Immune Engineering

BME 6938
Class Periods: M,W,F | Period 7 (1:55 PM - 2:45 PM)
Location: online
Academic Term: Fall 2020

Instructor:
Benjamin Keselowsky
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Office Hours: by appointment, BMS J297

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
An introductory immunology textbook such as *Janeway's Immunobiology*, or *Cellular and Molecular Immunology*, by Abdul K. Abbas, Andrew H.H. Lichtman, and Shiv Pillai, would enhance the student's experience.

Course Schedule
TBA

Online Course Recording
The following is UF policy: *Class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile*

or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

➔ In this course, the tentative plan is to not record class sessions. Note that unauthorized recording and unauthorized sharing of recorded materials is prohibited.
➔ This course will have both asynchronous and synchronous components. See attendance policy for synchronous meeting time expectations.

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 in compliance with university policies in the Graduate Catalog (http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance) and require appropriate documentation.

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
The following is given as an example only.

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 – 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 – 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:
http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades

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/.

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/policies/student-honor-code-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
• Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.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:

<u>*Health and Wellness*</u>

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: http://www.counseling.ufl.edu/cwc, 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**, 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 at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

<u>*Academic Resources*</u>

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

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. https://www.crc.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://care.dso.ufl.edu.

On-Line Students Complaints: http://www.distance.ufl.edu/student-complaint-process.

Tentative Course Topics (not necessarily all these will be covered or in this order):

Module 1: Fundamentals of Immunology
- Innate immunity
- Antigen capture and presentation
- Antigen recognition
- Cell-mediated immunity
- Humoral immunity
- Regional immunity
- Tolerance and autoimmunity

Module 2: Immunologist's Toolbox
- ELISA
- ELISPOT
- Flow cytometry/cell sorting
- Reporter cells
- Lymphocyte proliferation
- Immunodiagnostics

Module 3: Vaccines and Immunotherapies
- Vaccines
- Adjuvants and immunostimulants
- Cytokines and interferons
- Antibody therapeutics
- Cell-based therapies

Module 4: Immune Engineer's Toolbox
Drug Delivery Concepts in Immunotherapy
- Receptor-Ligand binding
- Delivery Routes and Barriers
- Pharmacokinetics and Biodistribution
- Delivery Challenges in Vaccines and Immunotherapeutics

Materials for Immuno-Engineering
- Fundamentals of drug carriers
- Polymers
- Microparticles
- Nanoparticles
- Stimuli-responsive materials
- Controlled release and depots
- Microneedles and patches
- Cell surface engineering
- Host response to materials
- Immune organ-on-a-chip
- Immunoseparations