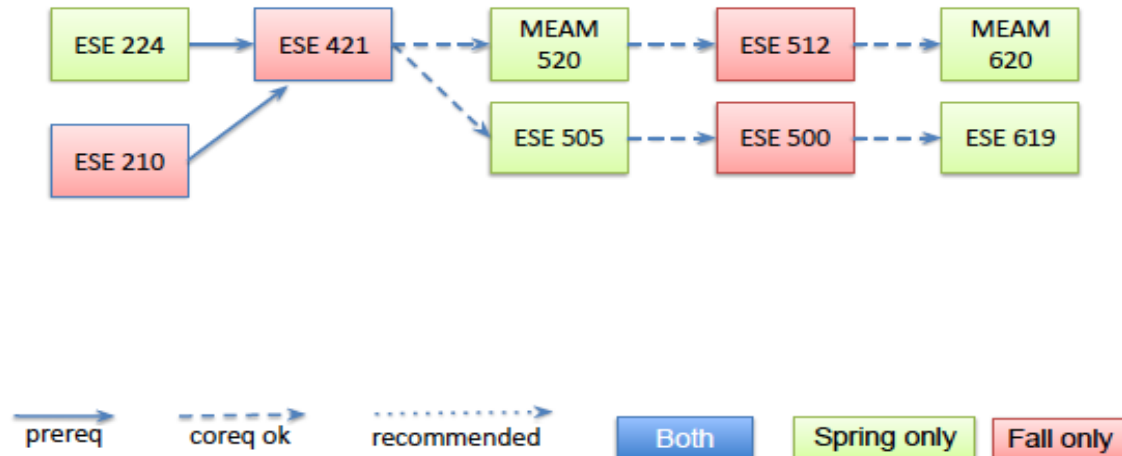# SSE Concentration: Robotics

Requirements: Complete ESE 421
Select 3 Electives: ESE 505, ESE 512, ESE 500, ESE 619, MEAM 520, MEAM 620

Requirement Flow:

Impact: Robotics, the embodiment of smart computation in complex sensorimotor hardware, has set into motion a "fourth industrial revolution" sweeping the entire world economy and its societies, attracting hundreds of billions of dollars and impacting billions of jobs. Despite notable advances in many of the constituent technologies – computation, sensing, materials – the field of robotics is still in a very early stage of development and students who pursue this concentration will be able to quickly come to the horizons of research and participate at the very seminal period of a world-changing technology.

Description: A major barrier to the development of agile robots that can operate effectively in unstructured environments is the coordination of their many degrees of freedom in response to the noisy data streams from their sensors. Compounding this problem is the need to ground users' abstract representations of desired behavior in terms of those real time signal loops. Designing and programming dexterous mechanisms that can accept high level symbolic task assignments and produce the complicated sensorimotor activities to realize them is a central problem of robotics. To build and use these systems, engineers must understand the functional capabilities and limits of mechatronic and computational hardware, the many different software tools available to guide their design and deployment, as well as the highly nonlinear models that describe them and the advanced mathematical methods required to control them. This concentration prepares students both to participate in the design of these machines and to use robots as intelligent physical agents to achieve complex tasks in a broad variety of environments.

Sample industries and companies:
- Manufacturing & Automation:, ABB, Amazon, Fanuc, Kollmorgen, Vecna
- Consumer & Service Devices: Apple, Samsung, many small, emerging ventures
- Social Systems Platforms: Amazon, Disney, Google, Facebook, Microsoft, Nvidia
- Automotive and Aerospace: GM, Ford, Space-X, Tesla, Waymo
- *Your startup*

Graduate research in: robotics, AI, transportation and manufacturing