COMPUTER ENGINEERING

AT

UNIVERSITY OF NEVADA, LAS VEGAS

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

UNIVERSITY OF NEVADA, LAS VEGAS
4505 MARYLAND PARKWAY, BOX 454026
LAS VEGAS, NV 89154-4026
PHONE: (702) 895-4183
DEPARTMENT OFFICE: TBE B325

Computer engineering is the application of scientific and mathematical principles to the design and analysis of all hardware, software, and operating systems for a computer system. Computer engineering integrates several fields of electrical engineering and computer science. Computer engineering is one of the most vibrant and constantly changing fields in engineering. Computational capability that was only possible by machines that weighed tens of tons and required thousands of square feet of room space some time ago, are now afforded by chips smaller than a thumbnail. Billion-transistor chips and Terabyte storage are now a reality, and Petaflop performance is within reach. On the other hand, software consideration has become an essential aspect of the design process. Devices such as cell phones, digital audio players, digital video recorders, alarm systems, x-ray machines, and laser surgical tools all require integration of hardware and software.

This discipline covers the study of hardware, software, and their integration. As such, students learn the principles of electricity, signals and systems, and technologies used in making digital devices. They further study programming languages, data structure, operating systems, and databases. The knowledge acquired in the first three years of undergraduate program will culminate in architecture and design-related courses in which students experience the cost-performance tradeoffs associated with mitigating hardware issues to software. Computer engineers are employed in the manufacturing and R&D companies, federal and state government departments and research laboratories, healthcare, transportation, financial institutions, and service oriented businesses.

The degree program is accredited by the Engineering Accreditation Commission of ABET (Accreditation Board for Engineering and Technology, Inc.) http://www.abet.org. It requires 130 credit hours, including 33 credits of the University's general education core. The full name of the degree is Bachelor of Science in Engineering with a Major in Computer Engineering.

1. MISSION, PROGRAM OBJECTIVES AND OUTCOMES

1.1 THE MISSION OF THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

The mission of the Department of Electrical and Computer Engineering is to serve society as a center of higher learning by providing an electrical and computer engineering education to society's future leaders, innovators, and engineers.

Goals

1. Provide undergraduate, graduate and professional education.
2. Create knowledge through research.
3. Disseminate knowledge through publication.
4. Provide private and public service, in as much as said service educates, creates and disseminates knowledge, or functions as a repository of knowledge

1.2 COMPUTER ENGINEERING PROGRAM EDUCATIONAL OBJECTIVES

The Program Educational Objective of the Computer Engineering program is to create, apply, and disseminate knowledge immediately or within a few years after graduation the graduate

1. can successfully practice and mature intellectually in the field of Computer Engineering or a related field
2. can be admitted to and successfully progress through a post graduate program in Computer Engineering or related program.

1.3 COMPUTER ENGINEERING STUDENT OUTCOMES

To achieve these objectives and goals, each graduate of the Computer Engineering Major will attain the following outcomes before graduation:

1. The appropriate technical knowledge and skills
    1. An ability to apply mathematics through differential and integral calculus,
    2. An ability to apply advanced mathematics such as differential equations and discrete mathematics,
    3. An ability to apply knowledge of basic sciences,
    4. An ability to apply knowledge of computer science
    5. An ability to apply knowledge of probability and statistics,
    6. An ability to apply knowledge of engineering
    7. An ability to design a system, component, or process to meet desired needs within realistic constraints
    8. An ability to identify, formulate, and solve engineering problems
    9. An ability to analyze and design software and systems containing hardware and software
    10. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
    11. An ability to design and conduct experiments, as well as to analyze and interpret data.

2. The appropriate interpersonal skills

1. An ability to function on multidisciplinary teams
2. An ability to communicate effectively

3. The knowledge and skills to be responsible citizens.
    1. An understanding of professional and ethical responsibility
    2. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
    3. A recognition of the need for, and an ability to engage in life-long learning
    4. A knowledge of contemporary issues
    5. A knowledge of the basic content and concepts of the U.S. and Nevada constitutions

2. COMPUTER ENGINEERING MAJOR ENTRANCE REQUIREMENTS

To enter the Computer Engineering (CpE) Major, a student must be admitted to the College of Engineering. Students who have been admitted to the College of Engineering and are interested in being admitted to the CpE Major will be placed in the Computer Engineering Pre-major (CpEPRE). A student in the CpEPRE is eligible to submit an application to the Advising Center for advanced standing in the CpE Major after completing the 23 credits of the 44 credit CpEPRE curriculum listed below. Students who have not completed the CpEPRE curriculum and do not have advanced standing in the CpE Major cannot enroll in upper division Computer Engineering courses except for those listed below in the CpEPRE Extended Curriculum.

COMPUTER ENGINEERING PRE-MAJOR (CpEPRE) CURRICULUM

Sciences (8 Credits)

- CHEM 121 General Chemistry I
- PHYS 180 Physics for Scientists and Engineers I
- PHYS 180L Physics for Scientists and Engineers Lab I

Mathematics (8 Credits)

- MATH 181 Calculus I
- MATH 182 Calculus II

Electrical and Computer Engineering (3 Credits)

- CpE 100 Computer Logic Design I

Computer Science (3 Credits)

- CS 135 Computer Science I

COMPUTER ENGINEERING PRE-MAJOR (CpEPRE) EXTENDED CURRICULUM

Sciences (4 Credits)

- PHYS 181 Physics for Scientists and Engineers II
- PHYS 181L Physics for Scientists and Engineers Lab II

Mathematics (9 Credits)

- MATH 251 Discrete Math I
- MATH 431 Mathematics for Engineers and Scientists I
  or CpE 260 or Signals and Systems for Computer Engineers
- STAT 411 Statistical Methods I

Electrical and Computer Engineering (9 Credits)

- CpE 200 Computer Logic Design II
- CpE 200L Computer Logic Design Laboratory
- CpE 300 Digital System Architecture and Design
- EE 220 Circuits I
- EE 220D Circuits I Discussion
- EE 221 Circuits II
- EE 221L Circuits II Laboratory

3. COMPUTER ENGINEERING CURRICULUM

3. 1 UNLV GENERAL EDUCATION CORE REQUIREMENTS FOR COMPUTER ENGINEERING MAJOR (33-37 CREDITS)

English Composition (6 credits)

- ENG 101 Composition & Rhetoric I
- ENG 102 Composition & Rhetoric II

Seminars (5 – 6 credits)

- EGG 101/L Introductory Engineering Experience / Lab (2 -3 Credits)
- SYS/PHIL 242 Sophomore Year Experience (3 Credits)

Constitutions (4-6 credits)

- HIST 100 Historical Issues and Contemporary Man
- PSC 101 Introduction to American Politics (OR)
- A combination of one course from each of the following two lists
  - US Constitution
    - HIST 101 United States: Colonial Period to 1865
    - HIST 106 European Civilization Since 1648
  - Nevada Constituion
    - HIST 102 United States: 1865 to Present
    - HIST 217 Nevada History
    - PSC 100 Nevada Constitution

Social Science (9 credits)

- ECON 190 Global Economics (Satisfies international requirement)
- EGG 307 Engineering Economics
- See the Faculty Senate General Education web-page for courses that satisfy this requirement. (Not ECON)

Humanities (6 credits)

- PHIL 242 Ethics For Engineers and Scientists
- COM 216 Survey of Communication Studies

Fine Arts (3 credits)

- See the Faculty Senate General Education website for courses that satisfy this requirement.

Multicultural and International Requirements (6 credits)

- Multicultural requirement (3 credits)
- International requirement (3 credits)

The multicultural and international requirements can simultaneously fulfill other general education core requirements; however, a single course cannot meet the multicultural and international requirements simultaneously. To determine courses satisfying these requirements, consult the Faculty Senate General Education Committee.

3.2 REQUIRED MATHEMATICS AND NATURAL SCIENCE COURSES (29 CREDITS)

CHEM 121	General Chemistry I
MATH 181	Calculus I
MATH 182	Calculus II
MATH 251	Discrete Math I
MATH 431	Mathematics for Engineers and Scientists I
or CPE 260	or Signals and Systems for CpE
PHYS 180	Engineering Physics I
PHYS 180L	Engineering Physics I Laboratory
PHYS 181	Engineering Physics II
PHYS 181L	Engineering Physics II Laboratory
STAT 463	Applied Statistics for Engineers
Or STAT 411	or Statistical Methods I

3.3 REQUIRED COMPUTER ENGINEERING FUNDAMENTAL COURSES (46 CREDITS)

CpE 100	Digital Logic Design I
CpE 200	Digital Logic Design II
CpE 200D	Digital Logic Design II Discussion
CpE 200L	Digital Logic Design II Laboratory
CpE 300	Digital System Architecture and Design
CpE 301	Embedded Systems Design
CpE 301L	Embedded Systems Design Laboratory for CpE
CpE 302	Synthesis and Verification using Programmable Devices
CS 135	Computer Science I
CS 202	Computer Science II
CS 218	Systems Programming
CS 302	Introduction to Data Structures
CS 370	Operating Systems
EE 220	Circuits I
EE 220D	Circuits I Discussion
EE 221	Circuits II
EE 221L	Circuits II Laboratory

EE 320 Engineering Electronics I
EE 320L Engineering Electronics I Laboratory
EE 497 Senior Design Project I
EE 498 Senior Design Project II

3.4 REQUIRED COMPUTER ENGINEERING CORE COURSES (12 CREDITS)

Each student must complete 12 credits by selecting two out of the four core areas: Digital Electronic Design, Computer Networks, Computer System Design, and Software Engineering. Core areas include:

Digital Electronic Design

- EE 421 Digital Integrated Circuit Design
- CpE 408 VLSI Physical Design and Testing

Computer Networks

- CpE 400 Computer Communications Networks
- CS 445 Internet Security

Computer System Design

- CpE 403 Advanced Embedded Systems
- CpE 404 Modern Processor Architecture
- CpE 409 Embedded DSP

Security Systems:

- CpE 407 Biometrics
- CpE 405 Information Coding Systems
- CS 445 Internet Security

3.5 REQUIRED COMPUTER ENGINEERING LABORATORY COURSE (1 CREDIT)

Each student must complete one credit of laboratory from the following list:

CpE 300L Digital Systems Architecture and Design Laboratory
EE 340L Power System Engineering Laboratory
EE 370L Control Systems Laboratory
EE 420L Engineering Electronics II Laboratory
EE 421L Digital Integrated Circuit Design Laboratory
EE 450L Solid State Characterization Laboratory
EE 460L Communication Systems Lab
EE 480L Digital Signal Processing Laboratory

3.6 REQUIRED COMPUTER ENGINEERING PROFESSIONAL ELECTIVE COURSES (9 CREDITS)

Each student must complete 9 credits of approved professional electives that are listed in Table 1. Of the 9 credits, six of the credits must be EE or CpE courses. Students are encouraged to select sequences within a particular core field. The other three credits must be mathematics or science

courses (BIOL, CHEM, MATH, PHYS, STAT). Students who want to apply a professional elective that is not listed in Table 1 towards their EE degree must obtain the Department Chair's and the Undergraduate Curriculum Committee's Chair's approval.

Table 1: Professional Electives for Computer Engineering

CpE 400	Computer Communications Network	EE 466	Wireless and Mobile Comm.
CpE 403	Advanced Embedded Systems	EE 472	Digital Control Systems
CpE 404	Modern Processor Architecture	EE 480	Digital Signal Processing
CpE 405	Information Coding Systems	EE 482	Intro to Biomedical Signals and Systems
CpE 407	Biometrics	EE 493	Independent Study
CpE 408	VLSI Physical Design and Testing	EE 495	Special Topics
CpE 409	Embedded DSP	CHEM 122A	General Chemistry II
EE 330	Engineering Electromagnetics	MATH 271	Elementary Probability
EE 340	Power System Engineering	MATH 283	Calculus III
EE 370	Control System	MATH 330	Linear Algebra
EE 420	Electronics II	MATH 432	Mathematics for Engineers & Scientists II
EE 421	Digital Integrated Circuit Design	MATH 451	Foundations of Mathematics I
EE 430	Transmission Lines	MATH 468	Applied Finite Element Analysis
EE 431	Engineering Optics	PHYS 182	Physics for Scientists & Engineers III
EE 432	Antenna Engineering	PHYS 250	Special Relativity
EE 436	Active and Passive Microwave Eng.	PHYS 411	Modern Physics I
EE 442	Power Electronics	PHYS 461	Light and Physical Optics
EE 446	Photovoltaic Devices and Systems	PHYS 462	Modern Optics
EE 450	Solid State Devices	PHYS 483	Special Topics in Physics
EE 451	Electronic & Mag. Materials & Devic.	STAT 467	Intro. to Mathematical Statistics
EE 452	Intro to Optical Electronics	STAT 493	Applied Regression Analysis
EE 453	Introduction to Nanotechnology	STAT 495	Nonparametric Statistics
EE 460	Analog and Digital Communication		
EE 462	Advanced Digital Communication		

3.7 GRADE REQUIREMENTS

All EE, CpE, ME, CS, BIOL, CHEM, MATH, PHYS, and STAT courses must be completed with a grade of *C* or better.

3.8 MISCELLANEOUS REQUIREMENTS

Each student must also meet all College of Engineering requirements including those relating to college suspension and readmission. The department can refuse to accept any course taken more than eight years prior to graduation.

4. COURSE PLANS AND GRADUATION APPLICATIONS

Every student must consult an advisor in the Engineering Advising Center every semester before registering and make or update a Year Ahead Study Plan. One year before graduation the student should submit a Graduation application. The flowchart and checklist provided at the end of this handout are provided to help guide students while planning their class schedules.

Electrical engineering students should expect to study about 2 to 3 hours per week outside class for each credit. For example, a student taking 16 credit hours should expect to spend 32 to 48 hours each week studying outside of class. Combined with time in class, this works out to a total of 48 to 64 hours spent on academic work. Students who are working while attending school should adjust their academic load accordingly. The following serves as a guideline:

Academic Load		**Expected Study Time**	**Maximum Non-Academic Work Load**
Fall or Spring	**Summer**		
16 credits	6 credits	32 to 48 hours / week	0 to 8 hours / week
12 credits	3 credits	24 to 32 hours / week	8 to 16 hours / week
8 credits		16 to 24 hours / week	16 to 22 hours / week
3 credits		6 to 9 hours / week	32 to 40 hours / week

5. FACULTY

The faculty of the Department of Electrical and Computer Engineering are:

Yingtao Jiang, Chair	Yahia Baghzouz
Jacob Baker	Biswajit Das
Peter Stubberud	Pushkin Kachroo
Shahram Latifi	Brendan Morris
Venkatesan Muthukumar (UGC)	Emma Regentova
Ebrahim Saberinia	Robert Schill, Jr. (GC)
Henry Selvaraj	Sahjendra Singh
Ke-Xun (Kevin) Sun	Rama Venkat
Mei Yang	Sarah Harris
Ramon Martinez (Emeritus)	William L. Brogan (Emeritus)
John Tryon (Emeritus)	Eugene McGaugh, Jr.(Emeritus)

6. COURSE DESCRIPTIONS IN COMPUTER ENGINEERING

COMPUTER ENGINEERING

All prerequisites must be completed with a grade of C or better.

CpE 100 Computer Logic Design I
Digital design concepts and fundamentals. Combinational circuits. MSI and LSI circuits. Sequential machine fundamentals. Sequential circuit analysis and design. Modern developments. **3 credits**
Prerequisites: MATH 126 and MATH 127 or MATH 128

CpE 100L Digital Logic Design I Laboratory
Logic gates. Simplification of Boolean functions, design and testing of combinational and sequential circuits including code converters, multiplexers, adders, and synchronous counters. For non-electrical and non-computer engineering majors only. **1credit**
Corequisite: CpE 100

CpE 200 Computer Logic Design II
Sequential logic, Synchronous and asynchronous circuits, Hazards, PAL/PLA based implementation, Introduction to computers, Introduction to instruction set architecture, Computer Arithmetic, Assembly Language. **3 credits**
Prerequisite: CpE 100

CpE 200D Computer Logic Design II Discussion
Introduction to HDL – simulation and synthesis tools for computer system design (soft-cores), assembly and C programming of computer systems.
Co-requisite: CpE 200

CpE 200L Computer Logic Design II Laboratory
Design and testing of combinational and sequential logic circuits. Includes synchronous and asynchronous circuits, races, cycles, hazards, timing considerations and design with programmable logic devices (PLD). Design and simulation of a simple arithmetic-logic unit, Assembly Language Simulation. **1 credit**
Corequisite: CpE 200; **Prerequisite:** CpE 100

CpE 260 Signals and Systems for Computer Engineers
Real and complex signals and linear time invariant (LTI) systems. Signal analysis using linear combinations of signals from linear signal spaces. Analysis of LTI systems described by linear constant coefficient differential equation using zero input and zero state responses, homogeneous and particular response, and the Laplace transform. **3 credits**
Prerequisite: MATH 182

CpE 300 Digital System Architecture and Design
Assembly for RISC architectures. Special and general purpose microprocessor design. Data and Control paths. Timing Analysis. Interfacing. Memory organization. **3 credits**
Prerequisite: CpE 200

CpE 300L Digital System Architecture and Design Lab
Design of dedicated digital systems and general purpose RISC microprocessors using HDL tools and design platforms. Instruction sets and assembly language. Datapath and Control Unit design. Performance analysis. Memory organization. **Credits 1**
Co-requisite: CpE 300

CpE 301 Embedded Systems Design
Study of microcontrollers and its application to a broad range of engineering problems. Study of microcontroller architecture, instruction set, and interfaces. Study of Assembly and C programming for microcontrollers. Use of simulation and emulation tools. Study of microcontroller interface with sensors, actuators, motors, peripheral devices and communication modules. **3 credits**
Prerequisite: CpE 300 and CS 218

CpE 301L Embedded Systems Design Laboratory for CpE
Hands-on study of the microcontrollers and its application to a broad range of engineering problems. Usage of simulation and emulation tools. Assembly and C microcontroller programming. Hardware interface design and programming. Advanced projects on sensors, acctuators, communication protocol, etc. **1 credit**
Co-requisite: CpE 301 and CS 218

CpE 302 Synthesis and Verification Using Programmable Devices
Advanced methodologies in the design of digital systems. Hardware Description Languages (HDLs). Simulation, synthesis, verification of digital system designs using FPGAs. FPGA placement, routing, and timing analysis tools. **3 credits**
Prerequisites: CpE 200 or CS 302

CpE 310L Embedded Systems Design Laboratory for EE
Hands-on study of the microcontrollers and its application to a broad range of engineering problems. Usage of simulation and emulation tools. Assembly and C microcontroller programming. Hardware interface design and programming. **1 credit**
Prerequisite: EE 221L or EE 292, and CpE 200L

CpE 400 Computer Communications Networks
Study of computer network architecture; OSI model; network protocols; local area networks; communication technologies; Network performance analysis, with emphasis on hardware design issues. **3 credits**
Prerequisites: CpE 300, CS 370, and (MATH 431 or CpE 260).

CpE 403 Advanced Embedded Systems
Design of hardware and software for embedded systems. Study of advanced 32-bit microcontrollers. Hands-on approach in learning assembly language, high-level language programming, debugging, simulators and emulators. Design of efficient embedded systems. RTOS for embedded systems and RTES Design. Project-based, requiring design/construction an embedded system. **3 credits**
Prerequisite: CpE 300

CpE 404 Modern Processor Architecture
Instruction, data, and thread-level parallelism. Scalar and superscalar pipelines. Instruction and data flow techniques. Cache memory. Performance analysis. Case studies. **3 credits**
Prerequisite: CpE 300

CpE 405 Information Coding Systems
Source Modeling. Foundations of lossy and lossless compression. Code properties, optimal codes. Differential coding. Scalar and vector quantization. Transform-based coding. Compression techniques and standards for facsimile, audio, image, and video data. **3 credits**
Prerequisites: (MATH 431 or CpE 260) and EE 220

CpE 407 Biometrics
Fundamentals of Biometric science and technology with a balance between the basic theoretical background (probability theory, statistics, pattern recognition) and practical applications. **3 credits**
Prerequisites: STAT 463 and (MATH 431 or CpE 260).

CpE 408 VLSI Physical Design and Testing
VLSI CAD algorithms for partitioning, floor planning, placement, routing, layout, and compaction. Test process and equipment, fault modeling and simulation, defects, Automatic Test Pattern Generation (ATPG), built-in self-test, design for testability. **3 credits**
Prerequisites: CpE 300 and EE 320.

CpE 409 Embedded DSP
Hardware implementation of DSP operations. Implementation of filters, interpolation and decimation, linear and non-linear transforms. Embedded audio and video processing, error control and coding. DSP processors. **3 credits**.
Prerequisites: CpE 300.

ELECTRICAL ENGINEERING

EE 190 Electrical and Computer Engineering Freshman Design
Introduces safety, ethics and various branches of electrical and computer engineering through one-hour weekly lectures by various professors and practitioners. Students introduced to design principles in electrical and computer engineering and design, build, and test an electrical and/or computer system. **1 credit**
Prerequisite: Freshman status in Electrical and/or Computer Engineering

EE 220 Circuits I
Introduction to linear circuit analysis. Kirchhoff's laws, operational amplifiers, node and loop analysis. Thevenin, Norton, and other network theorems, first order RL and RC circuits, second order RLC circuits. **3 credits**
Corequisite: EE 220D; **Prerequisite**: MATH 182

EE 220D Circuits I Discussion
Introduction to PSpice- simulation tool for Electrical circuits, problem solving using SPICE. **0 credit**
Corequisite: EE 220

EE 221 Circuits II
Sinusoidal steady state analysis using phasors, sinusoidal steady state power, three-phase circuits the Laplace transform and its application to circuit analysis, transfer functions, frequency response, magnetically coupled circuits and transformers, two-port networks. **3 credits**
Prerequisites: EE 220 and CS 117, CS 135

EE 221L Circuits II Laboratory
Basic measurements and instrumentation. Principles of experimentation. **1 credit**
Corequisite: EE 221

EE 292 Fundamentals of Electrical and Computer Engineering
Introduction to electric circuit analysis, electronic devices and circuits, transducers, electric machines and power transmission. For non-electrical engineering majors only. **3 credits**
Prerequisites: PHYS 180 or PHYS 151, and MATH 182

EE 320 Electronics I
Introduction to electronic devices, electronic circuits and electronic signal processing. Design and analysis of diode circuits including rectifiers and power supplies. Design and analysis of single stage amplifiers and digital circuits. **3 credits**
Prerequisites: CHEM 121, EE 221, MATH 431 or CpE 260, PHYS 181, and PHYS 181L

EE 320L Electronics I Laboratory
Laboratory based analysis and design of electrical and electronic systems. **1 credit**
Corequisite: EE 320; **Prerequisite:** EE 221L

EE 330 Engineering Electromagnetics
Static electric and magnetic fields. Dielectric and ferromagnetic materials. Laplace's equation. Time varying electric and magnetic fields. Maxwell's equations. Engineering applications. **3 credits**
Corequisite: MATH 432 and EE 330D; **Prerequisites:** PHYS 181, MATH 431 or CpE 260, and EE 221

EE 330D Engineering Electromagnetics Discussion
Problem solving related to EE 330 I. **0 credit**
Corequisite: EE 330

EE 340 Power System Engineering
Electric energy sources and energy conversion principles, modeling and analysis of synchronous generators, transmission lines, transformers, AC and DC machines, brief introduction to power system analysis including power flow, fault calculation and economic dispatch. **3 credits**
Corequisite: EE 330; **Prerequisite:** EE 320

EE 340L Power System Engineering Laboratory
Measurement of different electric powers, measurement of equivalent circuit parameters and characteristics of electric generators, transformers, transmission lines, AC and DC motors, use of software packages for fault calculation and load flow. **1 credit**
Corequisite: EE 340; **Prerequisite:** EE 320L

EE 360 Signals and Systems I
Deterministic signals and linear systems. Time domain description and analysis of analog and discrete linear systems. Analysis of linear systems using the Laplace transform and the *z*-transform. Block diagram and flow graph representation of signals and linear systems. Introduction to state space representation and analysis. **3 credits**
Corequisite: MATH 432 or MATH 459, and EE 360D; **Prerequisites:** EE 221 or EE 292, and MATH 431 or CpE 260

EE 360D Signals and Systems I Discussion
Introduction to MATLAB - simulation tool for signals and systems, solving problems using MATLAB. **0 credit**
Corequisite: EE 360

EE 361 Signals and Systems II
Stochastic and deterministic signals and linear systems. Analog and discrete Fourier series, analog and discrete Fourier transforms, basic probability theory, stochastic processes, stochastic signals and linear systems. **3 credits**
Prerequisites: EE 360 and MATH 432

EE 370 Control Systems
Introduction to control systems. Feedback control characteristics, performance, stability. Analysis, synthesis and design of feedback control systems including digital techniques. **3 credits**
Prerequisite: MATH 459 or MATH 432, and EE 360

EE 370L Control Systems Laboratory
Laboratory projects and exercises in feedback control. **1 credit**
Corequisite: EE 370; **Prerequisite:** EE 221L.

EE 420 Electronics II
Analysis, synthesis and design techniques of modern electronic analog and digital circuits. **3 credits**
Prerequisites: EE 320 and MATH 431 or CpE 260

EE 420L Electronics II Laboratory
Applications and study of modern electronic analog and digital circuits. Advanced instrumentation. **1 credit**
Co requisite: EE 420; **Prerequisite:** EE 320L

EE 421 Digital Integrated Circuit Design
Digital circuit analysis. Discrete and integrated circuit technology, logic families, A/D-D/A circuits, comparators, Schmitt triggers. **3 credits**
Prerequisites: CpE 100 and EE 320

EE 421L Digital Integrated Circuit Design Laboratory
Laboratory based analysis and design of digital and computer electronic systems. **1 credit**
Corequisite: EE 421; **Prerequisite:** EE 320L

EE 430 Transmission Lines
Telegraphist's equation; transient response--steady state response; reflection diagrams; Smith chart; matching techniques and designs; narrow and broadband impedance; scattering matrix; introduction to stripline and microstrip devices. **3 credits**
Prerequisite: EE 330

EE 431 Engineering Optics
Engineering applications of optics. Includes aperture and grating antennas, holography, optical image processing, optical waveguides, and tomography. **3 credits**
Prerequisites: EE 330 and MATH 432

EE 432 Antenna Engineering
Fundamentals of antennas and antenna design; linear wire, loop and antenna arrays; antenna measurements. **3 credits**
Prerequisites: EE 330 and MATH 432

EE 436 Active and Passive Microwave Engineering
Waveguides, dispersion diagrams, microwave network analysis, broadband impedance matching, open and closed resonators, power dividers, directional couplers, filters, circulators, phase shifters, solid state amplifier, and oscillator design. **3 credits**
Prerequisites: EE 330 and MATH 432

EE 442 Power Electronics
Topics include: Diode circuits and rectifiers, power semiconductor diodes and transistors, thyristors and static switches, controlled rectifiers, AC voltage controllers, DC choppers, inverters, AC and DC drives, power supplies, protection of devices and circuits. **3 credits**
Prerequisites: EE 320 and EE 340

EE 446 - Photovoltaic Devices and Systems
Solar resource characteristics, solar cell physics and technologies, cell electrical characteristics, PV module design, DC-AC inverters, battery energy storage and charge controllers, design of stand-alone and grid-connected PV Systems, economic considerations. **3 credits**
Prerequisites: MATH 182 or consent of instructor.

EE 450 Solid State Devices
Semiconductor physics, pn diode, bipolar junction transistor, metal semiconductor FET devices, metal oxide semiconductor FET devices. **3 credits**
Prerequisites: EE 320 and MATH 431 or CpE 260

EE 450L Solid State Devices Laboratory
Capacitance and voltage, Hall mobility and carrier concentration, oxidation and etching silicon dioxide processing of silicon. **1 credit**
Prerequisite: EE 450

EE 451 Electronic and Magnetic Materials and Devices
Semiconductors, dielectrics, ferroelectrics, antiferromagnetics, ferromagnetics, ferrimagnetics, crystal structure, structure-property relations, device applications. **3 credits**
Prerequisite: EE 330

EE 452 Introduction to Optical Electronics
Topics include: modulation of light, display devices, lasers, photodetectors, fiber optics, engineering applications, and systems. **3 credits**
Prerequisite: EE 330

EE 453 Introduction to Nanotechnology
Overview of Nanotechnology, Physics of the Solid State, Properties of Individual Nanostructures, Bulk Nanostructured materials, magnetic nanoparticles, Quantum Wells, Wires and Dots, Self-Assembly and Catalysis, nanoscale Biological materials. **3 credits**
Prerequisite: EE 320

EE 460 Analog and Digital Communications
Review of Fourier transform theory, linear system theory, probability and random processes. Modulation and detection. Noise in modulation systems. Introduction to digital data transmission. **3 credits**
Prerequisite: EE 361

EE 460L Communication Systems Lab
Laboratory experiments related to the communication system theory taught in EE 460. The lab includes experiments related to spectrum analysis, AM and FM modulations and demodulations, analog to digital conversion, PCM coding, and baseband and carrier digital modulations. **1 credit**
Co-requisite: EE 360

EE 462 Advanced Digital Communications
Information theory and fundamental limits on performance, digital coding of waveforms, pulse shaping for baseband transmission, digital band pass modulations, channel coding. **3 credits**
Prerequisite: EE 460

EE 466 Wireless and Mobile Communication
The study of wireless systems including cellular telephone systems, wireless local area networks and other wireless data services. Topics include digital modulation techniques, frequency reuse, diversity techniques, multiple access schemes and channel modeling including path loss, shadowing, fading and multipath interference. **3 credits**
Prerequisites: EE 460

EE 472 Digital Control Systems
Introduction to discrete time of control. State space representation of linear systems; stability; the concepts of controllability and observability. Sample data control system design techniques, including pole placement, observer design. **3 credits**
Prerequisite: EE 370 or ME 421

EE 480 Digital Signal Processing
Review of discrete linear system theory including the *z*-transform, the Fourier transform, discrete and fast Fourier transform. Sampling, reconstruction and multirate systems, IIR and FIR digital filter design including digital filter structures and finite word length effects. **3 credits**
Prerequisite: EE 361

EE 480L Digital Signal Processing Laboratory
Laboratory projects and exercises in digital signal processing including the design and implementation of FIR, IIR, and multirate systems. **1 credit**
Co-requisite: EE 480

EE 482 Introduction to Biomedical Signals and Systems
Introduction to biomedical signals, transduction devices, bioelectric potentials and sensors. Application of electrical signal and system principles to biosignals such as cardiovascular electric signals, neural electric communication, and diagnostic ultrasound. Includes current biomedical engineering topics. **3 credits**
Prerequisite: EE 361

EE 493 Independent Study
Independent study of a selected engineering topic. May be repeated once for credit. **1-3 credits**

Prerequisite: Senior standing in Electrical Engineering

EE 495 Special Topics
Covers experimental and other topics which may be of current interest. Topics and credits to be announced. May be repeated once under a different topic. May have a laboratory. May be repeated to a maximum of six credits. **1-4 credits**
Prerequisite: Upper division standing in Engineering

EE 497 Senior Design Project I
Capstone synthesis course to teach students the design process from problem definition, team building, to project planning, paper design, written and oral communications. **1 credit**
Prerequisite: Senior Standing and consent of faculty advisor

EE 498 Senior Design Project II
Capstone synthesis course to teach students hardware and software implementation of their projects proposed and paper-designed in EE 497, testing and recommendations, project presentations. **2 credits**
Prerequisite: EE 497 and final semester senior

COMPUTER SCIENCE

The Computer Courses listed here are only the courses required by the Computer Engineering Program. For a complete list of Computer Science Courses please refer to the catalog.

CS 135 Computer Science I
Problem-solving methods and algorithm development in a high level programming language. Program design, coding, debugging and documentation using techniques of good programming style. 3 hours lecture and 3 hours recitation. **3 credits**
Prerequisite: MATH 127 or MATH 128

CS 202 Computer Science II
Data structures and algorithms for manipulating liked lists. String and file processing. Recursion. Software engineering, structured programming and testing, especially larger programs. **3 credits**
Prerequisite: CS 135

CS 218 Introduction to Systems Programming
Algorithms from systems programming including conversion, buffering, device driver, assemblers and loaders. Use of system services, macros, and linkage conventions. Laboratory exercises are programmed in assembly language. **3 credits**
Prerequisites: CpE 100 and (CS 117 or CS 135)

CS 302 Data Structures
Introduction to sequential and linked structures. File access including sequential indexed sequential and other file organizations. Internal structures including stacks, queues, trees and graphs. Algorithms for implementing and manipulating structured objects. Big-O notation. **3 credits**
Prerequisites: CS 202 and MATH 181

CS 326 Programming Languages, Concepts, and Implementation

Design, evaluation and implementation of programming languages. Includes data types and data abstraction, sequence control and procedural abstraction, parameter passing techniques, scope rules, referencing environments and run-time storage management. Study and evaluation of a number of current programming languages. **3 credits**
3 credits: CS 302 and either CS 219 or CpE 300

CS 370 Operating Systems

Operating systems organization, sharing and allocation of system resources, protection mechanisms and integration of system components. **3 credits**
Prerequisites: CS 302 and either CS 219 or CpE 300

CS 465 Computer Networks

Data communication fundamentals. The hardware components, topology, interconnections, software, protocols and uses of computer networks. The OSI protocol. The physical datalink, network, transport, session, presentation and application layers. **3 credits**
Prerequisite: CS 370

CS 472 Software Product Design and Development I

A formal approach to current techniques in software design and development. Students work in teams in the organization, management, and development of a large software project. **3 credits**
Prerequisites: CS 326 and CS 370

CS 445 - Internet Security

Internet security theory and practice, advanced IP concepts, the concepts of stimulus and response in the context of securing a network, network packet and traffic analysis, internet protocol (IP) vulnerabilities, packet filtering, intrusion detection, internet exploits, exploit signatures, internet forensics, network security investigation. **Credits 3**
Prerequisites: CS 370.

COMPUTER ENGINEERING
FOUR-YEAR PROGRAM

CPE	FALL	SPRING	Credits
YEAR I	ENG 101 (3) CHEM 121 + L (4) MATH 181 (4) CS 135 (3) EGG 101/101L (2) 16 Credits	ENG 102 (3) MATH 182 (4) PHY 180 +L (4) CPE 100 (3) SCS 202 (3) 17 Credits	33
YEAR II	Sophomore Experience (3) PHYS 181 + L (4) MATH 251 (3) CS 302 (3) EE 220 (3) 16 Credits	CPE 200 + L (4) EE 221 + L (4) CPE 260 (3) CS 218 (3) ECON 190 (3) 17 Credits	33
YEAR III	Constitution Requirement (4) STAT 411 (3) CS 370 (3) CPE 300 (3) EE 320+L (4) 17 Credits	COM 216 (3) Non CPE Professional Elective (3) EGG 307 (3) CPE 301+L (4) CPE 302 (3) 16 Credits	33
YEAR IV	Social science / Multicultural (3) PHI 242 (3) CPE Concentration (6) CPE Professional Elective I (3) Lab (1) EE 497 (1) 17 Credits	Fine Arts Elective/Multicultural (3) CPE Concentration (6) CPE Professional Elective II (3) EE 498 (2) 14 Credits	31
Credits	66	64	130

COMPUTER ENGINEERING
FIVE-YEAR PROGRAM

CPE	FALL	SPRING	Credits
YEAR I	ENG 101 (3) CHEM 121 + L (4) MATH 181 (4) EGG 101 (FYS) (2) 13 Credits	ENG 102 (3) MATH 182 (4) PHY 180 +L (4) CPE 100 (3) 14 Credits	27
YEAR II	PHY 181 + L (4) SYS (3) CS 135 (3) MATH 251 (3) 13 Credits	CPE 200 + L (4) EE 220/D (3) CPE 260 (3) CS 202 (3) 13 Credits	26
YEAR III	CS 218 (3) EE 221 + L (4) Fine Arts Elective/Multicultural (3) STAT 411 (3) 13 Credits	EGG 307 (3) EE 320 + L (4) CpE 300 (3) CS 302 (3) 13 Credits	26
YEAR IV	COM 216 (3) CPE 301 + L (4) CS 370 (3) ECON 190 (3) 13 Credits	Math/Sci Elective (3) CPE 302 (3) CPE Core Area 1 (3) Constitution Requirement (4) 13 Credits	26
YEAR V	CPE Core Area 1, 2 (6) CPE Elective 1 (3) PHI 242 (3) EE 497 (1) 13 Credits	CPE Core Area 2 (3) CPE Elective 2 (3) EE 498 (2) CPE Lab (1) Social Sci./Multicultural (3) 12 Credits	25
Credits	65	65	130

COMPUTER ENGINEERING CHECKLIST
2017 – 2018 CATALOG

UNLV General Education Core (33-37 credits)

English: 6 Credits

		Sem	Cred	Grade
ENG 101			3	
ENG 102			3	

Seminars: 5 Credits.

EGG 101 / 101L			2	
SYS			3	

Constitution: 4-6 Credits. Choose from: PSC 101(4), HIST 100(4), or a combination from US Const: HIST 101 (3) or 106 (3); NV Const: HIST 102 (3), HIST 217 (3), or PSC 100(1).

Social Sciences: 9 Credits *

ECON 190			3	
EGG 307			3	
	(Not ECON)		3	

Humanities: 6 Credits *

COM 216			3	
PHIL 242			3	

Fine Arts: 3 Credits of appreciation or introduction courses in art, music, theater, and dance*.

			3	

Departmental Requirements:
Major-Related Fields: 29 Credits

		Sem.	Cred	Grade
CHEM 121/L			4	
MATH 181			4	
MATH 182			4	
MATH 251			3	
MATH 431 or CpE 260			3	
STAT 463 or 411			3	
PHYS 180			3	
PHYS 180L			1	
PHYS 181			3	
PHYS 181L			1	

NOTES:

* =	A 3-credit multicultural requirement must be

CE Fundamentals: 46 Credits

		Sem	Cred	Grade
CpE 100			3	
CpE 200/D			3	
CpE 200L			1	
CpE 300			3	
CpE 301			3	
CpE 301L			1	
CpE 302			3	
CS 135			3	
CS 202	(CSC 136)		3	
CS 218			3	
CS 302	(CSC 269)		3	
CS 370			3	
EE 220/D			3	
EE 221			3	
EE 221L			1	
EE 320			3	
EE 320L			1	
EE 497			1	
EE 498			2	

CE Core: 12 Credits. Must complete at least 2 concentration areas out of the following 4 areas.

		Sem	Cred	Grade
	Digital Electronic Design			
EE 421	Digital IC Design		3	
CpE 408	VLSI Physical Design and Testing		3	
	Computer Networks			
CpE 400	Comp. Comm. Networks		3	
CS 445	Internet Security		3	
	Computer System Design			
CpE 403	Advanced Embedded Sys.		3	
CpE 404	Modern Processor Arch.		3	
CpE409	Embedded DSP		3	
	Security Systems			
CpE 407	Biometrics		3	
CS 445	Internet Security			
CpE 405	Information Coding Sys.		3	

CE Labs: 1 Credit. Must complete 1 credit of laboratory.

		Sem.	Cred	Grade
CpE300L				
EE 420L				
EE 421L				
EE 340L				
EE 370L				
EE 450L				
EE 460L				
EE 480L				

Professional Electives: 6 Credits . 6 credits from EE/CpE

		Sem	Cred	Grade

Math/Science Elective: 3 Credits. 3 credits from math (MATH or STAT) or science (BIOL, CHEM, or PHYS)

		Sem	Cred	Grade

Total Credits: 130 (min)