“Scientists discover the world that exists; engineers create the world that never was.”

Theodore von Karman

Mechanical Engineering at WPI

John M. Sullivan, Jr.
Associate Department Head,
Professor, Mechanical Engineering

http://www.wpi.edu/~sullivan  http://www.me.wpi.edu/
Outline

- What is Mechanical Engineering?
- Mechanical Engineering at WPI.
- Student Project Presentation.
- Question and Answer Session.
Mechanical Engineering is the broadest and largest engineering discipline.
Mechanical Engineering deals with:

- Power, engines, material processing, manufacturing
- Design and analysis of structures and mechanical systems, flow of fluids, heat transfer
- Lots of interaction with other disciplines:
  - Mechatronics involves electrical and mechanical
  - Robotics involves mechanical, electronic, computers
  - Biomechanical engineering melds engineering and biology
With an engineering degree you can...

- Design new products, structures, devices
- Discover new technologies (research)
- Create new capabilities by integrating existing technologies (Systems Engineering)
- Pursue related fields:
  - Business
  - Medicine
  - Law
  - Education
  - Public policy
**Mechanical Engineering is the Most Popular Engineering Discipline**

### Incoming Freshmen by Engineering Degree Declarations

<table>
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<tr>
<th>MAJOR</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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<tr>
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<td>34</td>
<td>36</td>
<td>37</td>
<td>40</td>
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<td>Engineering - TBD</td>
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<td>212</td>
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<td>Electrical Engineering</td>
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<td>Environmental Eng.</td>
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<td>6</td>
<td>11</td>
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<td>3</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>8</td>
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<td>Mechanical Engineering</td>
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<td>99</td>
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<tr>
<td>Management Engineering</td>
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<td>1</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>7</td>
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<td>6</td>
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<td>Robotics Engineering</td>
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<td>NA</td>
<td>4</td>
<td>28</td>
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<td>57</td>
<td>55</td>
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<td><strong>Grand Total of Engineering</strong></td>
<td><strong>388</strong></td>
<td><strong>469</strong></td>
<td><strong>489</strong></td>
<td><strong>563</strong></td>
<td><strong>579</strong></td>
<td><strong>628</strong></td>
<td><strong>696</strong></td>
<td><strong>620</strong></td>
<td><strong>224</strong></td>
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<tr>
<td>Grand Total for all of WPI</td>
<td><strong>752</strong></td>
<td><strong>804</strong></td>
<td><strong>831</strong></td>
<td><strong>921</strong></td>
<td><strong>957</strong></td>
<td><strong>944</strong></td>
<td><strong>1005</strong></td>
<td><strong>948</strong></td>
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<td>Engineering to Total WPI %</td>
<td>52</td>
<td>58</td>
<td>59</td>
<td>61</td>
<td>61</td>
<td>67</td>
<td>69</td>
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</table>
WPI was established in 1868.
31 Full-time faculty plus several adjunct faculty in ME
874 Undergraduate students in Mechanical Engineering (in 4 yrs)
285 Graduate students (full and part-time)

Undergraduate Degrees awarded in
    Mechanical Engineering
    Aerospace Engineering
    Robotics Engineering

Within Mechanical Engineering Degree can Concentrate in:
    Aerospace, Biomechanical, Design, Manufacturing,
    Material Science, Mechanics, Robotics, Thermo-fluids
Need 45 courses minimum to graduate from WPI.

What courses must I take vs. what I have control over?

- (6) – Humanities Component
- (2) – Social Science Courses
- (3) – Interactive Qualifying Project (IQP)
- (3) – Major Qualifying Project (MQP)
- (1) – Physical Education
- (12) – Math and Science Component
- (8) – Required ME Core Component
- (1) – Electrical Engineering Course
- (6) – Your Choice of ME (or other) Courses
- (3) – Free Electives
What should I take as a Freshman?
What do you want to take?

<table>
<thead>
<tr>
<th>GPS</th>
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<th>CAD</th>
<th>Machining</th>
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<td>Humanities</td>
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<td>Math 3</td>
<td>Math 4</td>
<td>Intro Materials</td>
<td>Math 5</td>
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<tr>
<td>Math 1</td>
<td>Math 2</td>
<td>Machining</td>
<td>Intro Design</td>
</tr>
</tbody>
</table>
Every student must do a senior project in their major called the Major Qualification Project.

- Is worth three-course equivalents.
- Is usually done in teams of 3 or more students.
- Is a capstone experience.
- Ties together what was learned in prior years.
- Often involves building a model or system.

- Can be done
  - over three terms on campus,
  - or in one 7-week term at an off-campus project center.
Society of Automotive Engineering (SAE) Car, or Baja Vehicle
FIRST Robotic Team (with the Mass Academy)
Micro-Aerial Vehicle (MAV)
What Makes WPI Different?

- **Flexible curriculum.**
  - Project model allows customization of interest areas.

- **Strong ties to industry.**
  - A significant fraction of ME MQP’s are real world problems sponsored by companies.

- **Good access to senior faculty.**
  - Primarily an undergraduate institution.
  - Many faculty do research that incorporates undergraduate students.
  - WPI faculty spend significant time with students in small groups and care about their development.
TAs don’t teach classes.
- All courses are taught by faculty.
- Introductory classes are usually taught by experienced faculty.

High Quality Teaching.
- The M.E. Department has 15% of the faculty (and 25% of the student body). Over 41 years, 11 different M.E. professors have won the annual *Trustees Award for Outstanding Teaching*, more than any other department. One was selected as a U.S. Professor of the year in 2007. Multiple Faculty-of-the-State Awards.
- The M.E. Department has 3 *Trustees Award for Service to Community*, more than any other department (initiated 2003).
- The M.E. Department has 6 of the 11 Endowed Professorships at WPI.
Recognized for Excellence and Results

#1 in the country for student / faculty interaction

One of the top 25 "most wired campuses"

#1 in the US Part-Time MBA
#2 US in Academic Quality
Rated best for Career Advancers

Top Colleges for Getting Rich
#9 in the Country

… one of 16 national Leadership Institutions that will define the future of liberal education

“… best career prospects” for graduates of the MBA program
# 9 in the Country
New York Times Highlights WPI’s Success in Retaining STEM Students

Studies show that, nationwide, about 40 percent of students who plan to major in engineering and science end up switching to another major or fail to get a degree. Even students who excel in STEM courses in high school often wash out after experiencing the “math-science death march” in college. So how come 74 percent of WPI undergraduates earn bachelor’s degrees in four years, and 80 percent in six years?
Where do our graduates go?

- Some to top graduate schools such as:
  - Purdue, U. Michigan, U. Minnesota, Stanford, Cal Tech

- Most to jobs in industry at companies such as:
  - Gillette, Raytheon, General Electric, Westinghouse.
  - Pratt & Whitney, Sikorsky, Stanadyne, Teradyne, Foster-Miller, Genzyme, IRobot, Bose, Boston Scientific, QA Technologies, Siemans, Textron, Tyco Valves, Jacobs Technology, Accellent, Naval Research Labs, Lightolier, ITT Marine, Exxon Mobil, and many others.
A strong program in engineering fundamentals
Opportunities for freshman to take ME courses
Opportunity to work closely with members of the faculty
Emphasis on technical and professional aspects of M.E.
Pioneered project-based education: 40 years of experience
Projects in foreign and domestic off-campus centers.
Strong industrial connections (Theory and Practice)
Five-year BS/MS program
Five-year BS/MS program

- A MS in Mechanical Engineering requires 30 credits
- The BS/MS allows 12 credits to count in both degrees
- The WPI undergraduate degree requires 45 courses or 135 credits, yet 144 credits are within the 4 years
- Using only the 12 credits double counted, a MS degree can be completed in the 5th year.
- Alternately, using the additional 9 credits within the 4 year UG schedule, a MS can be completed in 1 subsequent semester.
Mechanical Engineers have always been leaders in the development of transportation systems

18th century: Railroads

19th century: Ships/Submarines

20th century: Automobiles/Airplanes/Aerospace

21st century: ???????????

This trend will continue!
WPI Haas Technical Center
Professor Brown, Director

Many Facilities, including

Micro Electro/Mechanical Systems (MEMS) Laboratory
Professor Pryputniewicz, Director
Mechanical Engineering
Transportation

“SKYCAR”
from Moller Corporation

Autonomous vehicles for remote places:
The NASA 2003 Rover

The International Space Station

SpaceShipOne
Mechanical Engineering
The Faculty

- Recognized authorities in their specialties
- Fellows of various societies such as ASME
- Editors of professional journals
- Authors of leading text books

Recent Books by ME Faculty
Mechanical Engineers have led the development and application of computer software for design and manufacturing

- Computer Aided Design and Manufacturing (CAD/CAM)
- Finite Element Methods for Structural Analysis (FEM)
- Computational Fluid Mechanics and Heat Transfer (CFD)
- Dynamics and Control of Mechanical Systems
Student Project Presentations:

Soft Robotics Exo Muscular Arm

Benjamin Leone*, Christopher Molica*
Michael Brauckmann, Elliott Calamari, Seth Lipkind,
Amanda Piscopiello, William Terry

Intelligent Preprocessing of Electronic Waste for Recycling: a Source for Critical Materials

Amy Loomis*, Patrick Ford,
Student Presentations
Questions?