

Immunoengineering

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Description: What vaccine best exploits the evolutionary weaknesses of a virus or a tumor's mutations? What is the intratumoral exposure history of intravenously injected antibodies? How does deregulated signaling tip the balance from healthy homeostasis to autoimmune disease? Can native T cell tropism overcome physical barriers to macromolecular drug delivery? How does our antibody repertoire respond to therapy or disease? How might innate and adaptive immunotherapies best be combined? How does lymphatic transport actively regulate adaptive immunity? Can injectable biomaterials program and effective anti-tumor immune response? A common thread through these varied topics is the engagement of biological, chemical, and materials engineers at the forefront. At their disposal in an analytical toolkit honed to solve problems in the petrochemical and materials industries, which share the presence of complex reaction networks, and convective and diffusive molecular transport. Powerful synthetic capabilities have also been crafted: binding proteins can be engineered with effectively arbitrary specificity and affinity, and multifunctional nanoparticles and gels have been designed to interact in highly specific fashions with cells and tissues. Fearless pursuit of knowledge and solutions across disciplinary boundaries characterizes this nascent discipline of immune engineering, synergizing with immunologist and clinicians to put immunotherapy into practice.

Guide for class selection:

While these courses can be taken in any order, students should consider starting the concentration with 7.23, which provides a comprehensive background in immunology helpful for contextualizing the other courses. Additionally, 20.365 is strongly recommended as the 'keystone' course for the concentration as it focuses on applying engineering approaches to immunology.

Restricted Electives

- 7.23 **Immunology (U)**
Prereq: 7.06
- 7.24 **Immunology in Medicine (U)**
Prereq: 7.06 or permission of instructor
- 7.26 **Molecular Basis of Infectious Disease (U)**
Prereq: 7.06
- 7.371 **Biological and Engineering Principles Underlying Novel Biotherapeutics (U)**
Prereq: 7.06
- 7.45 **The Hallmarks of Cancer (U)**
Prereq: None Coreq: 7.06
- 10.495 **Molecular Design and Bioprocess Development of Immunotherapies (U)**
Prereq: 7.06 or permission of instructor
- 20.365 **Engineering the Immune System in Cancer and Beyond (U)**
Prereq: 20.110 or permission of instructor