Tracks consist of course sequences that provide the student with strength in a specific area. Track requirements are listed below. Other courses may be substituted only with the written approval of both the student’s academic advisor and the Robotics Education Director. Many of these courses are offered in multiple departments – alternative course numbers for the same class are acceptable substitutions. Please confirm with your advisor that you have signed up for the correct courses. Not all courses will necessarily be offered each semester or each year.

NOTE: Students should discuss their academic plan with their advisor. Specific choices are subject to approval of plan by advisor.

Automation Science and Engineering Track – choose four (4) courses from the following list. Starred and bolded choices are strongly recommended.

- **530.414** Computer-Aided Design*
- **530.354** Manufacturing Engineering*
- **520.448** Electronics Design Lab
- **520.738** Advanced Electronic Lab Design
- **530.420** Robot Sensors/Actuators
- **530.421** Mechatronics
- **530.495** Microfabrication Laboratory
- **530.645** System Identification (Not listed for future/550.636 avail S16 System Identification and Likelihood Methods)
- **530.653** Advanced Systems Modeling
- **550.457** Topics in Operations Research
- **550.661** Foundations of Optimization
- **550.662** Optimization Algorithms
- **600.661** Computer Vision

BioRobotics Track – choose four (4) courses from the following list. Starred and bolded choices are strongly recommended.

- **530.686** Mechanics of Locomotion*
- **530.676** Locomotion in Mechanical and Biological Systems*
- **520.621** Introduction to Nonlinear Systems
- **530.485** Physics and Feedback in Living Systems
- **530.616/580.616/520.601** Introduction to Linear Systems
- **530.649** System Identification
- **530.682** Haptic Applications
Control and Dynamical Systems Track – choose four (4) courses from the following list. Starred and bolded choices are strongly recommended.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>520.621</td>
<td>Introduction to Nonlinear Systems*</td>
</tr>
<tr>
<td>520.601</td>
<td>Introduction to Linear Systems*</td>
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<tr>
<td>530.616/580.616</td>
<td>Nonlinear Control and Planning in Robotics*</td>
</tr>
<tr>
<td>520.629</td>
<td>Networked Dynamical Systems</td>
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<td>520.633</td>
<td>Intro to Robust Control</td>
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<tr>
<td>530.603</td>
<td>Applied Optimal Control</td>
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<tr>
<td>530.624</td>
<td>Dynamics of Robots and Spacecraft</td>
</tr>
<tr>
<td>530.647</td>
<td>Adaptive Systems</td>
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<tr>
<td>530.649</td>
<td>System Identification</td>
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<td>530.653</td>
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<tr>
<td>530.654</td>
<td>Advanced Systems Modeling II</td>
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<tr>
<td>530.676</td>
<td>Locomotion in Mechanical and Biological Systems</td>
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<tr>
<td>530.761</td>
<td>Mathematical Methods of Engineering I</td>
</tr>
<tr>
<td>550.692</td>
<td>Matrix Analysis and Linear Algebra</td>
</tr>
<tr>
<td>550.697</td>
<td>Introduction to Control Theory and Optimal Control</td>
</tr>
</tbody>
</table>

Medical Robotics and Computer Integrated Surgical Systems Track

Required for the track:

600.645 Computer Integrated Surgery I*
600.646 Computer Integrated Surgery II*

Choose two (2) of the following:

520.432/580.472 Medical Imaging Systems
520.433 Medical Image Analysis
520.613 Adv Topics in Optical Medical Imaging
520.631 Ultrasound and Photoacoustic Beamforming
530.420 Robot Sensors/Actuators
530.682 Haptic Applications
530.761 Mathematical Methods of Engineering I
580.673 Magnetic Resonance in Medicine
580.679 X-ray Imaging and Computed Tomography
580.683 Nuclear Medicine Imaging
580.684 Ultrasound Imaging: Theory and Applications
580.693 Imaging Instrumentation
600.661 Computer Vision
600.676 Machine Learning: Data to Models
600.684 Augmented Reality
Adv Topics in Machine Learning: Model. and Seg. of Multivariate
600.692 Mixed Data

Perception and Cognitive Systems Track – choose four (4) courses from the following list.
Starred and bolded choices are strongly recommended.

600.435 Artificial Intelligence*
600.661 Computer Vision*
520.414 Image Processing & Analysis
520.415 Image Process & Analysis II
520.646 Wavelets & Filter Banks
530.420 Robot Sensors/Actuators
530.421 Mechatronics
530.682 Haptic Applications
530.707 Robot System Programming
550.493 Mathematical Image Analysis
550.662 Optimization Algorithms
580.630 Theoretical Neuroscience
600.475 Introduction to Machine Learning
600.660 FFT in Graphics & Vision
600.684 Augmented Reality

General Robotics Track – choose four (4) courses from the following list.

520.621 Intro to Nonlinear Systems
520.633 Intro to Robust Control
530.420 Robot Sensors/ Actuators
530.421 Mechatronics
530.603 Applied Optimal Control
530.616/580.616/520.601 Introduction to Linear Systems
530.624 Dynamics of Robots and Spacecraft
530.645 Kinematics
530.647 Adaptive Systems
530.648 Group Theory in Engineering Design
530.649 System Identification
530.653 Advanced Systems Modeling
530.654 Advanced Systems Modeling II
530.676 Locomotion in Mechanical and Biological Systems
530.678 Nonlinear Control and Planning in Robotics
530.682 Haptic Applications
530.686 Mechanics of Locomotion
530.707 Robot System Programming
530.761 Mathematical Methods of Engineering I
550.662 Optimization Algorithms
550.692 Matrix Analysis and Linear Algebra
550.697 Introduction to Control Theory and Optimal Control
600.435 Artificial Intelligence
600.661 Computer Vision
600.475 Introduction to Machine Learning
600.645 Computer Integrated Surgery I
600.646 Computer Integrated Surgery II
600.684 Augmented Reality