EN.585.751.81 Immunoengineering Syllabus

Instructor Contact

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We prefer that students contact us via email. Please be sure to include course number in the subject line. We will make every effort to respond to your inquiry within 48 hours or earlier. If an issue is urgent, please indicate "urgent" within the subject line of the email and we will respond as soon as is practical.

Office Hours via Zoom

You will receive a link each week in the announcements to the Zoom office hours room. This course will use Zoom to facilitate weekly, synchronous office hours. You are not required to participate in all office hours; however, you may find them very beneficial for receiving more timely answers to questions related to the course content and assignments.

Office hours will be held on Mondays at 7PM ET. You are encouraged to post any questions you would like to have answered during the live office hour sessions by emailing them to the instructor. This will give us time to prepare an answer prior to the live session. We will also take live questions during the session. Recorded office hour sessions will be posted to the module for any students who were unable to participate in the "live" sessions or for students who like to listen to them again. For more information regarding Zoom, please see the Zoom Student Quick Start Guide.

Course Description

Immunoengineering is a quickly growing field where engineering principles are used to better understand the dynamics of the immune system and enhance the efficacy of current immunotherapeutics. This course will provide relevant background in our understanding of various immune responses including to pathogens, self, allergens, cancer, and biomaterials. An in-depth engineering perspective and approach will be taken in the analysis of these responses and the development of novel therapeutics. Topics include systems immunology, genetic engineering, nanotechnology, hydrogels, biomaterials, vaccines, cancer immunotherapy, autoimmunity, tissue engineering, stem cells, viruses, bacteria, etc.

Module Outline

1 Immunoengineering: A New Frontier
2 Immune Response: Pathogens
3 Immune Response: Autoimmunity, Allergen
4 Immune Response: Cancer
5 Immune Response: Biomaterials
6 Midterm Exam and Immune System Review
7 Engineering Therapies: Pathogens
8 Engineering Therapies: Autoimmunity, Allergens
9 Engineering Therapies: Cancer
10 Engineering Therapies: Biomaterials and Implants
11 Engineering Therapies: Biomaterials and Tissue Engineering
12 Engineering Tools: Immunoprofiling
13 Engineering Tools: Modeling
14 Final Projects/Presentations

Prerequisites

585.405 Physiology for Applied Biomedical Engineering

Basic understanding of cell and molecular biology, and math skills up through differential equations

Course Objectives

By the end of this course, you will be able to:

1. Explain various types of immune responses to someone not within the field of immunoengineering (i.e. pathogens, self, allergens, cancer, biomaterials)
2. Identify the advantages and disadvantages of current immunotherapies
3. Examine the applications of engineering principles that have led to advancements in the field of immunology
4. Apply principles of engineering to advanced topics in immunoengineering within problem sets and quizzes
5. Evaluate current advances in the immunoengineering field
6. Propose how engineering can further contribute to the field of immunology

Course Structure

The course materials are divided into modules which can be accessed by clicking Course Modules on the left menu. A module will have several sections including the overview, content, readings, quizzes, discussions, and assignments. You are encouraged to preview all sections of the module before starting. Most modules run for a period of seven (7) days, exceptions are noted on the Course Outline page. You should regularly check the Calendar and Announcements for assignment due dates.

Textbook

No textbooks are needed. All readings are provided or available online. However, some students have mentioned that having a basic physical immunology textbook has been beneficial. You can get old editions of the following textbooks that would be affordable online, but are not required:

- Janeway's Immunobiology by Kenneth M. Murphy
- How the Immune System Works (The How it Works Series) by Lauren M. Sompayrac

Technical Requirements

You should refer to Help on the left menu for a general listing of all the course technical requirements.

Student Coursework Requirements

It is expected that each module will take approximately 8–11 hours per week to complete. Here is an approximate breakdown: reading the assigned sections of the texts (approximately 3-4 hours per week) as well as some outside reading, listening to the audio annotated slide presentations (approximately 1-2 hours per week), and assignments including working on the final project (approximately 4–5 hours per week).

This course will consist of five basic student requirements:

1. **Participation (Online Quizzes and Module Discussions)** (15% of Final Grade Calculation)

   Module 1-5 will have a short online quiz that you must complete as part of your participation grade. The quizzes are designed to permit you to self-assess your knowledge on the topics that are covered and will help you prepare for the exam. You are responsible for carefully reading all assigned material and being prepared for discussion. You must complete the online reading, view the videos, and answer the questions in the online quiz and receive a score of **at least 90%** on the module quizzes prior to receiving access to the module assignment.

   Post your initial response to the discussion questions **by 11:59 PM on day 4 (Saturday)** for that module week. Posting a response to the discussion question is part one of your grade for module discussions (i.e., Timeliness). You are encouraged to use recent references from literature searches in your discussion postings.

   Part two of your grade for module discussion is your interaction (i.e., responding to classmate postings with thoughtful responses) to **at least one** classmate (i.e., Critical Thinking). Just posting your response to a discussion question is not sufficient; we want you to interact with your classmates. Be detailed in your postings and in your responses to your classmates' postings. Feel free to agree or disagree with your classmates. Please ensure that your postings are civil and constructive. You are encouraged to use references in responses to your classmates' postings.

   We will monitor module discussions and will respond to some of the discussions as discussions are posted. In some instances, we will summarize the overall discussions and post the summary for the module.

   Evaluation of preparation and participation is based on contribution to discussions.

   Preparation and participation is evaluated by the following grading elements:

   1. Timeliness (33%)
   2. Critical Thinking (33%)
   3. Quiz Completion with a grade of 90% or better (33%)

   Preparation and participation is graded as follows:

   100–90 = A—Timeliness [regularly participates; all required postings; early in discussion; throughout the discussion]; Critical Thinking [rich in content; comment based on solid references, full of thoughts, insight, and analysis]; Quiz Completion [completes all quiz questions by the due date with great effort].

   89–80 = B—Timeliness [frequently participates; all required postings; some not in time for others to read and respond]; Critical Thinking [substantial information; thought, insight, and analysis has taken place, used references]; Quiz Completion [completes 80% of quiz questions with good effort and by the due date].

79–70 = C—Timeliness [infrequently participates; all required postings; most at the last minute without allowing for response time]; Critical Thinking [generally competent; information is thin and commonplace, poor or no references]; Quiz Completion [completes 70% of the quiz questions with average effort and by the due date].

<70 = F—Timeliness [rarely participates; some, or all required postings missing]; Critical Thinking [no references, rudimentary and superficial; no analysis or insight is displayed]; Quiz Completion [less than 70% of the quiz questions were completed; no effort or timely submission is evident].

2. **Assignments** (20% of Final Grade Calculation)

Assignments will include a mix of qualitative assignments (e.g. literature reviews, model summaries), quantitative problem sets, and case study updates. Make sure your name, the assignment number, and a page number indicator (i.e., page x of y) are in the header of each page of your submissions. Each problem should have the problem statement, assumptions, computations, and conclusions/discussion delineated. All Figures and Tables should be captioned and labeled appropriately.

All assignments are due according to the dates in the Calendar and must be submitted as **pdf or Word files**.

Late submissions will be reduced **by one letter grade for each week late** (no exceptions without prior coordination with the instructors). In other words, the maximum grade for an assignment up to one week late is B, up to two weeks late is a C, and up to three weeks late is a D. Assignments will not be accepted after 4 weeks and will be given a grade of “0”. We will drop one homework assignment grade to accommodate for unforeseen situations.

<u>Qualitative assignments are graded as follows:</u>

100–90 = A—All parts of question are addressed; Writing Quality/ Rationale/ Examples/ Outside References [rich in content; full of thought, insight, and analysis].

89–80 = B—All parts of the question are addressed; Writing Quality/ Rationale/ Examples/ Outside References [substantial information; thought, insight, and analysis has taken place].

79–70 = C—Majority of parts of the question are addressed; Writing Quality/ Rationale/ Examples/ Outside References [generally competent; information is thin and commonplace].

<70 = F—Some parts of the question are addressed; Writing Quality/ Rationale/ Examples/ Outside References [rudimentary and superficial; no analysis or insight displayed].

<u>Quantitative assignments are graded as follows:</u>

100–90 = A—All parts of question are addressed; All assumptions are clearly stated; All intermediate derivations and calculations are provided; Answer is technically correct and is clearly indicated; Answer precision and units are appropriate.

89–80 = B—All parts of question are addressed; All assumptions are clearly stated; Some intermediate derivations and calculations are provided; Answer is technically correct and is indicated; Answer precision and units are appropriate.

79–70 = C—Most parts of question are addressed; Assumptions are partially stated; Few intermediate derivations and calculations are provided; Answer is not technically correct but is indicated; Answer precision and units are indicated but inappropriate.

<70 = F—Some parts of the question are addressed; Assumptions are not stated; Intermediate derivations and calculations are not provided; The answer is incorrect or missing; The answer precision and units are inappropriate or missing.

3. **Research Paper Review and Presentation** (45% of Final Grade Calculation - 20% Research assignments due during the course, 10% Presentation, 15% Research proposal) *Additional details can be found from the Research Project Tab and associated documents; this is to give an overview for grading purposes.*

One of the main methods of learning and demonstrating mastery of course concepts will be incorporated in your final project. You will produce 2 final products for this course's final project surrounding the same topic. You will come up with an engineering solution to a current disease or challenge in immunology. This will be in the form of a short, written proposal (similar to an R21) and a short pitch presentation (between 3 and 7 minutes) using a narrated PowerPoint presentation (or equivalent presentation software of your choice) using Voicethread. We will post specific details and instructions for each deliverable and what you will be evaluated on. Here is a brief outline of the project timeline and assignments:

Project Outline and Module Milestone Assignments

Project assignment	**Modules to work on it (final is when due)**
Project selection	2
Background research on problem (sources)	3
Significance section rough draft	4-5
Previous engineering approaches to solve problem (sources) and idea for how to solve	6-7
Innovation section rough draft	8
Experimental approach outline	9
Identify supporting data/potential pitfalls	10
Rough draft	11
Pitch Presentation	13
Final draft	13-14

The research paper will be graded as follows:

100-90 = A - Superior submission in all aspects. High quality research and analysis of the subject with excellent support, discussion, and justification at a level appropriate for a competent engineer with excellent organization and presentation.

89-80 = B - good submission in all aspects. Acceptable research analysis of the subject with adequate discussion and justification of major points. Good organization of paper that is generally

easy to follow and proceeds logically through the material. Presentation of paper is acceptable, may be missing minor elements like section headings or have minor spelling/grammar errors. An acceptable number of references are provided.

79-70 = C - paper has major flaws and is not representative of a quality graduate level submission. Major gaps in research, analysis and coverage of the subject; may have minor technical inaccuracies. Organization is lacking, with major breaks in logic and flow. Presentation is below average, with missing elements and spelling/grammar errors that make paper difficult to read. The number of citations is inacceptable or incomplete.

<70 = F - paper has major inaccuracies and incomplete analysis, plagiarized portions, and/or entire missing sections. Presentation or organization errors are so egregious that paper is judged to be entirely unacceptable for submission.

The pitch presentation will be evaluated by the following elements:

1. Format and Content (50%)
2. Delivery (50%)

The presentation will be posted on Canvas using VoiceThread and will be graded as follows:

100-90 = A - Complete and organized content; Innovative presentation structure; Superior presentation includes succinct overview of all the required elements; excellent use of multimedia content (e.g. video); and within the time limit

89-80 = B - Complete and organized content; Easy to follow presentation structure; Engaging presentation includes succinct overview of all the required elements; good use of multimedia content (e.g. video); and within the time limit

79-70 = C - Complete and organized content; Basic presentation includes succinct overview of most of the required elements and is reasonably within the time limit

<70 = F - Incomplete content; little or no organization; Presentation does not cover all the project elements, and is over or under the time limit

4. **Exams** (20% of Final Grade Calculation)

The multiple choice midterm exam will be available in Module 6. You will have 1.5 hours to complete the test and will be done entirely on Canvas. You may only use your class notes and may not receive any outside help on the exam. Students who miss exams due to documented illness will have a combination oral and written exam.

Grading

Assignments are due according to the dates posted in your Canvas course site. You may check these due dates in the Course Calendar or the Assignments in the corresponding modules. We will post grades one week after assignment due dates.

We generally do not directly grade spelling and grammar. However, egregious violations of the rules of the English language will be noted without comment. Consistently poor performance in either spelling or grammar is taken as an indication of poor written communication ability that may detract from your grade.

A grade of A indicates achievement of consistent excellence and distinction throughout the course—that is, conspicuous excellence in all aspects of assignments and discussion in every week.

A grade of B indicates work that meets all course requirements on a level appropriate for graduate academic work. These criteria apply to both undergraduates and graduate students taking the course.
100–98 = A+
97–94 = A
93–90 = A−
89–87 = B+
86–83 = B
82–80 = B−
79–70 = C
<70 = F

Final grades will be determined by the following weighting:

Item	% of Grade
Preparation and Participation (Module Discussions, online quizzes)	15%
Assignments	20%
Research Assignments, Proposal, and Presentation	45%
Midterm Exam	20%

Help & Support

You should refer to Help & Support on the left menu for a listing of all the student services and support available.

Policies and Guidelines

Academic Integrity

Academic Misconduct Policy

All students are required to read, know, and comply with the Johns Hopkins University Krieger School of Arts and Sciences (KSAS) / Whiting School of Engineering (WSE) Procedures for Handling Allegations of Misconduct by Full-Time and Part-Time Graduate Students.

This policy prohibits academic misconduct, including but not limited to the following: cheating or facilitating cheating; plagiarism; reuse of assignments; unauthorized collaboration; alteration of graded assignments; and unfair competition. You may request a paper copy of this policy at this by contacting jhep@jhu.edu.

Plagiarism

Plagiarism is defined as taking the words, ideas or thoughts of another and representing them as one's own. If you use the ideas of another, provide a complete citation in the source work; if you use the words of another, present the words in the correct quotation notation (indentation or enclosed in quotation marks, as appropriate) and include a complete citation to the source. Please remember that taking “ideas or thoughts”, even if you reword them, is unethical. Give credit where it is due!

If you need any help with research and citation, please refer to the comprehensive resources that are provided by the Online Writing Lab at Purdue: https://owl.english.purdue.edu/owl/resource/560/01/.

Policy on Disability Services

Johns Hopkins University (JHU) is committed to creating a welcoming and inclusive environment for students, faculty, staff and visitors with disabilities. The University does not discriminate on the basis of race, color, sex, religion, sexual orientation, national or ethnic origin, age, disability or veteran status in any student program or activity, or with regard to admission or employment. JHU works to ensure that students, employees and visitors with disabilities have equal access to university programs, facilities, technology and websites.

Under Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act (ADA) of 1990 and the ADA Amendments Act of 2008, a person is considered to have a disability if c (1) he or she has a physical or mental impairment that substantially limits one or more major life activities (such as hearing, seeing, speaking, breathing, performing manual tasks, walking, caring for oneself, learning, or concentrating); (2) has a record of having such an impairment; or (3) is regarded as having such an impairment class. The University provides reasonable and appropriate accommodations to students and employees with disabilities. In most cases, JHU will require documentation of the disability and the need for the specific requested accommodation.

The Disability Services program within the Office of Institutional Equity oversees the coordination of reasonable accommodations for students and employees with disabilities, and serves as the central point of contact for information on physical and programmatic access at the University. More information on this policy may be found at the Disabilities Services website or by contacting (410) 516-8075.

Disability Services

Johns Hopkins Engineering for Professionals is committed to providing reasonable and appropriate accommodations to students with disabilities.

Students requiring accommodations are encouraged to contact Disability Services at least four weeks before the start of the academic term or as soon as possible. Although requests can be made at any time, students should understand that there may be a delay of up to two weeks for implementation depending on the nature of the accommodations requested.

Requesting Accommodation

New students must submit a Disability Services Graduate Registration Form along with supporting documentation from a qualified diagnostician that:

- Identifies the type of disability
- Describes the current level of functioning in an academic setting
- Lists recommended accommodations

Questions about disability resources and requests for accommodation at Johns Hopkins Engineering for Professionals should be directed to:

EP Disability Services
Phone: 410-516-2306
Fax: 410-579-8049
E-mail: ep-disability-svcs@jhu.edu