What are Electrical Engineering and Computer Engineering?

ODU REYES Program

- Oscar R. González
  Professor and Chair

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What are the goals of this ODU REYES presentation?

- Promote interest in engineering
- Provide suggestions to succeed in engineering studies
- Introduce the disciplines of electrical and computer engineering
- Answer your questions
Why study engineering?

- Engineers solve problems and create products that benefit society.
- In February 2000, the National Academy of Engineers announced the top 20 engineering achievements of the 20th century.
- Neil Armstrong:
  - "Almost every part of our lives underwent profound changes during the past 100 years thanks to the effort of engineers, changes impossible to imagine a century ago. People living in the early 1900s would be amazed at the advancements wrought by engineers."
  - "As someone who has experienced firsthand one of engineering’s most incredible advancements-space exploration-I have no doubt that the next 100 years will be even more amazing."
National Academy of Engineering Top 10 Achievements

1. Electrification
2. Automobile
3. Airplane
4. Water Supply and Distribution
5. Electronics
6. Radio and Television
7. Agricultural Mechanization
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration

http://www.greatachievements.org/

https://www.epri.com/
What makes an engineer, an engineer?

- Engineers work in a team that solves problems using systematic techniques that include, for example,
  - Developing mathematical models of the problem
  - Performing engineering analysis of the mathematical model
  - Designing solutions to meet specifications while following ethical norms, dealing with economic & engineering constraints, and abiding by engineering standards
  - Testing the solution in simulation
  - Testing the solution in hardware under load conditions
  - Iterating the design process until the solution meets the design goals
What can you do to get an engineering job?

- Graduate from an ABET accredited program such as Electrical Engineering and Computer Engineering at Old Dominion University
- Gain experience working as an engineer in
  - Internships
  - Co-ops (cooperative education)
  - Undergraduate research projects
- Have a well-written resume
- Use your network
  - Friends
  - ODU alumni and faculty
  - Engineering networks (for example, IEEE)
USA Bachelor’s Degrees Awarded (ASEE 2017-2018)

**Bachelor’s Degrees Awarded by Engineering Discipline: 136,233***

[Bar chart showing the number of degrees awarded in various engineering disciplines.]
How do you prepare to major in engineering?

- Challenge yourself with math and science courses
  - Algebra, Geometry, Trigonometry, Pre Calculus, etc
  - Physics and Chemistry
  - AP courses, if possible
- Have fun by becoming active in STEM and other clubs
- Prepare and do well on standardized tests!
  - You qualify for scholarships with good test scores!
A product designed by electrical and computer engineers

- A smartphone

- Basic components designed by electrical and computer engineers
  - Battery
  - Processor
  - Antennas
  - Screen
iPhone components
A brief history of integrated circuits

- **Intel 4004**
  - 1st microprocessor
  - 4 bit
  - 2300 transistors
  - 10μm
  - 740 KHz

- **Apple A13 Bionic**
  - ARM-based system on a chip (SoC)
  - 64 bit
  - 6 cores
  - 8.5B transistors
  - 7nm
  - ≤ 2.66 GHz
Electrical Engineers

Computer Engineers
Computer Engineering Overview

- Holistic approach for solving data processing problems in a way that simultaneously optimizes both hardware and software considerations.
Computer Engineering Overview

- Use digital computing devices, and data processing software to solve problems
- Computer Engineers problems include
  - Computer networks
  - Computer system design/integration
  - Cybersecurity
  - Domain specific architectures/custom data processing systems
  - Embedded systems
  - Software engineering
**Computer Engineering Overview**

- Foundational Coursework in
  - Math: Calculus and Differential Equations
  - Science: Calculus-based Chemistry and Physics
  - English: Composition, Technical Writing, & Public Speaking
  - Computer Engineering: Digital Logic
  - Electrical Engineering: Circuit & System Analysis

- Further Coursework in
  - Computer Hardware: Microcontrollers
  - Computer Science: Computer Programming & Operating Systems

- Built-in minor in Computer Science
- Elective areas of concentration:
  - Computer Hardware Systems
  - Computer Networks
  - Cybersecurity
  - Data Analytics Engineering
Electrical Engineering Overview

- Design and build engineering solutions from the physics to the systems level
- Learn device fabrication processes and fabricate circuits in a hands-on laboratory in the clean room
- Solve power, system automation, machine learning problems, etc.
- Transform information
Microelectronics Fabrication Laboratory

Process Steps

1. Si

2. SiO2

3. PR

4. PR

5. P dopant

6. PR

7. Source Gate Drain

8. PR

9. PR

10. Al

11. PR

12. PR

13. Source Gate Drain

14. PR

Microelectronics Fabrication Laboratory
Machine Learning Applications

- Medical imaging analysis

New AI Estimates the Size of Remote Refugee Camps Using Satellite Data

Compared to previous models, the new machine learning algorithm proves to be more accurate and precise, which could help better support humanitarian efforts.
Senior design project conducted by electrical and computer engineering students designed, constructed, and tested a microprocessor-controlled thermal evaporator for fabrication of nanoparticles and thin films.

Undergraduate student studied the optical properties of photonic crystals assembled from silicon dioxide nanoparticles. The atomic force microscope image of the assembled nanoparticles is shown.
Computer Engineering Curriculum – 128 Credits

Senior Design Project
ECE 484W/486/487

Computer Hardware Systems
Computer Networks
Cybersecurity
Data Analytics Engineering

Computer Engineering & Electrical Engineering
& Computer Science Courses
56 Credits

Science Courses
15 Credits

Math Courses
17 Credits

Upper & Lower General Education Courses
21 Credits
Electrical Engineering Curriculum – 127 Credits

Senior Design Project
ECE 485W/486/487

Electrical Engineering Courses
48 Credits

Science Courses
15 Credits

Math Courses
18 Credits

Upper & Lower General Education Courses
27 Credits
Average Entry-level Salaries

- Electrical Engineering
  - 64,936
- Computer Engineering
  - 68,436 – 71,007

At ODU the two highest earning undergraduate majors are:
1. Computer Engineering
2. Electrical Engineering

Data from payscale.com, October 2019
Can electrical engineers be awarded a Nobel Prize?

- 1956 - Physics - John Bardeen with William Shockley and Walter H. Brattain
  "for their researches on semiconductors and their discovery of the transistor effect"

- 1972 – Physics - John Bardeen, Leon Neil Cooper and John Robert Schrieffer
  "for their jointly developed theory of superconductivity, usually called the BCS-theory"

- 2000 – Physics - Jack St. Clair Kilby
  "for his part in the invention of the integrated circuit"

- 2014 – Physics - Isamu Akasaki, Hiroshi Amano, and Shuji Nakamura
  "for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources"

- 2018 – Physics - Arthur Ashkin, Gérard Mourou, and Donna Strickland
  "for groundbreaking inventions in the field of laser physics", in particular "for their method of generating high-intensity, ultra-short optical pulses"
Electrical and Computer Engineering Links

ECE Undergraduate Programs
- Information on the BS Computer Engineering and BS Electrical Engineering degrees
- Program and Course highlights
- Application steps & more

ODU Online: Computer Engineering Online
- Information on online programs and the online learning environment
- Contact form for specialized assistance
- & more

Transfer Students Webpage
- Information for all transfer students including international students and military/veterans
- Course by course equivalencies
- Application checklist
- & more

Take the Next Step: Admissions
- Visit campus - LIVE online tours
- Cost estimator
- Applications & more

ECE & BME Graduate Programs
- Information on the MS and Ph.D. degrees
- Program and Course highlights
- Application steps & more

Connect with ECE:
www.odu.edu/ece
THANK YOU!

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Waleed Al-Assadi
Lee Belfore
Hani Elsayed-Ali
Sylvain Marsillac

Old Dominion University
Norfolk, Virginia 23529
USA

www.odu.edu/ece
ece@odu.edu