**Immune Engineering**

BME 6938

***Class Periods:*** T | Period 5-6 (11:45 PM - 1:40 PM); R | Period 6 (12:50 PM - 1:40 PM)

***Location:*** BL 0315

***Academic Term:*** Spring 2024

***Instructor:***

Benjamin Keselowsky

bgk@ufl.edu

Office Hours: by appointment; BMS J297, or

Zoom: <https://ufl.zoom.us/j/93563699656?pwd=RzRXUlc1dXBuODBwckg1K0NDZTk1UT09>

***Teaching Assistants:***

N/A

***Course Description***

3 credit hours

This course introduces immunology and engineering approaches to study and control immune responses, with an emphasis on applications for therapy and diagnostics.

***Course Pre-Requisites / Co-Requisites***

None

***Course Objectives***

Immune engineering represents the intersection of engineering and immunology to design new technologies that can be used to better understand the immune system as well as direct it to improve health. Students will gain proficiency in the field by becoming capable of integrating basic concepts in immunology with emerging technologies, understanding primary research literature, critically analyzing data, and designing experiments. Toward this objective, the course will be taught using modules: (1) fundamentals of immunology, covering nomenclature of immunology, components of innate and adaptive immunity, and more; (2) the immunologist’s toolbox, covering key experimental tools used to study immune responses, enabling students to critically analyze data in the literature and design experiments; (3) vaccines and immunotherapies, describing established and emerging vaccines and immunomodulatory drugs and mechanisms of action; and (4) the immune engineer’s toolbox, providing a foundation of drug-delivery, material science and molecular engineering principles in the context of vaccines and immunomodulatory drugs.

***Materials and Supply Fees***

None

***Required Textbooks and Software***

None

***Recommended Materials***

Provided in class: introductory immunology textbook materials from *Janeway’s Immunobiology*, and *Cellular and Molecular Immunology*, by Abdul K. Abbas, Andrew H.H. Lichtman, and Shiv Pillai.

***Course Schedule (Subject to change)***

|  |  |
| --- | --- |
| 1 | handout syllabus/discuss, meet&greet |
| 2 | Introductory lecture |
| 3 | Introductory lecture |
| 4 | Introductory lecture |
| 5 | Overview of the Immune System |
| 7 | Overview of the Immune System |
| 8 | Overview of the Immune System |
| 9 | Overview of the Immune System |
| 10 | Innate Immunity |
| 11 | Innate Immunity |
| 12 | Innate Immunity |
| 13 | Innate Immunity |
| 14 | Innate Immunity / Ab Overview |
| 15 | Ab Overview |
| 16 | Antigen Capture & Presentation |
| 17 | Antigen Capture & Presentation |
| 18 | Technique Presentations |
| 19 | Technique Presentations |
| 20 | Antigen Capture |
| 21 | Antigen Recognition by T cells |
| 22 | Antigen Recognition by T cells |
| 23 | Guest lecture - Clayton Mathews |
| 24 | Antigen Recognition by T cells |
| 25 | Journal paper presentations |
| 26 | Journal paper presentations |
| 27 | Journal paper presentations |
| 28 | Journal paper presentations |
| 29 | Antigen Recognition by T cells |
| 30 | Antigen Recognition by T cells |
| 31 | Drug Delivery - Overview; Biodistribution, PK |
| 32 | Drug Delivery - Biodistribution, PK |
| 33 | Drug Delivery - Biodistribution, PK |
| 34 | Drug Delivery - Biodistribution, PK |
| 35 | Materials for Immunotherapeutic Delivery |
| 36 | Materials for Immunotherapeutic Delivery |
| 37 | Drug Delivery - Transport barriers |
| 38 | Drug Delivery - Transport barriers |

***Attendance Policy, Class Expectations, and Make-Up Policy***

Attendance is required. During certain activities, attendance may be recorded and absences or excessive tardiness may be penalized. Arrangements can be made with the instructor for missed assignments other than those which require attendance on specified days (TBA). Excused absences must be consistent with university policies in the Graduate Catalog (<https://catalog.ufl.edu/graduate/regulations>) and require appropriate documentation. Additional information can be found here: <https://gradcatalog.ufl.edu/graduate/regulations/>

***Evaluation of Grades***

|  |  |
| --- | --- |
| **Assignment** | **Percentage of Final Grade** |
| Concept Checkups | 20% |
| Technique Presentation | 20% |
| Journal Club Assignment | 20% |
| Proposal Aims | 5% |
| Research Proposal | 20% |
| Review Panel Critique | 15% |
|  | 100% |

***Grading Policy***

|  |  |  |
| --- | --- | --- |
| **Percent**  | **Grade**  | **Grade Points**  |
| 93.4 - 100  | A  | 4.00  |
| 90.0 - 93.3  | A-  | 3.67  |
| 86.7 - 89.9  | B+  | 3.33  |
| 83.4 - 86.6  | B  | 3.00  |
| 80.0 - 83.3  | B-  | 2.67  |
| 76.7 - 79.9  | C+  | 2.33  |
| 73.4 - 76.6  | C  | 2.00  |
| 70.0 - 73.3  | C-  | 1.67  |
| 66.7 - 69.9  | D+  | 1.33  |
| 63.4 - 66.6  | D  | 1.00  |
| 60.0 - 63.3  | D-  | 0.67  |
| 0 - 59.9  | E  | 0.00  |

More information on UF grading policy may be found at:

[UF Graduate Catalog](https://catalog.ufl.edu/graduate/?catoid=10&navoid=2020#grades)
[Grades and Grading Policies](https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/)

***Students Requiring Accommodations***

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

***Course Evaluation***

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

**In-Class Recording**

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code ([https://sccr.dso.ufl.edu/process/student-conduct-code/)](https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

• Your academic advisor or Graduate Program Coordinator

• Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu

• Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu

• Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

***Campus Resources:***

*Health and Wellness*

**U Matter, We Care:**

Your well-being is important to the University of Florida.  The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need.  If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress.  A nighttime and weekend crisis counselor is available by phone at 352-392-1575.  The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center.  Please remember that asking for help is a sign of strength.  In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** [https://counseling.ufl.edu](https://counseling.ufl.edu/), and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

**Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [**Office of Title IX Compliance**](https://titleix.ufl.edu/), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

**Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department**at392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

*Academic Resources*

**E-learning technical suppor***t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

**Career Connections Center**, Reitz Union, 392-1601. Career assistance and counseling; [https://career.ufl.edu](https://career.ufl.edu/).

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall***,* 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus***:* <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>;[https://care.dso.ufl.edu](https://care.dso.ufl.edu/).

**On-Line Students Complaints***:* [*https://distance.ufl.edu/state-authorization-status/#student-complaint*](https://distance.ufl.edu/state-authorization-status/#student-complaint)*.*