	Capacity of Wireless Channels		
11	Digital Modulation and their performance in fading channels		
12			
13			
	Flat Fading Countermeasures		
14	Diversity		
15			
16	Midterm Exam		
17	Adaptive Modulation		
18			
19			

20	Multiple Input Multiple Output Systems (MIMO) & Space Time Coding		
	ISI Countermeasures		
21	Multicarrier Systems and OFDM		
22			
23	DS-CDMA		
24			
25	Waveforms for 5G		
	Multiuser Systems		
26	Multiple Access & Networking		
27			
28	Final Review		
	Final Exam		

University at Albany / Electrical and Computer Engineering

Projects in Communications and Networking

ECE 679 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Dola Saha
Instructor Title	Assistant Professor, ECE
Office Location	Li 89B
Office hours	TBD
E-mail Address	dsaha@albany.edu
TA's / Peer Educators	TBD
Prepared By	Gary J. Saulnier

Textbooks:

None. Students will utilize recent publications in the Communications and Networking area in addition to material from previous courses.

COURSE DESCRIPTION / OVERVIEW:

Supervised projects in Communications and Networking. Students investigate the state-of-the-art in Communications and Networking through the study of current publications, class discussions, student presentations, and a major project.

PREREQUISITES:

Students must have completed at least 3 courses within the Communications and Networking Concentration Area.

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES:

Upon successful completion of this course, students will be able to:

1. Discuss issues related to one or more current topics in Communications and Networking
2. Apply their knowledge of science, mathematics and engineering disciplines to solve problems in Communications and Networking.
3. Read, interpret, and utilize information in the published literature in Communications and Networking.
4. Present technical information in a variety of formats, including written reports and oral presentations.

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, class presentation schedules, and due dates. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

Assessment will be based on the quality of in-class presentations, written reports, and class attendance and participation. Students are expected to attend all presentations and actively participate in discussions and peer review tasks.

Exams: None.

Projects / Assignments:

1. Literature Search: Investigate a current topic in Communications and Networking using the published literature, including peer-reviewed journal papers. Summarize findings in a written report and class presentation.
2. Project: Use analysis, simulation, and/or implementation to apply Communications and Networking techniques to a problem of interest. This project could be an extension of the literature search or address a different topic.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

1. Literature Search Written Report: 15%
2. Literature Search Presentation: 10%
3. Project Progress Presentation: 10%
4. Project Written Report: 35%
5. Project Final Presentation: 20%
6. Class Attendance/Participation: 10%

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COURSE OUTLINE AND READINGS:

Week	Discussion Topic	Assignment
Week 1	Course structure and policies. Overview of topics in the field with discussion.	Select a topic for literature search, submit a one paragraph summary of the topic, including references to one or more papers that will be studied.

Week 2	Overview of topics in the field with discussion.	Study papers, work on report and presentation
Week 3	Overview of topics in the field with discussion.	
Week 4	Class presentations reporting on literature search	Submit literature search report
Week 5	Class presentations reporting on literature search	Submit 1 page project proposal
Week 6	TBD*	Work on project
Week 7	TBD	Work on project
Week 8	TBD	Work on project
Week 9	TBD	Prepare progress report for the class

Week 10	Project Progress Reports	Work on project
Week 11	Project Progress Reports	Work on project
Week 12	TBD	Work on project
Week 13	TBD	Work on project
Week 14	Project Final Presentations	Work on project
Week 15	Project Final Presentations	Submit Project Report

* TBD class meetings will vary depending on the specific needs of the class at that time. Lectures on topics related to student projects, tutorials on the use of simulation and analysis tools, general help sessions, class discussions, etc. are all possible.

University at Albany / Electrical and Computer Engineering

Advanced Linear Control Theory

ECE 680 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Aveek Dutta
Instructor Title	Assistant Professor, ECE
Office Location	Li 89A
Office hours	TBD
E-mail Address	adutta@albany.ed
TA's / Peer Educators	TBD
Prepared By	Aveek Dutta

Textbooks:

Linear Systems Theory **(required)**
J. P. Hespanha
Princeton UP
ISBN: 978-0-691-14021-6

Finite Dimensional Linear Systems **(optional)**
R. W. Brockett
SIAM Classics in Applied Mathematics, 2015
ISBN: 978-1-611-97387-7

COURSE DESCRIPTION / OVERVIEW:

This course continues the study of linear control systems. Topics include modeling, analysis, stability, structural properties, optimization, and design to meet specifications. Feedback control systems emphasizing state space techniques, optimum feedback control, and the minimum principle.

PREREQUISITES:

ECE 480/580 Linear Control Theory or permission of the instructor

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will have gained knowledge on the following topics:

- System modeling and analysis (system design, linearization, state-space models)
- System structural properties (stability, Lyapunov methods, controllability, observability, canonical forms and minimal realizations, modeling uncertainties, system sensitivity, robustness measures)
- Feedback system design (basic properties of feedback, stabilization and eigenvalue placement by state and output feedback, disturbance rejection observers for estimating states, and observer feedback systems)
- Optimum feedback control (dynamic programming and the Hamilton-Jacobi-Bellman equation, synthesis of optimum state regulator systems, numerical methods)
- Minimum principle (calculus of variations and necessary conditions for optimal trajectories, minimum principle for bounded controls, time-optimal control of linear systems, numerical methods)

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools of Control Systems in a combination of individual assignments and exams.

Exams: One midterm exam plus a final exam will be given. A portion of the class period preceding each exam will be utilized for a review session.

Projects / Assignments: Homework assignments will be assigned and will be completed out of class. It is highly recommended that computer assignments be done in Matlab - however, other programming languages (e.g. C/C++, Python) may also be acceptable with the permission of the instructor.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

30% Homework
30% Midterm Exam
35% Final Exam
5% Class Participation

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of coursework to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable._Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

Attendance/Lateness/Use of Computers in class

Students are expected to *attend every class and to arrive on time*. Please DO NOT disrupt the class by entering late or leaving early without instructor approval. Attendance will be taken at every class meeting. Each unexcused absence (one approved by either instructor prior to class) will result in a 1-point deduction from your class participation grade. Computers may be used during class for note taking as long as the use is not disruptive or distracting. Also see http://www.albany.edu/health_center/medicalexcuse.shtml.

Responsible Computing

Students are required to read the University at Albany Policy for the Responsible Use of Information Technology (http://www.albany.edu/its/policies_responsible_use_of_IT.htm). Students will be expected to apply the policies discussed in this document to all computing and electronic communications in the course.

Students With Disabilities

Reasonable accommodations will be provided for students with documented physical, sensory, systemic, cognitive, learning and psychiatric disabilities. If you believe you have a disability requiring accommodation in this class, please notify the Director of the Disability Resource Center (Campus Center 137, 442-5490). That office will provide the course instructor with verification of your disability, and will recommend appropriate accommodations. For further information refer to the University's Disclosure Statement regarding Reasonable Accommodation found at the bottom of the document at the following website: http://www.albany.edu/disability/docs/RAP.doc. This website can be reached by following the link under "Reasonable Accommodation Policy" at the following webpage

http://www.albany.edu/disability/faculty-staff.shtml.

Academic Honesty and Overall Regulations

Every student has the responsibility to become familiar with the standards of academic integrity at the University. Faculty members must specify in their syllabi information about academic integrity, and may refer students to this policy for more information. Nonetheless, student claims of ignorance, unintentional error, or personal or academic pressures cannot be excuses for violation of academic integrity. Students are responsible for familiarizing themselves with the standards and behaving accordingly, and UAlbany faculty are responsible for teaching, modeling and upholding them. Anything less undermines the worth and value of our intellectual work, and the reputation and credibility of the University at Albany degree. Plagiarism and other acts of academic dishonesty will be punished. Read the Standards of Academic Integrity and policies in the Undergraduate Bulletin

(http://www.albany.edu/undergraduate_bulletin/regulations.html).

COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
1	Course overview, Fields		
	Linear Algebra Review		
2	Vector spaces, subspaces, linear operators, range space, null space		
3	Linear operators as matrices, coordinate transformations, similarity transformations, eigenvalues and eigenvectors, diagonalization		Homework 1 Due
4	Jordan form, Cayley-Hamilton Theorem, matrix exponential, solutions to linear systems differential equations		
5	Computing the matrix exponentials		Homework 2 Due
	Solutions to linear time-varying (LTV) systems		
6	Peano-Baker Series, solutions form an n-dimensional vector space, fundamental matrices, the state transition matrix and its properties, solutions for forced systems (with a slight digression to the Leibniz rule for differentiating integrals), time varying coordinate transformations and equivalence transformations		
7	Inner products, norms, symmetric matrices, symmetric and antisymmetric parts of a matrix, quadratic forms, quadratic forms under change of coordinates, induced norms, sub-multiplicative property of the		Homework 3 Due

	induced matrix norm, positive definite matrices		
	Introduction to stability concepts		
8	BIBO stability, stability in the sense of Lyapunov, Asymptotic Stability (A.S.), Global Asymptotic Stability (G.A.S.), for LTI systems the origin is the only possible A.S. equilibrium, and A.S. implies G.A.S		
	Stability of LTI systems		
9	boundedness and stability, boundedness of solutions, boundedness for solutions in Jordan form. Lyapunov functions and Lyapunov's direct method.		Homework 4 Due
10	Lyapunov's 2nd method applied to LTI systems, the Lyapunov equation		
11	Stability subspaces, Lyapunov's first method, BIBO stability, examples		Homework 5 Due
	Controllability		
12	definition, controllability grammian, controllability for LTV systems, controllability for LTI systems, invariance w.r.t. similarity transformations		
13	Kalman controllability canonical form, Hautus-Rosenbrock and eigenvector tests for controllability		Homework 6 Due
	Observability		
14	distinguishable initial conditions, unobservable subspace, the observability Grammian, observability Grammian rank test, recovering initial state from output, duality		
15	Various applications of duality to LTI systems, transfer functions and realizations, uniqueness, minimal realizations, Markov parameters, equivalent realizations have the same Markov parameters		Homework 7 Due

16	Minimality, controllability and observability		
17	Midterm Exam		
	Feedback control		
18	controllable canonical form (CCF), pole placement for CCF case		Homework 8 Due
	Transformation to CCF, pole placement for general controllable systems, stabilization of systems that are not controllable		
	Observers		
19	Introduction to Observers, Luenberger observers, observable canonical form, observer feedback		Homework 9 Due
20	Reduced order observers, tracking and disturbance rejection		
	Optimal Control		
21	Overview of optimal control (HJB vs. PMP), discrete dynamic programming: cost, value function, principle of optimality, finite and infinite horizon problems, value iteration algorithm, computational complexity and the curse of dimensionality		Homework 10 Due
22	Formulation of the optimal control problem for continuous time systems, derivation of the HJB Equations		
23	Finding the optimal control by minimizing the Hamiltonian, sufficiency of HJB Equation, a simple scalar, linear system with quadratic cost		Homework 11 Due
24	Finite horizon LQR, the Riccati Differential Equation, HJB vs. the minimum priciple		
	Minimum Principle		
25	A first introduction to the minimum principle, including a derivation that relies		Homework 12 Due

	on the HJB equation, LQR via the minimum principle		
26	The Hamiltonian matrix, Infinite horizon LQR, the Algebraic Riccati Equation		
	Infinite horizon LQR		
27	value function, and the optimal control; Review of optimization and Lagrange multipliers		Homework 13 Due
28	Derivation of the minimum principle using Lagrange multiplier theory		
	Final Exam		

University at Albany / Electrical and Computer Engineering

Nonlinear and Adaptive Control

ECE 681 Section xxxx

Credits: 3

Term/Year

Meeting Time: TBD

This course will meet 165 minutes/week

Location: TBD

Instructor	Daphney-Stavroula Zois
Instructor Title	Assistant Professor, ECE
Office Location	Li 88A
Office hours	TBD
E-mail Address	dzois@albany.edu
TA's / Peer Educators	TBD
Prepared By	Daphney-Stavroula Zois

Textbooks:

Adaptive Control **(required)**
K. Astrom and B. Wittenmark
2nd ed., Addison-Wesley, 1994
ISBN: 978-0-201-55866-1

Robust Adaptive Control **(required)**
P. A. Ioannou and J. Sun
Prentice-Hall, 1996

The book is out of print but is downloadable from the author's website

(http://www-bcf.usc.edu/~ioannou/RobustAdaptiveBook95pdf/Robust_Adaptive_Control.pdf)

Adaptive Control Tutorial **(optional)**
P. A. Ioannou and B. Fidan
SIAM 2006
Link: http://www.siam.org/books/dc11/

Nonlinear Systems **(optional)**
H. K. Khalil
Prentice-Hall, 2002, 3rd edition
ISBN: 978-0-130-67389-3

Nonlinear and Adaptive Control Design **(optional)**
M. Krstic, I. Kanellakopoulos, P. V. Kokotovic
Wiley, New York, 1995
ISBN: 978-0-471-12732-1

COURSE DESCRIPTION / OVERVIEW:

This course introduces students to Nonlinear and Adaptive Control by teaching them basic concepts on this field. Relevant topics are:

- Design of nonlinear control systems based on stability considerations
- Lyapunov and hyperstability approaches to analysis and design of model reference adaptive systems
- Identifiers, observers, and controllers for unknown plants.

PREREQUISITES:

ECE 680 Linear Control Theory, ECE 661 Mathematical Models for Signal Processing and A MAT 370 Probability and Statistics for Engineering and the Sciences or permission or the instructor

COREQUISITES:

None

LEARNING OBJECTIVES / OUTCOMES: At the completion of the course students will have gained knowledge on the following topics:

- Lyapunov Stability and Boundedness
- Identification and Parameter Estimation
- Bayesian and Non-Bayesian Adaptive Control
- Gradient and Least Squares Schemes
- Direct and Indirect Adaptive Control
- Self Tuning Regulators, Model Reference and Pole Placement Algorithms
- Convergence, Stability and Robustness Properties

COURSE WEBSITE AND BLACKBOARD:

Blackboard will be used to provide essential course materials, the most current syllabus, and assignment documents and no separate course website will be maintained. However, this is not an online course and class attendance and participation is essential and required.

ASSESSMENT AND POLICIES:

The accomplishment of course objectives will be assessed by applying the concepts and tools of Nonlinear and Adaptive Control in a combination of individual assignments and exams.

Exams: One midterm exam plus a final exam will be given. A portion of the class period preceding each exam will be utilized for a review session.

Projects / Assignments: Homework assignments will be assigned and will be completed out of class. It is highly recommended that computer assignments be done in Matlab - however, other programming languages (e.g. C/C++, Python) may also be acceptable with the permission of the instructor.

Grading

A final grade will be determined as a weighted average of these scores using the following weights:

30% Homeworks
30% Midterm Exam
35% Final Exam
5% Class Participation

Students must complete all requirements in order to pass the course. A grade of incomplete will be given only when circumstances beyond the student's control cause a substantial amount of coursework to be unfinished by the end of the semester. Whenever possible, the student is expected to make extra efforts to prevent this situation from occurring. The instructor will be the sole judge of whether an incomplete is warranted. Final grades are computed based on the above formulas and are NOT negotiable._Per department policy, "…students may not submit additional work or be re-examined for the purpose of improving their grades once the course has been completed and final grades assigned."

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(http://www.albany.edu/undergraduate_bulletin/regulations.html).

COURSE OUTLINE AND READINGS:

The following schedule of lecture topics and reading assignments is preliminary and may be changed as the semester progresses. The final schedule and specific assignments will be provided in Blackboard. Students are expected to have read the listed material before it is covered in class.

Class	Topic	Readings	Notes
	Introduction		
1	What is nonlinear and adaptive control? What is this course about?		
2	Models for dynamic systems (state-space models, input/output models, plant parametric models)		
3			
	Stability and Boundness		
4	Input/Output Stability		Homework 1 Due
5	Lyapunov Stability		
6	Positive Real Functions and Stability		Homework 2 Due

7	Stability of LTI Feedback Systems		
	Parameter Estimation		
8	Introduction and Examples		Homework 3 Due
9	Adaptive Laws with Normalization		
10	Adaptive Laws with Projection		
11	Bilinear Parametric Model and Hybrid Adaptive Laws		Homework 4 Due
	Parameter Identifiers and Adaptive Observers		
12	Parameter Identifiers, Adaptive Observers		
13	Adaptive Observers with Auxiliary Input and Nonminimal Plant Models		Homework 5 Due
14	**Midterm**		
	Model Reference Adaptive Control		
15	Simple Direct MRAC Schemes		
16	MRC for SISO Plants		
17	Direct MRAC with Unnormalized Adaptive Laws		Homework 6 Due
18	Direct MRAC with Normalized Adaptive Laws		
19	Indirect MRAC, Relaxation of Assumptions in MRAC		Homework 7 Due
	Adaptive Pole Placement Control		
20	Simple APPC Scheme, PPC: Known Plant Parameters		
21	Indirect APPC Schemes, Hybrid APPC Schemes		Homework 8 Due
22			
23	Stabilizability Issues and Modified APPC		Homework 9 Due
	Self-Tuning Regulators		
24	Deterministic Self-Tuning Regulators		
25			Homework 10 Due
26			

27	Stochastic and Predictive Self-Tuning Regulators		
28	Practical Issues and Implementation, Commercial Products and Applications		Homework 11 Due
	Final Exam		

University at Albany / Electrical and Computer Engineering

Independent Study and Research

ECE 697 Section xxxx

Credits: 1 - 3

Term/Year

Instructor	Any ECE Faculty Member
Instructor Title	TBD
Office Location	TBD
Office hours	TBD
E-mail Address	TBD
TA's / Peer Educators	none
Prepared By	Gary J. Saulnier

COURSE DESCRIPTION / OVERVIEW:

Independent study at the graduate level under the direction of a member of the Electrical and Computer Engineering faculty. May be repeated for credit.

PREREQUISITES:

Permission of instructor and approval by the ECE Graduate Program Coordinator.

STUDENT LEARNING OUTCOMES:

At the completion of the course students be able to:

1. Independently study a topic in Electrical and Computer Engineering.
2. Read, interpret, and utilize information in the published literature in an area of Electrical and Computer Engineering.

GRADING:

Standard grading will be used (A – E). Grading criteria will be determined by the instructor and provided to the student at the start of the course.

University at Albany / Electrical and Computer Engineering

Doctoral Thesis

ECE 899 Section xxxx

Credits: 1 - 9

Term/Year

Instructor	Any ECE faculty member
Instructor Title	TBD
Office Location	TBD
Office hours	TBD
E-mail Address	TBD
TA’s / Peer Educators	none
Prepared By	Gary J. Saulnier

COURSE DESCRIPTION / OVERVIEW:

Original independent research at the master's level under the direction of a member of Electrical and Computer Engineering faculty.

PREREQUISITES:

Permission of instructor

STUDENT LEARNING OUTCOMES:

At the completion of the course students be able to:

1. Study an issue, identify and evaluate alternative actions, propose a course of action, implement a solution, and defend conclusions; and
2. Present technical information in a variety of formats, including written reports and oral presentations.

GRADING: S/U (Satisfactory/Unsatisfactory). Grading criteria will be determined by the instructor and provided to the student at the start of the course.

Appendix V: Position descriptions or announcements for faculty to-be-hired

University at Albany – SUNY

Electrical and Computer Engineering

The College of Engineering and Applied Sciences at the **University at Albany – SUNY** is seeking applicants for faculty positions (open rank) beginning Fall 2017 for its Electrical and Computer Engineering Department. Areas of particular interest include, but are not limited to, hardware and circuit design, control systems, communications, electromagnetics, RF systems, or energy sources and systems.

Applicants must have a PhD in Computer Engineering, Electrical Engineering, or a closely related discipline. For a complete job description and application procedures, visit:
https://albany.interviewexchange.com/jobofferdetails.jsp?JOBID=80892

Questions regarding the position may be addressed to eefacultysearch@albany.edu. The College of Engineering and Applied Sciences is in an exciting period of rapid expansion. The College presently includes Computer Science, Electrical and Computer Engineering, and Information Science, with Environmental and Sustainable Engineering to be established this year. For additional information on the College and its departments, please visit:
http://www.albany.edu/ceas/

Appendix VI: Evaluator Reports

External Evaluation Report

Form 2D
Version 201-08-02

SUNY The State University of New York

The External Evaluation Report is an important component of a new academic program proposal. The external evaluator's task is to examine the program proposal and related materials, visit the campus to discuss the proposal with faculty and review related instructional resources and facilities, respond to the questions in this Report form, and submit to the institution a signed report that speaks to the quality of, and need for, the proposed program. The report should aim for completeness, accuracy and objectivity.

The institution is expected to review each External Evaluation Report it receives, prepare a single institutional response to all reports, and, as appropriate, make changes to its program proposal and plan. Each separate External Evaluation Report and the Institutional Response become part of the full program proposal that the institution submits to SUNY for approval. If an external evaluation of the proposed program is required by the New York State Education Department (SED), SUNY includes the External Evaluation Reports and Institutional Response in the full proposal that it submits to SED for registration.

Institution: The University at Albany

Evaluator Name (Please print.): Scott F. Midkiff, Ph.D.

Evaluator Title and Institution: Vice President for Information Technology and Chief Information Officer, Professor of Electrical and Computer Engineering, Virginia Polytechnic Institute and State University (Virginia Tech)

Evaluator Signature: Scott F. M[signature]

Proposed Program Title: Electrical and Computer Engineering

Degree: Ph.D.

Date of evaluation: May 4, 2017

I. Program

1. Assess the program's **purpose, structure, and requirements** as well as formal mechanisms for program **administration and evaluation.** Address the program's academic rigor and intellectual coherence.

   Purpose
   The development of a Ph.D. program in electrical and computer engineering (ECE) is a natural next step in the University at Albany's goals of establishing "new academic programs to meet the high-demand employment needs of the regional, state and national economy" and to "transform the University into a highly-ranked public research institution." Almost every U.S. engineering school includes a program in electrical and computer engineering (or just electrical engineering). Thus, the creation of the Ph.D. ECE program is a very positive step from an institutional perspective. Also, the catalog description provided in the proposal communicates an appropriate purpose for a Ph.D. program in ECE at any research university.

   The proposal states five program educational objectives, summarized here as: 1) breadth; 2) depth; 3) teamwork; 4) professionalism, including communications; and 5) lifelong learning. These objectives support and are consistent with an appropriate purpose for a Ph.D. program in ECE. Breadth across the discipline and depth within the discipline ensure the rigor of the program and technical value of the degree. Development of teamwork skills, professionalism and communications skills, and lifelong learning increase the value of the Ph.D. ECE graduate to an employer and enhance the graduate's professional career.

The proposal also states five student outcomes that are expected of students upon graduation, summarized here as: 1) an in-depth and comprehensive understanding of ECE; 2) the ability to learn technical details on their own; 3) the ability to apply knowledge learned to solve technical problems; 4) the ability to study an issue, identify and evaluate alternative actions, and propose an optimal course of action; and 5) the ability to prepare technical point papers, brief seniors, and defend conclusions. These are appropriate student outcomes for a Ph.D. ECE program. The first four outcomes support the rigor of the program and the technical value of the graduate. The fifth outcome promotes the professional success of the graduate.

Structure and Requirements
The structure and requirements of the proposed Ph.D. ECE program are appropriate and consistent with those found in existing Ph.D. ECE programs. Across the M.S. and Ph.D. programs, a student is required to take 15 credits within one of the concentration areas, 6 credits of ECE courses from other areas, 6 credits of math and/or physics courses, 6 credits of other ECE or computer science courses, 6 credits of other approved classes, and at least 36 credits for the Ph.D. dissertation. The requirements ensure depth and breadth in ECE. The requirements also allow a student to broaden his or her background in a variety of other areas. The number of dissertation credit hours appropriately emphasizes the importance of dissertation research for the Ph.D. degree.

Approval of a plan of study ensures guidance to the student on how to fulfill degree requirements.

Administration
A Department of Electrical and Computer Engineering, which will evolve from the existing Department of Computer Engineering in the College of Engineering and Applied Sciences, will host the Ph.D. ECE program. Thus, there is an existing administrative structure to host the proposed program.

Evaluation
The program will evaluate the Ph.D. ECE program through a faculty committee and an external advisory board with members from academia and industry. (Also, see item 3 below.)

In addition, the program will follow the University at Albany's comprehensive graduate program review process. Every seven years, the program will prepare a self-study report. In addition, external visitors will review the program and prepare a report. The program will then submit this report and their response to the Dean of the College of Engineering and Applied Sciences, the Provost, and others.

2. Comment on the **special focus** of this program, if any, as it relates to the discipline.

Given the breadth of the discipline of electrical and computer engineering, it is wise to identify concentration areas rather than to try to support studies in all possible areas. The program is establishing four concentration areas for research and courses: 1) Communications & Networking; 2) Signal & Information Processing; 3) Computer Engineering; and 4) Integrated Circuits & Systems. These four concentration areas are clearly suitable for a program in electrical and computer engineering. They seem particularly well chosen for a department that is evolving from "computer engineering" to be a more comprehensive, and more common, "electrical and computer engineering" department. The four concentration areas are relevant to both research and professional employment. Electrical and computer engineering programs often include these concentrations. Three core classes are identified for each of the four concentration areas.

Cybersecurity is a particularly important topic in a number of academic disciplines, including electrical and computer engineering. ECE Ph.D. students will have access to cybersecurity-related courses through other programs. However, there should also be some deep technical cybersecurity content specifically for ECE students (or, perhaps, ECE and computer science students). As a recommendation, the program should consider how to include more cybersecurity content into current courses and/or to offer a course in cybersecurity that is technical and particularly relevant for ECE students.

3. Comment on the plans and expectations for **self-assessment and continuous improvement**.

The program will establish a faculty committee to evaluate the Ph.D. ECE program. The committee will assess annual outcomes and develop plans for improvement. The department has defined a set of metrics to be used in assessment that consider research productivity and quality, teaching quality, and employment and research opportunities for students.

The program will also establish an external advisory board with members from academia and industry. The advisory board will provide input on market needs and will assess skills of Ph.D. students.

The program will also follow the University at Albany's graduate program review process. Every seven years, the program will prepare a self-study report. In addition, external visitors will review the program and prepare a report. The program will then submit this report and their response to the Dean of the College of Engineering and Applied Sciences, the Provost, and others.

The university's graduate program review process already specifies a set of metrics for graduate programs. As a recommendation, the program should try to align its metrics for the Ph.D. program with metrics established at the university level.

4. Discuss **the relationship** of this program to other programs of the institution and collaboration with other institutions, and assess available support from related programs.

Collaboration with related programs is especially important for a Ph.D. program in electrical and computer engineering. The proposed Ph.D. ECE program appropriately taps into courses in the Physics, Computer Science, Mathematics, and other departments at the University at Albany.

In addition, the ECE Ph.D. program at the University at Albany has the potential to strengthen university's and the state's overall capabilities through research collaboration with other departments at the University at Albany and with other campuses in the SUNY system. The program's faculty are already building research collaborations with other departments at the University at Albany and with other institutions in New York and beyond. These collaborations have lead to collaborative research proposals and to scholarly publications.

5. What is the evidence of **need** and **demand** for the program locally, in the State, and in the field at large? What is the extent of occupational demand for graduates? What is the evidence that demand will continue?

Nationally and globally, there is strong demand for graduates at all levels, including the Ph.D., in ECE. Ph.D. ECE graduates find employment in academia, federal research laboratories, industrial research laboratories, industrial advanced technology groups, and start-ups. Growth in information technology, mobile communications, the "Internet of Things," data analytics, machine learning, and other areas depend on a robust, well-educated workforce in ECE to either directly research, design and provide these services and technologies or to provide the systems on which these services and technologies rely. While the job market may be affected by ups and downs in the economy, there is long-term growth in the demand for ECE and there is no reason to believe that this will change over the next several decades. This long-term growth in employment opportunities for Ph.D. ECE graduates is reflected in national enrollment data. Data from the American Society for Engineering Education (ASEE) show that Ph.D. enrollments in the U.S. in Fall 2015 (the most recent data available) were higher for ECE programs than for any other engineering discipline. Further, ASEE data shows that Ph.D. enrollments in ECE were the highest in 2015 for both full-time and part-time students across the reporting period of 2006-2015.

The proposal also makes the case that the University at Albany would be the only public institution in the New York Capital Region offering a graduate program in ECE. This should help differentiate the program in the region.

II. Faculty

6. **Evaluate the faculty**, individually and collectively, with regard to training, experience, research and publication, professional service, and recognition in the field.

The Ph.D. ECE program will be lead and taught by a strong group of mostly junior tenure-track faculty members and non-tenure-track lecturers (professors of practice). 11 tenured and tenure-track faculty members and two lecturers are on board, one additional tenure-track faculty member has been hired to start by fall of 2017, and a search is underway for an additional tenured or tenure-track faculty member. This number of faculty members is adequate to meet the teaching needs of the program and its four concentration areas and to be able to advise the Ph.D. ECE students.

Individually, the tenured and tenure-track faculty all have outstanding credentials and are well qualified to teach in any Ph.D. ECE program and to advise and mentor Ph.D. ECE students in their course work and research. The lecturers are all well qualified to teach in the Ph.D. ECE program and bring strong practical experience to the program.

7. **Assess the faculty in terms of number and qualifications** and **plans for future staffing**. Evaluate **faculty responsibilities** for the proposed program, taking into account their other institutional and programmatic commitments. Evaluate faculty **activity in generating funds** for research, training, facilities, equipment, etc. Discuss any **critical gaps and plans for addressing them.**

Collectively, the current faculty, including faculty joining by fall of 2017, is adequate to cover the proposed program. Teaching loads for tenured and tenure-track faculty are reasonable. Tenure-track assistant professors teach just two classes per year, which provides them with time to do research, advise graduate students, and help with department service activities. This teaching load is typical in research-focused engineering departments. However, it will be good to grow the size of the faculty to achieve the "critical mass" needed for national prominence and impact. Offering graduate degrees in ECE should allow the university to continue to hire well-qualified new faculty.

The tenured and tenure-track faculty members are very active in research and scholarship. They are also actively submitting research proposals, although with limited success to date. Securing funding takes time for a new faculty member, especially in today's highly competitive funding environment. Most of the faculty members have been at the university for less than one year.

It is observed that the vast majority of proposals are submitted to the National Science Foundation (NSF). The NSF is a good target for funding in electrical and computer engineering, but it is recommended that faculty members diversify the agencies to which they submit. Also, industrial partnerships may lead to sustained funding in some areas.

8. Evaluate credentials and involvement of **adjunct faculty** and **support personnel**.

The program does not currently use adjunct faculty. They may in the future and there should be well-qualified individuals at local companies who could serve as adjunct faculty.

The department has an administrative manager and a secretary. Two academic advisors, a director of finance, and a finance manager work for the College of Engineering and Applied Sciences and provide support to the department. The college plans to hire a graduate program advisor (see item 12). This support staff is sufficient for the current size of the program and its research activity, but will need to grow as the program and level of external research funding grows.

III. Students

9. Comment on the **student population the program seeks to serve**, and assess plans and projections for student recruitment and enrollment.

The program projects first year enrollment of 10 students, all full-time. Projected enrollment in the fifth year of the program is 30 full-time students. This seems achievable.

10. What are the prospects that recruitment efforts and admissions criteria will supply **a sufficient pool of highly qualified applicants and enrollees**?

Given that this is a new program without an established reputation, the program will need to apply resources to focus on recruiting sufficient numbers of qualified applicants. Faculty relationships are particularly important for recruiting. There is initial evidence that faculty are being successful in identifying and recruiting graduate students.

A key factor to success in recruiting will be the ability to offer financial assistance to qualified applicants. Full-time ECE Ph.D. students in the U.S. typically expect to be funded as either a teaching assistant (TA) or research assistant (RA) from the beginning of their program. A combination of resources from externally sponsored research (for RAs) and the institution (for TAs) must be available to all or almost all Ph.D. students expected to enroll in the program.

Two risks factors, present for all graduate programs, have the potential to increase the difficultly of achieving enrollment goals. First, potential reductions in federal funding for externally sponsored research may limit opportunities for faculty to obtain grants and contracts to support RAs. Second, current and potential policies that limit or discourage immigration to the U.S. by international students can reduce applications and yield on acceptances.

11. Comment on provisions for encouraging participation of **persons from underrepresented groups**. Is there adequate attention to the needs of part-time, minority, or disadvantaged students?

The program will engage with organizations at the university, state, and national levels to raise awareness of the proposed ECE graduate program and to encourage applications from underrepresented groups. Organizations cited in the proposal are the Society of Women Engineers (SWE), the National Society of Black Engineers (NSBE), the New York Society of Professional Engineers, the Women In Technology program in the College of Computing, the National Association of Multicultural Engineering Program Advocates, and the Two-Year Engineering Science Association. The college is a "platinum" sponsor the Grace Hopper Conference, which will present an outstanding opportunity to raise the program's visibility with prospective Ph.D. ECE students.

The proposal notes that half of the program's current faculty are women. This fact should increase the ability of the program to attract, retain, and graduate women from the ECE program.

The proposal states that "Electrical and computer engineering graduate programs nationwide typically attract about 40% women and about 20% underrepresented minorities." ASEE data for Fall 2015 Ph.D. enrollments in all engineering programs is 26% women and 14% from underrepresented groups (plus 9% unknown). Typically, the percentage of women in ECE programs is among the lowest for all engineering disciplines. Further, many other programs also have active programs to recruit women and students from other underrepresented groups. Achieving an enrollment of students from underrepresented groups of 25%, almost twice the national average (based on ASEE data), seems very challenging. Thus, the projections in the proposal seem too ambitious. As a recommendation, the program should review its expectations of the percentage of students from undergraduate groups to be enrolled to ensure that they are appropriate.

12. Assess the system for monitoring **students' progress and performance** and for **advising students** regarding academic and career matters.

As a first step in student success, the proposal outlines mechanisms for ensuring the quality of incoming students including international students. This includes a process to review requests for any waivers from standard admission requirements.

The college will appoint a Graduate Program Advisor to perform program administration, which will include ensuring that students address any shortcomings upon admission, that students make adequate progress toward degree completion, and that students comply with university and program requirements. Faculty advisors will be selected for longer term advising. This approach is reasonable and should provide sufficient support for student success in most cases.

13. Discuss prospects for graduates' post-completion success, whether **employment, job advancement, future study, or other outcomes related to the program's goals.**

As stated above (item 5), the long-term job prospects for Ph.D. ECE graduates should remain strong, with the possible exception of transient periods due to economic downturns. The program's emphasis on technical breadth and depth, teamwork, professionalism and communication, and lifelong learning will position graduates of the program to have long-term success as professionals in industry, government, or academia.

The proposal includes employment and salary data from the New York Department of Labor that point to growth in job opportunities for ECE graduates and prospects for good salaries. The proposal includes letters from three local employers, GLOBALFOUNDRIES, IEEE GlobalSpec, and Kitware. These letters point to the value of the University at Albany's proposed graduate ECE programs in meeting ongoing educational needs for current employees, providing future full-time workforce, and increasing the technical capabilities and vitality of the region.

IV. Resources

14. Comment on the adequacy of physical **resources** and **facilities**, e.g., library, computer, and laboratory facilities; practica and internship sites or other experiential learning opportunities, such as co-ops or service learning; and support services for the program, including use of resources outside the institution.

Resources
Based on the number of faculty and teaching loads, laboratory facilities, computing facilities, and other resources, it is clear that the university is devoting an appropriate level of resources to allow the ECE Ph.D. program to establish itself.

Computing and Laboratory Facilities

Laboratory facilities are adequate for a program of this size.

Computing facilities are very good for a program of this size. The program relies on computing facilities in its own laboratories and, increasingly, on computer systems maintained by the university's Information Technology Services (ITS) organization. A Dell graphics processing unit (GPU) cluster in the ITS data center supports a variety of research and instruction in electrical and computer engineering.

The program has access to necessary software. For example, MATLAB and associated toolboxes are available through a university-wide license.

Library
The university's library provides access to the IEEE Xplore Digital Library and the ACM Digital Library. These two sources fully meet the instructional needs of a graduate program in ECE and will fully or largely meet the needs of the associated research programs.

Internship Sites or Other Experiential Learning Opportunities
Given the demand for ECE students and the proximity of companies, there should be many opportunities for industrial co-ops for Ph.D. ECE students. Given the research collaborations of the faculty with other universities, there should also be visiting research opportunities for interested Ph.D. ECE students.

15. What is the **institution's commitment** to the program as demonstrated by the operating budget, faculty salaries, the number of faculty lines relative to student numbers and workload, and discussions about administrative support with faculty and administrators?

The University at Albany is clearly committed to creating the ECE Ph.D. program and the associated undergraduate and M.S. programs. The faculty size has ramped up quickly. Start-up funds for equipment and student support appear to be good. Salaries are competitive. The fact that the department was able to hire such strong faculty indicates that it was able to make attractive offers to faculty members.

V. Summary Comments and Additional Observations

16. Summarize the **major strengths and weaknesses** of the program as proposed with particular attention to feasibility of implementation and appropriateness of objectives for the degree offered.

Major Strengths
The program has developed a strong set of courses to offer through the Ph.D. ECE program. The courses offer the breadth and depth needed for an ECE graduate program. Three of the four concentration areas have good sets of courses available.

The program has an excellent group of new faculty to offer the program's courses and to mentor and advise students in their course work and their dissertation research. In particular, the faculty have the research activity necessary to enable a quality ECE Ph.D. program. The faculty are also active participants in creating the new department and its programs. They are enthusiastic and embrace the opportunity to create new programs.

Major Weaknesses
While the faculty are outstanding and highly energetic, they are mostly new to academia. They are all gaining experience in writing research proposals, advising students, teaching, and other responsibilities. This weakness is countered by the strong mentoring being provided by college and department leadership.

17. If applicable, particularly for graduate programs, comment on the ways that this program will make a **unique contribution** to the field, and its likelihood of achieving State, regional and/or national **prominence**.

The program has the strong potential to achieve state prominence in supporting the workforce needs of industry in the New York Capital Region. Given both the technical and professional objectives of the program and the fact that it would be the only graduate program in ECE at a state institution in the region, the program should be attractive to part-time students who are working full-time and to local students that will stay in the region to work.

Time will tell if the program can achieve national prominence, but there is clearly potential. A strategy of building within the existing four concentration areas rather than diversifying to other areas would seem to offer the best path toward national research prominence.

18. Include any **further observations** important to the evaluation of this program proposal and provide any **recommendations** for the proposed program.

Observations

Some plans have changed since the program proposal that I review was developed. These changes are all for the better. Key changes are as follows.

a) The names of the concentration areas have been changed. This change better describes the concentration areas and the new names better align with the faculty's teaching and research expertise.

b) The names of some courses have changed. These are all improvements.

c) The list of required courses for each of the four concentration areas has changed. This change better defines the core of each concentration area.

d) The graduate program is to be coordinated through a graduate program advisor (a support position) rather than through a graduate program director (a duty assigned to a faculty member). A faculty graduate committee in the department will provide oversight. Using a graduate program advisor is a very workable approach and will lead to more effective use of faculty members' time. It may be appropriate to create a graduate program director position as the number of graduate students and the number of faculty members grow.

Recommendations (all are summarized from above)
a) The University at Albany has an existing process for review of graduate programs. As a recommendation, the ECE program should try to align its metrics for the Ph.D. program with metrics established at the university level.

b) The vast majority of proposals from the faculty have been submitted to the NSF. As a recommendation, faculty members need to diversify the agencies to which they submit. Also, industrial partnerships may lead to sustained funding in selected areas.

c) Cybersecurity is an important topic in a number of academic disciplines, including electrical and computer engineering. As a recommendation, the program should consider how to include more cybersecurity content into current courses and/or to offer a course in cybersecurity that is focused on ECE students.

d) The projection for the percentage of students from underrepresented groups to be enrolled in the program seems very ambitious, perhaps too ambitious. As a recommendation, the program should review its goals for students from underrepresented groups to ensure that it is reasonable.

SUNY The State University of New York

External Reviewer Conflict of Interest Statement

I am providing an external review of the application submitted to the State University of New York by:

The University at Albany

(Name of Institution or Applicant)

The application is for (circle A **or** B below)

A) New Degree Authority

B) Registration of a new academic program by an existing institution of higher education:

Electrical and Computer Engineering – Ph.D.

(Title of Proposed Program)

I affirm that I:

1. am not a present or former employee, student, member of the governing board, owner or shareholder of, or consultant to the institution that is seeking approval for the proposed program or the entity seeking approval for new degree authority, and that I did not consult on, or help to develop, the application;

2. am not a spouse, parent, child, or sibling of any of the individuals listed above;

3. am not seeking or being sought for employment or other relationship with the institution/entity submitting the application?

4. do not have now, nor have had in the past, a relationship with the institution/entity submitting the application that might compromise my objectivity.

Name of External Reviewer (please print):

Scott F. Midkiff

Signature:

External Evaluation Report

Form 2D

Version 201-08-02

The External Evaluation Report is an important component of a new academic program proposal. The external evaluator's task is to examine the program proposal and related materials, visit the campus to discuss the proposal with faculty and review related instructional resources and facilities, respond to the questions in this Report form, and submit to the institution a signed report that speaks to the quality of, and need for, the proposed program. The report should aim for completeness, accuracy and objectivity.

The institution is expected to review each External Evaluation Report it receives, prepare a single institutional response to all reports, and, as appropriate, make changes to its program proposal and plan. Each separate External Evaluation Report and the Institutional Response become part of the full program proposal that the institution submits to SUNY for approval. If an external evaluation of the proposed program is required by the New York State Education Department (SED), SUNY includes the External Evaluation Reports and Institutional Response in the full proposal that it submits to SED for registration.

Institution: University at Albany

Evaluator Name (Please print.): Joanne Bechta Dugan

Evaluator Title and Institution: Professor of Electrical and Computer Engineering, University of Virginia

Evaluator Signature:

Proposed Program Title: Electrical and Computer Engineering

Degree: Ph.D. in Electrical and Computer Engineering

Date of evaluation: May, 2017

I. Program

1. Assess the program's **purpose, structure, and requirements** as well as formal mechanisms for program **administration and evaluation.** Address the program's academic rigor and intellectual coherence.

The proposed graduate program in Electrical and Computer Engineering builds upon and enhances the recently launched BS program in Computer Engineering and the BS program in Electrical Engineering that is currently under development. Both BS programs will be enhanced by a corresponding graduate program for several reasons: faculty who create new knowledge through active engagement in research and development help to keep an undergraduate program vibrant and relevant. Undergraduate students benefit from the research and development activities of the graduate students and faculty and many will be able to participate in research groups even while undergraduates. Active research and development faculty can develop new courses that investigate cutting-edge topics, These faculty mentor and guide graduate students to become active researchers and contributors to the technical community solving society's problems and improving our standard of living.

The structure and requirements of the Ph.D. program in Electrical and Computer Engineering is appropriate to the discipline and to the program's purpose and is well coordinated with the MS program.

The Ph.D program will be presented in a traditional in-person format and includes consideration of both depth and breadth in student learning.

Faculty have been involved in planning and developing the MS program in Electrical and Computer Engineering and appears to fully "own" it administratively and evaluatively.

2. Comment on the **special focus** of this program, if any, as it relates to the discipline.

Four concentration areas (Communications and Networking; Signal and Information Processing; Integrated Circuits and Systems; and Computer Engineering) have been defined. Each concentration area is supported by at least 5 different classes that provide depth and breadth and each represent an important topic area in the technical field. Together this set of concentration areas span the most important technical areas in electrical and computer engineering.

3. Comment on the plans and expectations for **self-assessment and continuous improvement**.

An assessment plan specifically for the Ph.D. degree is not fully formulated in the proposal that was reviewed. However, a Ph.D. program offers several points that afford assessment: the qualifying exam, the research proposal review and the dissertation defense. At the qualifying exam the program can assess readiness for research, including core knowledge, literature review, evaluation of current research in the field, consideration and evaluation of success measures, technical communication skills. At the research proposal stage the program can assess the ability to formulate a viable research plan, including problem statement and motivation, evaluation and success criteria, formulation of a research hypothesis and approaches to evaluate that hypothesis, technical communication skills. At the PhD defense, additional assessments to the earlier set could include aspects of the research itself as well as the quality and quantity of publications or other measures of impact and potential impact.

4. Discuss **the relationship** of this program to other programs of the institution and collaboration with other institutions, and assess available support from related programs.

The development of the program has benefitted from input from a team of consultants from top-notch programs, evaluation of programs at a set of peer institutions and from extensive conversations with local, state-wide and national industry. A graduate program in Electrical and Computer Engineering will complement undergrad programs in computer engineering and electrical engineering (under development) and will be an integral part of the College of Engineering and Applied Sciences. Support is available from both Physics and Computer Science; these programs have a history of effective collaboration.

5. What is the evidence of **need** and **demand** for the program locally, in the State, and in the field at large? What is the extent of occupational demand for graduates? What is the evidence that demand will continue?

The Capitol area of New York State has a demonstrated need for affordable engineering education to support both local industry and the residents of the area. Two private institutions currently serve the area at significant cost. However, there is unmet demand for engineers in this area, especially those with graduate degrees. Data in the proposal demonstrates a strong, sustained need for electrical and computer engineers across the state and the region.

II. Faculty

6. Evaluate the faculty, individually and collectively, with regard to training, experience, research and publication, professional service, and recognition in the field.

Program faculty are well-qualified, having earned the PhD degree in appropriate fields from highly regarded institutions. Many have excellent industrial experience and most are currently active researchers. Faculty who were hired in the past year form an outstanding core of collaborative researchers who are capable of making significant contributions to the field. The development of the graduate program in electrical and computer engineering will allow the faculty to grow in numbers, in expertise, in research productivity and in external recognition.

7. Assess the faculty in terms of number and qualifications and **plans for future staffing**. Evaluate **faculty responsibilities** for the proposed program, taking into account their other institutional and programmatic commitments. Evaluate faculty **activity in generating funds** for research, training, facilities, equipment, etc. Discuss any **critical gaps and plans for addressing them**.

The faculty is growing and new members will join the ranks. At the current time, there is need for new faculty but the program has plans to hire several more in the near future. As the current set of faculty is well-qualified, they will surely hold new hires to the highest standards. The faculty are largely responsible for the development and implementation of both the undergrad and graduate programs and are excited for this opportunity. The faculty are poised to develop significant research programs that are well-funded and highly productive. Their results are likely to be impactful in developing new technologies.

8. Evaluate credentials and involvement of **adjunct faculty** and **support personnel**.

Two lecturers are included on the faculty, both hold earned PhD degrees and are thus obviously qualified to teach in the program. Support personnel are highly qualified and provide value to the program.

III. Students

9. Comment on the **student population the program seeks to serve**, and assess plans and projections for student recruitment and enrollment.

The program plans to serve students who already hold BS or MS degrees in electrical and computer engineering from accredited (or equivalent) programs in the US and across the globe. Projections for student recruitment and enrollment are modest and conservative. The program should have no difficulty meeting these goals with highly qualified applicants.

10. What are the prospects that recruitment efforts and admissions criteria will supply **a sufficient pool of highly qualified applicants and enrollees**?

There is every reason to expect that there will be a large qualified pool of applicants. Similar programs across the nation turn away 10s of highly qualified applicants for every one who is accepted.

11. Comment on provisions for encouraging participation of **persons from underrepresented groups**. Is there adequate attention to the needs of part-time, minority, or disadvantaged students?

Engineering programs are striving to increase their enrollment of representatives from underrepresented groups. There is no reason to expect that this program will have significantly more or less success than programs across the nation.

12. Assess the system for monitoring **students' progress and performance** and for **advising students** regarding academic and career matters.

Faculty will be involved in academic and research advising of all graduate students (as is normal at all similar programs). Faculty efforts will be reviewed and coordinated by the appointment of a Graduate Program Director.

13. Discuss prospects for graduates' post-completion success, whether **employment, job advancement, future study, or other outcomes related to the program's goals.**

The demand for qualified electrical and computer engineers with advanced degrees, when coupled with the equality of the program being planned at UAlbany, virtually assures successful and productive research and development careers for its graduates.

IV. Resources

14. Comment on the adequacy of physical **resources** and **facilities**, e.g., library, computer, and laboratory facilities; practical and internship sites or other experiential learning opportunities, such as co-ops or service learning; and support services for the program, including use of resources outside the institution.

The University at Albany College of Engineering and Applied Science is somewhat space-limited at present, but plans are well underway for renovation of the Schuyler Building to convert it into a magnificent space for Engineering. There are excellent plans for the renovation of this building, and for expansion of the currently-allocated space in the interim period. Library, computer and lab facilities are supporting the program well.

15. What is the **institution's commitment** to the program as demonstrated by the operating budget, faculty salaries, the number of faculty lines relative to student numbers and workload, and discussions about administrative support with faculty and administrators?

The institution appears to be very strongly supportive of the program. This degree program is part of a larger vision for growing the engineering programs. The plan for developing the engineering programs is well designed and articulated and thus appears likely to succeed.

V. Summary Comments and Additional Observations

16. Summarize the **major strengths and weaknesses** of the program as proposed with particular attention to feasibility of implementation and appropriateness of objectives for the degree offered.

The strengths of the proposed program are many, from the faculty to the administration to the institution. The program is ambitious and the implementation plan is excellent. Given the people and resources currently involved in the development of the program, success appears assured (as much as success can ever be assured).

The new faculty that have brought the program to life in the past year or so are the greatest strength and promise an exciting and vibrant program that can have significant scholarly and technological impact. The new faculty is probably also the greatest vulnerability to the program; if the process of developing the program is too slow or onerous, they may feel hindered in their career development and may need to move elsewhere to establish their career paths.

17. If applicable, particularly for graduate programs, comment on the ways that this program will make a **unique contribution** to the field, and its likelihood of achieving State, regional and/or national **prominence**.

The quality and potential of the new faculty that have been brought into the program, as well as their ability to collaborate with each other and with others both inside and outside UAlbany may well result in significant contributions to the state of the art and the state of the practice in electronic and digital systems.

18. Include any **further observations** important to the evaluation of this program proposal and provide any **recommendations** for the proposed program.

The proposed curriculum structure may reveal itself to be somewhat restrictive as new faculty arrive and new research opportunities arise. The program may benefit from considering a more fluid and agile structure for the curriculum that could more easily accommodate emerging research areas.

External Reviewer Conflict of Interest Statement

I am providing an external review of the application submitted to the State University of New York by:

____

(Name of Institution or Applicant)

The application is for (circle A **or** B below) A)

New Degree Authority

B) Registration of a new academic program by an existing institution of higher education:

____

(Title of Proposed Program)

I affirm that I:

1. am not a present or former employee, student, member of the governing board, owner or shareholder of, or consultant to the institution that is seeking approval for the proposed program or the entity seeking approval for new degree authority, and that I did not consult on, or help to develop, the application;

2. am not a spouse, parent, child, or sibling of any of the individuals listed above;

3. am not seeking or being sought for employment or other relationship with the institution/entity submitting the application?

4. do not have now, nor have had in the past, a relationship with the institution/entity submitting the application that might compromise my objectivity.

Name of External Reviewer (please print):

Joanne Bechta Dugan, Ph.D.

Signature:

Appendix VII: Response to Evaluators

Evaluator Scott Midkiff's recommendations:

- Recommendation: Do not adhere strictly to the ABET process for program assessment.
  - Response: We agree. The college and department leadership is well-versed in the ABET accreditation process but realize that it does not translate effectively to a graduate program. Both evaluators recommended that we step away from using the ABET process for assessment. In following their recommendation, we now propose to follow UAlbany's Academic Program Review process which requires a self-study report and external review on a 7 year cycle. In addition, we will regularly assess the attainment of our Student Learning Outcomes and follow an ABET-like process to evaluate the assessment results and develop improvements to the program. The program proposal now reflects this approach.
- Recommendation: Diversify funding agencies.
  - Response: We agree. The Department Chair will work on supporting the faculty in diversifying their proposal activity to include a wider range of funding agencies. This expansion includes seeking non-governmental, industry funding.
- Recommendation: The department should include more cybersecurity content into courses and/or offer a course in cybersecurity that is focused on ECE students.
  - Response: We respectfully disagree. This area is covered within multiple colleges within the University at Albany, including our own. The Computer Science department offers courses in Cybersecurity and our students can take those courses. We do not recognize a need to build this into our program at this point in time.
- Recommendation: The program should review its goals for women students to ensure that it is reasonable.
  - Response: Duly noted. The program proposal now includes percentage goals that are better aligned with national statistics.

Evaluator Joanne Dugan's Recommendations:

- Recommendation: Do not adhere strictly to the ABET process for program assessment.
  - Response: We agree. The college and department leadership is well-versed in the ABET accreditation process but realize that it does not translate effectively to a graduate program. Both evaluators recommended that we step away from using the ABET process for assessment. In following their recommendation, we now propose to follow UAlbany's Academic Program Review process which requires a self-study report and external review on a 7 year cycle. In addition, we will regularly assess the attainment of our Student Learning Outcomes and follow an ABET-like process to evaluate the assessment results and develop improvements to the program. The program proposal now reflects this approach.
- Recommendation: Adjust the curriculum so that it isn't as structured.
  - Response: We agree somewhat. We believe that the proposed curriculum has the needed flexibility since we will be able to add new Concentration Areas as the faculty grows and/or research directions change. Additionally, the Technical Electives and Electives in the program enable students to explore topics through courses in emerging areas that may not fit within our official Concentration Areas. In response to the evaluator's comments, however, we did make the program

somewhat more flexible by removing the requirement that students take 3 specific courses in their depth concentration area, making it possible for students to further customize their selection of depth courses.