

## Precision Engineering

### FACULTY ADVISOR

Prof. Martin Culpepper

### DESCRIPTION

The Precision Engineering Track was formed for students that wish to augment a mechanical engineering foundation with deep knowledge of (1) mechanical system design and (2) the principles and practice of precision engineering. Precision engineers utilize the principles of precision machine design, applied physics, mechatronics and manufacturing to help transfer new technologies/discoveries/inventions into machines/products that satisfy demanding accuracy, repeatability and speed requirements. For example, emerging technologies are starting to require (a) nanometer tolerances, (b) 10s of picometers resolution or (c) the ability to measure and apply nano-/picoNewton forces. Medical devices often need or provide high precision motion within confined packages. In addition, the transfer of these technologies/discoveries/inventions into commercial products requires precision engineering of the products and the equipment that is used to make these products. Graduates of this track will be able to synthesize new concepts for precision machines/products, and then model, design, fabricate and control them. This track was created to allow students to select a series of related elective courses that provide deep knowledge in a discipline (e.g. optics, controls, nanomanufacturing, etc...) wherein the principles and practice of precision engineering are critical for advancing the state-of-the-art.

### CAREER OPPORTUNITIES

A continual stream of engineers is required to (1) research new concepts, methods and tools for precision engineering and (2) transfer new technologies/discoveries/inventions into machines/products. Graduates of this track will be prepared for entry into post graduate education or practicing engineer positions within classical and emerging fields. Some examples of potential career paths include research or engineering in:

- Classical fields: Mechatronics, Manufacturing Equipment, Optics, Automotive, Aerospace, Semiconductor, Medical Devices
- Emerging fields: Micro/Nanomanufacturing Equipment, Atomic/Molecular Metrology, Micro/Nano-scale Machine & Instrument Design, Nanopositioning Robots, Bioinstrumentation

## Precision Engineering

General Institute Requirements (GIRs) Subjects	Subjects
Science Requirement	6
Humanities, Arts, and Social Sciences Requirement	8
Restricted Electives in Science and Technology (REST) Requirement [may be satisfied by 2.001 and 18.03 in the Departmental Program]	2
Laboratory Requirement [may be satisfied by 2.671 in the Departmental Program]	1
<b>Total GIR Subjects Required for SB Degree</b>	<b>17</b>

Communication Requirement	Subjects
Communication Intensive in Humanities, Arts, and Social Sciences (CI-H)	2
Communication Intensive in the Major (CI-M)	2

**Departmental Program**  
Subject names listed below are followed by credit units and by prerequisites if any (co-requisites in italics).

**Required Departmental Core Subjects** **78 units**

- 2.001 Mechanics and Materials I, 12, REST; 8.01, 18.02, 18.03
- 2.003J Dynamics and Control I, 12, REST; 8.01, 18.03
- 2.005 Thermal-Fluids Engineering I, 12; REST, 8.02, 18.03
- 2.009 The Product Engineering Process, 12; 2.001, 2.003, 2.005, 2.670
- 2.670 Mechanical Engineering Tools, 6
- 2.671 Measurement and Instrumentation, 12, LAB, CI-M; 2.003, 8.02
- 18.03 Differential Equations, 12, REST; 18.02

**Second Level Subjects for This Track** **36 units**

- 2.002 Mechanics and Materials II, 12; 2.001, 3.091 or 5.111 or 5.112    OR    2.004 Dynamics and Control II, 12; 2.003, 8.02    OR    2.006 Thermal-Fluids Engineering II, 12; 18.03
- 2.007 Design and Manufacturing I, 12; 2.001, 2.670
- 2.008 Design and Manufacturing, II, 12; 2.001, 2.005, 2.007 or 2.017

**Precision Concentration** **60 units**

**A. Take these:**

- 2.72 Elements of Mechanical Design, 12; 2.005, 2.007, 2.671
- 2.75 Precision Machine Design, 12; 2.72

**B. Take at least one of these:**

- 2.71 Optics, 12; 8.02, 18.03, 2.004
- 2.737 Mechatronics, 12; 6.071, or 6.002; 2.14, or 6.302, or 16.30
- 2.760 Multi-scale System Design and Manufacturing, 12; 2.004, 2.008

**C. Take at least 24 units from:**

- 2.131 Advanced Instrumentation and Measurement, 12
- 2.14 Analysis and Design of Feedback Control Systems, 12; 2.004
- 2.168 Analysis, Design, and Control of Automated Equipment, 12; 2.003, 2.014, 2.151 (*co-requisite*)
- 2.372J Design and Fabrication of MEMS, 12; 6.003 or 2.004, 8.02
- 2.391J Submicrometer and Nanometer Technology, 12
- 2.71 Optics\*, 12; 8.02, 18.03, 2.004, or permission of instructor
- 2.737 Mechatronics\*, 12; 6.071, or 6.002; 2.14, or 6.302, or 16.30
- 2.760 Multi-scale System Design and Manufacturing\*, 12; 2.004, 2.008, or permission of instructor

\* If subject is taken to satisfy the section B requirement, it may not be used to satisfy the section C requirement.

**Strongly Recommended Unrestricted Electives**

- 6.071J Introduction to Electronics, 12; 18.03
- 18.06 Linear Algebra, 12; 18.02

**Other Recommendations for Unrestricted Electives**

- 2.06J Mechanical Vibration, 12; 2.003J
- 2.088 Introduction to Modeling and Simulation, 12; 18.03
- 2.092 Computer Methods in Dynamics, 12; 2.001, 2.003J
- 2.25 Advanced Fluid Mechanics, 12; 2.006, 18.075, 18.085
- 2.51 Intermediate Heat and Mass Transfer, 12; 2.006
- 18.075 Advanced Calculus for Engineers, 12; 18.02, 18.03

**Departmental Program units that also satisfy the GIRs** **(36 units)**

**Unrestricted Electives** **48 units**

**Total Units Beyond the GIRs Required for SB Degree** **186 units**

*No subject may be counted as part of the 17-subject GIRs and as part of the 186 units required beyond the GIRs. Every subject in the student's departmental program will count toward one or the other. For an explanation of units, or hours, refer to the Subject Key in Part 3 of the Bulletin.*