The Professional Engineer

Unit 1 Slides
EE 302
Fall 2000
Unit I - The Professional Engineer

- The engineer’s primary goal is to solve practical problems.
- The thing that sets engineers apart is the manner in which they approach problems. The discipline allows analyzing, reasoning, and solving difficult problems in an organized manner.
- Engineers have a basic knowledge of mathematics, physics, chemistry, and the ability to solve complex problems.

Engineering is technical creative challenging
exciting difficult
What is Engineering?

- The application of science and mathematics by which the properties of matter and the sources of energy in nature are made useful to people.

- The use of science and technology to solve the problems that society faces or to provide products which society desires.
ABET* Definition of Engineering

• The profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind.

* Accreditation Board for Engineering and Technology
Engineers vs. Scientists

- **Scientists**
  - Scientists attempt to understand how the natural world functions.
  - Result of their work is expansion of knowledge.
  - Final product often publication of a research paper.

- **Engineers**
  - Engineers solve problems; the result of their work is the development and production (or improvement) of a product or process.
Engineers vs. Scientists Con’t

• The role of engineer and scientist often merge
  ➢ An engineer may need new scientific knowledge to solve a problem.
  ➢ Scientists may be guided by the potential for their discovery.

• Many issues come up for Engineers when doing their job
  ➢ Questions to be asked
    ✓ Can it be done?
    ✓ Should it be done?
Video Telephone

- AT&T has had the technology to make this product for over 10 years

- Why are there no video phones?
Video Phones Con’t

- Metcalfe’s Law applies:
  - There is a small value to any service shared by only a small number of users.
  - The value of a network grows as the square of the number of users

- Society reluctance

- Why has the WWW caught when the technology existed many, many years ago?
# Where UT Ranks

<table>
<thead>
<tr>
<th>Number</th>
<th>School/University</th>
<th>Ranking (out of 5.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Massachusetts Inst. of Technology</td>
<td>4.8</td>
</tr>
<tr>
<td>2</td>
<td>Stanford University (CA)</td>
<td>4.7</td>
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<tr>
<td>2</td>
<td>University of California–Berkeley</td>
<td>4.7</td>
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<tr>
<td>4</td>
<td>California Institute of Technology</td>
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<tr>
<td>4</td>
<td>University of Illinois–Urbana-Champaign</td>
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<tr>
<td>6</td>
<td>University of Michigan–Ann Arbor</td>
<td>4.5</td>
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<tr>
<td>7</td>
<td>Carnegie Mellon University (PA)</td>
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<tr>
<td>7</td>
<td>Cornell University (NY)</td>
<td>4.4</td>
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<tr>
<td>7</td>
<td>Georgia Institute of Technology</td>
<td>4.4</td>
</tr>
<tr>
<td>10</td>
<td>University of Texas–Austin</td>
<td>4.3</td>
</tr>
<tr>
<td>18</td>
<td>Rice University</td>
<td>3.9</td>
</tr>
<tr>
<td>18</td>
<td>Texas A&amp;M University</td>
<td>3.9</td>
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UT-Austin ranks #9 in Graduate Program
Great Things about Austin!

- Consistently ranked in the Top 10 for Best Place to live or work
- My favorites things near campus
  - Coffee at Mojo’s (Drag) or Austin Java (12th and Lamar)
  - Live Music at the Cactus Café
  - Einstein’s Arcade on Drag
  - Meals at Hoover’s (East of IH-35 on Dean Keeton) or Trudy’s (30th and Lamar)
Other Great Things about Austin!

- Things in Austin area to check out
  - Swimming at Zilker Park
  - Hike and Bike Trail around Town Lake
  - Drive on Loop 360 from MoPac North
  - BBQ
    - Salt Lick
    - Lockhart
  - Waterloo Records and Book People
  - Brunch at Fonda San Miguel (make you parents pay!!)
  - Austin Chronicle
The ECE Curriculum: The Basics

- 128 hours required for degree
- Two slightly different programs (curricula)
  - Electrical Engineering
  - Computer Engineering
- Each curricula is broken into two parts
  - Basic sequence consists of 15 core courses in first two years
  - Major sequence consists of core course and elective
    - Need 2.5 GPA to move from basic to major sequence
Electrical vs. Computer Engineering

• Same number of hours in each curricula
• Differences
  ➢ Slightly different math requirements
  ➢ More required ECE courses
    ✓ Both free and technical electives reduced from 6 hours to 3 hours from 6 hours to 3 hours
• You can still “specialize” in computer engineering within the Electrical Engineering Curricula
ECE Technical Areas

- In your last two years, you specialize in a specific facet of ECE
  - 3-5 technical area courses and electives

- Biomedical/Premed
- Computer
- Communication and Control
- Information Systems
- Electromagnetic
- Electronic Materials and Devices
- Integrated Electronics
- Management and Production
- Power Systems and Energy Conservation
- Software Engineering
- Telecommunications and Signal Processing
Example: Electronic Materials and Devices

• Student Must Take EE 440: Microfabrication Techniques

• Take at least two of the following
  ➢ EE 325K: Antennas and Wireless Propagation
  ➢ EE 338L: Analog Integrated Circuit Design.
  ➢ EE 347: Modern Optics.
  ➢ EE 348: Laser and Optical Engineering.
  ➢ EE 360S : Digital Integrated Circuit Design.
Example: Telecommunication and Signal Processing

- Three course from the following list with at least one from each group

- Group 1 Courses
  - EE 371R: Digital Imaging Processing.

- Group 2 Courses
  - EE 360K: Communication Electronics.
  - EE 379K: Telecommunication Networks.
  - EE 379K: Information and Cryptography.
  - EE 379K: Network Engineering. EE 351K
Example: EE 302 Path

<table>
<thead>
<tr>
<th>Prerequisites</th>
<th>Future Courses</th>
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</thead>
<tbody>
<tr>
<td>2 Calculus 1 Physics</td>
<td>Electromagnetics</td>
</tr>
<tr>
<td></td>
<td>Semiconductors</td>
</tr>
<tr>
<td>3 Calculus 2 Physics</td>
<td>Random Processes</td>
</tr>
<tr>
<td></td>
<td>First Lab Course</td>
</tr>
<tr>
<td>First Lab Course</td>
<td>Second Lab Course</td>
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</tbody>
</table>

**EE 302** 
**EE 411** 
**EE 313** 
**EE 338** 
**EE 338K**
Non-Technical Courses

- There are other courses required for your degree
  
  - 2 courses in English (Rhetoric and Literature)
  - Social Science Elective (Psychology, Sociology, Economics, etc.)
  - Fine Arts/Humanities Elective
  - 2 courses in Government
  - 2 courses in American History
American History

• Don’t have to take the same old History!
  ➢ HIS 306N: Key Issues/Ideas in American History
  ➢ HIS 314K: History of Mexican American in the US
  ➢ HIS 317N: Introduction to African American History
  ➢ HIS 334L: AMER REV/FOUND OF US, 1763-89
  ➢ HIS 345J: COMING OF CIVIL WAR, 1829-1861
  ➢ HIS 350L: US CULTURE IN 1960S AND 70S-W
  ➢ HIS 355N: MAIN CURR OF AMER CUL TO 1865
  ➢ HIS 350L: 2-AM CUL HIST OF ALCHL/DRUGS-W
Government

• Focus on specific areas
  ➢ American Foreign Policy
  ➢ American Trade Policy
  ➢ POLITICS OF ENVIRONMENTAL ISSUES
  ➢ POVERTY AND POLITICS
  ➢ RUSSIAN-AMERICAN RELATIONS
  ➢ TEXAS POLITICAL HISTORY
  ➢ US FOREIGN POLICY SINCE WWII
  ➢ THE CONSTITUTIONAL DEBATES
ECE LRC Facilities

- The Learning Resource Center (LRC) is a series of fee-supported labs in ENS for use by students who are enrolled in Electrical and Computer Engineering (ECE).
- All ECE LRC computers have internet access as well as software used in various courses.
- The LRC is the result of a collaboration between the ECE Dept. and UT’s Academic Computing and Information Technology Services (ACITS) which operates the department’s computer lab facilities.
- Main Phone: 475-6124    Main Fax: 475-7095
  General Technical Questions: remark@ece.utexas.edu
  Main Web Pages: http://www.ece.utexas.edu
ENS Computer Lab Facilities

• Four proctored labs:
  ENS 317: PC lab with 64 Intel Pentium Systems
  ENS 334: PC lab with 30 Pentium Systems
  ENS 340: PC lab with 30 Dell Pentium Pro Systems
  ENS 507: Primarily a unix lab with 11 IBM RS/6000, 15 UltraSPARC, 42 X terminals, 1 HP 735/9000, 1 PowerMAC, and 8 Dell Optiplex

• Lab Operating Hours and Consulting Hours:
  Sunday-Friday 9 am - 11 PM    Saturday 9 am - 6 PM

Questions:
  General Mac/PC/Unix/Applications: 471-2675 or consult@ece.utexas.edu
  WWW questions: 475-6123 or webmaster@ece.utexas.edu
  System problems/complaints: 475-6124 or remark@ece.utexas.edu
  To report hardware problems: 475-8607 or lrctech@ece.utexas.edu
Setting Up Your Account

- To use the PC, Mac, or Unix systems, you have to set your passwords on each system.
- Go to the proctor in ENS 317, ENS 334, ENS 340, or ENS 507 with your ID.
- Set a good password!!

Otherwise, your account may deactivate during routine security screening. A good password does not appear in the dictionary, cannot be easily guessed, and has at least one number and punctuation mark.
A Few Rules

• Classwork has priority.
• Do not view offensive material: pornography, for example.
• Do not run a business from any UT facility.
• Use common sense and courtesy.

Abuse can result in temporary or permanent loss of your account and disciplinary action by the Dean of Student’s office.
Learning to Use the LRC Computers

• There are on-line documents that explain the basics of using the PC, Mac, and Unix systems. They can be found at: http://www.utexas.edu/cc/rack

• UT gives short classes that cover most aspects of the computer systems.
  The on-line reference is: http://www.utexas.edu/cc/training

• If you have a question, talk to a lab consultant.
Accessing LRC Computers Off-Site

- If you have an internet connection already, you can access UT resources from your worksite.
- If you have a PC or Mac and a phone line, you can dial up to UT systems.

You need an individually funded (IF) account.
You need software on your computer such as UT connect.
The location of instructions for UT connect:

http://www.utexas.edu/cc/rack/complete.html
Web Publishing

• Every user of ECE LRC computer systems is entitled to publish a web page.
• To do this, you need to learn a little HTML, the hypertext markup language used on the World Wide Web.
• You also need to learn a little bit of Unix.

Web publishing: http://www.ece.utexas.edu
Introduction to Unix: http://www.utexas.edu/cc/docs/ccug1
LRC Software

- A wide variety of software is installed on Learning Resource Center computer systems. Ex: ENS 334 - Matlab, Mathcad, PSpice, Works ...
- The software is listed at the LRC web page:
  http://www.ece.utexas.edu/lrc
- Different computer systems have different software.
- The most sophisticated packages tend to be on Unix.
Engineering Design Cycle

• ABET Definition

Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing, and evaluation.
Successful design procedures are quite varied - there is no widely accepted sequence of steps or algorithm for success.

Most good engineers develop their own approaches and strategies for design.

One has lots of freedom.

The engineer focuses on *design as a problem solution*. The design process may be viewed as the road map that guides the designer from the problem to its solution.
Identification of Need

- Often recognized by someone other than the engineer who will provide the solution.
- Requires specifications - what are the detailed functional, physical, etc. requirements? What are the economic constraints?
- The problem must be properly defined.
- Often overlooked and under appreciated: companies are now trying to deal more directly with their customers.
Conceptualization - Proposed Design

- Definition of the Problem
- Information Gathering
  - Often must solve a problem with incomplete information.
  - Make use of trade journals, books, catalogs, staff, etc.
- Development of a Proposed Solution
  - This is the creative problem solving stage. This step requires the greatest degree of inventiveness and imagination.
Evaluation of Proposed Solution

- Thorough analysis of the design.
  - Very important - production may involve huge investment.
  - Make use of computer simulations, prototypes, critique by others, etc.

- Must know when to exit this loop:
  - Apple - perfection. Release software when their people would like to use it.
  - Microsoft - Gates wants to know when it is good enough to sell.
Scientific Problem-Solving Method

• Step 1: Describe the problem to be solved (Problem Statement)
  ➢ The description must contain all the essential information regarding the problem.
  ➢ Ask two important questions
    ✓ What essential information is given
    ✓ What is to be determined?
Problem-Solving Method Con’t

- **Step 2: Diagram**
  - Visualize the problem by preparing a sketch or diagram.
  - The diagram should show the set up of the problem.

- **Step 3: Theory**
  - To obtain a solution, you must describe a relationship between what is given and what is to be found (called *modeling*).
  - It often consists of developing mathematical equations describing the system.
Problem-Solving Method Con’t

- **Step 4: Assumptions**
  - Clearly define the assumptions made to simplify the problem’s solution.
  - Different assumptions may lead to different results.
  - You may find some assumptions are not acceptable.

- **Step 5: Solution**
  - Present the solution in a manner easily followed by other engineers.
  - Document your solution carefully. Be comprehensive.
  - Provide enough data so that your solution can be checked.
Problem-Solving Method Con’t

• Step 6: Verification and Final Results
  ➢ You need to verify your result, if this is possible.
  ➢ You must check the accuracy of the solution, making sure that no errors are present.
  ➢ Always ask “Is this solution reasonable?”
    ✓ Just because your calculator says so does not make it so...
Problems in Engineering Curriculum

• Close-ended Problems
  ➢ Typically used in classes
  ➢ Appear at the back of textbooks
  ➢ Focus on teaching the use of a particular technique in solving problems

• Open-ended Problems
  ➢ Used in laboratories and sometimes in classes
  ➢ Multiple ways to solve problem exist
    ✔ User must choose which one to use
Types of Open-ended Problems

- **Design**
  - Developing a new process or item

- **Trouble-Shooting**
  - Diagnosing a problem in an existing item or process

- **Simulation**
  - Determining how something works and creating models to explain the behavior

- **Discovery**
  - Proving a hypothesis (Research)
What is Engineering Ethics?

- the study of moral issues and decisions confronting individuals and organizations involved in engineering
- the study of related questions about moral conduct, character, ideals and relationships of peoples and organizations involved in technological development.

The World of the Engineer

Law, Government, & Public Agencies

Industry (other firms)

Engineering Profession (societies)

Clients & Consumers

Engineering Firm

Family

Managers <-> Colleagues

Global Environment (society & nature)
National Society of Professional Engineers Code of Ethics for Engineers

Preamble: Engineering is an important and learned profession. As members of this profession, engineers are expected to exhibit the highest standards of honesty and integrity. Engineering has a direct and vital impact on the quality of life for all people. Accordingly, the services provided by engineers require honesty, impartiality, fairness and equity, and must be dedicated to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the highest principles of ethical conduct.

Fundamental Canons

Engineers, in the fulfillment of their professional duties, shall:
• Hold paramount the safety, health and welfare of the public.
• Perform services only in areas of their competence.
• Issue public statements only in an objective and truthful manner.
• Act for each employer or client as faithful agents or trustees.
• Avoid deceptive acts.
• Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.
Major Ethical Issue

- Dedication to employer vs. society
  - Business exists to make money(?)
  - Society expects businesses to act responsibly

- When do these dedications collide?