UNDERGRADUATE CURRICULUM CHANGE MEMO

Date: May 7, 2021

From: Dr. Michael McGarry, Department of Electrical and Computer Engineering

Through: Dr. Miguel Velez-Reyes, Chair, Department of Electrical and Computer Engineering

Through: Dr. Louis Everett, Chair, College of Engineering Curriculum Committee

Through: Dr. Norman Love, Associate Dean, College of Engineering

Through: Dr. Patricia Nava, Interim Dean, College of Engineering

To: Dr. Art Duval, Chair, Undergraduate Curriculum Committee

Proposal Title: New BS in Computer Engineering degree

We wish to establish a new degree program (BS in Computer Engineering) that will be the first of its kind within a 265-mile radius of El Paso and offer this degree at significantly lower cost compared to existing programs. There is a very strong job market demand for graduates of this program; 64 years of graduates are needed to satisfy the current job market demand.

This degree program will support our existing graduate degree programs in computer engineering. Specifically, we currently offer an MS in Computer Engineering and a PhD in Electrical and Computer Engineering; this BS degree will provide our students a complete credentialing path as a Computer Engineer.

Currently, our undergraduate students interested in computer engineering pursue the BS in Electrical Engineering degree with a concentration in Computer Engineering. This new undergraduate degree will offer those students a credential that more accurately communicates their professional preparation.

We have surveyed our students as well as potential employers. The survey data suggests there is strong demand for the BS in Computer Engineering among both of those groups.

CURRICULUM CHANGE PROPOSAL

APPROVAL PAGE

Proposal Title: New BS in Computer Engineering degree

College: Engineering **Department: Electrical and Computer Engineering**

DEPARTMENT CHAIR

I have read the enclosed proposal and approve this proposal on behalf of the department.

_____ _____

Signature **Date**

COLLEGE CURRICULUM COMMITTEE CHAIR

I have read the enclosed documents and approve the proposal on behalf of the college curriculum committee.

_____ _____

Signature **Date**

COLLEGE DEAN

I have read the enclosed documents and approve the proposal on behalf of the college. I certify that the necessary funds will be allocated by the college in support of this proposal.

_____ _____

Signature **Date**

From: Granda, Virginia D
To: Rivera, Julie A
Subject: FW: UG COECC May 14, 2021 Approved Proposals
Date: Tuesday, February 22, 2022 8:29:00 AM
Attachments: CE-BS-in-Construction-Engineering--Catalog Update.pdf
CS-Course-Prerequisites-Updates--CS-2101-CS-3350-CS-3432.pdf
ECE-BS-Comp-Engr-Propoosal.pdf
ME-Addition-of-MECH-4370-to-Solid-Mechanics-Area.pdf

Good morning Julie,

The approval was done by email.

Attached are the proposals.

Best Regards,

Virginia

Virginia Granda-Becker
Coordinator for Undergraduate Studies
and Academic Affairs

Engineering Edge Center
ENGR E-201B
The University of Texas at El Paso
500 WW. University Ave.
El Paso, TX 79968
Office: 915-747-8011
www.utep.edu/engineering/eec

-----Original Message-----
From: Granda, Virginia D
Sent: Monday, May 17, 2021 4:25 PM
To: Rivera, Julie A <jarivera6@utep.edu>
Cc: Nava, Patricia A. <pnava@utep.edu>; Everett, Louis <leverett@utep.edu>
Subject: FW: UG COECC May 14, 2021 Approved Proposals

Good afternoon Julie,

Attached are the UG proposals that were approved by our college.

Please let us know when the proposals will be discussed in the UGCC meeting.

Best Regards,

Virginia

Virginia Granda-Becker
Coordinator for Academic Affairs and Undergraduate Studies

College of Engineering
The University of Texas at El Paso
500 W. University Ave
El Paso, TX 79968
Office: (915) 747-8011
www.utep.edu/engineering/eec

-----Original Message-----
From: Nava, Patricia A.
Sent: Monday, May 17, 2021 4:03 PM
To: Granda, Virginia D <granda@utep.edu>
Subject: Re: UG COECC May 14, 2021 Approved Proposals

All are approved.

P. Nava, Ph.D.
Interim Dean
College of Engineering
University of Texas, El Paso

On May 14, 2021, at 3:17 PM, Granda, Virginia D <granda@utep.edu> wrote:

Good afternoon Dr. Nava,

Please find attached the UG proposals that were approved by our COECC and its chair.

Can you please reply letting me know if you approve these proposals?

Best Regards,

Virginia

Virginia Granda-Becker
Coordinator for Academic Affairs and Undergraduate Studies

College of Engineering
The University of Texas at El Paso
500 W. University Ave
El Paso, TX 79968
Office: (915) 747-8011
www.utep.edu/engineering/eec<http://www.utep.edu/engineering/eec>

From: Everett, Louis
Sent: Friday, May 14, 2021 3:08 PM
To: Granda, Virginia D <granda@utep.edu>
Subject: Re: UG COECC May 14, 2021 Approved Proposals

I approve these.

_____
From: Granda, Virginia D <granda@utep.edu<mailto:granda@utep.edu>>
Sent: Friday, May 14, 2021 3:07:04 PM
To: Everett, Louis <leverett@utep.edu<mailto:leverett@utep.edu>>
Subject: UG COECC May 14, 2021 Approved Proposals

Good afternoon Dr. Everett,

Attached are the UG proposals that were approved by our COECC on May 14, 2021.

Please reply if you approve these proposals as the COECC chair.

Best Regards,

Virginia

Virginia Granda-Becker
Coordinator for Academic Affairs and Undergraduate Studies

College of Engineering
The University of Texas at El Paso
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Catalog Copy

Program Name- Bachelor of Science in Computer Engineering

Program Description- Computer Engineering is the application of science to the design, implementation, and maintenance of hardware/software components of: i) computers and ii) systems that include computers (i.e., embedded systems). This program prepares students to practice Computer Engineering and enter graduate programs in various disciplines of science and engineering.

Graduates acquire core knowledge in the following areas:

a. circuits and electronics
b. software design (including data structures and algorithms)
c. digital design
d. computer architecture and organization
e. embedded systems
f. computer networks
g. signal processing
h. systems resource management

Marketable Skills

This subject matter will provide students with skills that are in high demand in the labor market, including but not limited to:

1. Software development
2. Digital design
3. Data analysis
4. Communication network design and management
5. Computer and network security analysis
6. Cybersecurity

The Program Educational objectives are:

1. Our graduates should apply their knowledge and skills to computer engineering practice or to pursue advanced education successfully as demonstrated by some of the following:
    a. Completion of certificates, graduate degrees, or professional licensing
    b. Sustained employment and/or full-time graduate school in electrical/computer engineering or related area
    c. Advancement and/or recognition in employment
2. Our graduates should demonstrate creativity, leadership and entrepreneurial thinking in the practice of engineering as demonstrated by some of the following
    a. Leadership roles in their organizations, their profession, and/or in society
    b. Effective participation in disciplinary and multidisciplinary teams

    c. Successful development and/or improvement of products, processes, and/or systems
3. Our graduates should engage successfully in professional communication as demonstrated by some of the following
    a. Publication of technical articles, engineering reports, and/or proposals
    b. Effective participation in disciplinary and multidisciplinary teams
    c. Presentation of their work at professional meetings or conferences
4. Our graduates should exhibit social and professional responsibility in the practice of engineering as demonstrated by some of the following
    a. Involvement in community service
    b. Evidence of commitment to lifelong learning
    c. Membership in professional organizations

The Student Outcomes for the program are:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Degree Requirements- The BS Degree in Computer Engineering consists of 128 semester credit hours divided into a lower division, providing diverse courses over a broad base of technical subjects, and an upper division providing more-specialized courses. The Degree culminates in a capstone design project.

Computer Engineering request for a waiver of the 120 credit-hour maximum

Summary: The BS in Computer Engineering degree program is seeking a waiver of the 120 credit-hour maximum. There are five BS degree programs in the UTEP College of Engineering (Aerospace, Civil, Electrical, Mechanical, and Metallurgical) that are 128 credit-hour programs. Most BS in Computer Engineering programs at Texas public universities require at least 126 credit-hours. Our waiver request is for the following three reasons.

1. Our program requires 128 credit-hours to meet curriculum standards outlined by our professional society (IEEE) and our accrediting agency (ABET). As a result, we cannot produce technically competent and globally competitive graduates with less than 128 credit-hours.
2. The number of credit-hours for our program is similar to peer programs in Texas.
3. We advise our students such that they are fully empowered to complete the degree program in 4 years with 128 credit-hours.

Producing technically competent and globally competitive graduates

Our degree plan was designed to meet three objectives: 1) align with the IEEE/ACM Computer Engineering Body of Knowledge (see the CE2016 curriculum guidelines published on December 15, 2016), 2) provide our students paths to specialize in areas of expertise with high industrial demand such as machine learning and information security, and 3) meet the requirements of our accrediting agency ABET. By meeting those three objectives we are able to produce graduates that are technically competent and globally competitive. The 128 credit-hour plan was required to meet those three critical objectives.

The IEEE/ACM Computer Engineering Curricula 2016 guidelines were co-produced by the professional societies for electrical engineering and computer science respectively. The guidelines were produced by a global committee consisting of constituents from industry and academia. Given the global perspective of the guidelines, we believe adhering to these guidelines makes our graduates globally competitive as their professional preparation meets global expectations.

The concentration areas in our degree plan were carefully selected to meet traditional expertise demand (e.g., digital design and embedded systems) as well as emerging expertise demand (e.g., machine learning and information security). By doing this we have empowered our graduates to be technically competent with respect to where the job market demands are.

All ABET accredited engineering programs require a minimum of 30 credit-hours in mathematics and science plus 45 credit-hours in engineering foundations. In addition, the specific program criteria for Computer Engineering requires "Breadth and Depth" on Electrical and Computer engineering topics requiring 20 more credit-hours for a total of 95 credit-hours. The Texas Core Curriculum requires 42 credit-hours but only 9 overlap with the required mathematics and science, thus adding 33 more credit-hours. The result is 128 total credit-hours to meet the requirements of our accrediting agency ABET.

Similar to credit-hours for peer programs

As can be seen in the data below for BS in Computer Engineering programs at other Texas public universities, all programs exceed 120 credit-hours. Most programs require at least 126 credit-hours (8 out of 11), and over a third require 128 credit-hours or more (4 out of 11).

Texas Tech	129 credit-hours
University of Houston	129 credit-hours
University of Houston, Clear Lake	129 credit-hours
Texas A&M	128 credit-hours
UT Dallas	126 credit-hours
UT San Antonio	126 credit-hours
UT Rio Grande Valley	126 credit-hours
Prairie View A&M	126 credit-hours
UT Austin	125 credit-hours
UT Arlington	123 credit-hours
University of North Texas	121 credit-hours

Empowering students to graduate within 4 years

Our degree plan is constructed to empower our students to complete the 128 credit-hours in 4 years. 6 out of the total 8 semesters require students to exceed 15 credit-hours; in half of those semesters the excess is only a single credit-hour and in the other half the excess is two credit-hours. The degree plan places most of those excess credit-hours in the first two years whereby students are taking 1 credit-hour labs and 4 credit-hour calculus and physics courses that produce the excess.

Texas Higher Education Coordinating Board
Texas Public General Academic and Health-Related Institutions

Proposal for a New Bachelor's or Master's Degree Program

Directions: Texas public institutions of higher education must complete this form to propose: (1) Bachelor's or Master's Degree programs in engineering; (2) Bachelor's or Master's degree programs that have an estimated cost of more than $2 million in the first five years of operation; and/or (3) Bachelor's or Master's degree programs that do not meet the certification requirements set forth in Texas Administrative Code (TAC), Title 19, Chapter 5, Subchapter C, Section 5.44 (a) (3).

Institutions should notify the Division of Academic Quality and Workforce of its intent to plan a new engineering program with a letter submitted through the Document Submission Portal prior to submission of the *Proposal for a New Bachelor's or Master's Degree Program.* The letter should include the title, degree designation, CIP code of the program, the anticipated submission date of the proposal, and a brief description of the program. Address the letter to the Assistant Commissioner of the Academic Division of Academic Quality and Workforce.

In completing the proposal, the institution should refer to the document *Standards for Bachelor's and Master's Degree Programs,* which prescribes specific requirements for new degree programs.

This form requires the signatures of: (1) the Chief Executive Officer, certifying adequacy of funding for the new program, the notification of other Texas public institutions of higher education, and adherence to Texas Education Code (TEC) Sections 61.822 through 61.823; (2) the Chief Financial Officer, certifying the accuracy of funding estimates for the new program; and (3) a member of the Board of Regents (or designee) certifying Board approval.

Contact: Division of Academic Quality and Workforce, 512-427-6200.

Administrative Information

1. Institution Name and Coordinating Board Accountability Group:

   The University of Texas at El Paso

2. Proposed Program:

   Bachelor of Science in Computer Engineering

3. Proposed CIP Code:

   14.0901.00 06

4. Semester Credit Hours Required:

   128

5. Location and Delivery of the Proposed Program:

Face-to-face to students on main campus in El Paso.

6. Administrative Unit:

Department of Electrical and Computer Engineering within the College of Engineering

7. Program Description:

Computer Engineering is the application of science to the design, implementation, and maintenance of hardware/software components of: i) computers and ii) systems that include computers (i.e., embedded systems). This program prepares students to practice Computer Engineering and enter graduate programs in various disciplines of science and engineering.

Graduates acquire core knowledge in the following areas:

a. circuits and electronics
b. software design (including data structures and algorithms)
c. digital design
d. computer architecture and organization
e. embedded systems
f. computer networks
g. signal processing
h. systems resource management

The program educational objectives are:

1. Our graduates should apply their knowledge and skills to computer engineering practice or to pursue advanced education successfully as demonstrated by some of the following:
    a. Completion of certificates, graduate degrees, or professional licensing
    b. Sustained employment and/or full-time graduate school in electrical/computer engineering or related area
    c. Advancement and/or recognition in employment
2. Our graduates should demonstrate creativity, leadership and entrepreneurial thinking in the practice of engineering as demonstrated by some of the following
    a. Leadership roles in their organizations, their profession, and/or in society
    b. Effective participation in disciplinary and multidisciplinary teams
    c. Successful development and/or improvement of products, processes, and/or systems
3. Our graduates should engage successfully in professional communication as demonstrated by some of the following
    a. Publication of technical articles, engineering reports, and/or proposals
    b. Effective participation in disciplinary and multidisciplinary teams
    c. Presentation of their work at professional meetings or conferences
4. Our graduates should exhibit social and professional responsibility in the practice of engineering as demonstrated by some of the following
    a. Involvement in community service

b. Evidence of commitment to lifelong learning
c. Membership in professional organizations

8. Proposed Implementation Date:

08/22/2022

9. Institutional and Departmental Contacts:

1. Name: Miguel Velez-Reyes

Title: Professor

E-mail: mvelezreyes@utep.edu

Phone: 915-747-5470

2. Name: Michael McGarry

Title: Associate Professor

E-mail: mpmcgarry@utep.edu

Phone: 915-747-6955

3. Name: Virgilio Gonzalez

Title: Professor of Practice

E-mail: vgonzalez3@utep.edu

Phone: 915-747-6622

10. Notification to Area Institutions:
Provide a copy of the notification sent to area institutions.
The institution proposing the new bachelor's or master's degree program must notify all public institutions of higher education within 50 miles of the teaching site of their intention to offer the program at least 30 days prior to submitting their request to the Coordinating Board. If objections occur, the proposing institution must resolve those objections prior to submitting the request to the Coordinating Board. If the proposing institution cannot resolve the objection(s), and the institution wishes to submit the proposed program, the proposing institution may request the assistance of the Assistant Commissioner of Academic Quality and Workforce to mediate the objections and determine whether the proposing institution may submit the proposed program. No new program will be approved until all objections are resolved.

Degree Plan

1st Year	Fall			Cr	Spring			Cr
	MATH	1411	Calculus I	4	MATH	1312	Calculus II	3
	ECE	1300	Intro to Electr/Comp Eng	3	ECE	2303	Digital Systems Design I	3
	ECE	1100	Lab for ECE 1300	1	ECE	2103	Lab for ECE 2303	1
	CS	1320	Computer Programming Sci/Engr	3	PHYS	2420	Introductory Mechanics	4
	RWS	1301	Rhetoric & Composition I	3	RWS	1302	Rhetoric & Composition 2	3
	UNIV	1301	Seminar/Critical Inquiry	3	HIST	1301	History of U.S. to 1865	3
	Total			**17**				**17**

2nd Year	Fall			Cr	Spring			Cr
	MATH	2326	Differential Equations	3	MATH	2313	Calculus III	3
	ECE	2301	Electric Circuits I	3	ECE	2302	Electric Circuits II	3
	ECE	2300	Software Design I	3	ECE	2102	Lab for ECE 2302	1
	CE	2326	Econ for Engrs & Scientists	3	ECE	2304	Microprocessor Systems I	3
	PHYS	2421	Introductory Electromagnetism	4	ECE	2104	Lab for ECE 2304	1
					MATH	2300	Discrete Mathematics	3
					HIST	1302	History of U.S. Since 1865	3
	Total			**16**				**17**

3rd Year	Fall			Cr	Spring			Cr
	MATH	3323	Matrix Algebra	3	ECE	3100	Junior Prof. Orientation	1
	ECE	3331	Discrete Time Signals & Sys	3	ECE	3332	Prob with App Elect/Comp Eng	3
	ECE	3341	Electronics I	3	ECE	3352	Operating System Design	3
	ECE	3141	Lab for ECE 3341	1	ECE	x3xx	***CpE Elective***	3
	ECE	3350	Software Design II	3	ECE	x1xx	***CpE Elective Lab***	1
	ECE	3351	Computer Architecture	3	ART	x3xx	*Core curriculum*	3
	Total			**16**				**14**

4th Year	Fall			Cr	Spring			Cr
		x1xx	Experiential Learning	1		x1xx	Experiential Learning	1
	ECE	4201	CpE Senior Project Lab I	2	ECE	4202	CpE Senior Project Lab II	2
	ECE	x3xx	***CpE Elective***	3	ECE	x3xx	***CpE Concentration or ECE Elective***	3
	ECE	x1xx	***CpE Elective Lab***	1	ECE	x3xx	***ECE Elective***	3
	ECE	x3xx	***CpE Concentration or ECE Elective***	3	ECE	x3xx	*ECE Elective*	3
	LPC	x3xx	*Core curriculum*	3	POLS	2311	American Gover & Politics	3
	POLS	2310	Introduction to Politics	3				
	Total			**16**				**15**

Computer Engineering (CpE) Electives with Lab

ECE	3380/3180	Intro to Communication Netwks	Lab for ECE 3380
ECE	4353/4153	Digital Systems Design II	Lab for ECE 4353
ECE	4354/4154	Microprocessor Systems II	Lab for ECE 4354

Computer Engineering (CpE) Concentrations

General computer engineering: Any two ECE 3xxx or ECE 4xxx elective courses selected with an advisor
Digital design: ECE 4353 Digital Systems Design II and ECE 4355 VLSI Design
Embedded systems: ECE 4354 Microprocessor Systems II and ECE 4353 Digital Systems Design II
Communication networks: ECE 3380 Intro to Communication Networks and ECE 4390 Special Topics
Machine learning: ECE 4360 Foundations of Deep Learning and (ECE 4361 Fuzzy Logic and Engineering or ECE 4362 Computer Vision)
Information security: ECE 4370 Introduction to Cybersecurity and ECE 4390 Special Topics

Proposed Bachelor's or Master's Degree Program Information

I. Need

A. Job Market Need

Demonstrating the need for additional graduates in the field is vital. Provide short- and long-term evidence of the need for graduates in the Texas and U.S. job markets. Cite the Bureau of Labor Statistics, Texas Workforce Commission, professional association data, and other documented data sources to create a supply/demand analysis. Institutions should be able to show how the number of new graduates produced both in Texas and nationally compares to the number of job openings that require a degree in the discipline now and in the future on both the state and national levels. The use of predictive modeling is encouraged. If the program is designed to address particular regional or state needs in addition to workforce demands, provide a detailed description.

Short-term need

Over the next decade, there will be strong demand for graduates with a BS in Computer Engineering. The job market demand for these graduates is growing and already compares very favorably to the number of annual graduates. Consequently, there is strong incentive to increase the supply of graduates with a BS in Computer Engineering.

The following occupational data from the *Texas Workforce Commission* indicates a very strong demand for occupations associated with a BS in Computer Engineering and high median salaries. In 2020 there were a total of 513 graduates of BS in Computer Engineering programs in the state of Texas, much less than the 19,272 relevant job openings in the state of Texas seen in the table below.

Occupation	**Median Salary**	**Annual Openings**
Computer and Information Research Scientists	$125,802	166
Computer Network Architects	$119,336	881
Computer Hardware Engineers	$116,721	249
Software Developer, Systems Software	$110,736	2443
Software Developer, Applications	$108,756	6322
Information Security Analysts	$104,169	823
Computer Systems Analysts	$97,901	4610
Database Administrators	$95,470	1017
Computer Programmers	$91,967	1266
Computer Occupations, all others	$90,290	1495
Total openings		**19272**

Source: https://texascareercheck.com/ExploreCareer/OccupationInfo

For a more complete job market analysis, we look at the national level. We obtain data on number of graduates from the American Society for Engineering Education (ASEE) and data on number of job openings from the Bureau of Labor Statistics (BLS).

National job market analysis

Supply side:

Degree	2018 Graduates (from ASEE)
BS in Computer Engineering	7906
BS in Computer Science (in Eng.)	19082
BS in Computer Science (outside Eng.)	10398
MS in Computer Engineering	2995
MS in Computer Science (in Eng.)	10946
MS in Computer Science (outside Eng.)	6094
Total relevant graduates	**57421**

Source: https://ira.asee.org/wp-content/uploads/2019/07/2018-Engineering-by-Numbers-Engineering-Statistics-UPDATED-15-July-2019.pdf

Demand side:

Occupation	Number of jobs, 2019 (from BLS)	10-year job growth outlook (from BLS)	10-year increase in jobs
Computer Hardware Engineers	71,100	2%	+1,422
Computer and Information Research Scientists	32,700	15%	+4,905
Computer and Information Systems Managers	461,000	10%	+46,100
Computer Network Architects	160,100	5%	+8,005
Computer Programmers	213,900	-9%	-19,251
Computer Systems Analysts	632,400	7%	+44,268
Database Administrators	132,500	10%	+13,250
Information Security Analysts	131,000	31%	+40,610
Network and Computer Systems Administrators	373,900	4%	+14,956
Software Developers	1,469,200	22%	+323,224
Total relevant jobs	**3,677,800**		**+477,489**

Source: https://www.bls.gov/ooh/computer-and-information-technology/home.htm *and* https://www.bls.gov/ooh/architecture-and-engineering/home.htm

The ratio of total jobs to total annual graduates is just over 64 to 1. We would need just

over 64 years of BS and MS graduates to provide the necessary supply; much longer than the typical career span. This analysis does not consider other degrees whose graduates could possibly fill these positions (e.g., electrical engineering, mathematics and physics). However, there are plenty of job opportunities for relevant graduates to obviate the need to consider other possible degree programs whose graduates may compete for these jobs.

Job growth

We show the job growth outlook from the BLS in the demand side table above; here we outline a few points.

According to the BLS *"Software developers and software quality assurance analysts and testers"* will see a 21.5% increase in employment during the period 2019 to 2029. This occupation will have the second highest median income, see https://www.bls.gov/emp/tables/occupations-most-job-growth.htm.

The BLS also reports that *"Information security analysts"*, and *"Data scientists and mathematical science occupations, all other"* will see over 30% job growth over that same period, see https://www.bls.gov/emp/tables/fastest-growing-occupations.htm.

Lastly, the BLS reports that *"Computer hardware engineers"* will see 3.1% job growth from 2014 to 2024 and median annual salaries higher than all other engineering occupations except *"Petroleum engineering"*, see https://www.bls.gov/opub/ted/2016/employment-outlook-for-engineering-occupations-to-2024.htm. The ASEE reports that *"Computer hardware engineers"* will see 6% job growth from 2018 to 2028, see http://www.asee-prism.org/wp-content/uploads/2020/01/Databytes.pdf.

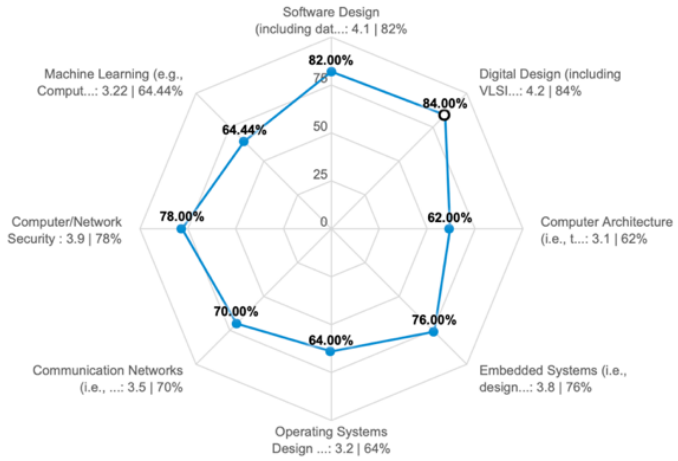
Research funding

The ASEE also reports that federal funding for research in the area of Computer Engineering increased 15.9% from 2017 to 2018 providing a promising outlook for Computer Engineers that will pursue academic research careers, see https://ira.asee.org/federal-research-funding-by-engineering-discipline-in-2018/

Employer demand survey

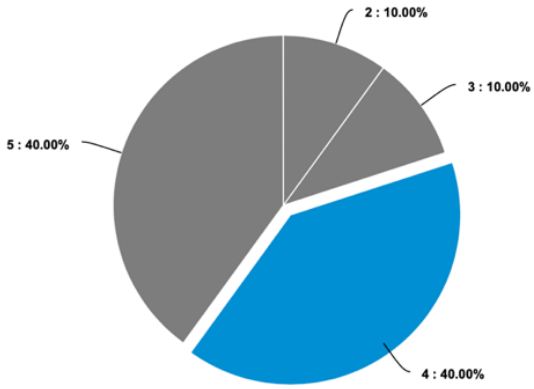
We conducted a survey of several employers of our graduates to understand their interest in hiring graduates with a BS in Computer Engineering. The survey was administered and analyzed using Question Pro. 80% of respondents expressed a strong interest in the program, 100% expressed some interest. We were also able to determine the sub-topics of most interest to potential employers: software design, digital design, computer/network security, and embedded systems.

Rate how valuable the following expertise is among members of the engineering team of your organization (now or in the future) on a scale from 1 to 5 (with 5 being most valuable):



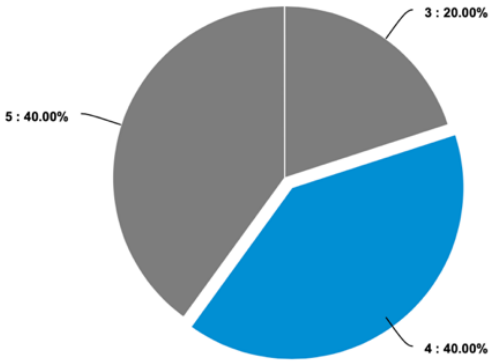
Powered by AI

A BS in Computer Engineering provides a clear credential reflecting expertise in those subjects listed above. As such, it will help me identify candidates for specific open positions on my engineering team. Rate how much you agree with this statement (5 strongly agree, 4 agree, 3 neutral, 2 disagree and 1 strongly disagree).



Answer	Count	Percent	20%	40%	60%
1	0	0%			
2	1	10%			
3	1	10%			
4	4	40%			
5	4	40%			
Total	**10**	**100%**			

Rate your interest in seeing a BS in Computer Engineering offered at UTEP to provide a pool of students that would be recruited by the engineering team of your organization. (with 5 being very interested).



Answer	Count	Percent	20%	40%	60%
1	0	0%			
2	0	0%			
3	2	20%			
4	4	40%			
5	4	40%			
Total	10	100%			

Long-term need

From the BLS data above, we see an increase in jobs of 477,489 over the next decade. If graduation numbers stay the same, there will be 574,210 graduates over that same time period. The supply will exceed the new demand but not account for workers retiring from the job market. Additionally, we believe new jobs and growth will be created that the BLS has not accounted for due to long-term industrial trends that favor the skill sets of computer engineers.

There are ***two long-term trends*** framed by the 4th Industrial Revolution or Second Machine Age that will drive long-term demand for computer engineers; see "The Second Machine Age: Work, progress, and prosperity in a time of brilliant technologies" by Brynjolfsson and McAfee.

First, the increasing *proliferation of computing devices and their constituent software* will drive sustained demand for computer engineers to design the hardware and software of these computing systems. These computing devices and software will be: a) *dispersed in every-day objects* (driven by exponential advancements in reduced cost, size, and power consumption) and b) *consolidated in data centers* (driven by economies of scale and supply elasticity).

Second, the consistently *increasing instrumentation of the world around us and its subsequent data generation* will create vast data science (including machine learning) opportunities where computer engineers can apply algorithms for data analysis tasks.

These two long-term trends will result in sustained high demand for computer engineers and consequent high median salaries within industry, government, and academic organizations for the foreseeable future.

B. Existing Programs

The information provided indicates knowledge of existing programs in Texas and of high-ranking programs nationally. This section provides an understanding of program duplication, capacity, and quality. Identify all existing degree programs in the state, include those specific to the region and major programs at peer institutions across the nation. Peer institutions have similar missions, programs, and research expenditures. Peer institutions include, but are not limited to, out-of-state peer groups identified in the Coordinating Board's Accountability System.

Identify the existing programs and their locations in Texas. Provide enrollments and graduates of these programs for the last five years, and explain how the proposed program would not unnecessarily duplicate existing or similar programs in Texas. Provide evidence that existing Texas programs are at or near capacity and describe how the existing programs are not meeting current workforce needs. Provide the job placement of existing Texas programs.

Include an assessment of capacity to accept additional students in existing Texas programs. One indicator of capacity is the faculty-to-student ratio in existing programs in the discipline. Another indicator is the number of students admitted to a program in comparison to the number of qualified applicants.

There are two primary reasons our program does not unnecessarily duplicate existing or similar programs:

Reason 1: *Existing programs are too far from the El Paso market*
Texas Tech University provides the only BS in Computer Engineering within 500 miles of El Paso within the state of Texas; 345 miles away. The University of New Mexico provides the same degree and the University of Arizona provides a combined BS in Electrical and Computer Engineering closer than Texas Tech at 265 miles away and 316 miles away respectively.

Reason 2: *We provide lower cost of attendance compared to existing programs*
UTEP annual total cost of attendance is $19,252 compared to $27,156 for Texas Tech. Out-of-state tuition rates are much higher; e.g., UNM total cost of attendance is $40,204. With a per-capita income of $21,683 according to the US Census Bureau (see https://www.census.gov/quickfacts/fact/table/elpasocountytexas/PST040219), many of the residents of the region have financial limitations that will suppress their ability to

attend programs out of the area and/or at out-of-state tuition rates. Staying in the region can allow students to be commuters that will further lower their cost of attendance.

The closest BS in Computer Engineering program (at the University of New Mexico) is 265 miles away and is out-of-state. The closest in-state program (at Texas Tech University) is 345 miles away. For this reason, we believe many students that need or want to stay in the region consider a BS in Electrical Engineering or a BS in Computer Science. Those degrees have some overlap with the BS in Computer Engineering but do not provide the same breadth and depth in the integrations between hardware, software, and communication networks. The proposed program will offer the students an option more closely matching their interests. *Due to the existing programs being very far from the El Paso market, we omit an analysis of capacity to accept additional students in existing programs.*

This program adds significant value to our department for the following reason:

A BS in Computer Engineering supports our other degree offerings and provides a natural pipeline to graduate degree offerings in the department
We are a Department of Electrical and Computer Engineering that offers a BS in Electrical Engineering, an MS in Electrical Engineering, an MS in Computer Engineering, and a PhD in Electrical and Computer Engineering. A BS in Computer Engineering perfectly completes our degree offerings and provides an appropriate set of graduates to enter our existing MS in Computer Engineering program.

This program adds significant value to national efforts to diversify the STEM workforce for the following reason:

This program can increase the representation of Hispanics in the computing workforce
According to the Pew Research Center, Hispanics represent 17% of the general workforce but 8% of the computing workforce; this imbalance needs to be corrected. Offering this undergraduate degree program in the El Paso region, which has a large proportion of Hispanic residents (over 80% of the population), will very likely increase the number of Hispanic graduates with a computing-related degree subsequently prepared to participate in the computing workforce. See https://www.pewresearch.org/science/2021/04/01/stem-jobs-see-uneven-progress-in-increasing-gender-racial-and-ethnic-diversity/.

This program has other benefits:

This program can potentially become only the third Texas BS in Computer Engineering program to appear in the Top 50 degree producing schools
Our projections indicate we will produce 49 graduates by Year 5 of the program, this will likely place us within the Top 50 BS in Computer Engineering degree producers. The only Texas programs currently on that list are UT Dallas and the University of North Texas. See https://ira.asee.org/wp-content/uploads/2019/07/2018-Engineering-by-Numbers-Engineering-Statistics-UPDATED-15-July-2019.pdf

Lastly, it is worth noting that this program should be preferred to online programs among students in the region. Our local student population has expressed a strong preference for in-person face-to-face instruction over online instruction; as indicated in an internal survey recently conducted.

Below we list all of the ABET accredited BS in Computer Engineering programs in the states of Texas, New Mexico, and Arizona. UNM is closer to El Paso than any Texas university. Texas Tech is the only university in Texas that is closer to El Paso than the universities in Arizona. Obtaining data on all of the programs we list across the 3 states was not practical. Therefore, we focused our data collection on the most relevant existing programs: *University of New Mexico, Texas Tech University, and Arizona State University*. Data was obtained through UTEP's Center for Institutional Evaluation, Research, and Planning (CIERP); not all desired data was attainable.

List of existing ABET accredited BS in Computer Engineering programs (in ascending distance from El Paso, TX):

University of New Mexico (BS in Computer Engineering) in Albuquerque, NM
UNM is located 265 miles from El Paso, TX.

	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
Enrollment	N/A	65	82	75	75
Graduates	28	22	26	22	N/A

Texas Tech University (BS in Computer Engineering) in Lubbock
Texas Tech is located 345 miles from El Paso, TX.

	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
Enrollment	54	57	77	96	115
Graduates	19	22	23	38	N/A

Arizona State University (BS in Computer Systems Engineering) in Tempe, AZ
ASU is located 423 miles from El Paso, TX.

	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
Enrollment	374	412	446	412	436
Graduates	69	78	80	87	N/A

Northern Arizona University (BS in Computer Systems Engineering) in Flagstaff, AZ
NAU is located 517 miles from El Paso, TX.

The University of Texas at San Antonio (BS in Computer Engineering) in San Antonio
UTSA is located 550 miles from El Paso, TX.

St. Mary's University (BS in Computer Engineering) in San Antonio
St. Mary's is located 550 miles from El Paso, TX.

The University of Texas Austin (BS in Electrical Engineering with Computer Engineering program of study) in Austin
UT Austin is located 575 miles from El Paso.

Baylor University (BS in Electrical and Computer Engineering) in Waco
Baylor is located 615 miles from El Paso, TX.

The University of Texas Arlington (BS in Computer Engineering) in Arlington
UT Arlington is located 618 miles from El Paso, TX.

The University of Texas Dallas (BS in Computer Engineering) in Dallas
UT Dallas is located 635 miles from El Paso, TX.

Southern Methodist University (BS in Computer Engineering) in Dallas
SMU is located 635 miles from El Paso, TX.

University of North Texas (BS in Computer Engineering) in Denton
UNT is located 640 miles from El Paso, TX.

Texas A&M University (BS in Computer Engineering) in College Station
Texas A&M is located 680 miles from El Paso, TX.

Prairie View A&M University (BS in Computer Engineering) in Prairie View
Prairie View A&M is located 690 miles from El Paso, TX.

University of Houston (BS in Computer Engineering) in Houston
UH is located 745 miles from El Paso, TX.

University of Houston Clear-Lake (BS in Computer Engineering) in Houston
UH Clear Lake is located 745 miles from El Paso, TX.

The University of Texas Rio Grande Valley (BS in Computer Engineering) in Edinburg
UTRGV is located 780 miles from El Paso, TX.

C. Student Demand

Provide short- and long-term evidence of student demand for the proposed program. Types of data commonly used to demonstrate this include increased enrollment in related and feeder programs at the institution, high enrollment in similar programs at other institutions, qualified applicants rejected at similar programs in the state, and student surveys (if used, include data collection and analysis methods). Surveying students currently enrolled in feeder programs provides limited data about actual student demand. Information that demonstrates student interest includes the development of a student interest group. Provide documentation that qualified applicants are leaving Texas for similar programs in other states.

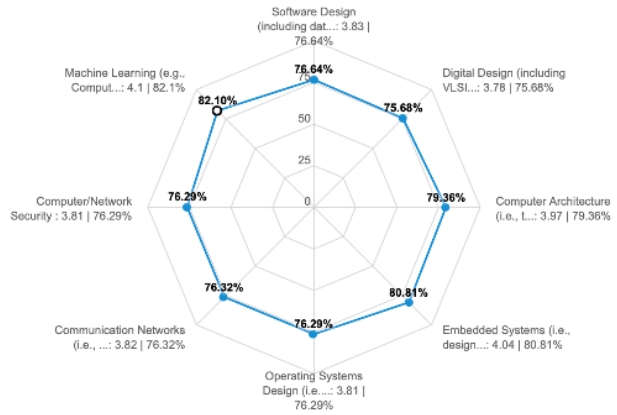
Short-term demand

Abundant employment opportunities, high salaries, and outstanding career opportunities will drive student demand for the BS in Computer Engineering. Offering this degree in El Paso will generate demand from regional students that were interested in Computer Engineering but either selected a related degree (Electrical Engineering or Computer Science) at UTEP or chose to leave the region to pursue that degree.

According to the American Society for Engineering Education (ASEE) the growth of undergraduates in Computer Engineering from 2014 to 2018 was a staggering 83.2% (see https://ira.asee.org/growth-in-engineering-degrees-by-discipline-2014-2018/). This can be primarily attributed to significant industrial demand for graduates with a BS in Computer Engineering; *see our job market analysis above*.

For a localized view of student demand, we conducted a survey of our undergraduate students. The survey was administered and analyzed using Question Pro. The survey assessed student interest in Computer Engineering subject matter and their interest in a BS program to provide them with precise credentials reflecting knowledge of the related subject matter. We found that 77% of respondents were strongly interested in a BS in Computer Engineering (a score of 4 or higher on a scale from 1 to 5) and 88% of respondents had some interest (a score of 3 or higher).

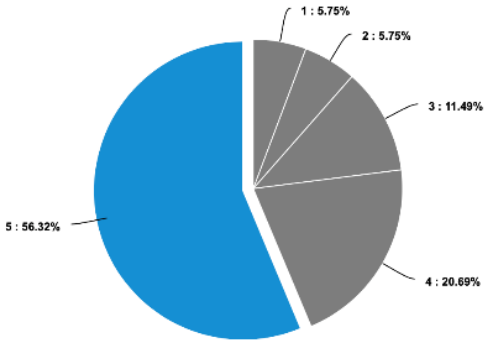
Rate your interest in the following subjects on a scale from 1 to 5 (with 5 being most interested)



Powered by AI

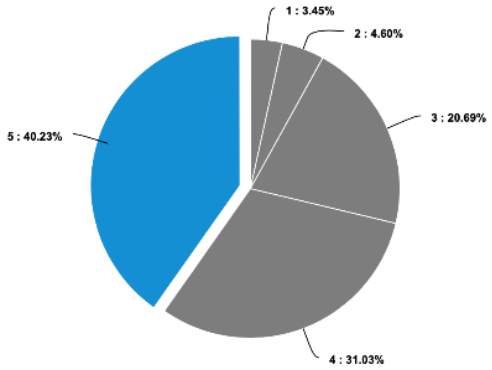
Question	Count	Score
Software Design (including data structures and algorithms)	125	3.83
Digital Design (including VLSI design)	125	3.78
Computer Architecture (i.e., the design of microprocessors)	125	3.97
Embedded Systems (i.e., designing broader systems that include microprocessors)	124	4.04
Operating Systems Design (i.e., designing the software that manages a computer's resources)	124	3.81
Communication Networks (i.e., the Internet)	125	3.82
Computer/Network Security	124	3.81
Machine Learning (e.g., Computer Vision, Self-Driving Cars)	124	4.1
Average		**3.89**

A BS in Computer Engineering will provide you a clear credential reflecting expertise in those subjects listed above. Rate your interest in earning a BS in Computer Engineering on a scale from 1 to 5 (with 5 being most interested).



Answer	Count	Percent
1	5	5.75%
2	5	5.75%
3	10	11.49%
4	18	20.69%
5	49	56.32%
Total	**87**	**100%**

On a scale from 1 to 5, what is your perception on the career opportunities available with a Bachelor of Science in Computer Engineering? (with 5 being the most opportunities available)



Answer	Count	Percent
1	3	3.45%
2	4	4.6%
3	18	20.69%
4	27	31.03%
5	35	40.23%
Total	87	100%

Long-term demand
Continued abundant employment opportunities, and very high median salaries (e.g., $126,000 for computer and information research scientists), will drive long-term student demand for a BS in Computer Engineering. The BLS data above shows nearly a half million new relevant jobs created over the next 10 years; a 13% increase. We also anticipate new jobs to be created that are not accounted for by the BLS; creating even more employment opportunities.

D. Enrollment Projections

Enrollment projections are realistic and based on demonstrable student demand. Projections take into account student attrition, graduation rates, and part-time students. Attrition calculations should be based upon the average rates of related supporting graduate programs at the institution, if available.

Complete Table 1 to show the estimated cumulative headcount and full-time student equivalent (FTSE) enrollment for the first five years of the proposed program. Include summer enrollments, if relevant, in the same year as fall enrollments. Subtract students as necessary for projected graduations or attrition. Provide explanations of how headcounts, FTSE numbers, and attrition were determined. Define full-time and part-time status.

Table 1. Enrollment Projections (New Students to UTEP)

	Year 1	Year 2	Year 3	Year 4	Year 5
Total New Students	**20**	**23**	**27**	**31**	**36**
Attrition	0	0	8	12	13
Cumulative Headcount	**20**	**43**	**62**	**81**	**94**
FTSE	18	39	56	73	86
Graduates	0	0	0	10	11

Our conversion enrollment projections (see Table 1b below), for students selecting this program over our BS in Electrical Engineering at UTEP, use the maximum enrollment in a single course across our Computer Engineering elective courses in a year for the last 5 years. This data measures students in our department that have strong interest in Computer Engineering and that we expect to enroll in the BS in Computer Engineering program. We fit that data to a linear model and used that model to predict incoming cohorts through 2026. For our attrition model we used historic department-wide enrollment data for key courses. Our data shows that 38% of students drop after the 2nd year, 21% of the remaining drop after the 3rd year, after the 4th year and beyond there is no attrition. We assumed students graduate after 4 years. We also assume 90% of students are full-time. We do not consider students that convert from programs other than our BSEE. To estimate new students to the program that are not conversions from other UTEP programs, we assumed an initial cohort of 20 students and a modest 15% annual enrollment growth rate.

Table 1b. Conversion Enrollment Projections (Students converting from BSEE)

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Converted Students	**72**	**78**	**84**	**90**	**96**
Attrition	0	0	27	39	42
Cumulative Headcount	**72**	**150**	**207**	**258**	**276**
FTSE	65	135	186	232	248
Graduates	0	0	0	35	38

E. Student Recruitment

Plans to recruit students are realistic and based on evidence of student demand and unmet need in similar programs in Texas. Indicate if the proposed program and its discipline are projected to have a special attraction for students of a particular population. Describe general recruitment efforts and admission requirements. Describe plans to recruit, retain, and graduate students from underrepresented groups to the proposed program.

We will leverage UTEP undergraduate recruiters in Texas, the Southwest, and Southern California for recruitment. Our program will be the only BS in Computer Engineering within 265 miles of El Paso, TX thereby providing us an advantage to recruit students interested in this specific degree that prefer to stay in the region.

We will use our senior project demonstrations from students in this proposed program as an outreach activity to students from local high schools. These demonstrations will showcase the design students with a BS in Computer Engineering are capable of as they

near graduation. Further, we will partner with our IEEE Women in Engineering chapter to create other outreach activities that exhibit the talents of our BS in Computer Engineering students.

UTEP's Office of Admissions and Recruitment utilizes the following strategies for student recruitment that will be leveraged for the proposed program:

- Application assistance offered at each high school in the region
- Financial aid assistance offered at each high school in the region including information on tuition promise program for families whose Adjusted Gross Income is $50,000 or less
- Increase collaboration with federally-funded outreach programs (including TRIO programs)
- Targeted recruitment events on the UTEP campus including Orange and Blue Day (UTEP's Open House)
- Expand undergraduate recruitment into new recruitment territories while continuing to target historically underserved students
- Strategic partnerships with area school districts including events for area counselors and administrators, on-site enrollment events at high schools, and memorandums of understanding that allow exchange of student information
- Comprehensive multi-modal communication strategies involving social media, print media, personalized email, text messaging, and live calling campaigns
- Enhance the existing communication strategy to include earlier communication with prospective students, targeted parent communication, and varied communication for prospective transfer students
- Strategic use of student-to-student communication

We will provide UTEP's Office of Admissions and Recruitment with program materials that can be distributed to prospective students.

II. Quality

A. Degree Requirements

Describe the similarities and differences between the proposed program and peer programs in Texas and nationally. Provide a justification if the program requires more than 120 semester credit hours for a bachelor's degree. Acceptable justifications may include program accreditation requirements, statutory requirements, and/or licensure/certification requirements that cannot be met without exceeding 120 SCH.

Complete Table 2 to show the degree requirements of the proposed program. Show semester credit hours (SCH) and clock hours (if applicable). Modify the table as needed. If necessary, replicate the table to show more than one option.

Table 2. Semester Credit Hour Requirements by Category

Category	Semester Credit Hours	Clock Hours
General Education Core Curriculum *(Bachelor's degree program only)*	42	
Required Courses	64	
Prescribed Electives	14	
Electives	8	
Other *(Specify, e.g., internships, clinical work)*	(if not included above)	
TOTAL	**128**	

Note: Bachelor's degree programs should not exceed 120 SCHs. Bachelor's degree programs that exceed 120 SCH must provide detailed documentation describing the compelling academic reason for the number of required hours, such as program accreditation requirements, statutory requirements, and/or licensure/certification requirements that cannot be met without exceeding 120 SCH.

Our program has been aligned very closely with the IEEE/ACM (i.e., relevant professional societies) Computer Engineering Curricula 2016 guidelines for undergraduate computer engineering programs. This alignment ensures our program is similar to other programs, not just nationally but internationally.

The program will be accredited by ABET, similarly to all other engineering programs at UTEP. The credit requirements are the same as the Electrical Engineering program and our current B.S.E.E. requires 128 credits to comply with accreditation. The differences between Computer Engineering and Electrical Engineering reside within the engineering topics specialization focus, the prescribed discrete mathematics, and the depth in computer engineering-related subject matter.

Below is an excerpt from the ABET program criteria for Computer Engineering. The ABET portal has the full accreditation criteria: https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2020-2021/

PROGRAM CRITERIA FOR ELECTRICAL, COMPUTER, COMMUNICATIONS, TELECOMMUNICATION(S) AND SIMILARLY NAMED ENGINEERING PROGRAMS

Lead Society: Institute of Electrical and Electronics Engineers Cooperating Society for Computer Engineering Programs: CSAB

These program criteria apply to engineering programs that include "electrical," "electronic(s)," "computer," "communication(s)," telecommunication(s), or similar modifiers in their titles.

1 Curriculum

The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program.

The curriculum must include probability and statistics, including applications appropriate to the program name; mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); and engineering topics (including computing science) necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.

The curriculum for programs containing the modifier "electrical," "electronic(s)," "communication(s)," or "telecommunication(s)" in the title must include advanced mathematics, such as differential equations, linear algebra, complex variables, and discrete mathematics.

	The curriculum for programs containing the modifier "computer" in the title must include discrete mathematics. The curriculum for programs containing the modifier "communication(s)" or "telecommunication(s)" in the title must include topics in communication theory and systems. The curriculum for programs containing the modifier "telecommunication(s)" must include design and operation of telecommunication networks for services such as voice, data, image, and video transport.

B. Curriculum

Describe the educational objectives of the proposed program. For the description of educational objectives, distinguish between aspects of the curriculum that are standard for the field and aspects that would be unique to the proposed program.

If the proposed program has a unique focus or niche, describe it in relationship to peer programs. Indicate how the niche or specialties of the proposed program are appropriate for the job market and student demand, and describe how they complement other peer programs in the state (or nation, if relevant).

Describe how the proposed program would achieve national prominence. Indicate if the proposed program is designed to have a particular regional focus.

Provide an explanation of required, prescribed, and elective courses and how they fulfill program requirements.

Describe policies for transfer of credit, course credit by examination, credit for professional experience, placing out of courses, and any accelerated advancement to degree. Provide a plan that would allow a student entering with relevant work experience to rapidly progress through the program or provide an explanation why this would not apply.

Identify any alternative learning strategies, such as competency-based education, that may increase efficiency in student progress in the curriculum. If no such policies are in place to improve student progression through a program, provide an explanation.

Complete Tables 3, 4, and 5 to list the required/core courses, prescribed elective courses, and elective courses of the proposed program and semester credit hours (SCH). Note with an asterisk (*) courses that would be added if the proposed program is approved. Modify the tables as needed. If applicable, replicate the tables for different tracks/options.

Our program has been designed to meet the Texas Core Curriculum and is aligned very closely with the IEEE/ACM (i.e., the relevant professional societies) Computer Engineering Curricula 2016 guidelines for undergraduate computer engineering programs. The required, prescribed, and elective courses are all selected for those design objectives. The alignment of our program with the Computer Engineering Curricula 2016 guidelines makes our program similar to other programs, not just

nationally but internationally. The program will be standard for the field without any specific focus.

Our projections indicate we will produce 49 graduates by Year 5 of the program, this will likely place us within the Top 50 BS in Computer Engineering degree producers; giving our program national prominence. The only Texas programs currently on that list are UT Dallas and the University of North Texas.

The program educational objectives are:

1. Our graduates should apply their knowledge and skills to computer engineering practice or to pursue advanced education successfully as demonstrated by some of the following:
    a. Completion of certificates, graduate degrees, or professional licensing
    b. Sustained employment and/or full-time graduate school in electrical/computer engineering or related area
    c. Advancement and/or recognition in employment
2. Our graduates should demonstrate creativity, leadership and entrepreneurial thinking in the practice of engineering as demonstrated by some of the following
    a. Leadership roles in their organizations, their profession, and/or in society
    b. Effective participation in disciplinary and multidisciplinary teams
    c. Successful development and/or improvement of products, processes, and/or systems
3. Our graduates should engage successfully in professional communication as demonstrated by some of the following
    a. Publication of technical articles, engineering reports, and/or proposals
    b. Effective participation in disciplinary and multidisciplinary teams
    c. Presentation of their work at professional meetings or conferences
4. Our graduates should exhibit social and professional responsibility in the practice of engineering as demonstrated by some of the following
    a. Involvement in community service
    b. Evidence of commitment to lifelong learning
    c. Membership in professional organizations

Students will have the following outcomes upon completion of the program:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Policies:
A transfer student's previous coursework is evaluated by comparing UTEP courses to descriptions of courses at previous universities/colleges. At times, the equivalence is not fully clear from the latter, an exam may be given by a professor that teaches the UTEP course to ascertain equivalence. Where similarities are sufficient, substitution credit for an equivalent UTEP course is allowed and recorded on UTEP transcripts. Credit for professional experience is not generally possible, but via an examination a student may be able to show sufficient knowledge to get credit for a course upon paying required tuition/fees but not needing to complete other aspects of a course. Continuing or New students are advised every semester by the departmental program advisor to assist the student in selecting a subsequent semester's courses.

Table 3. Required/Core Courses

Prefix and Number	Required/Core Course Title	SCH
MATH 1411	Calculus I	4 (1 beyond Core)
ECE 1300	Intro to Electr/Comp Engineer	3
ECE 1100	Lab for ECE 1300	1
MATH 1312	Calculus II	3
ECE 2303	Digital Systems Design I	3
ECE 2103	Lab for ECE 2303	1
PHYS 2420	Introductory Mechanics	4 (1 beyond Core)
MATH 2326	Differential Equations	3
ECE 2301	Electric Circuits I	3
ECE 2300	Software Design I	3
PHYS 2421	Introductory Electromagnetism	4 (1 beyond Core)
MATH 2313	Calculus III	3
ECE 2302	Electric Circuits II	3
ECE 2102	Lab for ECE 2302	1
ECE 2304	Microprocessor Systems I	3
ECE 2104	Lab for ECE 2304	1
MATH 2300	Discrete Mathematics	3
MATH 3323	Matrix Algebra	3
ECE 3331	Discrete Time Signals & Sys	3
ECE 3341	Electronics I	3
ECE 3141	Lab for ECE 3341	1
ECE 3350	Software Design II	3
ECE 3351	Computer Architecture	3
ECE 3100	Junior Prof. Orientation	1
ECE 3332	Prob with App Elect/Comp Eng	3
ECE 3352	Operating System Design	3
ECE 4201	CpE Senior Project Lab I	2
ECE 4202	CpE Senior Project Lab II	2

Table 4. Prescribed Elective Courses

Prefix and Number	Prescribed Elective Course Title	SCH
	Select Two Computer Engineering Electives with Lab	**8**
ECE 3380	Intro to Communication Netwks	3
ECE 3180	Lab for ECE 3380	1
ECE 4353	Digital Systems Design II	3
ECE 4153	Lab for ECE 4353	1
ECE 4354	Microprocessor Systems II	3
ECE 4154	Lab for ECE 4354	1
	Students must select one of the following 6 credit concentrations.	
	General Computer Engineering concentration	**6**
ECE 33xx or ECE 43xx	ECE Elective with advisor approval	3
ECE 33xx or ECE 43xx	ECE Elective with advisor approval	3
	Digital design concentration	**6**
ECE 4353 **OR** (ECE 33xx or ECE 43xx)	Digital Systems Design II **OR** ECE Elective with advisor approval	3
ECE 4355	VLSI Design	3
	Embedded systems concentration	**6**
ECE 4354 **OR** (ECE 33xx or ECE 43xx)	Microprocessor Systems II **OR** ECE Elective with advisor approval	3
ECE 4353 **OR** (ECE 33xx or ECE 43xx)	Digital Systems Design II **OR** ECE Elective with advisor approval	3
	Communication networks concentration	**6**
ECE 3380	Intro to Communication Netwks	3
ECE 4390	Special Topics with advisor approval	3
	Machine learning concentration	**6**
ECE 4360	Foundations of Deep Learning	3
ECE 4361 **OR** ECE 4362	Fuzzy Logic and Engineering **OR** Computer Vision	3
	Information security concentration	**6**
ECE 4370	Introduction to Cybersecurity	3
ECE 4390	Special Topics with advisor approval	3

Table 5. Elective Courses

Prefix and Number	Elective Course	SCH
x1xx	Experiential Learning	1
x1xx	Experiential Learning	1
ECE x3xx	ECE Elective	6

C. Strategic Plan and Marketable Skills

Describe how the proposed program fits into the institution's overall strategic plan, and provide the web link to the institution's strategic plan.

Describe how the proposed program will align with the state's 60x30TX plan, and address the goals related to completion, marketable skills, and student debt. Specifically identify the marketable skills the students will attain through the proposed program. Explain how students will be informed of the marketable skills included in the proposed program.

Explain how the proposed program builds on and expands the institution's existing recognized strengths.

UTEP's strategic plan (https://www.utep.edu/strategic-plan/) calls for access to excellent higher education. Adding this BS in Computer Engineering degree program to our offerings increases the quantity of options we can provide to educate the region. El Paso area residents will now have access to a degree program that was not previously available within 265 miles.

The 60x30TX plan calls for programs to have identified marketable skills. The students enrolled in this BS program will acquire expertise and experience in the following subject matter: software design, digital design, computer architecture, embedded systems, operating systems design, communication networks, cyber/computer/network security, and machine learning. This subject matter will provide students with skills that are in high demand in the labor market, including but not limited to:

1. Software development
2. Digital design
3. Data analysis
4. Communication network design and management
5. Computer and network security analysis
6. Cybersecurity
7. Non-technical skills, such as: critical thinking, communication, social responsibility, and leadership

Students will be informed of these marketable skills by way of our catalog description of the program as well as via our program advising channels.

The 60x30TX plan also calls for at least 60 percent of Texans between the ages of 25 and 34 to have a certificate or degree. Our program will be the first BS in Computer Engineering offered in the El Paso area, providing a valuable degree option for the regional population inducing an increase in the population possessing degrees. This regional degree option also allows students to stay in the region whereby they would have had to leave the region to pursue this specific degree if we did not offer it. Students may have chosen to pursue the degree in another state and not return after graduation. In that case their degree attainment would not contribute to this goal.

D. Faculty

The proposed program shall have a sufficient number of core and support faculty to teach the scope of the discipline, consistent with similar programs in the state and nation. At least 50 percent of the faculty full-time equivalent (FTE) supporting a bachelor's or master's program must be Core Faculty.

Complete Table 5 to provide information about Core Faculty. Add an asterisk (*) before the name of the individual who will have direct administrative responsibilities for the proposed program. Core Faculty are full-time tenured and tenure-track faculty who would teach 50 percent or more in the proposed program or other individuals integral to the proposed program. Modify the table as needed.

Table 5. Core Faculty

Name and Rank of Core Faculty	Highest Degree and Awarding Institution	Courses Assigned in Program	% Time Assigned to Program
Sai Mounika Errapotu, Asst. Professor	PhD in Electrical and Computer Engineering University of Houston	ECE 2103, ECE 2303, ECE 2300, ECE 3500, ECE 3351, ECE 4370, ECE 4390	60%
*Michael McGarry, Assoc. Professor	PhD in Electrical Engineering Arizona State University	ECE 2103, ECE 2303, ECE 2300, ECE 3350, ECE 3351, ECE 3352, ECE 4390	60%
John Moya, Assoc. Professor	PhD in Electrical Engineering University of New Mexico	ECE 3141, ECE 3341, ECE 4355, ECE 4362	40%
Patricia Nava, Professor	PhD in Electrical Engineering New Mexico State University	ECE 2103, ECE 2303, ECE 4153, ECE 4353, ECE 4360, ECE 4361	40%
Rodrigo Romero, Associate Professor of Practice	PhD in Electrical and Computer Engineering University of Texas at El Paso	ECE 2103, ECE 2303, ECE 2104, ECE 2304, ECE 4153, ECE 4154, ECE 4353, ECE 4354, ECE 4201, ECE 4202	40%
New Assistant Professor of Instruction in Year 2022-2023			65%
New Assistant Professor in Year 2023-2024			60%
New Assistant Professor in Year 2025-2026			60%

Table 6. Support Faculty

Name and Rank of Support Faculty	Highest Degree and Awarding Institution	Courses Assigned in Program or Other Support Activity	% Time Assigned to Program
Sergio Cabrera, Associate Professor	PhD in Electrical Engineering Rice University	ECE 3331, ECE 3332	20%

Hector Erives, Associate Professor of Practice	PhD in Electrical Engineering New Mexico State University	ECE 2102, ECE 2301, ECE 2302, ECE 2151, ECE 2350, ECE 2351, ECE 4201, ECE 4202, ECE 4353, ECE 4354, ECE 4154, ECE 4361	30%
Virgilio Gonzalez, Professor of Practice	PhD in Electrical and Computer Engineering University of Texas at El Paso	ECE 2102, ECE 2301, ECE 2302, ECE 2303, ECE 3100, ECE 3180, ECE 3380	35%
Robert C. Roberts, Assistant Professor	PhD in Electrical Engineering Case Western Reserve University	ECE 1100, ECE 1300, ECE 3331, ECE 4360, ECE 4361	20%
Ricardo von Borries, Associate Professor	PhD in Electrical Engineering Rice University	ECE 2102, ECE 2301, ECE 2302, ECE 3331, ECE 3332	20%

E. Library Resources

A printout of the library's relevant holdings or a list of the planned acquisitions is not necessary. A letter or other statement from the librarian describing the adequacy of existing resources is required (include in Required Appendices). Provide the library director's assessment of both paper and electronic library resources necessary for the proposed program. Describe plans to build the library holdings to support the proposed program. Include the amount allocated to the proposed program.

Describe how students will access library resources, including print, electronic, and in person. Describe how communication with the library and interaction with the library staff and librarians occur. Describe how resources are made available in a format that is accessible to remote students.

The analysis presented in Appendix E of the Library's collections and services reflects the existing resources. These resources have been determined adequate to support the proposed undergraduate program. Access to electronic books and periodicals is especially strong. These resources already support existing graduate degrees in Computer Engineering. Monographic, serial holdings and subscriptions cover all areas to be taught.

The library will consult with faculty on any additional print and electronic materials needed over time. It is recommended that $10,000.00 be allocated to the Library annually, increasing by 7%-10% annually.

Student access to materials and interaction with library staff will following existing university-wide practices.

F. Facilities and Equipment

Describe the availability and adequacy of facilities and equipment to support the proposed program. Describe plans for new facilities and equipment, improvements,

additions, and renovations.

Provide the amount of anticipated expenditures related to facilities and equipment, and include those amounts in the budget under "Costs and Revenues." Also, describe the status of all building project(s) related to the program and include the schedule for completion. For shared equipment and facilities, describe availability for the proposed program.

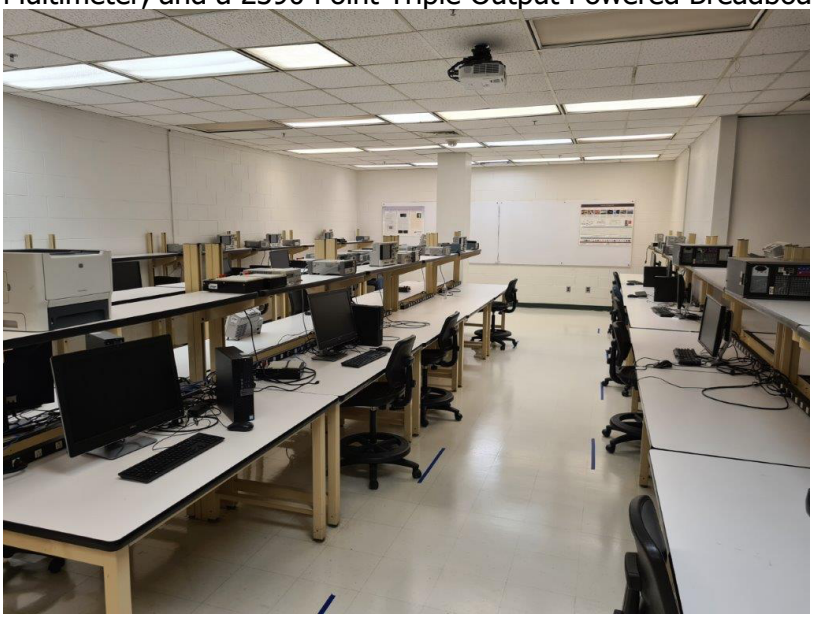
The proposed program will leverage existing facilities and equipment currently supporting our existing related programs: BS in Electrical Engineering (BSEE), Computer Engineering concentration area within the BSEE, MS in Computer Engineering, and PhD in Electrical and Computer Engineering.

We plan to refresh our computing laboratories with new computing equipment during the first five years of the program at a cost of $44,000.

Our department has multiple instructional laboratories to support our program:

Introduction to Electrical Engineering Lab (Supports ECE 1105) – *Engineering Building, Room 301E*
– area of 680 ft^2. The laboratory supports 20 students bringing their own laptops and Digilent Analog Discovery Boards to perform experiments for the course. Four desktops are provided for students who may not have access to a laptop computer. Each desktop contains the following installed software: Digilent Waveforms and Adept 2, MATLAB, and Microsoft Office.

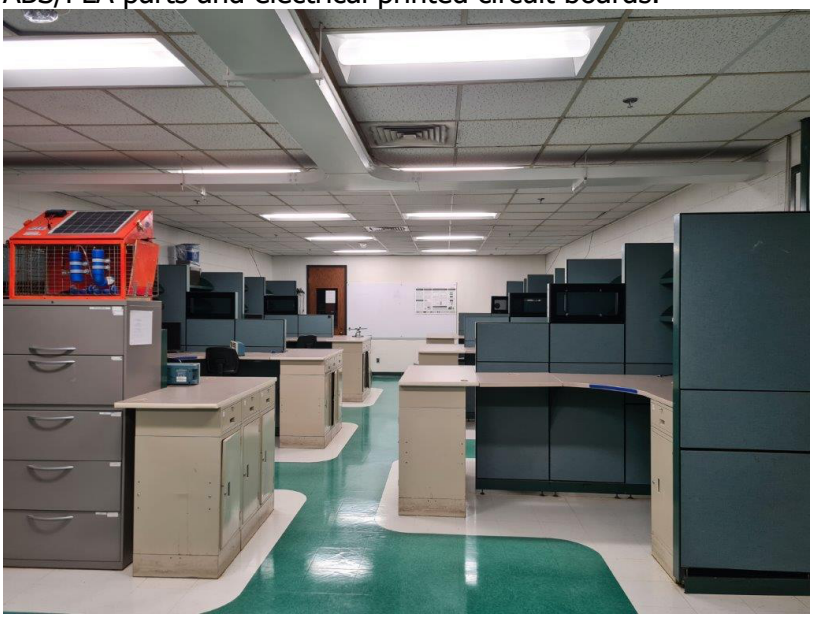
Circuits and Electronics Lab (Supports ECE 2151, ECE 3138, ECE 4200) – *Engineering Building, Room 333* – area of 1640 ft^2. This laboratory contains 15 workstations equipped with an Agilent Oscilloscope, a Function Generator, a Power Supply, a Digital Multimeter, and a 2390 Point Triple Output Powered Breadboard.



Digital Design/Microprocessors Lab (Supports ECE 2169, ECE 3176, ECE 4142, and ECE 4178) – *Engineering Building, Room 314B* – area of 958 ft^2. This laboratory contains 26 PC-based workstations with several connected development boards: Digilent BASYS-3 FPGA, TI-MSP430 microcontroller, and TI-MSP432 microcontroller development boards. Each workstation is further equipped with an Elvis II instrumentation board from National Instruments and has the following installed software: National Instruments Labview and Multisim, Xilinx ISE and Vivado, Texas Instruments Code Composer Studio, Digilent Waveforms and Adept 2, MATLAB, and Microsoft Office.

Cyber-physical Systems Lab (Supports ECE 3354) – Engineering Building, Room 314B – area of 536 ft^2. This laboratory supports 20 student workstations and is a combined teaching/research laboratory for communication related subject matter. Students have access to several computer software tools for robotics, wireless communications, network modeling, optical communications, etc. These tools include LabView, MATLAB, VMWARE, and network tools. There are 4 workstations and 3 Intel-Xeon Based servers for a Windows Domain. The laboratory has its own isolated network to perform networking experiments.

Senior Projects II Lab (Supports ECE 4205) – *Engineering Building, Room 335* – area of 2200 ft^2. This laboratory provides 20 workstations for second-semester senior capstone design teams. Each workstation is equipped with a desktop computer with installed software needed for the course. Wired and wireless network connectivity provide students access to university and college-available online and cloud cyberinfrastructure. Bench top equipment is available on demand from the electronic shop. The laboratory is equipped with soldering equipment as well as additive manufacturing (3D) printers for ABS/PLA parts and electrical printed circuit boards.



Our department has computing laboratories for general-purpose use:

LINUX/Windows Computer Lab – *Engineering Building, Room 332* – area of 2450 ft^2. The ECE UNIX/LINUX computer lab provides both LINUX and Microsoft Windows based workstations to support faculty, staff and student computing needs. There are 13 Linux workstations and 12 Windows workstations. The workstations are inter-connected by a heterogeneous network along with three Linux servers and a single Windows server providing services for user logon authentication, network file storage, web, and software licensing. The Linux workstations provide remote desktop services that can host multiple users simultaneously, on or off campus. The servers also provide DNS and DHCP services for the department's own subnet to support projects with special networking needs. The workstations have software development toolchains supporting many programming languages (e.g., C, C++, Python, Java, FORTRAN). Windows workstations are equipped with National Instruments Labview and Multisim, Xilinx ISE and Vivado, Texas Instruments Code Composer Studio, MATLAB, Microsoft Visual Studio, Microsoft Office, R4 Systems Proteus PCB Design, Cadence OrCAD, and ETAP Electrical Power System Analysis software. Linux workstations are equipped with Cadence IC Design Software (Virtuoso and related), Synopsys (TCAD Sentaurus and related), Eclipse software development environment for C, C++, Java, and Fortran, CUDA tools and MATLAB software.

Although available for use by ECE students at all levels, it primarily supports upper division and graduate teaching and research projects. The lab is staffed by a full-time network manager. The network manager consults with the Chair of the Departmental Computer Resources Committee, and reports to the Department chair.

Virgo Computing Cluster – *in the Research and Academic Data Center*. This computing cluster is a 23-node cluster supporting a wide variety of computational workloads for our department. The cluster supports a variety of workloads for both teaching and research: machine learning (including deep learning), MATLAB, general-purpose distributed computing using MPI, etc.

G. Accreditation

If the discipline has a national accrediting body, describe plans and timeline to obtain accreditation. For disciplines where licensure of graduates is necessary for employment, such as clinical psychology, plans for accreditation are required. If the program will not seek accreditation, provide a detailed rationale. If accreditation is not available but is projected to become so within the next five years, include that information. It is not necessary to provide copies of the accreditation criteria.

The program will seek professional accreditation under the Engineering Accreditation Commission from ABET Inc. The process has a typical 6-year cycle, or evaluations could be required earlier if shortcomings need to be fixed. The accreditation process is the same as that followed for other existing engineering programs at UTEP. The Computer Engineering program has a specific set of criteria requirements including curriculum, faculty, facilities, etc. and has many overlaps with the existing Electrical Engineering Program, as was presented in detail in section II.A. ABET assess the programs based on the established criteria that includes the following items:

- Student progress through the program. Programs should have adequate advising resources, follow consistent processes, and ensure students gain the proper knowledge. This criterion also evaluates enrollment, attrition, and graduation trends. The program should be able to track and provide adjustments to ensure the health of the program.
- The academic program should have well defined "Student Outcomes" aligned with the "Educational Objectives" that are appropriate for the engineering

discipline and consistent with the institution mission. The "Student Outcomes" describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills, and behaviors that students acquire as they progress through the program. The "Program Educational Objectives" are broad statements that describe what graduates are expected to attain within a few years after graduation. Program educational objectives are based on the needs of the program's constituencies and the job market needs.

- The program must have a Continuous Quality Improvement process to assess and evaluate the compliance with the different criteria elements with a focus on student attainment of "Student Outcomes".
- The program curriculum must provide adequate content for each area, consistent with the student outcomes and program educational objectives, to ensure that students are prepared to enter the practice of engineering.
- The program must have adequate facilities, faculty members and institutional support to prepare students in the practice of engineering.

Therefore, we will leverage existing resources and processes that support accreditation within the department and the College of Engineering. We will be able to apply for accreditation after we graduate the first cohort of students.

The University of Texas at El Paso is accredited by the Southern Association of Colleges and Schools (SACS). The proposed BS in Computer Engineering will use the same ABET methodology to provide the required documentation for SACS as it is being done with all other engineering programs at UTEP.

H. Evaluation

Describe how the proposed program would be evaluated. Describe any reviews that would be required by an accreditor, and show how the proposed program would be evaluated under Board Rule 5.52.

Describe procedures for evaluation of the program and its effectiveness in the first five years of the program, including admission and retention rates, program outcomes assessments, placement of graduates, changes of job market need/demand, ex-student/graduate surveys, or other procedures.

Describe how evaluations would be carried out. Describe how the results of evaluation would be used to improve distance delivery.

Board Rule 5.5.2 items a) and b) are satisfied by the ABET and SACSCOC accreditation processes. The ABET accreditation process requires a periodic assessment and evaluation of the quality of the program. Our cycle takes about two years and each six we have an ABET visit.

The program will be evaluated first by using the same methods to receive accreditation. The second part will require the metrics of success regarding the numbers of students enrolled and graduating from the program.

The process for the assessment and evaluation of the Student Outcomes (SOs) and Program Educational Objectives (PEOs), as defined by our ABET accreditation, consists

of several steps that are performed on a cyclical basis. Some tasks are executed every year, while others might take up to three years to complete. These tasks include:

- Validation of Program Educational Objectives (PEOs) by surveys and focus groups with the program constituents, including employers, alumni, faculty, and students. (Cycle of 3 years).
- Mapping of the Student Outcomes (SO's are program level learning outcomes) to support the PEOs. (Cycle of 3 years).
- Revision of curriculum maps to satisfy the SO's every two years.
- The assessment of SO's is done by individual instruments applied in selected courses where the level of attainment of specific skills is measured. Half of the SO's are assessed each year thus completing the cycle every two years.
- The evaluation and required improvement actions are taken on the alternate year to the SO's assessments.
- Every year there is qualitative feedback provided for all courses to help support the continuous quality improvement or help identify problems earlier.
- The previous processes should converge every 6 years to satisfy the ABET accreditation cycles.

III. Costs and Funding

A. Five-Year Costs and Funding Sources Summary

Adding a new degree program will cost the institution some amount of money. Calculating the costs and identifying the funding sources associated with implementation of a new program requires several institutional offices to collaborate to present an accurate estimate.

Provide an overview of new and reallocated costs for the proposed program using the form Costs to the Institution of the Proposed Program. Faculty salaries include all faculty assigned to the proposed program. If an existing faculty member is reassigned to the program, the salary is reflected as a reallocated cost. New faculty salaries need to be competitive for the discipline, and figures include start-up costs in proportion to the new faculty member's allotted time in the proposed program. Faculty salaries do not include benefits or pensions. If the proposed program will hire new faculty, it is a new cost. Program administration includes all institutional costs associated with running the program, including amounts associated with the Dean's office, Institutional Research, and other administrative costs. Graduate Assistant costs are identified either as new or reallocated, as appropriate. Clerical/Staff include specific costs associated with the new program. This includes the additional staff needed to organize applications, prepare for the proposed program, and for general administration of the proposed program. If the enrollments in the proposed program are projected to be large, the associated costs related to clerical/staff may also be more. New staff or purchases of new equipment should be adequate to support the stated goals and enrollments for the proposed program. Other program costs identified in the proposal should be realistic.

Total funding for the proposed program should meet or exceed total costs by the end of the first five years. On the forms provided, include a description of sources for existing and anticipated external funding. Include explanatory footnotes as needed.

Because enrollments are uncertain and programs need institutional support during their start-up phase, institutions should demonstrate that they could provide:

- *sufficient funds to support all the costs of the proposed program for the first two years (when no new formula funding will be generated); and*
- *half of the costs of the proposed program during years three through five from sources other than state funding.*

Funding sources may include formula income, other state funding, tuition and fees, reallocation of existing resources, federal funding, and other funding (such as awarded grants). The total projected income of state funding, tuition and fees, and private funds will allow the proposed program to become self-sufficient within five years.

Consult with your institution's Institutional Research department when calculating the formula funding.

When estimating program funding for new programs, institutions take into account that students switching programs do not generate additional formulas funds for the institution. For example, if a new program has ten students, but six of them switched

into the program from existing programs at the institution, only four of the students would generate additional formula funding.

The Other State Funding category could include special item funding appropriated by the Legislature, or other sources of funding from the state that do not include formula-generated funds (e.g., HEAF, PUF).

Reallocation of Existing Resources includes the salary of faculty reassigned who may be partially or wholly reallocated to the new program. Explain how the current teaching obligations of those faculty are reallocated and include any faculty replacement costs as program costs in the budget. If substantial funds are reallocated, explain how existing undergraduate and graduate programs will be affected.

Federal Funding (In-hand only) refers to federal monies from grants or other sources currently in hand. Do not include federal funding sought but not secured. If anticipated federal funding is obtained, at that time it can be substituted for funds designated in other funding categories. Make note within the text of the proposal of any anticipated federal funding.

Tuition and Fees includes revenue generated by the institution from student tuition and fees.

Other Funding category may include auxiliary enterprises, special endowment income, or other extramural funding.

Our student enrollment projections (in Table 1b) provide a convincing model of conversions from our BSEE program. New student enrollments (not conversions) are projected in Table 1 with an initial cohort of 20 students entering the program in the first year and subsequent new cohorts increasing annually by 15%.

Several of our existing faculty will support this new program. In addition, we will hire one Assistant Professor of Instruction (start in Year 1) and two tenure-track Assistant Professors (start in Years 2 and 4). We will hire a Program Advisor specific to this program to start in Year 4. Lastly, we will hire a total of five graduate assistants, one each to start in each year of the program.

We will refresh our general computing laboratories in Year 3 for a cost of $44,000.

Costs

Existing faculty re-allocation (all years)

Name	**Title**	**Appt. Percentage**
Sergio Cabrera	Associate Professor	20%
Hector Erives	Associate Professor of Practice	30%
Sai Mounika Errapotu	Assistant Professor	60%
Virgilio Gonzalez	Professor of Practice	35%
Michael McGarry	Associate Professor	60%

John Moya	Associate Professor	40%
Patricia Nava	Professor	40%
Robert C. Roberts	Assistant Professor	20%
Rodrigo Romero	Associate Professor of Practice	40%
Ricardo von Borries	Associate Professor	20%

New faculty to be hired

Name	Title	Starting Year
TBD	Assistant Professor of Instruction	1 (65%)
TBD	Assistant Professor	2 (60%)
TBD	Assistant Professor	4 (60%)

New staff to be hired

Name	Title	Starting Year
TBD	Program Advisor	4

Graduate assistants to be hired

Name	Title	Starting Year
TBD: 5 total	Teaching Assistant	1, 2, 3, 4, 5

$44,000 in computing equipment purchased in Year 3.

B. Signature Page

The signature page must be signed by the required institutional officials and board of regents.

V. Additional Distance Education Delivery Consideration

We will not pursue a distance education delivery option for the proposed degree program.

A. Adherence to *Principles of Good Practice*

Submit the Certification Form or provide a statement from the Chief Academic Officer certifying adherence to Principles of Good Practice as well as adherence to Coordinating Board distance education rules and policies.

B. Administrative Oversight and Structure

Identify the person/office directly responsible for the overall management of the proposed program. Identify other responsibilities of the person/office with primary responsibility and any modifications in responsibility made to accommodate the program. Describe the ways in which the delivery method will affect the proposed program.

For online programs:

1. *How will exam proctoring and monitoring be managed and evaluated?*
2. *How will user authentication be validated?*
3. *How will the proposed program assure compliance with accessibility standards and regulations (institutional, state, and federal) for instructional delivery, course materials, and other components of the proposed program?*

C. Collaborative Arrangements

Describe all collaborative arrangements with other institutions that will be participating in the delivery of the proposed program. Be certain to identify the:

1. *Responsibilities of each institution.*
2. *Process for the credentialing of faculty at each participant site.*
3. *Institution awarding credit.*

D. Program Differences

If the proposed program will be delivered both on-campus face-to-face at the main campus and at a distance, describe all differences between on-campus and distance delivery, including:

1. *Student admission and advisement.*
2. *Exams.*
3. *Independent study.*
4. *Courses and sequencing.*
5. *Library access.*

Discuss the accommodations available for students with special needs to assure accessibility to the course materials, activities, and support services related to the proposed program.

E. Student Interactions

Describe the student orientation process. Beyond the courses, how are students oriented to the services of the institution – library, student support, etc.

Describe how electronic and on-campus students would interact. How will interactions occur between distance education students?

Describe how instructor and students will interact throughout the program. Include interactions both in and out of the classroom setting. How is the sense of community developed?

Describe the advisement process throughout the proposed program.

VI. Required Appendices

A. Course Descriptions and Prescribed Sequence of Courses

See separate attached appendix.

B. Five-Year Faculty Recruitment Plan/Hiring Schedule

We plan to follow standard faculty hiring procedures for both untenured and tenure-track positions.

Our plan is to hire three faculty during the first five years of the program:
1) one tenure-track Assistant Professor to start in the first year of the program (2022-2023)
2) one untenured Assistant Professor of Instruction to start in the third year of the program (2024-2025) to increase our teaching capacity
3) one tenure-track Assistant Professor to start in the fourth year of the program (2025-2026)

C. Institution's Policy on Faculty Teaching Load

If teaching load policy is set at the departmental level, include that information.

4.3.3.2 University Policy

Faculty play a fundamental role in advancing the University and in fostering student success at all levels. The curricula the faculty design, the programs they offer, the learning environment they create, the instructional methods they employ, the research they conduct, the creative works they produce, the service they provide, and their professional engagement with students inside and outside of the classroom, including mentoring and advising, are important components of the educational experience and should be reflected in the academic workload and in all faculty assessment processes and instruments.

4.3.3.2.1 All individuals who hold paid tenure-track or tenured faculty appointments shall be assigned responsibility as instructors of record for organized coursework in each academic year unless they are on leave. Exceptions to this requirement require the written approval of the relevant Chair or Program Director, the Dean, and the Provost, and must be documented in a format that facilitates regular review and reporting.

4.3.3.2.2 During a regular long semester of the 9-month academic year, a faculty member who is not expected to generate research or creative work, or perform significant service responsibilities, shall teach a load equivalent to 15 semester credit hours of organized undergraduate courses.

4.3.3.2.3 Most faculty members have substantial non-teaching responsibilities, and their teaching loads shall be adjusted to accommodate those responsibilities. Adjustments shall be made based on approved college or school policies and department or program standards. These policies and standards will reflect the

varying missions, teaching methods, and student needs associated with different academic units and course levels. The policies and standards will be maintained and published by the Office of the Provost.

4.3.3.2.4 For a faculty member paid partially from a source of funds other than state appropriations, the teaching load shall be proportioned to the percentage of salary paid from state appropriations. Decisions regarding funding sources for faculty salaries should be made with reference to item 4.3.3.2.1, above.

4.3.3.2.5 The Office of the Provost shall monitor implementation of workload policies and standards, and work with institutional research staff to prepare, validate, and submit required reports regarding workload.

Department Policy
Tenured and tenure-track faculty in the ECE department generally teach two courses a semester, provide departmental/college/university/community service and conduct research and scholarly activities. Higher or lower teaching loads are negotiated with the Department chair and depend on engagement with research and service.

Non-tenure track faculty teach between 3-4 courses per semester and provide departmental/college/university/community service.

D. Itemized List of Capital Equipment Purchases During the Past Five Years[1]

Equipment means an article of nonexpendable, tangible personal property having a useful life of more than one year and an acquisition cost, which equals or exceeds the lesser of the capitalization level established by the governmental unit for financial statement purposes, or $5,000.

See separate attached appendix.

E. Librarian's Statement of Adequate Resources

The UTEP Library collection is sufficient to support a degree in Computer Engineering Program. Monographic, serial holdings and subscriptions cover all areas to be taught. Input will be requested from faculty and in the related subject areas regarding what additional printed and electronic journals would lend support to the proposed program. Funds should be allocated to annually renew the subscriptions to journals in this field.

In order to keep up with rising costs of existing subscriptions and continued purchases of monographs, it is recommended that $10,000.00 be allocated to the Library, increasing by 7-10% annually.

[1] "Equipment" has the meaning established in the Texas Administrative Code §252.7(3) as items and components whose cost are over $5,000 and have a useful life of at least one year.

New databases can be added if additional funds are provided. Faculty may request new materials through the Library's Computer Science Liaison or the Serials and Electronic Resources Librarian.

The UTEP Library has a collection of over one million items, including materials that support graduate degrees in Engineering, Science, and Business. Books and serials holding specifically supporting the proposed undergraduate degree in Computer Engineering (BSCE) are described in the table below. For library fund allocation for Engineering & Applied Sciences please refer to Appendix 1.

Topic	Books	e-Books	Serials/Periodicals
Computer Engineering	2,644	5,089	595
Applied Mathematics	1,579	1,537	176
Engineering Mathematics	1,145	1,879	119
Information Technology	4,325	10,756	1,184
Systems Engineering	3,779	8,824	594
Engineering Design	3,097	7,468	282
Digital Design	933	3,153	34
Electrical Engineering	1,405	2,052	639
Electric Circuits	335	387	37
Electronics	2,142	2,516	1,670
Data Communication	838	3,872	76
Signal Processing	1,085	1,767	313

The monograph collection includes the following Library of Congress classification system subject areas: Circuits design and analysis; Computer engineering; Communications; Cyber security; Data communication; Data mining and analysis; Digital design; Electrical engineering; Engineering (general); Engineering ethics; Engineering as a profession; Engineering design; Engineering graphs; Engineering management; Engineering mathematics; Information technology; Mechanical engineering, Machine design and drawing; Programming language; Project management; Renewable energy sources; Research and Development; Sustainable development; Systems engineering; Technological change; and Technology – general.

Regarding monographs, the Library collection includes relevant material in the areas the courses address. The collection includes standard reference works that are up-to-date. It is strong in many areas of computer engineering, especially materials related to computer hardware & software designs, computer aided design, cyber security, data

analysis, data communication and management, electrical engineering, engineering design, engineering ethics, engineering mathematics, programming languages, project management, software engineering, systems engineering, and technological innovations. The Library makes every effort to purchase new materials in computer science, computer engineering, electrical engineering, and systems engineering using monies provided for existing undergraduate and graduate programs in subject areas such as Civil Engineering, Computer Science, Electrical and Computer Engineering, Industrial Engineering, Mechanical Engineering, Materials Science and Engineering, and Mathematics. Although monographic materials in Main collection are reviewed periodically, it will need to be thoroughly analyzed and updated to reflect current curriculum and research needs.

Government Documents, E-books, Streaming Videos, Electronic Reports are among the sources for computer engineering, including materials on engineering design, engineering ethics, information technology, data mining, production engineering, project management, renewable energy, technological innovations, and technology. The Library also has a Texas Documents Collection for the same subject areas.

Plans are to continue to build on the existing monographic collection in preparation for the Computer Engineering Program. The Library already has an extensive coverage of materials in the other areas covered by this program. Materials purchased for academic programs in the Electrical Engineering, Mechanical Engineering, Mathematics and Physics add strength to the collection. Electronic databases with respect to this program include:

Databases and Full-Text Journal Packages

Academic Search Complete
AccessBiomedical Science (McGraw-Hill)
AccessEngineering
ACM Digital Library
Advanced Technologies & Aerospace Database (ProQuest)
American Mathematical Society Journals
Applied Science & Technology Source (Ebsco)
ASM Handbooks Online (ASM International)
ASME Digital Collection
ASTM Compass
Begell House Digital Library
Cambridge Journals
Computer Source (Ebsco)
ISI Web of Science
Engineering Source (Ebsco)
IEEE Xplore
Inspec (Ebsco)
IOPscience
LearnTechLib: The learning and Technology Library
Materials Science & Engineering Database (ProQuest)
MathEducDatabase
ScienceDirect

SPIE Digital Library
SpringerLink
Synthesis Digital Library of Engineering and Computer Science
Technology Collection (ProQuest)
Web of Science

Journal titles held in print and electronic formats by the library are crucial for the undergraduate program in Computer Engineering. The table in section 1 lists all the Library of Congress subjects pertaining to Computer Engineering and total volumes held in those areas. The library subscribes to many more titles relating to Computer Engineering in the databases mentioned in the table above. Input will be requested from faculty in the Computer Engineering program regarding what additional printed and electronic materials would lend support to the proposed BS program.

F. Articulation Agreements with Partner Institutions

Include copies of any agreements or Memoranda of Understanding related to the proposed program. These include formal and sustained arrangements with other universities, private businesses, or governmental agencies that contribute directly to the proposed program and student research/residency opportunities.

Not applicable.

G. Curricula Vitae for Core Faculty

See separate attached appendix.

H. Curricula Vitae for Support Faculty

See separate attached appendix.

I. List of Specific Clinical or In-Service Sites to Support the Proposed Program

Not applicable.

J. Letters of Support from Peer Institutions and/or Area Employers

Letters from regional and national companies who have made commitments to hire graduates from the proposed new program are particularly helpful. Also, include statements of support or commitments to shared research projects from other institutions in the state with similar programs.

See separate attached appendix.

Costs to the Institution of the Proposed Program

Complete the table to show the costs to the institution that are anticipated from the proposed program.

Cost Category	Cost Sub-Category	1st Year	2nd Year	3rd Year	4th Year	5th Year	TOTALS
Faculty Salaries[1]	**New**	$63,375	$141,375	$141,375	$223,275	$223,275	$792,675
	Reallocated	$476,165	$476,165	$476,165	$476,165	$476,165	$2,380,825
Program Administration	**New**	$0	$0	$0	$64,714	$64,714	$129,428
	Reallocated	$15,143	$30,286	$51,486	$0	$0	$96,915
Graduate Assistants	**New**	$23,891	$47,783	$71,674	$95,566	$119,457	$358,371
	Reallocated	$0	$0	$0	$0	$0	$0
Clerical/Staff	**New**	$0	$0	$0	$0	$0	$0
	Reallocated	$0	$0	$0	$0	$0	$0
Student Support (Scholarships)		$0	$0	$0	$0	$0	$0
Supplies and Materials		$0	$0	$0	$0	$0	$0
Library & Instructional Technology Resources[2]		$0	$0	$0	$0	$0	$0
Equipment[2]		$57,200	$0	$0	$0	$0	$57,200
Facilities		$0	$0	$0	$0	$0	$0
Other (Identify)		$0	$0	$0	$0	$0	$0
TOTALS		$635,774	$695,609	$740,700	$859,720	$883,611	$3,815,414

[1] Report costs for new faculty hires, graduate assistants, and technical support personnel. For new faculty, prorate individual salaries as a percentage of the time assigned to the program. If existing faculty will contribute to program, include costs necessary to maintain existing programs (e.g., cost of adjunct to cover courses previously taught by faculty who would teach in new program).
[2]Equipment has the meaning established in the Texas Administrative Code §252.7(3) as items and components whose cost are over $5,000 and have a useful life of at least one year.

Anticipated Sources of Funding

Complete the table to show the amounts anticipated from various sources to cover new costs to the institution as a result of the proposed program. Use the Non-Formula Sources of Funding form to specify as completely as possible each non-general revenue source.

Funding Category	1st Year	2nd Year	3rd Year	4th Year	5th Year	TOTALS
I. Formula Funding[1]			$81,827	$81,827	$196,452	$360,106
II. Other State Funding						
III. Reallocation of Existing Resources	$377,929	$389,578	$404,886	$366,281	$366,281	$1,904,955
IV. Federal Funding (In-hand only)						
V. Tuition and Fees	$170,557	$366,697	$528,726	$690,755	$801,617	$2,558,352
VI. Other Funding[2]						
TOTALS	$548,486	$756,275	$1,016,439	$1,138,863	$1,364,350	$4,824,413

[1] Indicate formula funding for students new to the institution because of the program; formula funding should be included only for years three through five of the program and should reflect enrollment projections for years three through five.
[2] Report other sources of funding here. In-hand grants, "likely" future grants, and special item funding can be included.

Non-Formula Sources of Funding

Complete the table to specify each of the non-formula funding sources for the amounts listed on the Anticipated Sources of Funding form.

Funding Category	Non-Formula Funding Sources
II. Other State Funding	#1
	#2
III. Reallocation of Existing Resources	#1 Faculty salaries funded by the state.
	#2
IV. Federal Funding (In-hand only)	#1
	#2
V. Tuition and Fees	#1 Statutory tuition
	#2 Undergraduate designated tuition
	#3 College major fee
VI. Other Funding	#1
	#2

Signature Page

1. **<u>Adequacy of Funding and Notification of Other Institutions</u>** – The Chief Executive Officer shall sign the following statements:

   I certify that the institution has adequate funds to cover the costs of the proposed program. Furthermore, the proposed program will not reduce the effectiveness or quality of existing programs at the institution.

   I certify that my institution has notified all public institutions within 50 miles of the teaching site of our intention to offer the proposed program at least 30 days prior to submitting this request. I also certify that if any objections were received, those objections were resolved prior to the submission of this proposal.

   I certify that my institution will adhere to Texas Education Code (TEC), Sections 61.822 through 61.823, requiring my institution to accept and apply to the proposed program Core Curriculum and Field of Study courses in transfer.

   Chief Executive Officer _____ Date _____

2. **<u>Accuracy of Financial Estimates</u>** – The Chief Financial Officer shall sign the following statement:

   I certify that the estimated costs and sources of funding presented in the proposal are complete and accurate.

   Chief Financial Officer _____ Date _____

3. **<u>Board of Regents or Designee Approval</u>** – A member of the Board of Regents or designee shall sign the following statement:

   On behalf of the Board of Regents, I hereby certify that the proposed program is appropriate for the mission of this institution and the Board of Regents has approved the proposed program.

   Board of Regents (Designee) _____ Date _____

Texas Higher Education Coordinating Board
Texas Public General Academic and Health-Related Institutions

New Bachelor's and Master's Degree Program Request Form

Directions: Texas public universities and health-related institutions complete this form to add a new bachelor's or master's degree program, if the following criteria for approval are met, per Texas Administrative Code (TAC), Title 19, Chapter 5, Subchapter C, Section 5.44 (a) (3): (A) the proposed program has institutional and board of regents approval; (B) the institution certifies compliance with the *Standards for New Bachelor's and Master's Programs*; (C) the institution certifies that adequate funds are available to cover the costs of the new program; (D) new costs to the program during the first five years of the program would not exceed $2 million; (E) the proposed program is a non-engineering program; and (F) the proposed program would be offered by a public university or health-related institution.

If the proposed program does not meet the criteria listed above, the institution must submit a request using the Full Request Form.

This form requires the signatures of: (1) the Chief Executive Officer, certifying adherence to the Texas Administrative Code (TAC), Title 19, Chapter 5, Subchapter C, Section 5.44 (a) (3) criteria, adequacy of funding for the new program, the notification of other Texas public institutions of higher education, and adherence to Texas Education Code (TEC) Sections 61.822 through 61.823; and (2) a member of the Board of Regents (or designee) certifying Board approval.

Contact: Division of Academic Quality and Workforce, 512-427-6200.

Administrative Information

1. Institution Name and Coordinating Board Accountability Group:
The University of Texas at El Paso
Emerging Research Institution

2. Proposed Program:
Show how the proposed program would appear on the institution's Program Inventory (e.g., Bachelor of Business Administration with a major in accounting).
Bachelor of Science in Computer Engineering

3. Proposed CIP Code:
List of CIP Codes may be accessed online at www.txhighereddata.org/Interactive/CIP/. Include justification if the proposed program name is not included in the Texas Classification of Instructional Programs.
14.0901.00.06

4. Semester Credit Hours Required:
Bachelor's degree programs should not exceed 120 semester credit hours (SCH). If the number of SCH exceeds 120 for a bachelor's degree program, the institution must submit documentation explaining the compelling academic reason). Master's degree programs do not have semester credit hour restrictions; however, 30 to 36 SCH is common.
128 SCH

5. Location and Delivery of the Proposed Program:
Provide the location of instruction and how the proposed program will be delivered to students (e.g., Instructed on the main campus in Lubbock, face-to-face).
Face-to-face to students on main campus in El Paso

6. Administrative Unit:
Identify where the proposed program would fit within the organizational structure of the institution (e.g., Department of Biology within the College of Natural Sciences).
Department of Electrical and Computer Engineering within the College of Science

7. Proposed Implementation Date:
Provide the date that students would enter the proposed program (MM/DD/YYYY).
08.22.2022

8. Institutional and Department Contacts:
Provide contact information for the person(s) responsible for addressing any questions related to the proposed program.

1. Name: Miguel Velez-Reyes

   Title: Professor

   E-mail: mvelezreyes@utep.edu

   Phone: 915-747-5470

2. Name: Michael McGarry

   Title: Associate Professor

   E-mail: mpmcgarry@utep.edu

   Phone: 915-747-6955

Signature Page

1. **<u>Chief Executive Officer Certification</u>** – The Chief Executive Officer shall sign the following statements:

   I hereby certify that all of the following criteria have been met in accordance with the procedures outlined in Texas Administrative Code (TAC), Title 19, Chapter 5, Subchapter C, Section 5.44 (a) (3):

   (A) The proposed program has institutional and governing board approval.

   (B) The institution certifies compliance with the *Standards for New Bachelor's and Master's Programs*.

   (C) The institution certifies that adequate funds are available to cover the costs of the new program.

   (D) New costs during the first five years of the program would not exceed $2 million.

   (E) The proposed program is a non-engineering program.

   (F) The proposed program would be offered by a public university or health-related institution.

   I certify that my institution has notified all public institutions within 50 miles of the teaching site of our intention to offer the proposed program at least 30 days prior to submitting this request. I also certify that if any objections were received, those objections were resolved prior to the submission of this request.

   I certify that my institution will adhere to Texas Education Code (TEC), Sections 61.822 through 61.823, requiring my institution to accept and apply to the degree program Core Curriculum and Field of Study courses in transfer.

   _____ _____
   Chief Executive Officer Date

2. **<u>Board of Regents or Designee Approval</u>** – A member of the Board of Regents or designee shall sign the following statement:

   On behalf of the Board of Regents, I hereby certify that the proposed program is appropriate for the mission of this institution, and the Board of Regents has approved the proposed program.

   Date of Board of Regents approval: _____

   _____ _____
   Board of Regents (Designee) Date

Appendix A: Course Descriptions and Prescribed Sequence of Courses

Degree Plan

1st Year	Fall			Cr	Spring			Cr
	MATH	1411	Calculus I	4	MATH	1312	Calculus II	3
	ECE	1300	Intro to Electr/Comp Eng	3	ECE	2303	Digital Systems Design I	3
	ECE	1100	Lab for ECE 1300	1	ECE	2103	Lab for ECE 2303	1
	CS	1320	Computer Programming Sci/Engr	3	PHYS	2420	Introductory Mechanics	4
	RWS	1301	Rhetoric & Composition I	3	RWS	1302	Rhetoric & Composition 2	3
	UNIV	1301	Seminar/Critical Inquiry	3	HIST	1301	History of U.S. to 1865	3
	Total			**17**				**17**

2nd Year	Fall			Cr	Spring			Cr
	MATH	2326	Differential Equations	3	MATH	2313	Calculus III	3
	ECE	2301	Electric Circuits I	3	ECE	2302	Electric Circuits II	3
	ECE	2300	Software Design I	3	ECE	2102	Lab for ECE 2302	1
	CE	2326	Econ for Engrs & Scientists	3	ECE	2304	Microprocessor Systems I	3
	PHYS	2421	Introductory Electromagnetism	4	ECE	2104	Lab for ECE 2304	1
					MATH	2300	Discrete Mathematics	3
					HIST	1302	History of U.S. Since 1865	3
	Total			**16**				**17**

3rd Year	Fall			Cr	Spring			Cr
	MATH	3323	Matrix Algebra	3	ECE	3100	Junior Prof. Orientation	1
	ECE	3331	Discrete Time Signals & Sys	3	ECE	3332	Prob with App Elect/Comp Eng	3
	ECE	3341	Electronics I	3	ECE	3352	Operating System Design	3
	ECE	3141	Lab for ECE 3341	1	ECE	x3xx	***CpE Elective***	3
	ECE	3350	Software Design II	3	ECE	x1xx	***CpE Elective Lab***	1
	ECE	3351	Computer Architecture	3	ART	x3xx	*Core curriculum*	3
	Total			**16**				**14**

4th Year	Fall			Cr	Spring			Cr
		x1xx	Experiential Learning	1		x1xx	Experiential Learning	1
	ECE	4201	CpE Senior Project Lab I	2	ECE	4202	CpE Senior Project Lab II	2
	ECE	x3xx	***CpE Elective***	3	ECE	x3xx	***CpE Concentration or ECE Elective***	3
	ECE	x1xx	***CpE Elective Lab***	1	ECE	x3xx	***ECE Elective***	3
	ECE	x3xx	***CpE Concentration or ECE Elective***	3	ECE	x3xx	*ECE Elective*	3
	LPC	x3xx	*Core curriculum*	3	POLS	2311	American Gover & Politics	3
	POLS	2310	Introduction to Politics	3				
	Total			**16**				**15**

Computer Engineering (CpE) Electives with Lab

ECE	3380/3180	Intro to Communication Netwks	Lab for ECE 3380
ECE	4353/4153	Digital Systems Design II	Lab for ECE 4353
ECE	4354/4154	Microprocessor Systems II	Lab for ECE 4354

Computer Engineering (CpE) Concentrations

General computer engineering: Any two ECE 3xxx or ECE 4xxx elective courses selected with an advisor
Digital design: ECE 4353 Digital Systems Design II and ECE 4355 VLSI Design
Embedded systems: ECE 4354 Microprocessor Systems II and ECE 4353 Digital Systems Design II
Communication networks: ECE 3380 Intro to Communication Networks and ECE 4390 Special Topics
Machine learning: ECE 4360 Foundations of Deep Learning and (ECE 4361 Fuzzy Logic and Engineering or ECE 4362 Computer Vision)
Information security: ECE 4370 Introduction to Cybersecurity and ECE 4390 Special Topics

1. Course number and name
   - ECE 1100/ECE 1300 Introduction to Electrical/Computer Engineering

2. Credits and contact hours
   - 4 Credits, 6 contact hours

3. Instructor's or course coordinator's name
   - Robert Roberts

4. Text book, title, author, and year
   - Students are not required to purchase a textbook. All course material for the lecture and lab is included on the course website. Lecture power point slides are available that provide a comprehensive resource for learning fundamental circuit theory with plenty of examples and links to educational videos.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. ECE 1300: In this course students will learn how to use electronic components to build and design circuits for a variety of medical and miscellaneous sensor applications. Through hands on activities, the course will emphasize (1) mathematical and systems concepts that form the basis for electrical engineering, (2) an introduction to circuit components, voltage and current concepts, and (3) sinusoidal signal characteristics, basic filter responses and bandwidth concepts.
      ii. ECE 1100: Introduction to Electrical Engineering laboratory procedures, causes, and correction of errors in measurements theory of operation and usage of basic Electrical Engineering test instruments, and report writing.
   b. prerequisites or co-requisites
      i. Prerequisites: MATH 1411 with a grade of "C" or better, may be taken concurrently with ECE 1300.
      ii. Corequisites: ECE 1100 and ECE 1300
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required Course

6. Specific goals for the course
   a. To introduce the fundamental concepts and understanding of electronic circuit components, circuit analysis, and electrical engineering mathematical basics. Expanding on the concepts, students should learn how to apply engineering skills (ABET 1c) to implement circuits in the laboratory experimentally, learn to collect real data, and interpret their results (ABET 6a-6c) and specifically demonstrate
      i. Become familiar with the Analog Discovery device (oscilloscope and waveform functions).
      ii. Use MATLAB to model experimental data.
      iii. Analyze Simple Circuits using KVL, KCL and voltage divider methods.
      iv. Build circuits using passive and active components. Build and analyze signals through circuits with low pass, high pass and band pass filters.

v. Use Bode Plots to characterize filters and predict signal response.
vi. Build circuits using sensor inputs to create a measureable output.
vii. Use complex impedance to model and analyze Op-Amp circuits.
viii. Learn to report their experimental results in a formal manner.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
    i. This course introduces students to the learning outcomes of applying engineering (ABET 1c), conducting experiments (ABET 6a), interpreting data (ABET 6b), and drawing conclusions (ABET 6c).

7. Brief list of topics to be covered
    - Electrical engineering units and unit conversion
    - Ohms Law, Kirchhoff's Voltage Law, Kirchhoff's Current Law
    - Circuit analysis and simplification
    - Operational amplifiers
    - Passive and active filter design
    - Bode plot analysis of filters
    - Experimental circuit prototyping
    - Computerized data collection
    - Data plotting and analysis
    - Written engineering communication and teamwork

1. Course number and name
   - ECE 2300 Software Design I

2. Credits and contact hours
   - 3 credits, 3 contact hours

3. Instructor's or course coordinator's name
   - Michael McGarry

4. Text book, title, author, and year
   - Programming in C (4th Edition) by Stephen Kochan
     a. other supplemental materials
        i. Data Structures and Algorithms in C++ (2nd Edition) By Michael Goodrich, Roberto Tamassia, and David Mount

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Foundations of data structures and algorithms. These foundations include: space and time complexity analysis, the use of data structures such as linked lists and binary trees, basic sorting and searching algorithms, and foundations of software testing/verification/validation.
   b. prerequisites or co-requisites
      i. Prerequisites: CS 1320 with a grade of "C" or better
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required course

6. Specific goals for the course
   a. Become a proficient user of the Linux software development environment and GNU software development tool-chain
      i. Linux software development environment
      ii. GNU software development tools – *gcc, gdb, make, gprof, gcov*
   b. Understand C language programming constructs
      i. variables, algebraic and logical expressions (including operator set)
      ii. simple I/O
      iii. decision statements, iterative control statements
   c. Understand and follow structured software design strategies [***ABET 2a/b***]
      i. programming paradigms: procedural/modular, object-oriented
      ii. design for reuse using the procedural/modular paradigm
      iii. utilizing standard libraries, focus on C standard library
   d. Understand and utilize fundamental data structures [***ABET 1c***]
      i. arrays and structures
      ii. strings and string processing
      iii. pointers, linked lists, and binary trees
      iv. storage allocation: static, stack and heap
   e. Software testing, verification, and validation
      i. Understand the differences between testing, verification, and validation.

ii. Demonstrate an understanding of unit testing strategies and tradeoffs.
iii. Ability to construct test vectors and use tools to automate their construction.

f. Understand the foundations of algorithm analysis [***ABET 1a***]
   i. history and the role of algorithms
   ii. algorithms available in the C standard library
   iii. determine time complexity of algorithms
   iv. determine space complexity of algorithms

g. Understand and utilize fundamental algorithms [***ABET 1c***]
   i. sorting algorithms: bubble sort and insertion sort
   ii. searching algorithms: linear search, binary search, and hash functions

h. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   i. Student Outcome 1a and 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"
   ii. Student Outcome 2a and 2b, "an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors"

7. Brief list of topics to be covered
   - GNU/Linux software development environment
   - C language programming constructs: variables, algebraic expressions, simple I/O
   - C language programming constructs: decision statements and iterative control statements
   - Fundamental data structures: arrays, pointers, and structures
   - Fundamental data structures: strings and string processing
   - C standard library: console and file I/O
   - Software engineering process
   - Software testing/verification/validation
   - Object-oriented programming with C++
   - Fundamental data structures: linked-lists
   - Fundamental data structures: binary trees
   - Fundamental algorithms: sorting and searching
   - Time and space complexity analysis of algorithms

1. Course number and name
   - ECE 2301: Electric Circuits 1

2. Credits and contact hours
   - 3 credits, 3 contact hours

3. Instructor's or course coordinator's name
   - Hector Erives

4. Text book, title, author, and year
   - Electric Circuits, 11th Edition, Prentice Hall, 2014. J. W. Nilsson and S. A. Riedel.
     a. other supplemental materials
        i. Required to purchase the Mastering Engineering package which includes electronic access to the book.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Introduction to systematic methodologies for the analysis of electric circuits in DC and AC steady state. Use of simulation tools for steady state circuit analysis.
   b. prerequisites or co-requisites
      i. Prerequisites ECE 1300, MATH 1312, PHYS 2421 and MATH 2326, each with grade of "C" or better. (PHYS 2421 and MATH 2326 may be taken concurrently).
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required Course

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

      Upon completion of the course students will be able to:
      i. Understand the terminology used in conjunction with electric circuits and the terminal characteristics of ideal circuit elements.
      ii. Mathematically model electric systems using ideal resistive, inductive, and capacitive elements.
      iii. Apply phasors and impedance transformations to the analysis of electric circuits fed by a sinusoidal input in steady state.
      iv. Apply systematic methods (node, mesh, terminal equivalency, circuit theorems) to electric circuit analysis.
      v. Apply circuit analysis techniques to study circuits that include ideal operational amplifiers.
      vi. Develop the ability to identify and solve complex engineering problems by applying principles of engineering.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
    i. Student Outcome 1a and 1c, “an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics”

7. Brief list of topics to be covered
    - Circuit variables and units. Kirchhoff’s laws. Ohm’s law. Power and energy. Passive convention
    - Circuit elements and circuit abstractions
    - Ideal operational amplifier and its inverting and non-inverting configurations
    - Resistance, inductance, capacitance, and impedance
    - Analysis of linear circuits in sinusoidal steady state (AC circuits)
    - DC and AC circuit analysis using Thevenin and Norton equivalents and source transformations
    - Power in AC circuits: instantaneous power; average, reactive, and complex power; power factor; power triangle
    - Three-phase circuits

1. Course number and name
   - ECE 2302: Electric Circuits II

2. Credits and contact hours
   - 3 credit hours, 3 contact hours

3. Instructor's or course coordinator's name
   - Hector Erives

4. Text book, title, author, and year
   - Electric Circuits, 11th Edition, Prentice Hall, 2014. J. W. Nilsson and S. A. Riedel.
     a. other supplemental materials
        i. Required to purchase the Mastering Engineering package which includes electronic access to the book.
5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Circuit analysis using the Laplace transforms. Network functions and frequency response representation of circuits. Steady-state analysis of circuits fed by non-sinusoidal period signals using Fourier series. Two-port network. Computer aided analysis of circuits.
   b. prerequisites or co-requisites
      i. Prerequisites ECE 2301, MATH 2326, PHYS 2421 each with grade of "C" or better.
      ii. Corequisite: ECE 2102
   c. indicate whether a required, elective, or selected elective (as per Table 5-1)
      i. Required Course

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

   Upon completion of this course, student will be able to:
      i. Understand the concepts of natural and forced response, zero-input and zero-initial conditions in the analysis of electric circuits.
      ii. Apply Laplace transform techniques to represent circuits in the frequency domain. Analyze and derive input-output representations using node, mesh, terminal equivalency methods.
      iii. Derive input-output representations of electric circuits such as the transfer function.
      iv. Understand the concepts of resonance and apply circuit analysis techniques to series and parallel RLC circuits.
      v. Apply Fourier series to analyze circuits fed by non-sinusoidal period sources in steady-state.
      vi. Understand and analyze two-port representation of circuits.
      vii. Apply software tools to the analysis of electric circuits in the frequency and time domains.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
    i. Student Outcome 1a, and 1c, “an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics”

7. Brief list of topics to be covered
    - Introduction to the Laplace transform. Functional and operational transforms.
    - The Laplace transforms in circuit analysis. Natural response of RC circuits. Step response of parallel circuits.
    - Introduction to passive filter circuits.
    - Active filter circuits. Low-pass and high-pass circuits. Op-amp band-pass and band-reject circuits.
    - Using Laplace transforms to find Fourier transform.
    - Two-port circuits and two-port parameters.

1. Course number and name
    - ECE 2102: Lab for ECE 2302

2. Credits and contact hours
    - 1 credit, 3 contact hours

3. Instructor's or course coordinator's name
    - Hector Erives

4. Text book, title, author, and year
    - J.W. Nilsson and S.A. Riedel, Electric Circuits, 10th Edition, Prentice Hall, 2014.
    a. Other supplemental materials
        i. Lab assignments
        ii. Composition Notebook
5. Specific course information
    a. brief description of the content of the course (catalog description)
        i. Use of oscilloscopes, function generators, and power supplies to test and study electrical networks and their behavior. Technical writing and computer aided circuit design.
    b. prerequisites or co-requisites
        i. Prerequisite(s): (ECE 1100 w/C or better)
        ii. Corequisite: ECE 2302

    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
        i. Required course

6. Specific goals for the course
    a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

    Students completing ECE 2151 will be able to:
    i. Measure voltage, current, and power using multimeters. (D)
    ii. Use basic electronic test equipment such as oscilloscopes and function generators to measure and verify signal parameters. (D)
    iii. Use Oscilloscope and Function Generator to analyze basic Op-Amp functionality. (D)
    iv. Analyze, simulate, and construct first and second order circuits in the time domain. (I, D)
    v. Analyze, simulate, and construct series and parallel RLC circuits with a sinusoidal source. (I, D)
    vi. Analyze, simulate, and construct RL circuits with average and complex power. (I, D)
    vii. Experimentally investigate the magnitude and phase frequency response of passive circuits (RL, RC, and RLC), and applications of these circuits.
    viii. Design and implement a 3-way audio crossover. (I, D)
    ix. Apply software tools to the analysis of electric circuits in the frequency and time domain. (I, D)

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
    i. Student Outcome 5a, “an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives”
    ii. Student Outcome 6a, 6b, and 6c, “an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions”

7. Brief list of topics to be covered

- Lab Exercise 1: Introduction of Simulation Software Using Multisim.
- Lab Exercise 2: Introduction to Basic Circuits on Breadboard
- Lab Exercise 3: Introduction to Oscilloscopes and Function Generators
- Lab Exercise 4: Analysis of Op-Amps.
- Lab Exercise 5: Sinusoidal Steady State Analysis
- Lab Exercise 6: Steady State Power Analysis
- Lab Exercise 7: Natural Response of RC and RL Circuits
- Lab Exercise 8: Transient Response of Second Order RLC Circuits
- Lab Exercise 9: Frequency Response and Filters
- Lab Exercise 10: Filters and Transfer Functions (3-way audio crossover)

1. Course number and name
   - ECE 2303: Digital System Design I
   - ECE 2103: Lab for ECE 2303

2. Credits and contact hours
   - ECE 2303: 3 credit hours
   - ECE 2103: 1 credit hour

3. Instructor's or course coordinator's name
   - Patricia Nava

4. Text book, title, author, and year
   - REQUIRED Online Text from Zybooks – Digital Design by Frank Vahid (https://www.zybooks.com/) OPTIONAL Reference Text: Digital Design with RTL Design, VHDL, and Verilog, by Frank Vahid.

5. Specific course information

   ECE 2303

   a. brief description of the content of the course (catalog description)
      i. Design and synthesis of digital systems using both combinational and sequential circuits. Includes laboratory projects implemented with standard ICs.
   b. prerequisites or co-requisites
      i. Prerequisite: ECE 1300 or CS 1301
      ii. Corequisite: ECE 2103
   c. indicate whether a required, elective, or selected elective (as per Table 5-1
      i. Required course

   ECE 2103

   a. brief description of the content of the course (catalog description)
      i. Implementation and testing of basic combinational and sequential digital systems
   b. prerequisites or co-requisites
      i. prerequisite: ECE 1100 or CS 1101

   c. indicate whether a required, elective, or selected elective (as per Table 5-1)
      i. Required course

6. Specific goals for the course

   After successful completion of ECE 2303 and associated lab, students will be able to:

      i. Apply concepts of number systems to perform binary arithmetic and conversions between bases. (ABET Criterion 3:1a)
      ii. Apply Boolean algebra and K-Map methods in order to simplify Boolean expressions, and analysis and synthesis of digital circuits. (ABET Criterion 3:1a, 1c))
      iii. Design combinational circuits, such as binary adders, code converters, etc., by using logic gates. (ABET Criterion 3:2a, 2b)

iv. Design sequential circuits, such as counters, registers, etc., by using flip-flops and other hardware. (ABET Criterion 3:2a, 2b)

After successful completion of the ECE 2103 lab, students will be able to:

i. Design, simulate or implement, and test digital circuits, both hands-on (using physical devices) and with CAD tools (6a, 6b, 6c)
ii. Solve engineering problems with the Algorithmic State Machines (ASM) technique (6a, 6b, 6c)
iii. Design, simulate, and test digital circuitry using a Hardware Description Language (6a, 6b, 6c)
iv. Design, implement, and test digital circuitry by prototyping designs using the selected development system (6a, 6b, 6c)

a. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
    i. Student Outcome 1a, 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"
    ii. Student Outcome 2a, 2b, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"
    iii. Student Outcome 6a, 6b, 6c, "an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions"

7. Brief list of topics to be covered
    - Introduction, Number Systems, and Basic Boolean Operators
    - Basic Boolean Algebra, Equations, and Logic Gates
    - Logic Diagrams, Design of Circuits, Arithmetic and 2's Complement
    - Canonical & Reduced Equations, K-Maps
    - Design of Combinational Systems, Design Considerations
    - Quine-McCluskey Reduction, MSI devices
    - Flip-flops, Timing Diagrams, Registers
    - Sequential Machines, Capturing behavior with FSMs
    - Sequential Design Considerations, State Encoding & Reduction
    - FSMs as Controllers: Algorithmic State Machine Methodology, ASM Design
    - ASM design with MSI, Incorporation of LSI
    - Design Considerations, Design Examples
    - Advanced Controller Design

1. Course number and name
   - ECE 2304 Microprocessor Systems I
   - ECE 2104 Lab for ECE 2304

2. Credits and contact hours
   - ECE 2304: 3 credits, 3 contact hours
   - ECE 2104: 1 credit, 3 contact hours

3. Instructor's or course coordinator's name
   - Rodrigo Romero

4. Text book, title, author, and year
   - Programmable Microcontrollers with Applications – MSP430 LaunchPad with CCS and Grace. Cem Ünsalan and H. Deniz Gürhan. ISBN 978-0-07- 183003-4. McGraw Hill

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. ECE 2304: Study of microprocessor programming models, assembly language, macro assemblers, and an introduction to system integration and interfacing.
      ii. ECE 2104: Assembly language programming of microcomputer systems.
   b. prerequisites or co-requisites
      i. Prerequisites: ECE 2303 (Digital System Design I), ECE 2300 (Software Design I), and ECE 2301 (Electric Circuits II), each with a "C" or better
      ii. Co-requisites: ECE 2304: ECE 2104
      ECE 2104: ECE 2304
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required course

6. Specific goals for the course
   a. specific outcomes of instruction
      Upon completion of ECE 3376 and its corresponding lab, student will be able to
      i. Write assembly language programs (ABET 1c, 2a, 2b, 3b, 6a, 6b, 6c).
      ii. Explain program organization and general software environment of a microprocessor system (ABET 1c, 3b).
      iii. Understand the basic features of computer hardware (ABET 1c, 2a, 2b, 6a, 6b, 6c).
      iv. Understand system integration and interfacing at a basic level (ABET 1a, 1b, 1c, 2a, 2b, 6a, 6b, 6c).
      v. Demonstrate competence in written technical communication (ABET 3b).

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

i. Student outcome 1c, “an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics”
ii. Student outcome 2a, 2b, “an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors”
iii. Student outcome 6a-6c, “an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions”

7. Brief list of topics to be covered
   - Microcontroller micro-architecture
   - Assembly Language Programming
   - Instruction Set Architecture
   - Digital I/O
   - Interrupts
   - Stack Operations
   - Functions of Timers
   - Microcontroller Datasheet
   - Microcontroller Interfacing
   - Serial Communications
   - Analog to Digital Conversion

1. Course number and name
   - ECE 3100: Junior Professional Orientation

2. Credits and contact hours
   - 1 credit hours, 3 contact hours

3. Instructor's or course coordinator's name
   - Virgilio Gonzalez

4. Text book, title, author, and year
   - No Textbook Required

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. This course provides an introduction to the profession of electrical engineering with emphasis on career placement, public service, graduate study, engineering ethics and professional registration
   b. prerequisites or co-requisites
      i. Be considered a junior level student
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

   By the end of the term, each student will have:

      i. Become informed about the Career Services Office and the process associated with obtaining placement both as an intern and/or a career professional.
      ii. Prepared a resume suitable for use to secure future professional employment.
      iii. Learned techniques for face-to-face and telephone interviews.
      iv. Learned how to evaluate job offers.
      v. Explored possible career paths, including large company, small company, government, and academia.
      vi. Gained knowledge related to graduate studies and continuing education.
      vii. Become aware of the process involved in becoming registered as a Professional Engineer.
      viii. Gained an appreciation of common issues in engineering ethics
      ix. Developed an awareness of personal finances and saving for the future.
      x. Designed a plan to lead to professional career employment.

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

i. Student Outcome 1c, “an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics”
ii. Student Outcome 4a, 4b, 4c, “an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts”
iii. Student Outcome 5b, “an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives”
iv. Student Outcome 7a, 7b, “an ability to acquire and apply new knowledge as needed, using appropriate learning strategies”

7. Brief list of topics to be covered
   - How to prepare your Resume and Cover Letter and to prepare for an interview.
   - Working for industry vs working in education.
   - Undergraduate research and entrepreneurship.
   - Graduate programs and project management

1. Course number and name
   - ECE 3331: Discrete Time Signals and Systems

2. Credits and contact hours
   - 3 credit hours, 3 contact hours

3. Instructor's or course coordinator's name
   - Sergio Cabrera

4. Text book, title, author, and year
   - C. L. Phillips, J. M. Parr, E. A. Riskin, Signal, Systems, and Transforms, 5th Edition, Pearson Prentice Hall, 2014.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Discrete Time Signals & Systems (3-0) Representation and analysis of discrete time signals and systems, Z-transform, DT Fourier transform, DFT, FFT, and difference equations. Emphasizes applications to communications, control and signal processing.
   b. prerequisites or co-requisites
      i. Prerequisites: CS 1320 and ECE 2301 with a grade of "C" or better
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required Course

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      i. Perform D-T signal transformations and recognize signal properties. (ABET 3:1a,1c).
      ii. Recognize properties of D-T systems, solve for the impulse response and perform the convolution operation for D-T Linear Time-Invariant (LTI) Systems. (ABET 3:1a,1c).
      iii. Solve Difference Equations (DEs) in the time-domain. (ABET 3:1a).
      iv. Recognize important z-transform pairs, use z-transform properties to derive new transform pairs, determine inverse z-transforms, and apply the z-transform in LTI system analysis including the solution of Difference Equations. (ABET 3:1a,1c).
      v. Recognize important Discrete-Time Fourier Transform (DTFT) pairs, use DTFT properties and z-transforms to determine forward and inverse DTFTs, and apply the DTFT in LTI systems analysis and digital filtering. (ABET 3:1a,1c).
      vi. Analyze Fourier domain relationships between D-T signals and analog signals, and select appropriate digital filters to perform basic analog filtering tasks. (ABET 3:1c).
      vii. Recognize important Discrete Fourier Transform (DFT) pairs, apply the DFT to analyze the spectrum of D-T and analog signals, apply the DFT to

perform convolution, and select efficient computational algorithms to evaluate the DFT using Fast Fourier Transform (FFT) methods. (ABET 3:1c).

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
    i. Student Outcome 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"

7. Brief list of topics to be covered

I- Preliminaries, Introduction and Software
- I- Samplers and discrete-time physical systems
- II- Intro. to Matlab and Simulink

II- Discrete-Time (D-T) Signals and Systems
- a) Axis and amplitude transformations and basic signal properties
- b) Basic, important D-T signals including D-T sinusoids
- c) Definition and properties of discrete-time systems

III- Discrete-Time Linear, Time-Invariant (LTI) Systems
- a) Impulse response and D-T convolution for LTI systems
- b) Properties of D-T LTI systems
- c) Iterative solution of Difference Equations (DEs) and LTI Difference Equations
- d) Difference Equation (DE) models, block diagrams

IV- The z-Transform
- a) Definition and evaluation of unilateral z-transforms of basic causal signals
- b) Unilateral z-transform properties and inverse z-transform
- c) LTI systems analysis and D-T convolution using the unilateral z-transform.
- d) Solution of LTI DEs using unilateral z-transforms
- e) Intro. to bilateral z-transform, region of convergence, non-causal signals, etc.

V- Discrete-Time Fourier Transform (DTFT) and Discrete Fourier Transform (DFT)
- a) Review Sampling theory relating to Continuous-Time Fourier Transform
- b) DTFT Definition and basic transform pairs
- c) Properties of the DTFT and relationship to bilateral z-transform
- d) Discrete-time processing of continuous-time signals (handout)
- e) The Discrete Fourier Transform (DFT) and its computation using Fast Fourier Transform (FFT) algorithms
- f) Application of the DFT to perform convolution
- g) Windowing and spectrum analysis using the DTFT and the DFT.

VI- Digital Filtering based on LTI Systems (in parallel with Chapters 10-12 mostly using Matlab projects)
- a) Response of LTIs systems to sinusoidal inputs.
- b) Frequency response of Finite Impulse Response (FIR) LTI systems
- c) Frequency response of DE based, Infinite Impulse Response (IIR) LTI systems.
- d) Applications of LTI digital filtering: signal separation, noise removal, etc.

1. Course number and name
   - ECE 3332: Probability with Applications in Electrical and Computer Engineering

2. Credits and contact hours
   - 3 credit hours, 3 contact hours

3. Instructor's or course coordinator's name
   - Ricardo von Borries

4. Text book, title, author, and year
   - A First Course in Probability, Ross, Sheldon, 2014

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. An introduction to probability, sets, combinatorics, discrete and continuous random variables, single and multiple random variables, probability and cumulative functions, conditional probability, statistical independence, moments of random variables, and functions of random variables. In addition, the course presents applications of probability in areas such as quantization, data compression, estimation, detection, clustering, and queueing. Computer simulations provide motivation and facilitate understanding of the theory and applications.
   b. prerequisites or co-requisites
      i. Prerequisites: MATH 2326 and (EE 2353 or ECE 3331) each with a grade of "C" or better.
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required course

6. Specific goals for the course
   a. Specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      i. Solve basic counting problems involving permutations and combination of equally likely events.
      ii. Solve simple probability problems with electrical and computer engineering applications using the basic axioms of probability.
      iii. Determine marginal and Joint cumulative distribution functions, probability density functions and use them to compute various expected values of discrete and continuous random variables.
      iv. Describe the functional characteristics of distributions frequently encountered in electrical and computer engineering such as the Gaussian, Bernoulli, Binomial, Poisson, and Uniform.
      v. Compute probability density functions and cumulative density functions of a random variable.
      vi. Compute expected values of sums of random variables and the covariance and correlation of pairs of random variables.
      vii. Use Matlab to do some simulation examples.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
    i. Student Outcome 1a, “an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics”

7. Brief list of topics to be covered
    - Chapter 1, Sections 1.1 - 1.4 – Combinatorial Analysis
    - Chapter 2, Sections 2.1-2.5 – Axioms of Probability
    - Chapter 3, Sections 3.1-3.4 – Conditional Probability and Independence
    - Chapter 4, Sections 4.1- 4.10– Random Variables (discrete)
    - Chapter 5, Sections 5.1-5.7 – Continuous Random Variables
    - Chapter 6, Sections 6.1-6.3, 6.5 – Jointly Distributed Random Variables
    - Chapter 7, Sections 7.1-7.8 – Properties of Expectation
    - Chapter 8, Sections 8.1-8.4– Limit Theorems

1. Course number and name
   - ECE 3341: Electronics I

2. Credits and contact hours
   - 3 credit hours, 3 contact hours

3. Instructor's or course coordinator's name
   - John Moya

4. Text book, title, author, and year
   - Microelectronic Circuits 7th ed., by Adel Sedra and Kenneth Smith, 2014.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Electronics I is an introduction to electronic devices and circuits: Amplifier concepts, diodes, field effect transistor amplifiers, bipolar junction transistor amplifiers.
   b. prerequisites or co-requisites
      i. Prerequisites: ECE 2302 and ECE 2102 with "C" or better.
      ii. Corequisite: ECE 3141
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required Course

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      i. Students will understand the design aspects of and be capable of analyzing circuits containing Diodes, Op Amps, and Field Effect and Bipolar Junction transistors. (ABET Criterion 3: 1c, 6)
      ii. Demonstrate competence in written technical communication. (ABET Criterion 3: 3b

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      i. Student Outcome 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"

7. Brief list of topics to be covered
   - Review of pertain circuits material
   - Bode Plots
   - Op Amps and Op Amp Circuit Analysis
   - Diodes and Diode Circuit Analysis
   - Transistors and Transistor Circuit Analysis

1. Course number and name
   - ECE 3141: Lab for ECE 3341

2. Credits and contact hours
   - 1 credit hour, 3 contact hours

3. Instructor's or course coordinator's name
   - John Moya

4. Text book, title, author, and year
   - No textbook required
     a. other supplemental materials
        i. A bounded notebook (i.e. a composition notebook) I required for this lab. Lab assignments will be handed out the week before they are due.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Laboratory for Electrical Engineering (0-3) Introduction to experimental analysis of junction diodes, bipolar junction transistors, and junction field effect transistors. Frequency response measurements of operational amplifier circuits. Fourier analysis. PSPICE simulations.
   b. prerequisites or co-requisites
      i. Prerequisites: ECE 2102 and ECE 2302 with "C" or better
      ii. Corequisites: ECE 3341
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required course

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

Upon completion of this course, student will:

   i. Demonstrate competence using common EE measurement instruments, such as digital multimeters (DMM) and oscilloscopes, for the measurement of resistance, current, voltage, etc.
   ii. Understand basic techniques for analyzing data.
   iii. Understand basic concepts for designing circuits including components such as diodes, Op Amps, and transistors.
   iv. Demonstrate competence in written technical communications

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      i. Student Outcome 1c, "an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors"

ii. Student Outcome 6a, 6b, 6c, “an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions”

7. Brief list of topics to be covered
   - Operational Amplifiers. Closed loop gain, finite open loop gain, inverting and non-inverting configuration, integrator and differentiators
   - Diodes, forwards and reverse bias, breakdown region, Zener diodes, full and half wave rectifiers.
   - Metal-semiconductor Field-Effect Transistor, device structure, current-voltage characteristics, modes.
   - Bipolar Junction Transistor, device structure, operation, current-voltage characteristics.

1. Course number and name
   - ECE 3350: Software Design II

2. Credits and contact hours
   - 3 credit hours, 3 contact hours

3. Instructor's or course coordinator's name
   - Michael McGarry

4. Text book, title, author, and year
   - Data Structures and Algorithms in C++ (2nd Edition) By Michael Goodrich, Roberto Tamassia, and David Mount
   - PThreads Programming: A POSIX Standard for Better Multiprocessing by Dick Buttlar, Jacqueline Farrell, and Bradford Nichols

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Object-oriented software design (including polymorphism), multi-threaded programming techniques, algorithmic complexity analysis, classes of algorithms, heuristic algorithms, and basics of database systems. Utilize the C and C++ programming languages in a Linux development environment using the GNU toolchain.
   b. prerequisites or co-requisites
      i. Prerequisite: ECE 2300 with a grade of "C" or better.

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Selected Elective

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      I. Object-oriented design and programming [***ABET 1c***]
         i. Use C++ classes and namespaces in programming practice.
         ii. Decompose a problem into classes of objects having related state (data members) and behavior (methods).
         iii. Understand the concepts of abstract data types, information hiding, inheritance, and polymorphism.
      II. Multi-threaded programming [***ABET 1c***]
         i. Understand multi-processor architectures and associated parallel programming models.
         ii. Analyze inherent parallelism in a computation and calculate speedup.
         iii. Understand multi-threaded programming using the pthreads library.
         iv. Thread synchronization to avoid race conditions on shared variables.
      III. Understand classes of algorithms and algorithm selection
         i. recursion
         ii. brute-force algorithms

iii. greedy algorithms
iv. divide and conquer
v. heuristics
vi. algorithm choice

IV. Analyzing the complexity of algorithms and using heuristics [***ABET 1a***]
i. Understand the foundations of complexity analysis.
ii. Understand the use of heuristics to find good solutions to NP problems.
iii. Understand competitive analysis of heuristics.

V. Basics of database systems
i. Explain and provide examples of data models and their use.
ii. Understand the architecture of modern database systems.
iii. Construct queries using SQL.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   i. Student Outcome 1a, 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"
   ii. Student Outcome 2a, 2b, "an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors"

7. Brief list of topics to be covered
   - Object-oriented programming using C++
   - C++ standard template library
   - Multi-processor architectures and classes of parallelism
   - Multi-threaded programming with pthreads
   - Race conditions in multi-threaded programs
   - Thread synchronization using mutual exclusion semaphores
   - Classes of algorithms: brute-force, greedy, divide-and-conquer
   - Recursion
   - Algorithmic complexity classes (including NP-complete)
   - Brute-force algorithms
   - Heuristic algorithms for intractable problems
   - Database systems and SQL

1. Course number and name
   - ECE 3351 Computer Architecture

2. Credits and contact hours
   - 3 credits, 3 hours

3. Instructor's or course coordinator's name
   - Michael McGarry

4. Text book, title, author, and year
   - Computer Organization and Design: The Hardware/Software Interface by David Patterson and John Hennessy (5th Edition)

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Binary representation of characters, integers, floating point numbers and assembly language instructions. Integer arithmetic circuit design. Data path and control path design of a non-pipelined and pipelined microprocessor. Multi-processing architectures. Hierarchical memory design.
   b. prerequisites or co-requisites
      i. Prerequisite: ECE 2103 and ECE 2304 with a grade of "C" or better.
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Elective

6. Specific goals for the course
   a. specific outcomes of instruction
      i. Overview of computing history and definition of computer architecture and organization
      ii. Learn methods of analyzing the performance of computer systems [ABET 1a/1c]
         - Characterization of program execution time and power consumption
         - Benchmarks and Amdahl's law
      iii. Learn the organization and architecture of computer systems
         - Hardware/Software Interface (Instruction Set Architecture)
            - ISA design principles
            - MIPS ISA (including constructs for control flow and procedure calls)
            - Converting C language constructs to MPIS ISA
         - Computer Representation of Instructions and Data
            - Signed/Unsigned Integers
            - IEEE 754 Floating Point
            - MIPS ISA Instruction Formats
         - Integer Arithmetic Circuit Design
         - Review of Digital Design with the Verilog HDL and other EDA tools
         - Basic Microprocessor Design

        - Data Path (ALU, Register File, etc.)
        - Control Path
        - Pipelining and its Hazards (structural, control, data)
    - Parallel architectures and types of parallelism
        - Job-level, Thread-level, Data-level, and Instruction-level parallelism
        - Multi-issue, multi-core, multi-processor, cluster
        - SISD, SIMD, MIMD
    - Hierarchical Memory Architectures
        - Exploiting temporal/spatial locality
        - Cache organization and performance analysis
        - Techniques to reduce miss rate and miss penalty
        - Virtual memory

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course
    i. Student Outcome 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"

7. Brief list of topics to be covered

- Computer Performance Analysis Techniques
- MIPS Assembly Language
- Support for Procedures; Instruction Formats
- Character and Integer Representation; Computer Integer
- Arithmetic
- Floating Point Number Representation
- Verilog HDL
- Processor Architecture: Data Path
- Processor Architecture: Control Path
- Pipelining
- Parallel Structures: Multi-Issue, Multi-Core, Multi-Processor, Cluster
- Exploiting Parallelism: Job, Thread, Data, and Instruction
- Hierarchical Memory Design: Cache Memory
- Hierarchical Memory Design: Virtual Memory

1. Course number and name
   - ECE 3352 Operating System Design

2. Credits and contact hours
   - 3 credits, 3 contact hours

3. Instructor's or course coordinator's name
   - Michael McGarry

4. Text book, title, author, and year
   - Operating System Concepts Essentials (2nd Edition) Abraham Silberschatz, Peter Galvin, and Greg Gagne
   - TCP/IP Sockets in C (2nd Edition) Michael Donahoo and Kenneth Calvert

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Design and implementation of single and multiuser operating systems. Topics include OS structure, process management, interprocess communication within and between CPUs, memory management, file systems, and I/O. Contemporary operating systems provide design examples.

   b. prerequisites or co-requisites
      i. Prerequisite: ECE 2300 and ECE 2304 with a grade of "C" or better.

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Elective

6. Specific goals for the course
   a. specific outcomes of instruction
      i. Overview of operating system history and definition of operating systems
      ii. Common set of services provided by an operating system
         1. user interfaces
         2. programming interfaces

      iii. Process/Thread Management [ABET 1a/c]
         1. Definition of Processes/Threads
         2. Basic process/thread management
         3. Process/thread scheduling
         4. Scheduling theory
         5. Race conditions
         6. Process/thread synchronization
         7. Deadlocks
      iv. Multi-threaded programming and Multi-core processors
         1. POSIX pthreads library
      v. Memory Management

- Hierarchical memory design
- Virtual memory
- Memory sharing and allocation
- Paging and page replacement algorithms
- Frame allocation to avoid thrashing

vi. File Systems
    1. File and directory abstractions
    2. Storage allocation methods
    3. Disk scheduling

vii. I/O Systems
    1. Characteristics of I/O devices (byte/block, sequential/random, synchronous/asynchronous, polling/interrupts)
    2. Memory-mapped device registers
    3. Device driver design (hardware abstraction layer); blocking, non-blocking, and asynchronous models

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
    i. Student Outcome 1c, “an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics”

7. Brief list of topics to be covered
    - Operating Systems Structures
    - Introduction to Processes/Threads
    - Process Scheduling
    - Process Synchronization
    - Network Communication
    - Deadlocks: Characterization and Prevention
    - Memory Management
    - File Systems
    - Input/Output Systems

1. Course number and name
   - ECE 3380 Introduction to Communication Networks
   - ECE 3180 Lab for ECE 3380

2. Credits and contact hours
   - ECE 3380 – Lecture, 3 credits
   - ECE 3180 – Laboratory, 1 credit

3. Instructor's or course coordinator's name
   - Virgilio Gonzalez

4. Text book, title, author, and year
   - "Data and Computer Communications", William Stallings, 10th, 2014.
     a. other supplemental materials
        i. LabView
        ii. MatLab

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Familiarization with communication networks through simulation experiments done with computer software. Topics include Protocol Layers, Link Analysis, Circuit and Packet switches, LANs, and Internet Protocols.
   b. prerequisites or co-requisites
      i. Prerequisites: (EE 2353 or ECE 3331) and ECE 2300
      ii. Co-requisites: ECE 3180
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Selected Elective

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      Students in ECE 3380 / ECE 3180 will be able to:
      i. Analyze Analog Transmission Links
      ii. Analyze Digital Transmission Links
      iii. Understand Fundamentals of Low Level Protocols
      iv. Design Basic Communication Networks
      v. Use computer simulation tools for the analysis of communication systems
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      i. Student Outcome 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering "

7. Brief list of topics to be covered
   - Data Communications Overview
   - Layering Protocol Model

- Physical Layer, Physical Media
- Properties of Signals, Analog & Digital
- Signal Encoding, Analog Modulation
- Digital Baseband Transmission, Digital Modulation
- Data Link, Point to Point
- Multiplexing
- Switched and Cellular Networks
- Local Area Networks (Contention based)
- IP and Routing (Network Layer)
- Transport layer and upper applications
- Selected Topics along major chapters

1. Course number and name
   - ECE 4201 CpE Senior Project Lab I

2. Credits and contact hours
   - ECE 4201: 2 credits, 4 contact hours

3. Instructor's or course coordinator's name
   - Rodrigo Romero

4. Text book, title, author, and year
   - None

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Research & Analysis leading to a preliminary design for an approved engineering project. Includes formal project proposal and work plan; specification of functional, performance and cost goals; generation of computer-aided design documents and simulation or modeling results. Design process is concluded in ECE 4202 through prototyping, testing and revisions.
   b. prerequisites or co-requisites
      i. Prerequisites: ECE 2304 and ECE 2104 and ECE 3100 and ECE 3141 and ECE 3331 and ECE 3341 and ECE 3350 and ECE 3351 and ECE 3352 and CE 2326 with a grade of "C" or better
      ii. Corequisite: None
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required

6. Specific goals for the course
   a. specific outcomes of instruction

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

7. Brief list of topics to be covered
   - Capstone project

1. Course number and name
   - ECE 4202 CpE Senior Project Lab II

2. Credits and contact hours
   - ECE 4202: 2 credits, 4 contact hours

3. Instructor's or course coordinator's name
   - Rodrigo Romero

4. Text book, title, author, and year
   - None

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Laboratory development of special projects concerned with various computer engineering systems. Small group or individual semester projects are stressed.
   b. prerequisites or co-requisites
      i. Prerequisites: ECE 4201 with a grade of "C" or better
      ii. Corequisite: None
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Required

6. Specific goals for the course
   a. specific outcomes of instruction

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

7. Brief list of topics to be covered
   - Capstone project

1. Course number and name
   - ECE 4353 Digital Systems Design II
   - ECE 4153 Lab for ECE 4353

2. Credits and contact hours
   - ECE 4353: 3 credit hours
   - ECE 4153: 1 credit hour lab

3. Instructor's or course coordinator's name
   - Patricia Nava

4. Text book, title, author, and year
   - OPTIONAL Reference Text: Logic and Computer Design Fundamentals, 4th edition, updated by M. Morris Mano and C.R. Kime, Prentice-Hall, Inc.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. ECE 4353: Design techniques for complex digital systems, with emphasis on computer hardware design and computer-aided techniques, including hardware description languages and hardware simulation packages. Algorithmic State Machine design is stressed for small systems. Emphasis on problem definition, design, and verification.
      ii. ECE 4153: Design and verification of digital systems using simulation. Laboratory implementation using standard, integrated circuits and programmable logic devices.
   b. prerequisites or co-requisites
      i. Prerequisite for ECE 4353: ECE 2304 (with a "C" or better)
      ii. Prerequisite for ECE 4353: ECE 2104 (with a "C" or better).
   c. indicate whether a required, elective, or selected elective as per Table 5-1 course in the program
      i. Selected Elective

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)

After successful completion of ECE 4353 and associated ECE 4153 lab, students will be able to:

   i. Apply different design methods for digital circuitry from problem statement to physical implementation. (ABET Criterion 3:1c)
   ii. Use good design techniques, especially top-down design, such as the ASM method. (ABET Criterion 3:1c)
   iii. Recognize and apply typical hardware constructs for processing units. (ABET Criterion 3:1c)
   iv. Recognize and apply typical hardware constructs for control units: hardwired and microprogrammed. (ABET Criterion 3:1c)
   v. Use computer aided tools to simulate and verify designs. (ABET Criterion 3:1c)

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
    i. Student Outcome 1c, “an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics”

7. Brief list of topics to be covered
    - Review of combinational and sequential digital design techniques, HDL representation, memory components, PLDs and FPGAs
    - Algorithmic state machine design procedure
    - Datapath (PU) design
    - Datapath (PU) operations and design of a control word
    - Control Units (Sequencing): hardwired and microprogrammed control
    - Instruction set architecture

8. Course number and name
   - ECE 4354 Microprocessor Systems II
   - ECE 4154 Lab for ECE 4354

9. Credits and contact hours
   - ECE 4354: 3 credits, 3 contact hours
   - ECE 4154: 1 credit, 3 contact hours

10. Instructor's or course coordinator's name
    - Rodrigo Romero

11. Text book, title, author, and year
    - Embedded Systems: Real-Time Interfacing to the Arm Cortex-M Microcontrollers, 2014, Fourth Edition.

12. Specific course information
    a. brief description of the content of the course (catalog description)
       i. ECE 4354: A study of a 16/32 bit microprocessor family and companion devices, and various design aspects of microprocessor systems.
       ii. ECE 4154: Use of development tools in the design and implementation of microprocessor-based systems.
    b. prerequisites or co-requisites
       i. Prerequisites: ECE 2304 and ECE 2104 with a grade of "C" or better
       ii. Corequisite: ECE 4354: ECE 4154
           ECE 4154: ECE 4354
    c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
       i. Elective

13. Specific goals for the course
    a. specific outcomes of instruction

Students completing this course and associated laboratory (ECE 4154) will be able to:

i. Design and implement embedded systems using an advanced microcontroller, a modular software system, I/O and other devices (ABET 1c, 2a, 2b, 3b, 6a, 6b, 6c).
ii. Understand major architectural features of advanced microcontrollers (ABET 1c).
iii. Apply concepts and principles of sensors, actuators, analog and digital signals, device interfaces, and communications to design systems (ABET 1b, 1c, 2a, 2b, 6a, 6b, 6c).
iv. Understand and apply the principles of real-time processing to embedded system design (ABET 1c, 2a, 2b, 6a, 6b, 6c).

    b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

i. Student Outcome 1a, 1c, “an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics”
ii. Student Outcome 6a-6c, “an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions”

14. Brief list of topics to be covered
    - Embedded System Design Process
    - ARM Processor Architecture
    - Embedded Software Design
    - I/O and Hardware-Software Synchronization
    - Interrupts
    - Time Interfacing
    - Serial Interfacing
    - Analog Interfacing
    - Data Acquisition Systems
    - Communication Systems
    - Real-Time Operating Systems

1. Course number and name
   - ECE 4355: VLSI Design

2. Credits and contact hours
   - 3 credits, 3 contact hours

3. Instructor's or course coordinator's name
   - John Moya

4. Text book, title, author, and year
   - CMOS VLSI DESIGN: A Circuit and Systems Perspective 4th ed. by Neil Weste and David Harris, 2011.
     a. other supplemental materials
        i. Website tutorial: www.ece.utep.edu/courses/vlsi/Fall/cadence/cadence.html

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Introduction to CMOS VLSI design and computer-aided VLSI design tools. A term project is required that involves high-level design approaches, layout editing, simulation, logic verification, timing analysis, and testing.
   b. prerequisites or co-requisites
      i. Prerequisite: ECE 3341, with a grade of "C" or better.
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Elective

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      i. Students will understand the properties of, and be capable of analyzing, circuits containing MOS transistors. (ABET Criterion 3: lc)
      ii. Students will be able to use CMOS design approaches to create basic logic gates, implement Boolean logic functions and simple logical circuits. (ABET Criterion 3: lc)
      iii. Students will understand layout rules and the process used to build CMOS circuits on an IC. (ABET Criterion 3: lc)
      iv. Students will become familiar with, and be able to utilize, modern VLSI CAD approaches to create and analyze a CMOS design. (ABET Criterion 3: lc)

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      i. Student Outcomes 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"

7. Brief list of topics to be covered
    - Introduction and Overview
    - Simplified transistor switch circuits
    - HDLs
    - Verilog programming
    - MOS transistor theory
    - CMOS circuit fabrication
    - CMOS circuit characterization and performance estimation
    - CMOS design approaches
    - VLSI CAD software

1. Course number and name
   - ECE 4360: Foundations of Deep Learning

2. Credits and contact hours
   - 3 credits, 3 contact hours

3. Instructor's or course coordinator's name
   - Patricia Nava

4. Text book, title, author, and year
   - Deep Learning, by I. Goodfellow, Y. Bengio, and A. Courville. MIT Press, 2016.
   - Neural Networks and Deep Learning: A Textbook, by C. Aggarwal. Springer International Publishing, 2018

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Foundations of Deep Learning, beginning with an overview of Intelligent Systems (AKA Artificial Intelligence), including a taxonomy of current systems. Focused introduction to basic concepts and techniques of artificial neural networks (ANNs), including their relation to biological neurons. Summary discussion of ANN's computational and learning abilities, and applications. Methodologies for improvement of performance, including fuzzy theory and other biology-based models.
   b. prerequisites or co-requisites
      i. ECE 2300 and ECE 3331, each with a grade of "c" or better.
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Selected Elective

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.) '
      Students successfully completing EE 4365 will be able to:
      i. Utilize a working knowledge of the taxonomy of Artificial Intelligence to classify new and unconventional models.
      ii. Identify different architectures and paradigms, their limitations and appropriate learning structures.
      iii. Describe the difference between Shallow, Deep Feedforward, Convolution, Recurrent, and Recursive Networks, and identify appropriate optimization techniques for Deep Models.
      iv. Design and implement a deep learning network simulation (with two modes of operation: learning and processing) using a high-level language.
      v. Select appropriate system topology, based application characteristics and hyperparameters.

7. Brief list of topics to be covered

- Taxonomy of Artificial Intelligence
- Overview of Historically Significant Models
- Historical Foundations of Learning
- Modern Practices in Deep Networks
- Regularization for Deep Learning
- Computational Challenges and Optimization for Training of Deep Models
- Practical Methodology and Unconventional Architectures
- Current Applications and Deep Learning Research

1. Course number and name
   - ECE 4361: Fuzzy Logic and Engineering

2. Credits and contact hours
   - 3 credits, 3 contact hours

3. Instructor's or course coordinator's name
   - Hector Erives

4. Text book, title, author, and year
   - Fuzzy Logic and Applications, 2nd Ed., by Timothy J. Ross, John Wiley & Sons, 2004

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Underlying philosophy of the theory of fuzzy sets and its applications in engineering. Fuzzy logic, fuzzy reasoning and rules, and fuzzy systems. Decision- making in the realm of vague, qualitative and imprecise data. Current models, simulation tools, hardware implementations and their applications will also be covered.
   b. prerequisites or co-requisites
      i. ECE 3331 and ECE 3332, each with a grade of "c" or better.
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Selected Elective

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.) '
      i. provide a gradual transition from the realm of rigorous, quantitative and precise phenomena to that of a vague, qualitative and imprecise conceptions
      ii. characterize imprecision in terms of "fuzziness", a concept to which one can assign many meanings: for example, ambiguity, a problem of the collective, reasoning with "ball-park" figures, an abstraction, and as a characteristic of ill-formed problems

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      i. Student Outcome 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"

7. Brief list of topics to be covered
   - Background and Preview
   - Highlights of classical set theory
   - Introduction to fuzzy sets

- Linguistic Variables; possibility distributions
- Fuzzy Sets; membership functions.
- Operations of fuzzy sets, cardinality, height
- Fuzzy Relations
- Possibility Theory
- Composition of fuzzy relations,
- Fuzzy If-Then Rules
- Fuzzy Rule-based Methods
- Foundation of Fuzzy Mapping Rules
- Fuzzy Implications and Approximate Reasoning
- Fuzzy Logic and Probability Theory
- Hierarchical Intelligent Control.

1. Course number and name
   - ECE 4362: Computer Vision

2. Credits and contact hours
   - 3 credits, 3 contact hours

3. Instructor's or course coordinator's name
   - John Moya

4. Text book, title, author, and year
   Various textbooks and other material will be used as reference material.

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Fundamental concepts associated with the construction of meaningful understanding of physical objects from images/video; including basic animal vision structure/operation, image segmentation/understanding, knowledge representation, matching and inference.
   b. prerequisites or co-requisites
      i. Prerequisite: ECE 3331 with a grade of "C" or better.

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Elective

6. Specific goals for the course
   a. specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.)
      Students will understand
      i. the basic structure/operation of animal vision.
      ii. processing and available information associated with masks, Fourier transforms, Morphological filtering, other techniques and required pre- and post- processing.
      iii. implications of possible optical illusion processing in animals upon computer vision processing approaches.
      iv. color encoding and processing.
      v. advanced topics presented via student exploration of conference session papers.

7. Brief list of topics to be covered

1. Course number and name
   - ECE 4370 Introduction to Cybersecurity

2. Credits and contact hours
   - 3 credits, 3 contact hours

3. Instructor's or course coordinator's name
   - Sai Mounika Errapotu

4. Text book, title, author, and year
   - Network Security, Private Communication in a Public World (2nd edition), Pearson Publishers.
   - Understanding Cryptography, Christof Paar and Jan Pelzl

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Introduction to cryptographic systems, how they work, and their usage in real-world applications. Discussion on security and privacy issues in computer communications and relevant mathematical techniques that address them. Discussions on open problems in the field, work on hands-on projects to learn about implementation of cryptographic tools in hardware platforms.

   b. prerequisites or co-requisites
      i. Prerequisite: ECE 2304 and MATH 2300 with a grade of "C" or better.

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Elective

6. Specific goals for the course
   a. specific outcomes of instruction
      i. Crypto and Security - Understand how cryptography helps in achieving common security goals (data secrecy, message integrity, non-repudiation) and tasks (authentication).

      ii. Symmetric vs. Public Key Crypto - Identify the differences between symmetric and public- key cryptography.

      iii. Symmetric Crypto - Understand the notions of symmetric encryption, hash functions, and message authentication, their formal security definitions and implementation.
      iv. Symmetric Crypto Practice - Learn and implement the specifics of some of the prominent techniques for encryption, hashing, and message authentication (DES, AES, SHA etc.,).

v. Public Key Encryption - Understand the notions of public-key encryption and digital signatures, and their formal security definitions. Understanding the mathematical foundations of cryptographic algorithms.

vi. Public Key Crypto Practice - Learn and implement the specifics of some of the prominent techniques for public-key cryptosystems and digital signature schemes (RSA, ElGamal, DSA etc.,).

vii. Privacy Mechanisms - Study about the role of privacy and its importance in this world of internet. Study algorithms and tools to protect privacy.

viii. Cryptanalysis - Analyze cryptographic primitives and their implementations for correctness, efficiency, and security.

ix. Crypto in modern world: Study about how cryptography and cryptographic requirements for different hardware devices are changing in this inter-connected world. Work on hands-on hardware projects to understand strength of security and privacy algorithms for real-time applications.

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
   i. Student Outcome 1c, "an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics"

7. Brief list of topics to be covered
   - Introduction to Cryptography, Core Security Principles, Vulnerabilities and Threats
   - Stream Ciphers, Symmetric-key Crypto
   - DES and Alternatives
   - AES and Block Ciphers
   - Intro to Public-Key Crypto/Asymmetric Crypto
   - RSA
   - Discrete Logarithm Based Crypto
   - Elliptic Curve Crypto
   - Digital Signatures
   - Hash Functions
   - Considerations while implementing these techniques in real time
   - Key Establishment
   - Privacy preserving algorithms and architectures
   - Applications in Cyber Physical Systems

1. Course number and name
   - ECE 4390 Special Topics

2. Credits and contact hours
   - 3 credits, 3 contact hours

3. Instructor's or course coordinator's name
   - TBD

4. Text book, title, author, and year
   - TBD

5. Specific course information
   a. brief description of the content of the course (catalog description)
      i. Selected topics of current interest in Electrical/Computer Engineering.

   b. prerequisites or co-requisites
      i. Prerequisite: None

   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
      i. Elective

6. Specific goals for the course
   a. specific outcomes of instruction
      i. TBD

   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
      i. TBD

7. Brief list of topics to be covered
   a. TBD

Appendix D: Itemized List of Capital Equipment Purchases During the Past Five Years

Acq Date	Asset Description	Cost
4/9/21	Dell Precision 3630 Tower	765.720
2/25/21	Dell Xps 13 Laptop	1404.320
2/25/21	Dell Xps 13 Laptop	1404.320
2/23/21	Dell Latitude 7424 Rugged Lap	4975.380
2/10/21	Bison 1000 3D Printer DLP	15845.500
11/10/20	TDK Lambda Gen Power Supply	8947.930
10/30/20	Dell Latitude 7410	1312.130
10/30/20	Dell Latitude 7410	1312.130
8/31/20	Dell Precision 7740 Laptop	3755.850
8/6/20	Dell Precision 3541	1074.300
7/8/20	Slot Die Coater	7850.000
6/18/20	Dell Latitude 7400	1218.730
6/18/20	Dell Latitude 7400	1218.730
6/18/20	Dell Latitude 7400	1218.730
4/17/20	Cannon Rebel Camera T7i	1187.240
4/17/20	Dell Precision 3630 Tower	2884.980
4/16/20	DELL LATITUDE 7400	1469.000
1/24/20	Dell Precision 7920 Tower	10536.210
1/24/20	Centrifuge mixer Thinky	15970.000
1/23/20	Dell Optiplex 7070	1414.410
7/12/19	Dell XPS 15 2-in-1 Laptop	3176.900
6/17/19	Radio Reconfig Device USAP2954	13004.300
4/22/19	Dell Precision Tower 5820	2305.090
3/22/19	DELL LATITUDE 7490	1403.720
3/6/19	Dell Precision Tower 7920	9276.800
3/6/19	Voltera V One PCB Printer	5315.650
1/10/19	USRP 2974 Radio SDR	24881.940
9/1/18	Dell Precision 5810	2451.840
6/8/18	Dell Latitude 7480 Laptop	1468.430
2/27/18	Optiplex 5050	807.250
2/27/18	Optiplex 5050	807.250
2/21/18	Dell Optiplex 5050	807.250
2/21/18	Optiplex 5050	807.250
2/19/18	Optiplex 5050	807.250
2/19/18	Optiplex 5050	807.250
2/15/18	Optiplex 5050	807.250
2/14/18	Dell Latitude E5285 2-in-1	1163.920
2/6/18	Dell Optiplex 7450	768.690
1/29/18	Radio Emitter USRP-2944R	8236.300

1/8/18	Optiplex 7450	768.690
11/18/17	MBP 15.4 SPACE GRAY	2985.000
11/18/17	MBP 15.4 SPACE GRAY	2985.000
11/18/17	MBP 15.4 SPACE GRAY	2985.000
9/1/17	Haskris Proline Water Chiller	9250.000
9/1/17	Apple Macbook	1482.000
9/1/17	Television VIZIO 60"	1196.220
9/1/17	Thin DiElect Sheet Tester125HC	8850.000
9/1/17	Thin Dielect Sheet Tester 015	8600.000
6/16/17	Sciencetech 150BSolarSimulator	6316.500
1/25/17	Laptop Dell Latitude E7470	800.000
1/25/17	Laptop Dell Latitude E7470	212.820
1/9/17	4200A SCS perimeter analyzer	62575.950
1/6/17	USRP-2943R Radio Recon Device	6510.910
8/1/16	GLOVE BOX BENCH ST STEEL VACUU	7998.000
1/22/16	Desktop Dell Precision T5810	1602.260
1/22/16	Desktop Dell Precision T5810	1602.260
1/22/16	Desktop Dell Precision T5810	1602.260
1/22/16	Desktop Dell Precision T5810	1602.260
8/31/15	RESISTIVITY MEASURE SYS PRO	19220.400
8/31/15	SOLAR CELL EFF MEAS SYS	24357.500
8/31/15	SPECT HYPERSENSOR IMAGING SYS	89537.000
8/29/15	PROCESS CHAMBER LESKER CO	55118.850

Appendix G: Curricula Vitae for Core Faculty

1. **Sai Mounika Errapotu**

2. Education
    a. University of Houston
        i. PhD in Electrical and Computer Engineering (May 2018)
    b. Jawaharlal Nehru Technological University, India
        i. BTech in Electronics and Communication Engineering (May 2013)

3. Academic experience
    a. University of Texas at El Paso (August 2019 to Present)
        i. Assistant Professor
    b. University of Houston (June 2018 to July 2019)
        i. Post-doctoral Researcher

4. Non-academic experience
    a. Pantech Solutions (January 2012 to May 2013)
        i. Student intern

5. Certifications or professional registrations
    a. None

6. Current membership in professional organizations
    a. Member of IEEE Communications and Computer Societies
    b. Women in Cybersecurity (WiCys)
    c. Networking Networking (N2) Women

7. Honors and awards
    a. Best Dissertation Award ECE, 2018
    b. Rising Stars Funding Award, UT system, 2019

8. Service activities (within and outside of the institution)
    a. **Reviewer Board** for Vehicles Journal
    b. **Founding Member** of Artificial Intelligence empowered Internet of Vehicles (AIIoV) SIG
    c. **Technical Program Committee Member** for:
        i. International Conference on Networking and Services 2021
        ii. IEEE SmartGridComm 2020
        iii. International Conference on Digital Forensics and Cyber Crime (2021, 2020)
        iv. Mobiquitous (2020, 2019)
    d. UTEP ECE Outreach Committee

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation

- J. Ding, S.M. Errapotu, Y. Guo, H. Zhang, D. Yuan and M. Pan, "Private Empirical Risk Minimization with Analytic Gaussian Mechanism for Healthcare System", in *IEEE Transactions on Big Data.*

- S.M. Errapotu, J. Wang, Y. Gong, J. Cho, M. Pan and Z. Han, "SAFE: Secure Appliance Scheduling for Flexible and Efficient Energy Consumption for Smart Home IoT" in *IEEE Internet of Things Issue on AI Powered Network Management: Data Driven Approaches under Resource Constraints*, Vol. 5, no. 6, pp.4380-4391, Dec 2018.

- M. Pan, J. Wang, S.M. Errapotu, X. Zhang, J. Ding and Z. Han, "Big Data Privacy Preservation for Cyber Physical Systems", Electrical and Computer Engineering Briefs, *Springer*, 2019.

- J. Ding, S. M. Errapotu, H. Zhang, Y. Gong, M. Pan and Z. Han, "Stochastic ADMM Based Distributed Machine Learning with Differential Privacy" in *SecureComm*, Orlando, FL, 2019.

- X. Zhang, J. Ding, S.M. Errapotu, X. Huang, P. Li and M. Pan, "Differentially Private Functional Mechanism for Generative Adversarial Networks", in *IEEE Global Communications Conference (GLOBECOM)*, Waikaloa, HI, 2019.

- D. Shi, J. Ding, S.M. Errapotu, H. Yue, W. Xu, X. Zhou and M. Pan, "Deep Q-Network Based Route Scheduling for TNC Vehicles with Passengers' Location Differential Privacy", in IEEE Internet of Things, 2019.

- S.M. Errapotu, H. Li, R. Yu, S. Ren, Q. Pei, M. Pan and Z. Han, "Clock Auction Inspired Privacy Preserving Emergency Demand Response in Colocation Data Centers," in *IEEE Transactions on Dependable and Secure Computing*, Oct 2018.

- S.M. Errapotu, J. Wang, X. Li, Z. Lu, W. Li, M. Pan and Z. Han, "Bid Privacy Preservation in Matching Based Multi-Radio Multi-Channel Spectrum Trading," in *IEEE Transactions on Vehicular Technology*, vol. 67, no. 9, pp.8336-8347, June 2018.

10. Briefly list the most recent professional development activities

    - Completed 4-week course and received Certification in Online Teaching offered by UTEP's Center for Instructional Design (CID) in collaboration with Teaching Online Academy (TOA) that serves as a credential to teach online courses, May 2020.

    - "Blackboard Institute: Transform Teaching and Learning with Blackboard Learn," 2019, Academic Technologies, for teaching and mentoring.

1. **Michael McGarry**

2. Education
    a. Arizona State University
        i. PhD in Electrical Engineering (August 2007)
        ii. MS in Electrical Engineering (December 2004)
    b. Polytechnic Institute of New York University
        i. BS in Computer Engineering (May 1997)

3. Academic experience
    a. University of Texas at El Paso (August 2010 to Present)
        i. Associate Professor (August 2016 to Present)
        ii. Assistant Professor (August 2010 to August 2016)
    b. University of Akron (August 2008 to August 2010)
        i. Assistant Professor
    c. Arizona State University (August 2007 to Present)
        i. Adjunct Professor

4. Non-academic experience
    a. PMC-Sierra (April 1999 to May 2003)
        i. Software Design Engineer

5. Certifications or professional registrations
    a. None

6. Current membership in professional organizations
    a. IEEE senior member

7. Honors and awards
    a. 2009 IEEE Communications Society Best Tutorial Paper Award

8. Service activities (within and outside of the institution)
    a. **Editor** for:
        i. Elsevier Optical Switching and Networking *Special Issue on PON Supported Networking*
    b. **Associate Editor** for:
        i. Elsevier Optical Switching and Networking (2014-Present)
        ii. IEEE Communications Surveys and Tutorials (2010-Present)
    c. **Technical Committee** for:
        i. Elsevier Computer Communications (2014-Present)
    d. **Committee Chair** for:
        i. UTEP Computer Engineering Curriculum Committee
9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation

- F. Jovel, J. McCartney, P. J. Teller, E. Ruiz, and M. P. McGarry “Neighbor Discovery Message Hold Times for MANETs“, *Elsevier Computer Communications*, vol. 112, Nov. 2017

- Thyagaturu, A. Mercian, M. P. McGarry, M. Reisslein, and W. Kellerer “Software Defined Optical Networks (SDONs): A Comprehensive Survey“, *IEEE Communications Surveys and Tutorials*, vol. 18, no. 4, Fourth Quarter 2016

- Mercian, E. Gurrola, F. Aurzada, M. P. McGarry, and M. Reisslein “Upstream Polling Protocols for Flow Control in PON/xDSL Hybrid Access Networks“, *IEEE Transactions on Communications*, vol. 64, no. 7, Jul. 2016

- E. Gurrola, M. P. McGarry, Y. Luo, and F. Effenberger “PON/xDSL Hybrid Access Networks“, *Elsevier Optical Switching and Networking*, vol. 14, Aug. 2014

10. Briefly list the most recent professional development activities

    - UTEP JumpStart Your Research (Spring 2012)

1. **John Moya**

2. Education –
   BSEE, New Mexico State Univ., 1985
   MSEE, New Mexico State Univ., 1988
   PhD EE, Univ. of New Mexico, 1998

3. Academic experience –
   New Mexico Institute of Mining and Technology (New Mexico Tech), Visiting Professor, 1998-2000, full-time
   University of Texas at El Paso,
   Assistant Professor, 2000-2006, full-time
   Associate Professor, 2006-present, full-time

4. Non-Academic experience –
   TRW, Systems Engineer, K-Band subsystem testing and post-launch specialist, 1985, full-time
   Hewlett Packard, Marketing Engineer, Application and Service support for PCB testers, 1988-1990, full-time

5. Certifications or professional registrations: None

6. Current membership in professional organizations: None

7. Honors and awards: 2014 ECE Department Service Award

8. Service activities
   Yucca Council STEM Committee, 2018-present
   El Paso Independent Sch. Dist. Bond Accountability Committee, 2007– 2015
   El Paso Independent Sch. Dist. Facilities Steering Committee, 2014-2015
   UTEP Faculty Senate, 2014-2016, 2018-present
   UTEP Engineering Faculty Council, 2014-present
   UTEP ECE Computer Engineering Area Committee, 2000-present
   UTEP ECE Core Area Committee, 2006-present
   UTEP ECE Lab Committee, 2000-present
   UTEP ECE Transfer Advisor, 2011-present

1. **Patricia A. Nava**

2. Education
   a. New Mexico State University
      i. PhD in Electrical Engineering (December 1995)
      ii. MS in Electrical Engineering (December 1982)
      iii. BS in Electrical Engineering (May 1980)

3. Academic experience
   a. University of Texas at El Paso (September 1996 to Present)
      i. Full Professor (September 2008 to Present)
      ii. Associate Dean for Undergraduate Studies and Academic Affairs (July 2011 to December 2018)
      iii. Department Chair/Program Head (September 2004 to June 2011)
      iv. Associate Professor (September 2002 to August 2008)
      ii. Assistant Professor (September 1996 to August 2002)
   b. New Mexico State University (January 1991 to May 1996)
      i. College Assistant Professor (January 1996 to May 1996
      ii. Lecturer (January 1992 to December 1996)
   c. California State University, Los Angeles (September 1988 to December 1991)
      i. Assistant Professor (August 1988 to December 1991)
   d. Northern Arizona University (August 1984 to July 1988)
      i. Lecturer (August 1984 to July 1988)

4. Non-academic experience
   a. White Sands Missile Range, Office of Advanced Technology, Instrumentation Directorate (September 1982 to July 1984)
      i. Electronics Engineer
   b. IBM, Office Products Division (May 1979 to August 1980)
      i. Design Engineer
   c. Naval Electronic Systems Command (May 1976 to August 1976)
      i. Engineer Aide

5. Certifications or professional registrations
   a. Licensed Professional Engineer in Texas since 2000, License #87489

6. Current membership in professional organizations
   a. IEEE member

7. Honors and awards
   a. 2019 UTEP Academy of Distinguished Teachers
   b. 2018 El Paso Electric Professor in Engineering Education – endowed professorship
   c. 2013 Executive Leadership in Academic Technology and Engineering (ELATE, Drexel Univ.)
   d. 2009 UT Regents' Outstanding Teaching Award

e. 2008 UT System Leadership Dimensions I
f. 2006 Best Professor Award, ECE Senior Projects
g. 2006 Izquierdo Award for Teaching (Endowed Award)
h. 2004 Chancellor's Council Outstanding Teaching Award
i. 2004 "Top 3 Teachers" Award, ECE Department
j. 2003 Lockheed Martin Award for Teaching Excellence
k. 2003, 2002, 2001, 2000, 1999 College of Engineering Top Performer in Teaching Category
l. 2003, 2003 Outstanding Faculty Member, Senior Projects
m. 2001 IEEE Millennium Medal Award
n. 1999 Dean Eugene Thomas Award for Outstanding Faculty Member
o. 1999 NASA Faculty Award for Research
p. 1998 Forrest and Henrietta Lewis Endowed Professor
q. 1996 NSF Engineering Scholars: Faculty for the Future
r. 1987 Arizona Educator of the Year Award (Collegiate Division)

8. Service activities (within and outside of the institution)
   a. **Panelist** for:
      i. National Science Foundation (2003, 2005-2012)
      ii. UT Pan American Faculty Excellence Awards (2010-2013)
   b. **Reviewer** for:
      i. IEEE Transactions on Systems, Man, and Cybernetics
      ii. IEEE Transactions on Education
      iii. Journal of Intelligent and Fuzzy Systems
      iv. AutoSoft Journal
      v. John Wiley & Sons, Inc. Textbooks
   c. **Advisory Board Member** for:
      i. NSF-CISE/EIA (2003-2005)
      ii. NMSU ECE Academy
      iii. WELI: NSF Women in Engineering Leadership Institute (2002-2006)
   d. **Committee Member** for:
      i. IEEE SMC Program Committee (2004-2009)
      ii. Treasurer, IEEE El Paso/Las Cruces Section (1998-2003)
      iii. UT System Innovation in Teaching Awards Selection Committee (2006-2007)
      iv. UTEP Leadership Development Institute Task Force (2010-2012)
      v. UTEP Execute Council (2004-2006)
      vi. UTEP Distinguished Achievement Awards Selection Committee (2005)
      vii. UTEP Undergraduate Curriculum Committee (2000-2003)
      viii. UTEP Student Service Fee Committee (1999-2003, 2008-2012)
      ix. UTEP Computer Engineering Curriculum Committee (1996- present)

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation (* = student author)

R. Villegas*, P. Nava, and A. Vazquez*, “Short-Term Electricity Market Price Forecasting based on De-noised Wavelets and NARX Neural Networks – Data Analytics Approach,” accepted for presentation at, and publication in the Proceedings of, The 21st International Conference on Artificial Intelligence (ICAI’19), July 29 - August 1, 2019.

A. Solis* and P. Nava, “Domain specific architectures: hardware acceleration for machine/deep learning,” Proceedings Volume 11013, Disruptive Technologies in Information Sciences II; 1101307 (2019) https://doi.org/10.1117/12.2519554 Event: SPIE Defense + Commercial Sensing, April 2019, Baltimore, Maryland, United States.

R. Villegas*, P. Nava, and M. Barua*, “Data Mining-based Techniques in Critical Operation of Electrical Transmission and Distribution Systems in a Natural Disaster Event: Future Direction Review,” Proceedings of the 13th Annual IEEE International Systems Conference (SYSCON 2019), pp. 888-895, ISBN 978-1-5386-8396-5, March 2019.

A. Ogilvie, D. Knight, M. Borrego, A. Fuentes, P. Nava, V. Taylor, “Understanding and Diversifying Transfer Student Pathways to Engineering Degrees: An Update on Project Findings,” NSF Grantees Poster Session, Proceedings of the 2017 ASEE Annual Conference & Exposition.

A. Ogilvie, D. Knight, M. Borrego, A. Fuentes, P. Nava, V. Taylor, “Transfer Student Pathways to Engineering Degrees: Progress and Preliminary Findings from a Multi-Institutional Study Based in Texas,” NSF Grantees Poster Session I, Proceedings of the 2016 ASEE Annual Conference & Exposition.

B. Verdin*, R. vonBorries, P. Nava, and A. Butler, “An experiment to enhance signals and systems learning by using technology-based teaching strategies,” ASEE Annual Conference and Exposition, 2014.

D. Valles*, D. Williams, and P. Nava, “Load Balancing Approach Based on Limitations and Bottlenecks of Multi-core Architecture on a Beowulf Cluster Compute-Node,” Proceedings of the 18th International Conference on Parallel and Distributed Processing Techniques and Applications (PDPTA’12), Hamid R. Arabnia (Ed.), July 2012.

J. Flores*, O. Salcedo, R. Pineda, and P. Nava, “"Senior Project Design Success and Quality: A Systems Engineering Approach,” Proceedings of the 10th Annual Conference on Systems Engineering Research (CSER 2012), Procedia Computer Science 8:452-460. DOI:10.1016/j.procs.2012.01.085

10. Briefly list the most recent professional development activities

Machine Learning (2018)
Artificial Intelligence: Technologies for Smart System Design (2017)
Software Engineering (2017)

Advanced Digital Design (2016)

1. **Rodrigo A. Romero**

2. Education
    a. University of Texas at El Paso
        i. Ph.D. in Electrical Engineering (December 2004)
        ii. M.S. in Computer Science (December 1989)
    b. Institute of Technology of Chihuahua, Mexico
        i. M.S. in Electrical Engineering (June 1987)
        ii. B.S. in Industrial and Electronics Engineering (January 1984)

3. Academic experience
    a. University of Texas at El Paso (Sept. 2004 to Present)
        i. Assoc. Prof. of Practice, Dept. of Electrical and Computer Engr. (July '17 – Present)
        ii. Resrch. Assist. Prof. , Dept. of Electrical and Computer Engr. (Sept. '13 – June '17)
        iii. Assist. Dir. of Educ., Outreach, and Training, Cyber-ShARE (Sept. '12 – March '13)
        iv. Undergraduate Prog. Dir., Dept. of Computer Science (Jan. '12 – July '12)
        v. Assoc. Director Cyber–ShARE Center of Excellence (Sept. '08 – Aug. '12)
        vi. Project Manager (Sept. – Dec. '07)
        vii. Lecturer (Dec. '04 – Sept. '13)
        viii. Postdoctoral Researcher, C.S. Lecturer (Sept. '04 – Nov. '05)

4. Non-academic experience
        i. Holguin Group, (Oct. 2000 – April '03)
        Vice President - Director of Technology
        ii. EDM International (April '97 – Oct. 2000)
        Systems and Software Engineering Manager
        iii. Accugraph Corporation, (Sept. '89 – April '97)
        Software Engineering Manager (Dec. '93 – April '97)
        Software Engineer (Sept. '89 – Dec. '93)
        iv. Data General, (March 1986 – Aug. '87)
        Test Engineer
        v. I.M.S.S. Chih. Mexico (1978 – 1984)
        Nurse Aid.
        vi. Hospital Clinica del Parque, Chih. Mexico (1974 – 1979)
        Nurse Aid

5. Certifications or professional registrations
    a. None
6. Current membership in professional organizations
    a. IEEE senior member
7. Honors and awards
    a. NAFIPS 2010, Best Paper Award
8. Service activities (within and outside of the institution)

a. Panelist in three National Science Foundation Proposal Review Panels
b. President of IEEE El Paso Section
c. Judge in the 2011 and 2012 National GEM Consortium
d. Founding faculty mentor of IEEE CS LEAD student chapter at UTEP
e. Faculty mentor of INNOVA Gameworks & Animations at UTEP
f. Liaison of IEEE CS in the Coalition to Diversify Computing (CDC)
g. President of Software and Information Tech. Org. of El Paso

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation
    a. Y. Cheon, R. Romero, and J. Garcia, “HifoCap: An Android App for Wearable Health Devices,” Advances in Digital Technologies, 8th Intl. Conf. on ADIWT, Volume 295 of Frontiers in A.I. and Applications, pp 178-192, IOS Press, DOI: 10.3233/978-1-61499-773-3-178, 2017
    b. V. Kreinovich, O. Kosheleva, A. Pownuk, and R. Romero, "How to Take Into Account Model Inaccuracy When Estimating the Uncertainty of the Result of Data Processing," ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part B: Mech. Eng., 2017
    c. M. Ghamari, C. Soltanpur, S. Cabrera, R. Romero, R. Martinek, and H. Nazeran,"Design and Prototyping of a Wristband-Type Wireless Photoplethysmographic Device for Heart Rate Variability Signal Analysis," Eng. in Medicine and Biology Conf. Mgt. System, EMBC 2016
    d. M. Ceberio, L. Valera, O. Kosheleva, and R. Romero, "Model Reduction: Why It Is Possible and How It Can Potentially Help to Control Swarms of Unmanned Arial Vehicles (UAVs)," Fuzzy Information Processing Society (NAFIPS) 2015 5th, 2015
    e. J. Olaya and R. Romero, ”Runtime Pipeline Scheduling System for Heterogeneous Architectures,” Conf. on Extreme Science and Engineering Discovery Environment XSEDE14, ACM, July 13-14, Atlanta
    f. A. Sosa, L. Thompson, A.A. Velasco, R. Romero, and R.B. Herrmann, "3-D Structure of the Rio Grande Rift from 1-D Constrained Joint Inversion of Receiver Functions and Surface Wave Dispersion," Earth and Planetary Science Letters, June 2014, DOI: 10.1016/j.epsl.2014.06.002
    g. A. Sosa, A.A. Velasco, L. Velazquez, M. Argaez, and R. Romero, “Constrained optimization framework for joint inversion of geophysical data sets”, Geophysical Journal International, December, 2013, 195 (3), pp. 1745-1762, doi: 10.1093/gji/ggt326

Appendix H: Curricula Vitae for Support Faculty

1. Name:
   - **Sergio D. Cabrera**

2. Education

Massachusetts Institute of Tech.	Cambridge, MA.	Electrical Eng: S. B. 1977
University of Arizona	Tucson, AZ	Electrical Eng: M. S. 1979
Rice University	Houston, TX	Electrical Eng: Ph. D. 1985

3. Academic Experience

9/1994 to present	Associate Professor, Dept. Electrical & Comp. Eng., UTEP
8/2018 to 1/2019	Designated Campus Colleague, Dept. Electrical & Comp. Eng., U. Arizona
1/1992 to 8/1994	Assistant Professor, Dept. Electrical & Comp. Eng., UTEP
8/1987 to 12/1991	Assistant Professor, Dept. Electrical & Comp. Eng., Penn. State Univ., U. P.

4. Non-Academic Experience

6/1985 to 8/1987	Senior Engineer, Anadrill/Schlumberger, Sugar Land, Texas

6. Current membership in professional organizations:
IEEE (Signal Processing Society; Engineering in Medicine and Biology Society; El Paso Section Secretary)

7. Honors and awards:
Texas Instruments Foundation Professorship in Digital Signal Processing (2002-2011)

8. Service activities (within and outside of the institution):
   - Reviewer for various IEEE Signal Processing Society conferences: ICASSP (yearly), ICIP (yearly), Southwest Symposium on Image Analysis and Interpretation (every 2 years), others.
   - Technical Program Committee member: 2010, 2012, 2014, 2016 IEEE Southwest Symposium on Image Analysis and Interpretation.
   - Faculty Senate Council, Faculty Senate Committee on Faculty Welfare, Committee on Committees, Graduate Scholarships Committee, etc.
   - Departmental Committees:
     1. Committee Member, Electrical and Computer Engineering Ph. D. Program. (January 2012 - Present).
     2. Committee Chair, member: Systems and Communications Area. (January 2010 - Present).
     3. Committee Chair, Texas Instruments Foundation Endowed Scholarships Selection Committee. (January 2010 - Present), etc.

9. Publications and presentations from the past five years

- Deeksha Seetharama-Bhat, **Sergio Cabrera**, Rodrigo Romero, and Stephen Sands, "Assessing Performance of Detectors of High-Frequency Oscillations in EEG Signals," in Proc. of *9th Intl. IEEE EMBS Conference on Neural Engineering*, San Francisco, CA, March 20-23, 2019.
- Basavarajaiah S. Totada, **Sergio D. Cabrera**, "Detection of People from Time-of-Flight Depth Images Using a Cell-Tracking Methodology," in Proc. of *IEEE International Symposium on Signal Processing and Information Technology,* Louisville, Kentucky, December 6 - 8, 2018.
- Deeksha S Bhat*, Bryan D Kern, **Sergio D Cabrera**, Rodrigo A Romero, Stephen F Sands, "Assessing High-Frequency Oscillation Rates in EEG Signals for Seizure Prediction,", Neuroscience 2018, poster presentation, November 3-7, San Diego, CA
- M. Ghamari, C. Soltanpur, **S. Cabrera**, R. Romero, R. Martinek and H. Nazeran, "Design and prototyping of a wristband-type wireless photoplethysmographic device for heart rate variability signal analysis," *2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, Orlando, FL, 2016, pp. 4967-4970.
- Verma AK, **Cabrera SD**, Fazel-Rezai R. Continuous Balance Assessment of Autonomic Nervous System Using Time-Varying Analysis of Heart Rate Variability1. *ASME. J. Med. Devices. 2016*;10(2):020933-020933-2. doi:10.1115/1.4033144.
- S. Cabrera and Luis Ponce, "Efficient Optimal Recovery Based Spatially-Adaptive Multi-Frame Super-Resolution," SIAM Conference on Imaging Science, poster presentation, Albuquerque NM, May 2016.
- Ismael Silva, B. Mederos, L. Ortega-Maynez and **S. Cabrera**, "Multi-frame super-resolution for mixed Gaussian and impulse noise based on blind inpainting," 2015 IEEE Signal Processing and Signal Processing Education Workshop (SP/SPE), Salt Lake City, UT, 2015, pp. 208-213.
- Jose Mejia, Boris Mederos, **Sergio Cabrera**, Humberto Ochoa-Dominguez, Osslan Vergara-Villegas, "Noise Reduction in PET Sinograms Using Non-Local Total Variation Regularization, in Proc. of 2014 IEEE Southwest Symposium on Image Analysis and Interpretation, San Diego, CA, April 2014.
- Ajay Verma, **Sergio Cabrera**, Homer Nazeran, "Spectral- and Time-Domain Analysis of Heart Rate Variability Signals from Multiple Photoplethysmographic (PPG) Sensors"*"* in Proc. Of *30th Southern Biomedical Engineering Conference (SBEC)*, Gulfport, MS, April 2014 and Journal of Mississippi Academy of Sciences 2014. Vol 59, pp 351-354.

10. Recent professional development activities

Faculty Development Leave (sabbatical), University of Arizona, Tucson AZ, August 2018 – December 2018:
Joined the Magnetic Resonance Imaging (MRI) multidisciplinary group (8 faculty, post-docs, Ph. D. students) for research meetings, discussions, seminars, etc., hosted by Prof. Ali Bilgin, Dept. of Electrical and Computer Engineering. Also audited 2 graduate courses:

1- Biomedical Engineering 516: Biomedical Imaging, Fall 2018, instructor Prof. Art Gmitro
2- Systems and Industrial Engineering 545: Fundamentals of Optimization, Fall 2018, Prof. Jianqiang Cheng

1. Name
   - **Hector Erives**

2. Education – degree, discipline, institution, year
   - Ph.D. EE New Mexico State University 1996
   - M.S. IE The University of Texas at El Paso 1990
   - B.S. ET&IE Chihuahua Institute of Technology 1988

3. Academic experience – institution, rank, title (chair, coordinator, etc. if appropriate), when (e.g., 2002-2007), full-time or part-time

Institution	**Rank**	**Title**	**Date**	**FT/PT**
University of Texas at El Paso	Visiting Professor	Instructor	2018-Present	Full-time
University of Texas At El Paso	Lecturer	Instructor	Jan 2018-Aug. 2018	Part-time
New Mexico Tech	Adjunct Professor		2018-Present	
New Mexico Tech	Associate Professor	Instructor	2010-2018	Full-time
New Mexico Tech	Assistant Professor	Instructor	2005-2010	Full-time

4. Non-academic experience – company or entity, title, brief description of position, when (e.g., 2008-2012), full-time or part-time

Company	**Title**	**Description**	**Date**	**FT/PT**
Applied Technology Associates	CV Engineer	Development of Computer Vision algorithms	Summer 2017	Part-time
Altamira Corporation	Senior Software Engineer	Development of Communications method	2016	Part-time
USDA	Consultant	Remote Sensing Software implementation	2012	Part-time
Science Systems and Applications	Instrument Engineer	Calibration algorithm implementation	2001-2004	Full-time
Opto-Knowledge Systems	Staff Scientist	Algorithm development	1997-2000	Full-time

5. Certifications or professional registrations

Professional Engineer in the State of New Mexico

6. Current membership in professional organizations

Senior Member IEEE, Senior Member SPIE

7. Honors and awards

8. Service activities (within and outside of the institution)

Event Organizer (Fall 2018): First Worshop on Biomedical and Medical Imaging at UTEP.

Mentor (Summer 2018): Nexo Global Colombia and UTEP student exchange program.

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation

Acoustic vs Interferometric Measurements of Lightning, Arechiga R., Erives H., Sonnenfeld R., Stanley M., Rison W., Thomas R., Harald Edens H., Lapierre J., Jensen D., Morris K., A*merican Geophysical Union*, San Francisco, CA, December 14-18, 2015.
Comparison of Acoustic Location, VHF Mapping, and High Speed Video Recordings of Lighting Flashes, Arechiga R., Edens, H., Erives H., Thomas, R., Rison, W., International Conference on Lightning & Static Electricity, Toulouse, 9-11 September, 2015.
Lightning Mapping with Inexpensive Acoustic Arrays, Arechiga R., Stock M., Thomas R.J., Erives H., Rison W., 95th American Meteorological Society Annual Meeting, Phoenix, AZ, January 2015.

10. Briefly list the most recent professional development activities

1. Name:
   - **Virgilio E. Gonzalez**
2. Education – degree, discipline, institution, year
   - B.S., Electronics and Communications Engineering, Instituto Tecnologico y de Estudios Superiores de Monterrey – CEM, Mexico , 1988
   - M.S., Manufacturing Systems Engineering, Instituto Tecnologico y de Estudios Superiores de Monterrey – CEM, Mexico , 1991
   - Ph.D. , Computer Engineering, University of Texas at El Paso,1999
3. Academic experience – institution, rank, title (chair, coordinator, etc. if appropriate), when (e.g., 2002-2007), full-time or part-time
   - University of Texas at El Paso, Clinical Associate Professor, ECE Associate Chair, (2013 – Present), FT
   - University of Texas at El Paso, ECE Undergraduate Program Director, (2009- 2013), FT
   - University of Texas at El Paso, Assistant Professor, (2003-2009), FT
   - University of Texas at El Paso, Visiting Assistant Professor, (2001– 2003), FT
   - University of Texas at El Paso, Research Assistant, (1993-1996), PT
4. Non-academic experience – company or entity, title, brief description of position, when (e.g., 2008-2012), full-time or part-time
   - AT&T Mexico (Servicios Alestra), Technology Planning Manager, Responsible national network planning and technology certification, (1996-2001), FT
   - Telecommunications Director, Instituto Tecnologico de Monterrey (Mexico), Planning and implementation of telecommunications services for academic applications, (1989-1993)
5. Certifications or professional registrations
   - Professional License in Mexico (CEDULA)
   - LabVIEW CLAD certification
6. Current membership in professional organizations
   - Senior Member, Institute of Electrical and Electronic Engineers, 8/1986 – Present.
   - IEEE Member, Communications Society, Computer society, Education Society, Robotics and Automation Society
   - Member, American Society for Engineering Education, 1/2005 – Present.
7. Honors and awards
   - 2019 Dean's Award for Excellence in Service , UTEP College of Engineering, Spring 2019
   - Regents' Outstanding Teaching Award, University of Texas System, September 2012
   - Woody Everett Award, American Society of Engineering Education – Computers in Education division, June 2011
   - ECE Service Award for support to students, UTEP – ECE department, 2010
8. Service activities (within and outside of the institution)
   - ABET Program Evaluator since June 2014
   - FIRST Robotic programs, FLL Affiliate partner for West Texas since 2010.
   - Institute of Electrical and Electronic Engineers, Secretary of El Paso section (2009-2015) , Treasurer (2019-present).

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation
    - J. Gonzalez, M. Elahi, J. A. Castillo, V. Gonzalez, P. Corral, and D. Yasuda, "4G LTE and Telemetry Interference Analysis on a Flexible Software-Defined Radio Testbed Platform," presented at the International Telemetry Conference, Glendale , Arizona, 2018.
    - Perez, O. A., P. Golding, V. E. Gonzalez and M. T. Pitcher (2017). Work in progress: Year two of analysis of the impact of a web-based student dashboard for a multi-agent approach to academic advising. 124th ASEE Annual Conference and Exposition, June 25, 2017 - June 28, 2017, Columbus, OH.
    - Perez, O. A. and V. E. Gonzalez (2016). “Student dashboard for a multi-agent approach for academic advising”. 123rd ASEE Annual Conference and Exposition, June 26, 2016 - June 29, 2016, New Orleans, LA.
    - Gonzalez, V. E., & Perez, O. A., “Work-in-Progress: Student Dashboard for a Multi-agent Approach for Academic Advising”, Transactions on Techniques in STEM Education, NCEE, vol 1, pp. 2-14, 2015
    - Perez, O. A., Gonzalez, V., Golding, P., Pitcher, M. T., Gomez, H., Espinoza, P., Hemmitt, H., Anaya, R. H., (2014). A Three Year Longitudinal Study of Mobile Technology and Analysis of the Impact on a STEM-Based Course. ASEE Computers in Education Journal, 5(1), 85-94
    - Quintana. J. and Gonzalez, V., "Detection and calculation of reflected spectral shifts in fiber-Bragg gratings (FBG) in polarization maintaining optical fiber," in Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems 2014, March 10, 2014 - March 13, 2014, San Diego, CA, United states, 2014, pp. American Society of Mechanical Engineers; The Society of Photo-Optical Instrumentation Engineers (SPIE).
    - Quintana, J., Rumpf, R., and Gonzalez, V., "Modified transfer matrix method model for a fiber Bragg grating strain sensor in polarization maintaining single mode optical fiber," in Integrated Optics: Devices, Materials, and Technologies XVIII. San Francisco, CA, USA, 20140203, Place of Publication: San Francisco, CA, USA. Country of Publication: USA., 2014, p. (8 pp.).
10. Briefly list the most recent professional development activities
    - NI Week Conference (2019)
    - FIRST Community Partners meeting (2019)
    - NI LabView CORE training, Fall 2018
    - International Telemetry Conference (2018)

1. Name
    - **Robert Christopher Roberts**

2. Education
    a. Ph.D., Electrical Engineering, Case Western Reserve University, 2012
    b. M.S., Systems & Control Engineering, Case Western Reserve University, 2006
    c. B.S., Systems & Control Engineering, Case Western Reserve University, 2005

3. Academic experience
    - University of Hong Kong, Lecturer, 2018, Full-Time
    - University of Hong Kong, Senior Research Associate, 2017-2018, Full-Time
    - University of Hong Kong, Research Assistant Professor, 2013-2017, Full-Time
    - University of Hong Kong, Postdoctoral Research Associate, 2012-2013, Full-Time

4. Non-academic experience
    a. Hestia Innovations (HK) Limited, Co-Founder, Start-up venture building robotic culinary equipment, 2018, Part-Time
    b. Corvidae Technology (HK) Limited, Co-Founder, Start-up venture building robotic drone-based industrial inspection solutions, 2017-2018, Part-Time
    c. Pacific Industries (HK) Limited, Consultant, Product development of mass-produced consumer-grade 3D printers, 2012-2014, Part-Time
    d. The Sherwin Williams Company, Laboratory Technician, 25% software development and 75% research on color mixing algorithm implementation in the Color Group, 2005-2006, Full-Time

5. Certifications or professional registrations
    - N/A

6. Current membership in professional organizations
    - Member, Institute of Electrical and Electronics Engineers
    - Member, Material Research Society
    - Member, Surface Mount Technology Association

7. Honors and awards
    - 2015 Lab on a Chip – Top 30 Most Downloaded Articles of 2014
    - 2015 HKU Engineering Research Output Prize
    - 2012 Keithley Graduate Fellowship
    - 2010 Honorable Mention: Lenore A. Kola Graduate Student Community Service Award
    - 2009 Outstanding Graduate Student Award – EECS @ CWRU
    - 2007 Eta Kappa Nu (HKN) Honor Society
    - 2006-2007 Case Prime Fellowship

8. Service activities (within and outside of the institution)
    - Service activities (within and outside of the institution)

- Judge and Event Volunteer – US FIRST robotics competitions in El Paso
- Demonstrator – Inaugural U.S. Army Drone Design Competition
- Review Panelist – National Science Foundation
- Organizing Committee –Hilton Head Workshop 2020
- Associate Editor - IEEE Sensors Journal
- Reviewer – Journal of Micro-electro-mechanical Systems, IEEE Sensors Journal, IEEE Sensors Letters, Sensors and Actuators B, Nature Scientific Reports

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation
    - M. Salek, X. Shang, R.C. Roberts, M.J. Lancaster, F. Boettcher, D. Weber, T. Starke,"W-Band Waveguide Bandpass Filters Fabricated by Micro Laser Sintering," in IEEE Transactions on Circuits and Systems II: Express Briefs, vol. 66, no. 1, pp.61-65, Jan. 2019. doi: 10.1109/TCSII.2018.2824898
    - X. Wu, K.Y. Au-Yeung, X. Li, R.C. Roberts, J. Tian, C. Hu, Y. Huang, S. Wang, Z. Yang, and W. Wen, "High-efficiency ventilated metamaterial absorber at low frequency," Appl. Phys. Lett. 112, 103505 (2018).
    - M. Clark and R.C. Roberts, “Autonomous Quadrotor Terrain-Following with a Laser Rangefinder and Gimbal System,” Technical Digest, The 16th IEEE Conference on Sensors (Sensors 2017), Glasgow, Scotland, Oct. 29 – Nov. 1, 2017, pp. 1176-1178. Oral Presentation.
    - R.C. Roberts, and N.C. Tien, "3D Printed Stainless Steel Microelectrode Arrays," Technical Digest, The 19th International Conference on Solid-State Sensors, Actuators and Microsystems (Transducers 2017), June 18-28, 2017, pp. 1233-1236. Poster Presentation.
    - J.E. Kabigting, A.D. Chen, E. J.-H. Chang, W.-N. Lee, and R.C. Roberts, "MEMS Pressure Sensor Array Wearable for Traditional Chinese Medicine Pulse-Taking," Technical Digest, The 14th Annual IEEE EMBS Conference on Wearable and Implantable Body Sensor Networks (BSN2017), Eindhoven, Netherlands, May 9-12, 2017, Poster Presentation.
    - P. Wang, R.C. Roberts, A.H.W. Ngan, "Direct microfabrication of oxide patterns by local electrodeposition of precisely positioned electrolyte: the case of Cu2O," Nature Scientific Reports 6, Article number: 27423 (2016) doi:10.1038/srep27423
    - Z. Wang, S. Wang, J. Zeng, X. Ren, A.J.Y. Chee, B.Y.S. Yiu, W.C. Chung, Y. Yang, A.C.H. Yu, R.C. Roberts, A.C.O. Tsang, K.W. Chow, P.K.L. Chan, “High sensitivity, wearable, piezoresistive pressure sensors based on irregular micro-hump structures,” Small, Vol. 12(28), pp. 3827-36. (2016 July) doi: 10.1002/smll.201601419
    - R.C. Roberts, S. Zheng, N.C. Tien, “Design and Fabrication of Buckled Metal Strain Gauges Using Shape Memory Polymer and Inkjet Additive Microfabrication,” Technical Digest, The 14th IEEE Conference on Sensors (Sensors 2015), Busan, Korea, Nov. 1-4, 2015, pp. 1665-1668. Poster Presentation.

- Z. Liu, S.T. Chan, H.A. Faizi, R.C. Roberts, H.C. Shum, "Droplet-based electro-coalescence for probing threshold disjoining pressure," Lab on a Chip, 2nd March 2015 DOI: 10.1039/C5LC00177C
- R.C. Roberts, J. Wu, N.Y. Hau, Y.H. Chang, S.P. Feng, D.C. Li, "Facile 3D Metal Electrode Fabrication for Energy Applications via Inkjet Printing and Shape Memory Polymer," PowerMEMS 2014, Journal of Physics: Conference Series, Vol. 557, (2014) 012006. DOI: 10.1088/1742-6596/557/1/012006. Oral Presentation.
- G. Li, R.C. Roberts*, N.C. Tien, "Interlacing Method for Micro-Patterning Silver via Inkjet Printing," Technical Digest, The 13th IEEE Conference on Sensors (Sensors 2014), Nov. 2-5, 2014, pp. 1687-1690. Oral Presentation.
- J. Wu, R.C. Roberts*, N.C. Tien, D.C. Li, "Inkjet Printed Silver Patterning on PDMS to Fabricate Microelectrodes for Microfluidic Sensing," Technical Digest, The 13th IEEE Conference on Sensors (Sensors 2014), Nov. 2-5, 2014, pp. 1100-1104. Poster Presentation.
- J.S. Lee, X.Q. Zheng, R.C. Roberts, P.X.-L. Feng, "Scanning Electron Microscopy Characterization of Structural Features in Suspended and Non-Suspended Graphene by Customized CVD Growth," Diamond & Related Materials, Vol. 51, DOI: 10.1016/j.diamond.2014.11.012 (2014).
- J. Wu, R. Wang, H. Yu, G. Li, K. Xu, N.C. Tien, R.C. Roberts*, D.C. Li, "Inkjet Printed Microelectrodes on PDMS as Biosensors for Functionalized Microfluidic Systems," Lab on a Chip, 10th November 2014 DOI: 10.1039/C4LC01121J - "Top 30 Most Downloaded Articles in 2015" – PI on project and corresponding author
-
- B. Peng, X. Ren, Z. Wang, R.C. Roberts, P.K.L. Chan, "High performance organic transistor active-matrix driver developed on paper substrate," Nature Scientific Reports, 19th September 2014 Vol. 4 No. 6430, DOI: 10.1038/srep06430 - "2015 HKU Research Output Prize"
-
- S. Gupta, G. Li, R.C. Roberts, L.J. Jiang, "Log-Periodic Dipole Array Antenna as a Chipless Radio-Frequency Identification (RFID) Tag," Electronic Letters, 27th February 2014 Vol. 50 No. 5 pp. 339–341

10. Briefly list the most recent professional development activities
    a. NSF Panel Reviewer – Washington DC – March 21-22, 2019
    b. NIST Campus Visit – Gaithersburg, MD – March 20, 2019
    c. UTEP Engineering NSF Career Writing Workshop – March 8, 2019
    d. UTEP New Faculty Lunch Series – El Paso, TX – Spring 2019
    e. Hilton Head Workshop 2018 w/ NSF Seminar – Hilton Head, SC, June 2018

1. Name:

- **Ricardo Freitas von Borries**

2. Education

- Rice University, Houston, TX, 2005. PhD, Electrical and Computer Engineering.
- Universidade Federal do Rio de Janeiro (COPPE/UFRJ), Brazil, Rio de Janeiro, RJ, 1989. Master of Science in Electrical Engineering.
- Universidade de Bras´ılia (UnB), Brazil, Bras´ılia, DF, 1982. Bachelor of Science in Electrical Engineering with double concentration in Electronics Engineering and Power Engineering.

3. Academic Experience

- University of Texas at El Paso, El Paso, USA Associate Professor

Department of Electrical and Computer Engineering (2010–Present). Taught Undergraduate courses: Continuous-Time Signals and Systems, Probabilistic Methods. Graduate courses: Probability and Random Processes, Statistical Signal Processing: Estimation Theory; Probability and Random Processes.

- Assistant Professor

Department of Electrical and Computer Engineering (2004–2010). Taught undergraduate courses: Probabilistic Methods, Electric Circuits, Lab for electric Circuits, Electronic Circuits, Lab for Electronic Circuits. Graduate courses: Tomographic Imaging, Probability and Random Processes, Statistical Signal Processing: Estimation Theory.

- Universidade de Bras´ılia, Bras´ılia, Brazil Assistant Professor

Department of Electrical Engineering (1989–1998). Taught undergraduate courses: Architecture of Microprocessors, Electric Circuits, Linear and Non-Linear Electronic Circuits, Power Electronics. Supervised 23 undergraduate senior projects.

4. Non-Academic Experience

- Pr´ologo S.A., Bras´ılia, Brazil R&D Electrical Engineer Division of Electronics (1983–1986).

Designed or took part in the design team of over 10 products: communication protocol for a communication processing unit, microcomputer interface card, switched-mode power supplies.

6. Current membership in professional organizations:

- IEEE – Institute of Electrical and Electronics Engineers (1992–Present). SIAM – Society for Industrial and Applied Mathematics (2002–Present). ASEE – American Society for Engineering Education (2006–Present).

7. Honors and awards:

- Rice University Fellowship, Rice University, Research Assistant Fellowship (1998–2004).
- Japan International Cooperation Agency (JICA), Fellowship, Japan (1995–1995).
- Outstanding Teacher, selected by graduating seniors of the Department of Electrical Engineering at Universidade de Bras´ılia, Brazil, 1992, 1996, 1997.

8. Service activities (within and outside of the institution):

- CoE-ECE Chair Search and Screen Committee, Chair of the Committee (2011–2012).
- MSPL Lab (Multi−Sensing−Processing and Learning Laboratory), director, ECE, UTEP (2008– Present).
- Senior Project Advisor.
- NSF Panel Reviewer (2006–2009)
- IEEE and Elsevier Journal Paper Reviewer (2005–Present).

9. Publications and presentations from the past five years

- [F. B. da Silva, R. von Borries, and C. Jacques Miosso. Golden number sampling applied to compressive sensing. In IEEE Southwest Symposium on Image Analysis and Interpretation (SSIAI), April 8–10 2018.
- C. Jacques Miosso, R. F. von Borries, and J. H. Pierluissi. Compressive sensing with prior information - Requirements and probabilities of reconstruction in ℓ1-minimization. IEEE Trans- actions on Signal Processing, October 2012. Accepted.
- C. Jacques Miosso, R. F. von Borries, M. Arga´ez, and L. Velazquez et. al. Compressive sensing reconstruction with prior information by iteratively reweighted least-squares. IEEE Transac- tions on Signal Processing, 57(6):2424–2431, June 2009.
- R. F. von Borries, J. H. Pierluissi, and H. Nazeran. Redundant discrete wavelet transform for ECG signal processing. International Journal of Biomedical Soft Computing and Human Sciences, 14(2):69–80, March 2009.

10. Recent professional development activities

- Faculty developmental leave January-June, 2019 at the University of Brasilia (UnB), Brasilia, DF, Brazil
- “Postdoctoral Fellowship for Teaching Excellence and Innovation,” UTEP’s Provost Office, November 2011, $80,000 for two years, June 2012 to May 2014.
- “Detection and Imaging of Improvised Explosive Devices,” Army Research Office (ARO), De- partment of Defense (DoD) Program HBCU/MI, R. von Borries (PI), April 2011, $564,904 for three years.
- “Collaborative Research: CI-Team Implementation Project: The Signal Processing Education Network,” National Science Foundation (NSF), (CI-TEAM), Rice University: R. G. Baraniuk (PI).UTEP: R. von Borries (PI) and P. A. Nava (Co-PI); August 2010, $43,750 for three years.
- “LIDAR Compressed Sensing Using Prior Information,” National Geospatial Agency (NGA), Post Doctoral Program, R. von Borries (PI), June 2010, $239,716 for two years.

Joined the Magnetic Resonance Imaging (MRI) multidisciplinary group (8 faculty, post-docs, Ph. D. students) for research meetings, discussions, seminars, etc., hosted by Prof. Ali Bilgin, Dept. of Electrical and Computer Engineering. Also audited 2 graduate courses:

3- Biomedical Engineering 516: Biomedical Imaging, Fall 2018, instructor Prof. Art Gmitro
4- Systems and Industrial Engineering 545: Fundamentals of Optimization, Fall 2018, Prof. Jianqiang Cheng

Appendix J: Letters of Support from Peer Institutions and/or Area Employers

Texas Instruments Incorporated
12500 TI Boulevard, MS/ B4000
Dallas, TX 75243

November 23, 2021

To: Dr. Miguel Velez-Reyes
Department Chair
Department of Electrical and Computer Engineering
University of Texas at El Paso
500 W University Ave
El Paso, TX 79968

From: Mark Easley, Marketing Manager, University Marketing
measley@ti.com

CC: Laura Chambers, Director, University Marketing

Subject: UTEP Letter of Collaboration

Texas Instruments is in support of the proposed BS in Computer Engineering degree program at the University of Texas at El Paso. We have reviewed the proposed degree plan and believe that it will provide graduates with the marketable skills we are interested in. It is extremely important for our Texas based workforce to attract, retain, and graduate computer engineers from our state universities. The labor demand for computer engineers is extremely high, both locally in Texas and nationwide. The semiconductor industry and technology sector require computer engineers to design and build embedded systems and electronics products, so this is a crucial area of study that should be added to the undergraduate programs at University of Texas at El Paso. Computer Engineers also are critical to many other industries requiring technology or electronics such as software, automotive, energy, consumer products, industrial automation and control, robotics, aerospace, medical devices, telecommunications, cloud computing, entertainment, defense, and countless more. Giving more students access to pursue this engineering degree will keep Texas competitive in the global market.

In conclusion, we offer our strong support for the proposed BS in Computer Engineering and look forward to recruiting its graduates to join our organization.

TI Approval:

Mark Easley
Marketing Manager, University Marketing

Date: 11/23/2021

December 10, 2021

Dr. Miguel Velez-Reyes
Department Chair
Department of Electrical and Computer Engineering
University of Texas at El Paso
500 W University Ave
El Paso, TX 79968

Dear Dr. Velez-Reyes:

Tektronix writes this letter supporting the proposed BS in Computer Engineering degree program at the University of Texas at El Paso. We believe the proposed degree plan will provide graduates with the industry ready, marketable skills we are interested in recruiting.

Tektronix seeks engineering candidates who are well rounded beyond the specificity of an EE or CE degree – with combined cross-disciplined skills that would include strong problem solving, communication/collaboration skills-- along with a mindset of inclusiveness/respect, inquisitiveness, willing to take on challenges and adaptability.

As collaborative context, Tektronix is honored to have recently contributed to the Inclusive Engineering Consortium's (IEC) Foundation in support of its Diversity, Inclusion and Equity charter. As part of this, we are collaboratively working to support IEC's emerging student internship program going into 2022.

In conclusion, we offer our strong support for the proposed BS in Computer Engineering and look forward to supporting their graduating students a placement path into industry (recruiting its graduates to join our organization.)

Sincerely,

Wilson Lee

Wilson Lee
Education Market Segment Lead
14150 SW Karl Braun Drive
Beaverton, Oregon 97005
E/ wilson.lee@tektronix.com
T/ 503.627.5830 **M**/ 971.708.5907
tek.com
Tektronix®
KEITHLEY
A Tektronix Company

December 10, 2021

Dr. Miguel Velez-Reyes
Department Chair
Department of Electrical and Computer Engineering
University of Texas at El Paso
500 W University Ave
El Paso, TX 79968

Dear Dr. Velez-Reyes:

We at Infineon write this letter in support of the proposed BS in Computer Engineering degree program at the University of Texas at El Paso. We have reviewed the proposed degree plan and believe that it will provide graduates with the marketable skills we are interested in.

As a global company with over 50,000 employees, Infineon believes there is strength in diversity. These graduates will be qualified to work not only at Infineon, but at many technology companies. Infineon has many opportunities for engineers across the United States. Additionally, Infineon has a large footprint in Austin, Texas. The need for new college graduates in computer engineering changes dynamically, but is increasing as our workforce in the Americas is growing. For example, there is a rapidly increasing growth in the areas of artificial intelligence and machine learning and these technologies rely heavily on computer engineers.

While we cannot guarantee future employment for any graduates (e.g. each candidate will need to go through Infineon's hiring process), we offer our strong support for the proposed BS in Computer Engineering and look forward to recruiting some well-qualified graduates to join our organization should open requisitions arise.

Sincerely,

Patrick R. Kane

Patrick R. Kane EdD
Director, University Alliance Program

C +1 408.550.4508
Cypress Semiconductor Corporation
An Infineon Technologies Company
198 Champion Court, San Jose, CA USA 95134
www.infineon.com www.cypress.com/cua

DEPARTMENT OF THE ARMY
U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND
DATA AND ANALYSIS CENTER
6509 WAYBERRY ROAD
ABERDEEN PROVING GROUND, MARYLAND 21005

MEMORANDUM: Dr. Miguel Velez-Reyes, Department Chair, Electrical Engineering Department, The University of Texas at El Paso (UTEP), 500 W. University Avenue, El Paso, TX, 79968

SUBJECT: U.S. Army Combat Capabilities Development Command, Data and Analysis Center (DEVCOM DAC) supports UTEP's proposal of the new Bachelor of Science in Computer Engineering degree program.

1. DEVCOM DAC is pleased to support UTEP's proposal of the new Bachelor of Science in Computer Engineering degree program. DEVCOM DAC and UTEP's long-standing and highly-productive collaboration, through the Cyber Center for Analysis and Assessment (CCAA), aligns with the US Army Futures Command's (AFC) Talent Management lines of effort. This partnership focuses on research & development (R&D) as well as information sharing across various government agencies. Cybersecurity subject matter experts (SMEs) leading DEVCOM DAC's CCAA facilitate various R&D projects involving tools, techniques, and methodologies (TTMs) through capstone projects within the Computer Science and Electrical/Electronic Engineering Departments. These hands-on projects enable UTEP professors and students to assist in the development of TTMs to address DEVCOM DAC's gaps within cybersecurity analysis, as needed, to execute cybersecurity assessments and experimentation of emerging technologies and Army Modernization Priorities.

2. DEVCOM DAC views the new Bachelor in Computer Engineering degree program as an excellent opportunity for UTEP to equip and empower students with the technical skills to help solve the Army's modernization challenges. UTEP's state-of-the-art laboratories will help DEVCOM DAC continue to drive mission effectiveness and advance capability development. As such, we strongly support the proposed Bachelor in Computer Engineering degree program where the curriculum is aligned to further develop our future workforce skills in the areas of Digital Design, Embedded Systems, Communication Networks, Machine Learning, and most importantly Cybersecurity. Our workforce needs to be highly skilled in these areas to make significant contributions to the Army's Modernization Priorities. This proposal will benefit the U.S. Army, the warfighter, and will increase the cyber resilience of Army emerging technologies. In conclusion, we offer our strong support for the proposed BS in Computer Engineering and look forward to recruiting its graduates to join our organization.

3. Technical points of contact for this action are:
Dr. Oscar A. Perez, (575) 678-0047, oscar.a.perez46.civ@mail.mil
Dr. Jayashree Harikumar, (575) 678-8616, jayashree.harikumar.civ@mail.mil.

Dr. Jayashree Harikumar,
Chief, Cyberspace Emerging Technology & Integration Branch

January 6, 2022

Dr. Miguel Velez-Reyes
Department Chair
Department of Electrical and Computer Engineering
University of Texas at El Paso
500 W University Ave
El Paso, TX 79968

Dear Dr. Velez-Reyes:

We at Schneider Electric write this letter in support of the proposed BS in Computer Engineering degree program at the University of Texas at El Paso. We have reviewed the proposed degree plan and believe that it will provide graduates with the marketable skills needed to address the talent gap we are facing in our nation.

The pandemic has accelerated the deployment of digital, automation and connected. The Bureau of Labor Statistics has estimated that at the end of 2021 there were approx. **461,100 jobs** for Computer and Information Sciences and Support Services professionals. It is one of the fastest job markets with an anticipated growth between 22-26% annually.

At Schneider we partner closely with UTP as a feeder school for our plants. This additional major would be of significant preparing students for a career in the digital connected economy and providing corporations such as ours a pool of talent.

In conclusion, we offer our strong support for the proposed BS in Computer Engineering and look forward to recruiting its graduates to join our organization.

Best Regards,

Ivonne Valdes
Global Vice President Strategic Sales
Schneider Electric

Schneider Electric
Pleasanton, California
Phone: 1(925)353-5215
se.com

Infrastructure Masons

3855 SW 153rd Drive
Beaverton, OR 97003

January 6, 2022

Dr. Miguel Velez-Reyes
Department Chair
Department of Electrical and Computer Engineering
University of Texas at El Paso
500 W University Ave
El Paso, TX 79968

Dear Dr. Velez-Reyes:

We at Infrastructure Masons write this letter in support of the proposed BS in Computer Engineering degree program at the University of Texas at El Paso. We have reviewed the proposed degree plan and believe that it will provide graduates with the marketable skills the digital infrastructure industry needs.

Infrastructure Masons (iMasons) is a non-profit, professional society of technology and business leaders who represent over $150Bn in infrastructure projects in over 130 countries. The organization is guided by an Advisory Council composed of global leaders who manage some of the largest digital infrastructure portfolios in the world. The iMasons vision is to Unite the Builders of the Digital Age by enabling our global membership to Connect, Grow, and Give Back. iMasons has four strategic priorities – enhance Education opportunities, champion Diversity & Inclusion, inspire Sustainability and promote Innovation and Technical Excellence. We believe that a BS Computer Engineering program at UTEP will enhance the flow of diverse talent into our industry.

iMasons currently manages a Capstone Program in which we support students in a year long project to learn about our industry. We have active projects at Hampton University, Morgan State, and Prairie View A&M, and we look forward to UTEP joining this program this month with a first team of students. We certainly would welcome Computer Engineering students in this program!

iMasons is just getting started with our Capstone project, but as a result of our pilot program at Hampton University last academic year, all of the ECE graduates who were not previously otherwise committed (grad school, other jobs, etc.) were hired into our industry. We believe we can place most or all of this year's students, and we look forward to this BS CE degree program at UTEP providing a strong pipeline of talent into our industry.

In conclusion, we offer our strong support for the proposed BS in Computer Engineering and look forward to recruiting its graduates to join our industry

[Type here]

Sincerely,

Jeff Omelchuck
Executive Director
Infrastructure Masons
www.imasons.org

BLUE ORIGIN

January 7, 2022

Dr. Miguel Velez-Reyes
Department Chair for Department of Electrical and Computer Engineering
University of Texas at El Paso
500 W University Ave, El Paso, TX 79968

RE: Proposal for the Bachelor of Science in Computer Engineering at UTEP

Dear Dr. Velez-Reyes,

I am writing to support the proposed Bachelor of Science in Computer Engineering degree program at the University of Texas at El Paso (UTEP). Over the past six years, Blue Origin has partnered with UTEP in developing an engineering workforce for NASA and commercial space exploration companies. Blue Origin has hired more than fifteen full-time engineers from UTEP, mostly employed at Launch Site One. That partnership has specifically focused on mechanical engineers, but as Blue Origin grows its workforce, we are also in need of electrical and computer engineering students both for internships and for our early-career roles. We have reviewed the proposed degree plan and believe that it will provide graduates with the marketable skills we are interested in.

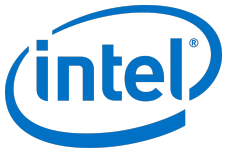
UTEP alumni have been essential to the development of our rocket engines. The BE-3 engine is the first new liquid hydrogen-fueled rocket engine that was designed, built, tested, and produced in America in over a decade. Additionally, our BE-4 engine, fueled by Liquefied Natural Gas, is currently under development for both Blue Origin and United Launch Alliance, another strong supporter for the university. The fundamental and applied research performed by UTEP has been highly successful in developing propulsion and test engineers who make a vital and immediate contribution to companies like Blue Origin. In addition to propulsion and test engineers, we need electrical and computer engineers to support the development and flight of our vehicles and engines. This program would enable Blue Origin and UTEP to grow our partnership to support the development of electrical and computer engineers who are ready to take on early-career roles within the space industry.

Blue Origin has an ongoing cooperative relationship with UTEP. We continually engage with students at career fairs and the SETS conference, and several Blue Origin employees mentor students as they develop liquid rocket engine test stands. UTEP excels in educating minority students in engineering, particularly Hispanic students who have historically been under-represented in the aerospace industry. We look forward to continuing to provide skilled engineers access to aerospace careers through internships and employment opportunities. We believe the United States' global leadership in space technologies depends on our ability to educate and train a propulsion engineering work force with 21st century demographics. We view it critical to Blue Origin as well as the general emerging commercial space ecosystem that UTEP continues along its successful trajectory in developing this workforce.

For the benefit of Earth,

Michael Edmonds
SVP| Strategy, Marketing, & Sales

21218 76TH AVE S. | KENT, WA 98032



January 13th, 2022

Dr. Miguel Velez-Reyes
Department Chair
Department of Electrical and Computer Engineering
University of Texas at El Paso
500 W University Ave
El Paso, TX 79968

Dear Dr. Velez-Reyes:

We at Intel's Programmable Solutions Group Academic team endorse the proposed BS in Computer Engineering degree program at the University of Texas at El Paso. We have reviewed the proposed degree plan and believe that it will provide graduates with the marketable skills we are interested in.

Your curriculum aligns with the computer engineering skills we seek in hiring interns and college graduates into Intel PSG division. We look forward to evaluating and exploring the possibility of hiring more University of Texas, El Paso students in the coming years.

Sincerely,

José Roberto Alvarez
Sr. Director, Intel Programmable Solutions Group
Technology and Innovation
CTO and Strategy Office Head
101 Innovation Drive
San José, CA 95134
jose.alvarez@intel.com

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 1100

Title (29 characters or fewer): Lab for ECE 1300

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Introduction to Electrical Engineering laboratory procedures, causes, and correction of errors in measurements theory of operation and usage of basic Electrical Engineering test instruments, and report writing.

Contact Hours (per week): Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**

Corequisite Course(s):
ECE 1305

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Lower Div. Electrical Engr

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 1300

Title (29 characters or fewer): Intro to Electr/Comp Eng

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
An introduction to mathematical and systems concepts that form the basis for electrical engineering. Includes an introduction to circuit components, voltage and current concepts. Also included are sinusoidal signal characteristics, basic filter responses and bandwidth concepts.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MATH 1411	C	Y

Corequisite Course(s):
ECE 1100

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Lower Div. Electrical Engr or Pre-engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 2102

Title (29 characters or fewer): Lab for ECE 2302

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Use of oscilloscopes, function generators, and power supplies to test and study electrical networks and their behavior. Technical writing and computer aided design.

Contact Hours (per week): Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 1100	C	N

Corequisite Course(s):
ECE 2302

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Lower Div. Electrical Engr

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 2103

Title (29 characters or fewer): Lab for ECE 2303

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Implementation and testing of basic cominational and sequential digital systems.

Contact Hours (per week): Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 1300 and ECE 1100	C	N
or CS 1301 and CS 1101	C	N
or CS 1401	C	N

Corequisite Course(s):
ECE 2303

Equivalent Course(s):

Restrictions:	
Classification	Sophomore or Junior or Senior
Major	Electrical Engineering or Computer Engineering or Computer Science or Lower Div. Electrical Engr

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 2104

Title (29 characters or fewer): Lab for ECE 2304

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Assembly language programming of microcomputer systems.

Contact Hours (per week): Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2103	C	N
ECE 2303	C	N
ECE 2300	C	N

Corequisite Course(s):
ECE 2304

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Computer Science

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 2300

Title (29 characters or fewer): Software Design I

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Foundations of data structures and algorithms. These foundations include: space and time complexity analysis, the use of data structures such as linked lists and binary trees, basic sorting and searching algorithms, and foundations of software testing/verification/validation.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
CS 1320	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 2301

Title (29 characters or fewer): Electric Circuits I

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Introduction to systematic methodologies for the analysis of electric circuits in DC and AC steady state. Use of simulation tools for steady state circuit analysis.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 1300	C	N
PHYS 2421	C	Y
MATH 1312	C	N
MATH 2326	C	Y

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Lower Div. Electrical Engr

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 2302

Title (29 characters or fewer): Electric Circuits II

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Analysis of transient behavior in first-order and second order circuits. Circuit analysis using the Laplace transforms. Network functions and frequency response representation of circuits. Frequency selective circuits. Resonance in electric circuits. Steady-state analysis of circuits fed by non-sinusodial periodic signals using Fourier series. Two-port networks. Computer-aided analysis of circuits.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2301	C	N
PHYS 2421	C	N
MATH 2326	C	N

Corequisite Course(s):
ECE 2102

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Lower Div. Electrical Engr

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 2303

Title (29 characters or fewer): Digital Systems Design I

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Design and synthesis of digital systems using both combinational and sequential circuits. Includes laboratory projects implemented with standard ICs.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 1300 and ECE 1100	C	N
or CS 1301 and CS 1101	C	N
or CS 1401	C	N

Corequisite Course(s):
ECE 2103

Equivalent Course(s):

Restrictions:	
Classification	Sophomore or Junior or Senior
Major	Electrical Engineering or Computer Engineering or Computer Science or Lower Div. Electrical Engr

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 2304

Title (29 characters or fewer): Microprocessor Systems I

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Study of microprocessor programming models, assembly language, macro assembles, and an introduction to system integration and interfacing.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2300	C	N
ECE 2302	C	N
ECE 2303	C	N

Corequisite Course(s):
ECE 2104

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Computer Science

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 3100

Title (29 characters or fewer): Junior Prof. Orientation

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Professional Orientation for Junior Electrical/Computer Engineering Students. Introduction to the engineering profession with emphasis on systems engineering, job placement, and professional and ethical conduct in the engineering workplace. Required of all students prior to graduation.

Contact Hours (per week): 1 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	**Junior or Senior**
Major	**Electrical Engineering or Computer Engineering**

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 3141

Title (29 characters or fewer): Lab for ECE 3341

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Introduction to experimental analysis of junction diodes, bipolar junction transistors, and junction field effect transistors. Frequency response measurements of operational amplifier circuits. Fourier analysis. PSPICE simulations.

Contact Hours (per week): Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2102	C	N
ECE 2302	C	N

Corequisite Course(s):
ECE 3341

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 3180

Title (29 characters or fewer): Lab for ECE 3380

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
The objective is to apply the theory covered in the lecture to analyze and simulate the behavior of communication technologies.

Contact Hours (per week): Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**

Corequisite Course(s):
ECE 3380

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Lower Div. Electrical Engr

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 3331

Title (29 characters or fewer): Discrete Time Signals & Sys

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Representation and analysis of discrete time signals and systems, digital filtering, sampling, spectrum analysis, Z-transform, DT Fourier transform, and the DFT. Emphasizes computer simulations and some basic applications to communications, control and signal processing.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
CS 1320	C	N
ECE 2301	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 3332

Title (29 characters or fewer): Prob with App Elect/Comp Eng

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
An introduction to probability, sets, combinatorics, discrete and continuous random variables, single and multiple random variables, probability and cumulative functions, conditional probability, statistical independence, moments of random variables, and functions of random variables. In addition, the course presents applications of probability in areas such as quantization, data compression, estimation, detection, clustering, and queueing. Computer simulations provide motivation and facilitate understanding of the theory and applications.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MATH 2326	C	N
EE 2353 or ECE 3331	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Computer Science

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 3341

Title (29 characters or fewer): Electronics I

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Electronics I is an introduction to electronic devices and circuits: Amplifier concepts, diodes, field effect transistor amplifiers, bipolar junction transistor amplifiers.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2302	C	N

Corequisite Course(s):
ECE 3141

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 3350

Title (29 characters or fewer): Software Design II

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Object-oriented software design (including polymorphism), multi-threaded programming techniques, algorithmic complexity analysis, classes of algorithms, heuristic algorithms, and basics of database systems. Utilize the C and C++ programming languages in a Linux development environment using the GNU toolchain.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2300	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Computer Science

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 3351

Title (29 characters or fewer): Computer Architecture

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Binary representation of characters, integers, floating point numbers and assembly language instructions. Integer arithmetic circuit design. Data path and control path design of a non-pipelined and pipelined microprocessor. Multi-processing architectures. Hierarchical memory design.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2304	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Computer Science

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 3352

Title (29 characters or fewer): Operating System Design

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Design and implementation of single and multiuser operating systems. Topics include OS structure, process management, interprocess communication within and between CPUs, memory management, file systems, and I/O. Contemporary operating systems provide design examples.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2300	C	N
ECE 2304	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Computer Science

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 3380

Title (29 characters or fewer): Intro to Communication Netwks

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Familiarization with communication networks through simulation experiments done with computer software. Topics include Protocol Layers, Link Analysis, Circuit and Packet switches, LANs, and Internet Protocols.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2300	C	N
EE 2353 or ECE 3331	C	N

Corequisite Course(s):
ECE 3180

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 4153

Title (29 characters or fewer): Lab for ECE 4353

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Design and verification of digital systems using simulation. Laboratory implementation using standard, integrated circuits and programmable logic devices.

Contact Hours (per week): Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2104	C	N
ECE 2304	C	N

Corequisite Course(s):
ECE 4353

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 4154

Title (29 characters or fewer): Lab for ECE 4354

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Use of development tools in the design and implementation of microprocessor-based systems.

Contact Hours (per week): Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☐ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2104	C	N
ECE 2304	C	N

Corequisite Course(s):
ECE 4354

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Computer Science

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
We need a sequence of capstone project courses specific to our new BS in Computer Engineering program.

All fields below are required

Subject Prefix and # ECE 4201

Title (29 characters or fewer): CpE Senior Project Lab I

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Research & Analysis leading to a preliminary design for an approved engineering project. Includes formal project proposal and work plan; specification of functional, performance and cost goals; generation of computer-aided design documents and simulation or modeling results. Design process is concluded in ECE 4202 through prototyping, testing and revisions.

Contact Hours (per week): 1 Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2104	C	N
ECE 2304	C	N
ECE 3100	C	N
ECE 3141	C	N
ECE 3331	C	N
ECE 3341	C	N
ECE 3350	C	N
ECE 3351	C	N
ECE 3352	C	N
CE 2326	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Senior or Junior
Major	Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
We need a sequence of capstone project courses specific to our new BS in Computer Engineering program.

All fields below are required

Subject Prefix and # ECE 4202

Title (29 characters or fewer): CpE Senior Project Lab II

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☒Yes ☐No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Laboratory development of special projects concerned with various computer engineering systems. Small group or individual semester projects are stressed.

Contact Hours (per week): 1 Lecture Hours 3 Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☒ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 4201	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Senior
Major	Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 4353

Title (29 characters or fewer): Digital Systems Design II

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Design techniques for complex digital systems, with emphasis on computer hardware design and computer- aided techniques, including hardware description languages and hardware simulation packages. Algorithmic State Machine design is stressed for small systems. Emphasis on problem definition, design, and verification.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2304	C	N

Corequisite Course(s):
ECE 4153

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 4354

Title (29 characters or fewer): Microprocessor Systems II

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
A study of a 16/32 bit microprocessor family and companion devices and various design aspects of microprocessor systems.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2304	C	N

Corequisite Course(s):
ECE 4154

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Computer Science

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 4355

Title (29 characters or fewer): VLSI Design

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Introduction to CMOS VLSI design and computer-aided VLSI design tools. A term project is required that involves high-level design approaches, layout editing, simulation, logic verification, timing analysis, and testing

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 3341	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Junior or Senior
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 4360

Title (29 characters or fewer): Foundations of Deep Learning

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Concepts and techniques in deep learning in AI. Historical and current paradigms for implementation, and their applications.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 2300	C	N
ECE 3331	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering or Computer Science

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 4361

Title (29 characters or fewer): Fuzzy Logic and Engineering

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Underlying philosophy of the theory of fuzzy sets and its applications in engineering. Fuzzy logic, fuzzy reasoning and rules, and fuzzy systems. Decision-making in the realm of vague, qualitative and imprecise data. Current models, simulation tools, hardware implementations and their applications will also be covered.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 3331	C	N
ECE 3332	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	Senior
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 4362

Title (29 characters or fewer): Computer Vision

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Fundamental concepts associated with the construction of meaningful understanding of physical objects from images/video; including basic animal vision structure/operation, image segmentation/understanding, knowledge representation, matching and inference.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
ECE 3331	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 4370

Title (29 characters or fewer): Introduction to Cybersecurity

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☒Yes ☐No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Cryptography is an indispensable tool for protecting information in computer systems. In this course, students will be introduced to cryptographic systems, how they work, and their usage in real-world applications. Students will learn about security issues in computer communications, about cryptographic tools and their implementation on MSP 430/432, Arduino or Rasp Pi. The lessons are primarily aimed at beginners, all mathematical concepts will be covered in detail. Throughout the course, participants will be exposed to many exciting open problems in the field and work on hands on projects.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**
MATH 2303	C	N
ECE 2304	C	N

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	Electrical Engineering or Computer Engineering

COURSE ADD

All fields below are required

College : Engineering **Department :** Electrical and Computer Engineering

Rationale for adding the course:
New Bachelor of Science in Computer Engineering

All fields below are required

Subject Prefix and # ECE 4390

Title (29 characters or fewer): Special Topics

Dept. Administrative Code : 936

CIP Code 14 .0901 .00

Departmental Approval Required ☐Yes ☒No

Course Level ☒UG ☐GR ☐DR ☐SP

Course will be taught: ☒ Face-to-Face ☐ Online ☐ Hybrid

How many times may the course be taken for credit? (Please indicate 1-9 times): 1

Should the course be exempt from the "Three Repeat Rule?" ☐Yes ☒No

Grading Mode: ☒Standard ☐Pass/Fail ☐Audit

Description (600 characters maximum):
Selected topics of current interest in Electrical/Computer Engineering.

Contact Hours (per week): 3 Lecture Hours Lab Hours Other

Types of Instruction (Schedule Type): Select all that apply

☒ A	Lecture	☐ H	Thesis
☐ B	Laboratory	☐ I	Dissertation
☐ C	Practicum	☐ K	Lecture/Lab Combined
☐ D	Seminar	☐ O	Discussion or Review (Study Skills)
☐ E	Independent Study	☐ P	Specialized Instruction
☐ F	Private Lesson	☐ Q	Student Teaching

Fields below if applicable

If course is taught during a part of term in addition to a full 16-week term please indicate the length of the course (ex., 8 weeks):

TCCN (Use for lower division courses) :

Prerequisite(s):		
Course Number/ Placement Test	**Minimum Grade Required/ Test Scores**	**Concurrent Enrollment Permitted? (Y/N)**

Corequisite Course(s):

Equivalent Course(s):

Restrictions:	
Classification	
Major	**Electrical Engineering or Computer Engineering**