University of Oklahoma - ECE
Electrical Engineering (EE)
Computer Engineering (CpE)

Technology
Opportunity
Research
Education

If you are into high-tech things you have come to the right place.
Information comes from the US Bureau of Labor Statistics (bls.gov)

<table>
<thead>
<tr>
<th>Job Type</th>
<th>Median Pay</th>
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<tbody>
<tr>
<td>Petroleum engineers</td>
<td>$129,990</td>
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<tr>
<td>Computer hardware engineers</td>
<td>$111,730</td>
</tr>
<tr>
<td>Aerospace engineers</td>
<td>$107,830</td>
</tr>
<tr>
<td>Nuclear engineers</td>
<td>$102,950</td>
</tr>
<tr>
<td>Software developers (Engineers)</td>
<td>$100,690</td>
</tr>
<tr>
<td>Chemical engineers</td>
<td>$97,360</td>
</tr>
<tr>
<td>Electrical and electronics engineers</td>
<td>$95,230</td>
</tr>
<tr>
<td>Materials engineers</td>
<td>$91,310</td>
</tr>
<tr>
<td>Biomedical engineers</td>
<td>$86,220</td>
</tr>
<tr>
<td>Environmental engineers</td>
<td>$84,560</td>
</tr>
<tr>
<td>Mechanical engineers</td>
<td>$83,590</td>
</tr>
<tr>
<td>Industrial engineers</td>
<td>$83,470</td>
</tr>
<tr>
<td>Civil engineers</td>
<td>$82,220</td>
</tr>
<tr>
<td>Agricultural engineers</td>
<td>$75,090</td>
</tr>
</tbody>
</table>

The primary ECE Jobs on this table are: **Computer hardware, Software, Electrical, and Electronics Engineering**.

ECE is a very flexible degree. MANY ECE graduates work in the Petroleum, Aerospace, Nuclear, Materials, and Biomedical fields. For example: you could have an Electrical Engineering (EE) or a Computer Engineering (CpE) degree and be called a biomedical engineer.
What Do ECE’s Work On?

- Energy / Power
- Communications
- Telecommunications
- Control Systems
- Circuit Design / Electronics / Avionics
- Radar/Signal Processing
- Bio/Image Processing
- Computer Architecture
- Solid State Electronics / Nanotechnology

http://www.apple.com/ipad/
Energy / Power Systems

www.freephotobank.org

Communications / Telecommunications

http://www.apple.com/iphone/
Control Systems / Robotics

http://www.youtube.com/BostonDynamics#p/a/u/1/cNZPRsrwumQ

http://www.youtube.com/watch?v=W1czBcnX1Ww
Electronics / Avionics

http://news.cnet.com/8301-17938_105-9934275-1.html

www.boeing.com
Radar / Signal Processing
Biomedical Imaging

www.dixray.com/images/digital-mammography2.jpg

Many ECE Job Opportunities

- Energy / Power
- Communications
- Telecommunications
- Control Systems
- Circuit Design / Electronics / Avionics
- Radar/Signal Processing
- Bio/Image Processing
- Computer Architecture
- Solid State Electronics / Nanotechnology
- Many, Many More

- Design
- Production
- R&D
- Testing
- Manufacturing
- Sales
- System Integration
- Field Support
- Research/Academia
Major Employers

- Hewlett-Packard
- Motorola
- National Instruments
- Raytheon
- Texas Instruments
- Dell Computers
- Schlumberger
- Exxon Mobil
- More than 50 Oklahoma Industries, including
  - FAA, Boeing, Northup Grumman, Tinker Air Force Base, etc.
  - Significant Start-up Companies
Electrical & Computer Engineering Fields

- Energy / Power
- Communications / Wireless / Fiber optics
- Telecommunications
- Robotics
- Circuit Design
- Control Systems
- Radar / Microwave / RF / Signal Processing
- Sound / Speech / DSP
- Biomedical
- Image Processing / Graphics
- Computer Architecture / Embedded Systems
- Solid State Electronics / Lasers
- Nanotechnology
- Many, Many More…
• **Bioengineering** - Instrumentation, medical imaging, biomedical optics, digital hearing aids, physiological modeling. bio-computing: interactions of electromagnetic fields and biological tissue.

• **Communications** - Adaptive antenna arrays, fixed wireless access, wideband CDMA, wireless telemetry systems, equalization and coding for storage.

• **Computer Systems** - Advanced computer systems and architecture, fault tolerant systems, networking, embedded systems, programmable logic, hardware design languages.

• **Electric Power Systems** - Power systems planning and operation; electric power network economics; regulation, privatization and competition in network.

• **Electric Vehicle Research** - High efficiency motor control systems, battery systems, ergonomic subsystems, solar power and formula racing vehicles.
Electromagnetics - Computational electromagnetics, phased array antennas, RF medical applications.

Image Processing - Digital image processing, computer vision, robotics vision, pattern recognition, image interpretation.

Intelligent Systems - Soft computing, neural networks, fuzzy logic modeling, solution programming, optimization, artificial intelligence, genetic algorithms.

Instrumentation and Control Systems - Multivariable controls design and analysis, robust & fuzzy logic controls, GPS flight control & location systems.

Sensor Electronics - Integration of state-of-the-art optoelectronic components with high performance embedded processors, design and fabrication of analog/digital mixed-signal circuits, and development of chemical and biological sensors based on fluorescence, laser absorption and Raman scattering spectroscopies - all of which are integrated around a common platform for low-cost, low-power consumption deployment.
• **Signal Processing** - Speech and image representations for enhancement, compression, synthesis and recognition systems. Adaptive systems for telecommunications, multimedia, and other systems. Digital filter methods and implementations.

• **Solid State Devices and Materials** - Molecular beam epitaxy growth of IV-VI semiconductors and group II-A fluoride insulators, liquid phase epitaxy, tunable diode laser fabrication, interface chemistry and heteroepitaxial growth mechanisms, optical device integration on silicon substrates, UV solar blind detectors, Bragg reflector-based devices for solid state lasers.

• **Telecommunications Engineering** - Wireless and fiber optic networking technology, systems interoperability, security.

• **Weather Radar** - Radar detection and signal processing, adaptive processing, phased arrays, weather detecting waveforms and filtering.

- Go to [http://www.ou.edu/content/coe/ece/research_areas.html](http://www.ou.edu/content/coe/ece/research_areas.html) for more info.
OU-ECE consistently has more research expenditures than any other department in the College of Engineering at OU. In academic year 2016, OU-ECE had nearly $8.3 Million in expenditures, which was more than twice any other school in the College of Engineering.

Why should a future OU-ECE student care about this?

This money supports students as research assistants.

✓ Many research assistants are undergraduates.
✓ Better chance of getting a part-time job in research.
✓ Research experience helps you get a better job.
Intelligent Highways
See http://its.ou.edu/ for details
Intelligent Highway System helps with emergency response time.
Intelligent Highway System uses advanced image processing techniques
• The ARRC has over 140 faculty, staff, and students – arguably the largest academic radar program in the nation.

• Radar research incorporates near all aspects of ECE, such as circuit theory, electromagnetics, random variables, signal processing…

• Research is focused on all aspects of weather and defense radar system applications.
Advanced Lighting Technology

OU’s Solid State research group performs research on advanced lighting, laser fabrication, semiconductor growth, and much more. In 2012 OU-ECE opened a new state-of-the-art clean room to further advance research in this area.
This is a “mine sweeping robot” (the mines were actually magnets).
ECE Student Class Competitions - Intelligent Robots

Modified RC Tank ➔
ECE Student Class Competitions – Intelligent Robots

Spider-Bot Battle
ECE Student Class Competitions - Intelligent Robots

Sumo Wrestling Robots is another popular ECE class project. See http://www.youtube.com/watch?v=vBLzpOi7_YI for a past OU Sumo Bot student competition.
ECE Student Class Competitions – Magnetic Levitation

You can do a lot of cool things with electromagnetism. ECE students also had a competition to build a an electromagnetic projectile launcher. see http://www.youtube.com/watch?v=Cn oek5XQ7vU&feature=related for a video of a magnetic levitator in action that was built by OU-ECE students. Our students also recently built a Tesla Coil!
Opportunities for Participation

- Institute of Electrical & Electronics Engineers (IEEE), This group competes in national robot competition
- Sooner Competitive Robotics (SCR)
- Solar Car
- Women in ECE (WECE)
- Sooner Racing Team
- Electric Race Team (SER)
- Robotics Club
- Sooner Rover Team
- Eta Kappa Nu (ECE Honor Society)

And Many More! – Click here for more info
Recent Capstone Projects

- GPS vehicle tracking - Del City
- Downhole instrumentation - DitchWitch
- Radar level monitoring system - NWS
- Web-weather monitor - ODOT
- Proprioception test system – Scott Sabolich Prosthetics
- Laser tracking system – TCOM
- “Follow-me” golf cart
OU-ECE = Student Friendly

• Dedicated ECE faculty members advise students
• Devon Energy Hall – Space is allocated primarily for students
• Focused on Hands-On learning (seen in previous slides)
  • 5 undergraduate required lab classes
  • Numerous elective lab classes
  • Student competition teams
  • Undergraduate research/employment opportunities
• ECE is focused on student success
  • Faculty are available for office hours and appointment times
  • High quality teaching assistants with office hours
  • Dedicated ECE student assistants for software support
  • Several software packages to help solve problems (shown next)
• Many, Many Scholarship Opportunities:
  ✓ http://www.ou.edu/scholarships.html
  ✓ http://www.ou.edu/coe/ece/student_resources/scholarships/ece_scholarships.html
Designing and Building Circuits

Circuit Simulation

Breadboard
Multisim Circuit Design Software

- Multisim allows you to design and simulate complicated circuits.

Pulse Width Modulator

Choose Simulate/Run to view the operation of the circuit using the virtual instruments. Double click on an instrument to view the panel.
Designing and Building Circuits

Circuit Layout

Printed Circuit Board
 Ultiboard makes designing Printed Circuit Boards easy.
Matlab provides built-in functions to help you solve engineering problems.
It is excellent for signal and image processing applications (seen below)

Isosurface of MRI Data
figure; colordef(gcf,'black') load mri;
D = squeeze(D);
[x y z D] = subvolume(D, [nan nan nan nan nan 4]);
p = patch(isosurface(x,y,z,D, 5),
'FaceColor', 'red', 'EdgeColor',
'none');
p2 = patch(isocaps(x,y,z,D, 5),
'FaceColor', 'interp', 'EdgeColor',
'none');
isonormals(x,y,z,D,p); view(3);
daspect([1 1 .4]) colormap(gray(100))
camva(9); box on camlight(40, 40);
camlight(-20,-10);
lighting gouraud
LabVIEW Graphical Software (ni.com)

- LabVIEW offers an alternative to text based programming languages such as C++, Java, and Matlab. LabVIEW programming is done graphically.
- LabVIEW also comes with many built-in functions and plug and play capability with hardware so complicated projects can be completed quickly.
You can take an elective class in OU-ECE to learn LabView or you can learn outside of classes from our NI student ambassador or from NI workshops. You can even get a **LabView certification**! LabView is very good for the resume and a **whole lot of FUN**!
ECE Program Options

- BS Electrical Engineering (125 Hrs), BS Computer Engineering (126 Hrs)
  - 15-hours of Electives to Shape Career
  - Undergraduate Research / Internships Available
- MS in Electrical and Computer Engineering
  - The dual discipline MS degree gives you more flexibility when job searching
  - Accelerated MS can be completed in as little as 18 extra Hrs beyond the BS.
  - Half-time Teaching/Research Assistantships Available
- One of the following would look really good on your resume:
  - BS in Electrical Engineering  ←OR→  BS in Computer Engineering
  - MS in Electrical and Computer Engineering  BS in Electrical and Computer Engineering  or MS in Computer Science
- We also offer a PhD in Electrical and Computer Engineering
  - 90 Hours above BS degree (Masters work counts toward PhD degree).
- The following slides show details of our programs & links for downloading

OU college of engineering
• **Bachelors Degrees (See Flowcharts on the following slides)**
  • Bachelor of Science in Electrical Engineering
    – Bachelor of Science in Computer Engineering

• **Accelerated Masters Degrees (Reduces Masters by 12 hours)**
  • Bachelor of Science in Electrical Engineering AND Masters of Science in Electrical and Computer Engineering
  • Bachelor of Science in Computer Engineering AND Masters of Science in Electrical and Computer Engineering
  • Bachelor of Science in Computer Engineering AND Masters of Science Computer Science

More info → [http://catalog.ou.edu/current/Engineering_Electrical_and_Computer.htm](http://catalog.ou.edu/current/Engineering_Electrical_and_Computer.htm)
ECE Elective Areas

- Signal Processing
- Controls and Automation
- Solid-State Electronics
- Communications/ Wireless Systems
- Digital / Computer Systems
- Electromagnetism
- Energy
- Radar/Microwave/RF Engineering
- Power Engineering
- Bio-Engineering
- Advanced Software Systems
ECE Electives

- Many ECE electives available. Some are listed by topic here → → → → → →
- Allows you to specialize in your interest.
- Elective class sizes are very small.
- Taught by faculty engaged in cutting edge research.
- See Catalogue Description Link Below: https://www.ou.edu/content/dam/admissions/documents/Course-Descriptions-June-2016.pdf

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<td>5523 Random Signals</td>
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<tr>
<td>5273 Digital Image Processing</td>
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<tr>
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<tr>
<td>4/5363 Optical Engineering</td>
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<tr>
<td>5573 Optical Sys &amp; Networks</td>
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<tr>
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<td>5583 Information Theory</td>
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<tbody>
<tr>
<td>4113 Analysis of Electrical Transmission,</td>
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<td>5113 Analysis of Faulted Power System</td>
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<td>5243 Logic &amp; Computer Design in Nanospace.</td>
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<tr>
<td>5543 T-Com Network Design &amp; Management</td>
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<td>5563 Computer &amp; Communication Security</td>
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<td>5833 VLSI</td>
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<th>Solid State:</th>
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<tr>
<td>4/5383 IC Fabrication</td>
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<tr>
<td>5303 Solid State Electronics</td>
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<tr>
<td>5323 Opto-Electronics</td>
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<tr>
<th>Radar/Applied Electromagnetics:</th>
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<tr>
<td>4/5663 Radar Engineering</td>
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<tr>
<td>4/5673 Weather Radar Theory &amp; Practice</td>
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<tr>
<td>4/5703 EM Fields and Wave Propagation</td>
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<th>Controls:</th>
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<td>4413 Intro to Control Theory</td>
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<tr>
<td>5403 Linear Systems Analysis</td>
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<tr>
<td>5413 Control Theory</td>
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<tr>
<td>4/5433 Measurement and Automation</td>
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<th>Bio-Medical Engineering:</th>
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<tbody>
<tr>
<td>4823 Prin. Human Body</td>
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<tr>
<td>5843 Medical Imaging Systems</td>
</tr>
<tr>
<td>4/5853 Biomedical Signals &amp; System</td>
</tr>
<tr>
<td>4/5863 Biomedical Instrumentation</td>
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Email the Recruitment Coordinator, Chad Davis, weeb@ou.edu if you have any questions.

visit our website: ece.ou.edu

YouTube Channel: www.youtube.com/ECEatOU

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