This handbook describes the undergraduate Computer Engineering major at the University of Nevada, Las Vegas. The handbook includes the following sections.

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Overview of the Computer Engineering Major</td>
<td>2</td>
</tr>
<tr>
<td>2. Mission, Program Objectives, and Outcomes</td>
<td>3</td>
</tr>
<tr>
<td>3. Computer Engineering Major Entrance Requirements</td>
<td>4</td>
</tr>
<tr>
<td>5. Course Plans and Graduation Applications</td>
<td>9</td>
</tr>
<tr>
<td>6. Faculty</td>
<td>9</td>
</tr>
<tr>
<td>7. Course Descriptions</td>
<td>10</td>
</tr>
<tr>
<td>8. Example Course Schedules and Degree Worksheet</td>
<td>20</td>
</tr>
</tbody>
</table>
1. OVERVIEW OF THE COMPUTER ENGINEERING MAJOR

Computer engineering is the application of scientific and mathematical principles to the design and analysis of hardware, software, and operating systems for a computer system. Computer engineering integrates several fields of electrical engineering and computer science, and it 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 not long 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 by 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 120 credit hours, including at least 27 credits from UNLV's General Education Core. Graduates of the program will receive a Bachelor of Science in Engineering with a Major in Computer Engineering.

The Department also offers a major in Electrical Engineering. For further information about that major, a separate handbook is available on the Electrical and Computer Engineering Department website.
2. MISSION, PROGRAM OBJECTIVES AND OUTCOMES

2.1 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.

2.2 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.

2.3 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. 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.
3. 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 18 credits of the 45-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 (4 Credits)
- 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 Digital 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 (14 Credits)
- CpE 200 Digital Logic Design II
- CpE 200L Digital 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
4. COMPUTER ENGINEERING CURRICULUM

The undergraduate Computer Engineering major requires the completion of courses in the following areas, which are described in the remainder of this section.

- General Education: 27-30 credits
- Math, Computer Science, and Natural Science: 25 credits
- Fundamental Courses: 43 credits
- Core Courses: 12 credits
- Labs: 1 credit
- Professional Electives: 6 credits
- Math/Science Elective: 6 credits

**TOTAL:** 120-122 credits

4.1 REQUIRED UNLV GENERAL EDUCATION CORE COURSES (27-30 CREDITS)

**English Composition (6 credits)**
- ENG 101 Composition & Rhetoric I
- ENG 102 Composition & Rhetoric II

**Seminars (2-3 credits)**
- EGG 101/L Introductory Engineering Experience / Lab (1-2 Credits)
- EGG 202 Second Year Hands-on Design Experiences in Engineering and Computer Science (1 Credit)

**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 Constitution
    - HIST 102 United States: 1865 to Present
    - HIST 217 Nevada History
    - PSC 100 Nevada Constitution

**Social Science (6 credits)**
- CEE 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.
Mathematics - Credits: (Fulfilled by Major Requirements)

- MATH 181 - Calculus I

Multicultural and International Requirements (overlap)

- 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.

4.2 REQUIRED MATHEMATICS AND NATURAL SCIENCE COURSES (25 CREDITS)

- 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

ABET Math Requirements of 1 year study or 30 credits are satisfied by taking MATH & SCIENCE electives of 6 credits.

4.3 REQUIRED COMPUTER ENGINEERING FUNDAMENTAL COURSES (43 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 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
4.4 REQUIRED COMPUTER ENGINEERING CORE COURSES (12 CREDITS)

Each student must complete at least two courses in two out of the four core areas below:

**Digital Electronic Design**
- EE 421 Digital Integrated Circuit Design
- CpE 404 Modern Processor Architecture
- CpE 408 VLSI Physical Design and Testing

**Computer Networks**
- CpE 400 Computer Communications Networks
- CpE 405 Information Coding Systems
- CS 445 Internet Security

**Computer System Design**
- CpE 403 Advanced Embedded Systems
- CpE 409 Embedded DSP
- CpE 476 Mobile Robotics
- CpE 477 Embedded Security and Machine Learning

**Intelligent Systems:**
- CpE 407 Biometrics and Machine Learning
- CpE 417 IoT Systems
- CS 458 Introduction to Data Mining

4.5 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 420L Engineering Electronics II Laboratory
- EE 421L Digital Integrated Circuit Design Laboratory

4.6 REQUIRED COMPUTER ENGINEERING PROFESSIONAL ELECTIVE COURSES (6 CREDITS)

Each student must complete 6 credits of approved professional electives that are listed in Table 1. Students are encouraged to select sequences within a particular core field. Students who want to apply a professional elective that is not listed in Table 1 towards their CpE degree must obtain the Department Chair’s and the Undergraduate Coordinator’s approval.

### Table 1: Professional Electives for Computer Engineering

<table>
<thead>
<tr>
<th>CpE 400</th>
<th>Computer Communications Network</th>
<th>CpE 409</th>
<th>Embedded DSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>CpE 404</td>
<td>Modern Processor Architecture</td>
<td>CpE 417</td>
<td>Cloud Computing in Engineering</td>
</tr>
<tr>
<td>CpE 405</td>
<td>Information Coding Systems</td>
<td>CpE 418</td>
<td>Mobile Robotics</td>
</tr>
<tr>
<td>CpE 408</td>
<td>VLSI Physical Design and Testing</td>
<td>CpE 477</td>
<td>Learning</td>
</tr>
</tbody>
</table>


### 4.7 REQUIRED MATH / SCIENCE ELECTIVE COURSE (6 CREDITS)

All majors must also take 6 credits of elective math (MATH or STAT) or science (BIOL, CHEM, or PHYS) courses.

### 4.8 GRADE REQUIREMENTS

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

### 4.9 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.
5. 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 Degree Worksheet. One year before graduation the student should submit a Graduation application. The example schedules and degree worksheet located at the end of this handbook 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 an overall guideline.

<table>
<thead>
<tr>
<th>Academic Load</th>
<th>Expected Study Time</th>
<th>Maximum Non-Academic Work Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall or Spring</td>
<td>Summer</td>
<td></td>
</tr>
<tr>
<td>16 credits</td>
<td>6 credits</td>
<td>32 to 48 hours / week</td>
</tr>
<tr>
<td>12 credits</td>
<td>3 credits</td>
<td>24 to 32 hours / week</td>
</tr>
<tr>
<td>8 credits</td>
<td></td>
<td>16 to 24 hours / week</td>
</tr>
<tr>
<td>3 credits</td>
<td></td>
<td>6 to 9 hours / week</td>
</tr>
</tbody>
</table>

6. FACULTY

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yahia Baghzouz</td>
<td></td>
</tr>
<tr>
<td>Jacob Baker</td>
<td></td>
</tr>
<tr>
<td>Biswajit Das, Chair</td>
<td></td>
</tr>
<tr>
<td>Sarah Harris, Undergraduate Coordinator</td>
<td>Henry Selvaraj</td>
</tr>
<tr>
<td>Yingtao Jiang</td>
<td>Sahjendra Singh</td>
</tr>
<tr>
<td>Pushkin Kachroo</td>
<td>Peter Stubberud</td>
</tr>
<tr>
<td>Shahram Latifi</td>
<td>Ke-Xun (Kevin) Sun</td>
</tr>
<tr>
<td>Brendan Morris</td>
<td>Rama Venkat</td>
</tr>
<tr>
<td>Venkatesan Muthukumar</td>
<td>Mei Yang, Graduate Coordinator</td>
</tr>
<tr>
<td>William L. Brogan (Emeritus)</td>
<td>Eugene McGaugh, Jr.(Emeritus)</td>
</tr>
<tr>
<td>Ramon Martinez (Emeritus)</td>
<td>John Tryon (Emeritus)</td>
</tr>
</tbody>
</table>
7. COURSE DESCRIPTIONS IN COMPUTER ENGINEERING

COMPUTER ENGINEERING

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

**EGG 101 - Introduction to Engineering Experience**
Seminar: Introduction to UNLV learning outcomes and the programs that reside within the College of Engineering. Topics include professional ethics, technical communication, the design process, and technology’s impact on a global society. **1-2 Credits.**
**Prerequisites:** For undergraduate degree-seeking students only.
**Notes:** Combination of EGG 101 and EGG 202 satisfies First Year Seminar requirement.

**EGG 202 - Second Year Hands-on Design Experiences in Engineering and Computer Science**
A holistic experience for second-year engineering and computer science students. Lab work, improve study skills, strengthen/solidify their sense of community, career paths exploration, update of their academic plan. **1 Credit.**
**Prerequisites:** Sophomore standing and EGG 101.
**Notes:** Combination of EGG 101 and EGG 202 satisfies First Year Seminar requirement.

**CpE 100 Digital Logic Design I**
Number systems, including unsigned binary and two’s complement numbers. Logic gates. Boolean algebra. Combinational circuits. Introduction to sequential circuits. **3 credits.**
**Prerequisites:** MATH 127 or MATH 128 or MATH 181

**CpE 200 Digital Logic Design II**
Sequential circuits, finite state machines (FSMs), and integer arithmetic circuits. Timing analysis. Programmable logic devices (PLDs). Hardware Description Language (HDL). Assembly language. **3 credits.**
**Corequisite:** CpE 200D; **Prerequisite:** CpE 100

**CpE 200D Digital Logic Design II Discussion**
HDL tools and assembly language.
**Corequisite:** CpE 200

**CpE 200L Digital Logic Design II Laboratory**
Sequential circuits, finite state machines (FSMs), and integer arithmetic circuits. Timing analysis. Programmable logic devices (PLDs). Hardware Description Language (HDL). Assembly language. Modeling, verification, simulation and testing of design solutions using programmable logic devices and hardware description language (HDL). **1 credit.**
**Corequisite:** CpE 200; **Prerequisite:** CpE 100

**CpE 260 Theory of Systems**
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 responses, and the Laplace transform. **3 credits.**
**Prerequisite:** MATH 182
CpE 300 Digital Systems Architecture and Design
Design of dedicated digital systems and general microprocessors using HDL and CAD tools. RISC-V Instruction set and assembly language. Performance analysis. Memory systems. **3 credits.**
**Prerequisite:** CpE 200

CpE 300L Digital Systems 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 systems. **1 credit.**
**Corequisite:** CpE 300; **Prerequisite:** CpE 200L

CpE 301 Embedded Systems Design
Microcontrollers and their application to a broad range of engineering problems. Microcontroller architecture, instruction set, and interfaces with sensors, actuators, motors, peripheral devices, and communication modules. Assembly and C programming for microcontrollers. Use of simulation and emulation tools. **3 credits.**
**Prerequisite:** CpE 200 or CS 218

CpE 301L Embedded Systems Design Laboratory for CpE
Hands-on study of microcontroller applications for a broad range of engineering problems. Use of simulation and emulation tools. Assembly and C microcontroller programming. Hardware interface design and programming. Advanced projects using sensors, actuators, and communication protocols. **1 credit.**
**Corequisite:** CpE 301; **Prerequisites:** CpE 200L

CpE 310L Embedded Systems Design Laboratory for EE
Hands-on study of microcontroller applications for a broad range of engineering problems. Use of simulation and emulation tools. Assembly and C microcontroller programming. Hardware interface design and programming. Advanced projects using sensors, actuators, and communication protocols. **1 credit.**
**Prerequisite:** CpE 200L and (EE 221L or EE 292)

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 400 Computer Communications Networks
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
Hardware and software for embedded systems using 32-bit microcontrollers. High-level language programming, simulators, and emulators. RTOS (real-time operating systems) for embedded systems. Project-based course. **3 credits.**
**Prerequisite:** CpE 301
CpE 404 Modern Processor Architecture
Prerequisite: CpE 300

CpE 405 Information Coding Systems
Information coding for efficient data storage and communication. Design and implementation of coding methods. 3 credits.
Prerequisites: (MATH 431 or CpE 260) and EE 220

CpE 407 Biometrics and Machine Learning
This course is designed to cover fundamentals of Biometrics Science and Technology with a balance between the basic theoretical background (probability theory, statistics, pattern recognition, signal processing) and practical applications. Some relevant topics from Machine Learning will also be covered. 3 credits.
Prerequisites: CpE 260 or EE 360 or MATH 431

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
DSP operations in spatial and transform domains. Hardware mapping techniques. Design of accelerator circuits for embedded audio and video processing. Introduction to high-level synthesis. 3 credits.
Prerequisites: CpE 300

CPE 417 - Internet of Things Systems
Principles and design of Internet of Things systems. IoT operation, sensors, and node types. Data management, IoT operating systems, and security. Project-based. 3 credits.
Prerequisites: CS 135 and (CpE 200 or CS 218).

CPE 418 – Cloud Computing in Engineering
Principles and design of Internet of Things systems. IoT operation, sensors, and node types. Data management, IoT operating systems, and security. Project-based. 3 credits.
Prerequisites: CS 135 and Advanced Standing.

CPE 476 Mobile Robotics
Design, implementation, and programming of autonomous mobile robots (UAVs and Rovers), kinematics and dynamics of robots, basic control theory, sensors and actuators for robots, autopilots and autonomous control, and robot application development. 3 credits.
Prerequisites: CS 135 and either CS 218 or CpE 200.

CPE 477 Embedded Security and Machine Learning
Design of hardware and software for embedded systems focused on security and machine learning. Introduction to embedded security, Cryptography, current embedded security features, and
security in practice. Introduction to TinyML, quantization techniques, optimization of TinyML, and online/-offline-training. Project-based, requiring the design/construction of an embedded system. 3 credits.

**Prerequisites:** CpE 301

---

**ELECTRICAL 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 credits.**

**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 or 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:** MATH 182 and (PHYS 180 or PHYS 151)

**EE 320 Engineering Electronics I**
Circuit design and analysis using diodes and transistors. Introduction to semiconductor physics. Circuit simulation with SPICE. **3 credits.**

**Prerequisites:** CHEM 121, EE 221, PHYS 181, PHYS 181L, and (MATH 431 or CpE 260)

**EE 320L Engineering Electronics I Laboratory**
Laboratory based analysis and design of electrical and electronic systems. **1 credit.**

**Corequisite:** EE 320; **Prerequisites:** CHEM 121, EE 221, MATH 431 or CpE 260, PHYS 181, and PHYS 181L

**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:** EE 221, PHYS 181, and MATH 431
EE 330D Engineering Electromagnetics Discussion
This discussion class reinforces electromagnetic theory and problem solving by applying the laws of nature in a vector calculus manner. **0 credits.**
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: EE 360D and (MATH 432 or MATH 459); **Prerequisites:** (EE 221 or EE 292) and (MATH 431 or CpE 260)

EE 360D Signals and Systems I Discussion
Programming methods in signals and systems. Topics include generating signals, implementing systems including direct form and state space implementations, determining zero input and zero state responses of linear systems, plotting linear system frequency responses and generating pole zero plots from system functions. **0 credits.**
Corequisite: EE 360; **Prerequisites:** (EE 221 or EE 292) and (MATH 431 or CpE 260)

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 or MATH 459)

EE 370 Classical Feedback and 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:** EE 360 and (MATH 459 or MATH 432)

EE 370L Classical Feedback and Control Systems Laboratory
Introduction to using MATLAB to model/simulate control systems, feedback control characteristics, performance, stability, analysis, synthesis and design of feedback control systems including digital techniques. **1 credit.**
Corequisite: EE 370; **Prerequisites:** EE 360 and (MATH 459 or MATH 432)
EE 414 Quantum Communication
**Prerequisites:** EE 310

EE 416 Space Sensors and Instruments
**Prerequisites:** EE 310

EE 420 Engineering Electronics II
An introduction to the design, layout, and simulation of analog integrated circuits including current mirrors, voltage and current references, amplifiers, and op-amps. **3 credits.**
**Prerequisites:** EE 320

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

EE 421 Digital Integrated Circuit Design
An introduction to the design, layout, and simulation of digital integrated circuits. MOSFET operation and parasitics. Digital design fundamentals including the design of digital logic blocks. **3 credits.**
**Prerequisites:** CpE 100 and EE 320

EE 421L Digital Integrated Circuit Design Laboratory
Digital circuit analysis. Discrete and integrated circuit technology, logic families, A/D-D/A circuits, comparators, Schmitt triggers. **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 or MATH 459)

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 or MATH 459)

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, introduction to solid state amplifier or oscillator design. 3 credits
Prerequisites: EE 330 and (MATH 432 or MATH 459)

EE 438 Radar in Industry
Fundamentals of radar including industry applications such as mapping, imaging and electronic warfare. 3 credits.
Prerequisites: EE 320 or equivalent or consent of instructor.

EE 442 Power Electronics
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
An introduction to analog and digital communication systems. Communication channels, modulation and demodulation, DSB, AM, SSB, FM and PM modulation schemes. Analog to digital conversation, sampling theorem, quantization noise and PCM systems. Line coding and digital carrier modulation schemes including ASK, PSK, FSK and QAM. **3 credits.**
**Prerequisite:** EE 361

EE 460L Communication Systems Laboratory
An introduction to analog and digital communication systems. Communication channels, modulation and demodulation, DSB, AM, SSB, FM and PM modulation schemes. Analog to digital conversation, sampling theorem, quantization noise and PCM systems. Line coding and digital carrier modulation schemes including ASK, PSK, FSK and QAM. **1 credit.**
**Corequisite:** EE 360

EE 462 Advanced Digital Communications
Fundamentals of digital communication systems including Line Coding, ASK, PSK, FSK and QAM modulations, receiver design and performance evaluation, band-limited channels. **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

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.**
**Corequisite:** EE 480

EE 482 Introduction to Biomedical Signals and Systems
Application of signals and system theory. Topics may include audio and speech signal processing, image processing, multi-spectral imaging, biomedical signals, and active sensing technologies such as Radar and Lidar. **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 UNLV 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 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. 3 credits.  
**Prerequisites:** CS 370.

**CS 458 Introduction to Data Mining**  
Introduction to basic concepts in data mining. Topics include association-rule mining, information extraction, web mining, categorization, and clustering. 3 credits.  
**Prerequisites:** CS 302 and MATH 251.
## 8. EXAMPLE COURSE SCHEDULES AND DEGREE WORKSHEET

### COMPUTER ENGINEERING

#### FOUR-YEAR PROGRAM

<table>
<thead>
<tr>
<th>EE</th>
<th>FALL</th>
<th>SPRING</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>YEAR I</td>
<td>ENG 101 (3)</td>
<td>ENG 102 (3)</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>Constitutional Requirement (4)</td>
<td>MATH 182 (4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MATH 181 (4)</td>
<td>PHY 180 +L (4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EGG 101/101L (1-2)</td>
<td>CS 135 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CPE 100 (3)</td>
<td>Social Science (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15 Credits</td>
<td>17 Credits</td>
<td></td>
</tr>
<tr>
<td>YEAR II</td>
<td>PHY 181 + L (4)</td>
<td>CS 302 (3)</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>CPE 200+L (4)</td>
<td>CPE 301+L (4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EE 220/D (3)</td>
<td>EGG 307 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CS 202 (3)</td>
<td>EE 221+L (4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MATH 251 (3)</td>
<td>18 Credits</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EGG 202 (1)</td>
<td>14 Credits</td>
<td></td>
</tr>
<tr>
<td>YEAR III</td>
<td>STAT 411 (3)</td>
<td>EE 320 + L (4)</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>CPE 260 (3)</td>
<td>CPE 302 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CPE 300 (3)</td>
<td>COM 216 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CS 370 (3)</td>
<td>CPE Concentration Area I/1 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PHIL 242 (3)</td>
<td>CPE LAB I (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15 Credits</td>
<td>14 Credits</td>
<td></td>
</tr>
<tr>
<td>YEAR IV</td>
<td>CPE Concentration Area I/2 (3)</td>
<td>CPE Concentration Area II/2 (3)</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>CPE Prof. Elective 1 (3)</td>
<td>CPE Prof. Elective 2 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CPE Concentration Area II/1 (3)</td>
<td>Math &amp; Sci. Elec. II (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fine Arts Elective/Multicultural (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Math &amp; Sci. Elec. I (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EE 497 (1)</td>
<td>EE 498 (2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16 Credits</td>
<td>11 Credits</td>
<td></td>
</tr>
</tbody>
</table>

Credits | 64 | 56 | 120 |
## COMPUTER ENGINEERING
### FIVE-YEAR PROGRAM

<table>
<thead>
<tr>
<th>Year</th>
<th>CPE</th>
<th>Fall</th>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>ENG 101 (3)</td>
<td>CPE 100 (3)</td>
<td>ENG 102 (3)</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>CPE 100 (3)</td>
<td>MATH 182 (4)</td>
<td>MATH 181 (4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MATH 181 (4)</td>
<td>PHY 180 +L (4)</td>
<td>CS 135 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EGG 101 (FYS) (1-2)</td>
<td>CS 202 (3)</td>
<td>CPE 200 + L (4)</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>11 Credits</td>
<td>13 Credits</td>
<td>13 Credits</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>PHY 181 + L (4)</td>
<td>CPE 200 + L (4)</td>
<td>COM 216 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EGG 202 (1)</td>
<td>EE 220/D (3)</td>
<td>CPE 260 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EE 220/D (3)</td>
<td>MATH 251 (3)</td>
<td>CS 202 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MATH 251 (3)</td>
<td>11 Credits</td>
<td>13 Credits</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>CPE 301 + L (4)</td>
<td>EE 320 + L (4)</td>
<td>CPE 300 (3)</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>EE 221 + L (4)</td>
<td>Fine Arts Elective/Multicultural (3)</td>
<td>CS 302 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fine Arts Elective/Multicultural (3)</td>
<td>STAT 411 (3)</td>
<td>CPE Lab (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>14 Credits</td>
<td>13 Credits</td>
<td>10 Credits</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>Constitution Requirement (4)</td>
<td>Math &amp; Sci. Elec. I (3)</td>
<td>PHI 242 (3)</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>CPE 302 (3)</td>
<td>CPE Concentration Area I/2 (3)</td>
<td>CPE Concentration Area I/2 (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CS 370 (3)</td>
<td>13 Credits</td>
<td>CPE Lab (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CPE Concentration Area I/1 (3)</td>
<td>Math &amp; Sci. Elec. II (3)</td>
<td>EE 498 (2)</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>CPE Elective 1 (3)</td>
<td>EE 497 (1)</td>
<td>Social Sci./Multicultural (3)</td>
<td>11 Credits</td>
</tr>
<tr>
<td></td>
<td>Math &amp; Sci. Elec. II (3)</td>
<td>10 Credits</td>
<td>11 Credits</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>CPE Concentration Area II/1 (3)</td>
<td>CPE Elective 2 (3)</td>
<td>CPE Elective 2 (3)</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>CPE Concentration Area II/2 (3)</td>
<td>Math &amp; Sci. Elec. II (3)</td>
<td>EE 498 (2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CPE Elective 1 (3)</td>
<td>Math &amp; Sci. Elec. II (3)</td>
<td>Social Sci./Multicultural (3)</td>
<td>11 Credits</td>
</tr>
<tr>
<td></td>
<td>EE 497 (1)</td>
<td>EE 498 (2)</td>
<td>11 Credits</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EE 497 (1)</td>
<td>EE 498 (2)</td>
<td>11 Credits</td>
<td></td>
</tr>
</tbody>
</table>

Credits: 59, 61, 120
UNLV General Education Core (27-30 credits)

<table>
<thead>
<tr>
<th>English: 6 Credits</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 101</td>
<td>3</td>
</tr>
<tr>
<td>ENG 102</td>
<td>3</td>
</tr>
</tbody>
</table>

Seminars: 2-3 Credits

| EGG 101 / 101L    | 1-2 |
| EGG 202           | 1  |

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: 6 Credits***

<table>
<thead>
<tr>
<th>***Social Science course from an area other than economics</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGG 101 / 101L / 101L</td>
</tr>
<tr>
<td>EGG 202</td>
</tr>
</tbody>
</table>

Humanities: 6 Credits *

<table>
<thead>
<tr>
<th>$ humanities courses to satisfy Multi-cultural and International requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHIL 242**</td>
</tr>
</tbody>
</table>

Notes: $ or * = A 3-credit multicultural and International requirement must be completed

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

| Digital Design | CpE 100 | 3 |
|                | CpE 200 | 3 |
|                | CpE 200L| 1 |
|                | CpE 300 | 3 |
|                | CpE 301 | 3 |
|                | CpE 301L| 1 |
|                | CpE 302 | 3 |
|                | CS 135  | 3 |
|                | CS 202  | 3 |
|                | CS 302  | 3 |
|                | CS 370  | 3 |
|                | EE 220/D| 3 |
|                | EE 221  | 3 |
|                | EE 221L | 1 |
|                | EE 320  | 3 |
|                | EE 497  | 1 |
|                | EE 498  | 2 |

CpE Fundamentals: 43 Credits

| Digital Design | CpE 100 | 3 |
|                | CpE 200 | 3 |
|                | CpE 200L| 1 |
|                | CpE 300 | 3 |
|                | CpE 301 | 3 |
|                | CpE 301L| 1 |
|                | CpE 302 | 3 |
|                | CS 135  | 3 |
|                | CS 202  | 3 |
|                | CS 302  | 3 |
|                | CS 370  | 3 |
|                | EE 220/D| 3 |
|                | EE 221  | 3 |
|                | EE 221L | 1 |
|                | EE 320  | 3 |
|                | EE 497  | 1 |
|                | EE 498  | 2 |

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

| Digital Design | EE 421 | Digital IC Design | F | 3 |
|               | CpE 404 | Modern Processor Arch. | S | 3 |
|               | CpE 406 | VLSI Phys Design & Testing | S | 3 |

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

| Digital Design | EE 420L | F |
|               | EE 421L  |   |

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

Math/Science Elective: 6 Credits. 6 credits from math (MATH or STAT) or science (BIOL, CHEM, or PHYS)

Total Credits: 120 (min)