ROBO MSE PLAN OF STUDY FORM

Student Name:______________________________________________________________

Advisor Name:_______________________________________________________________

Expected Graduation Date:______________ Do you plan to write a master’s thesis?:   Yes  /  No

The Robotics M.S.E. requirements consist of a total of ten courses, including an optional thesis project.

**Foundational Courses (at least 3)**

<table>
<thead>
<tr>
<th>Area</th>
<th>Course Number</th>
<th>Semester taken/to be taken:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artificial Intelligence</td>
<td></td>
<td></td>
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<tr>
<td>Robot Design and Analysis</td>
<td></td>
<td></td>
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<tr>
<td>Control</td>
<td></td>
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<tr>
<td>Perception</td>
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**Technical Elective Courses (at least 5)**

Students are required to take at least 5 courses from the list of Technical Electives:*  

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<th>3.</th>
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<th>5.</th>
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**General Elective Courses (at most 2)**

(a) Graduate level courses in Mathematics, Computer Science, Electrical Engineering or Mechanical Engineering.

(b) Students can also use any of the foundational or technical elective courses listed as well.*

(c) Courses in other disciplines may be used with the approval of the Robotics Program Director.

(d) The following courses may also be used as General Electives: EAS 545 Engineering Entrepreneurship I, EAS 546 Engineering Entrepreneurship II, ESE 540 Engineering Economics

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Student Signature:_________________________ Date:________________

Advisor Signature:_________________________ Date:________________

Robotics Program Director Signature:_________________ Date:________________

Only applicable for (c) above.

Please give completed/signed Plan of Study Form to Charity Payne in Levine 459.

*List of courses can be found below and here: [https://www.grasp.upenn.edu/education/masters](https://www.grasp.upenn.edu/education/masters)
Academic Curriculum
The Robotics M.S.E. requirements consist of a total of ten courses, including an optional thesis project.

Courses:
Students are required to take courses in at least three of the four foundational areas: Artificial Intelligence, Mechanism Design and Analysis, Perception and Control. The list below indicates the foundational courses in each of these four areas.

Note: Students are allowed and in fact encouraged to take more than three courses from this list. These additional courses can be counted as Technical Electives or as General Electives.

Students are required to take at least 5 courses from the list of Technical Electives. Students are allowed 2 General Elective courses which can be taken from any technical field (e.g., Mathematics, Computer Science, Electrical and Systems Engineering, or Mechanical Engineering). Courses in other disciplines may be used as General Electives with the approval of the Robotics Program Director.

Foundational Courses (at least 3)

Artificial Intelligence:

- CIS 519 Introduction to Machine Learning
- CIS 520 Machine Learning
- CIS 521 Fundamentals of AI
- ESE 650 Learning in Robotics

Robot Design and Analysis:

- MEAM 510 Design of Mechatronic Systems
- MEAM 520 Introduction to Robotics
- MEAM 620 Advanced Robotics

Control:

- ESE 500 Linear Systems
- ESE 505/MEAM 513 Control Systems Design

Perception:

- CIS 580 Machine Perception
- CIS 581 Computer Vision & Computational Photography

Technical Elective Courses (at least 5)

- BE 521 Brain-Computer Interfaces
- CIS 502 Analysis of Algorithms
- CIS 510 Curves & Surfaces: Theory & Applications
- CIS 511 Theory of Computation
- CIS 515 Foundations of Linear Algebra & Optimization
- CIS 519 Introduction to Machine Learning
- CIS 520 Machine Learning
- CIS 521 Fundamentals of AI
- CIS 526 Machine Translation
- CIS 530 Computational Linguistics
- CIS 540 Principles of Embedded Computation
- CIS 541 Embedded Software for Life-Critical Applications
- CIS 560 Computer Graphics
- CIS 562 Computer Animation
- CIS 563 Physically Based Animation
- CIS 564 Game Design & Development
- CIS 565 GPU Programming & Architecture
- CIS 580 Machine Perception
- CIS 581 Computer Vision & Computational Photography
- CIS 610 Advanced Geometric Methods
- CIS 620 Advanced Topics in AI
- CIS 680 Vision and Learning
- ENM 502 Numerical Methods & Modeling
- ENM 503 Introduction to Probability & Statistics
- ENM 510 Foundations of Engineering Math I
- ENM 511 Foundations of Engineering Math II
- ENM 520 Principles and Techniques of Applied Math I
- ENM 521 Principles and Techniques of Applied Math II
- ESE 500 Linear Systems
- ESE 504 Introduction to Optimization
- ESE 505/MEAM 513 Control Systems Design
- ESE 519 Real Time & Embedded Systems
- ESE 530 Elements of Probability Theory & Random Processes
- ESE 531 Digital Signal Processing
- ESE 601 Hybrid Systems
- ESE 605 Convex Optimization
- ESE 617 Nonlinear Systems
- ESE 650 Learning in Robotics
- ESE 680 Dynamic Programming - Special Topics in ESE
- IPD 501 Integrated Computer-Aided Design, Manufacturing & Analysis
- IPD 515 Product Design (formerly MEAM 515)
- MEAM 510 Design of Mechatronic Systems
- MEAM 513/ESE 505 Control Systems Design
- MEAM 516 Advanced Mechatronic Reactive Spaces
- MEAM 520 Introduction to Robotics
- MEAM 535 Advanced Dynamics
- MEAM 545 Aerodynamics
- MEAM 620 Robotics
- MEAM 625 Haptic Interfaces
- PSYC 719 Experimental Methods in Perception
- ROBO 599 (ESE/CIS/MEAM 599 for older students starting before Fall 2014) (Note: Only one Independent Study may be taken for the degree)
• ROBO 597 (ESE/CIS/MEAM 599 for students starting before Fall 2014) (Click here for masters thesis requirements.)

**General Elective Courses (at most 2)**
Graduate level courses in Mathematics, Computer Science, Electrical Engineering or Mechanical Engineering. Students can also use any of the foundational or technical elective courses listed above as general electives.
Courses in other disciplines may be used with the approval of the Robotics Program Director.

The following courses may also be used as General Electives...

- EAS 545 Engineering Entrepreneurship I
- EAS 546 Engineering Entrepreneurship II
- ESE 540 Engineering Economics
- IPD 504/BE 514 Rehab Engineering and Design
- IPD 511 Creative Thinking & Functional Iteration in Design
- IPD 514 (MEAM514) Design for Manufacturability
- IPD 525 Ergonomics/Human Factors Based Product Design
- IPD 527 (ARCH727) Industrial Design I