

## **BME 4531: Medical Imaging**

**Class periods:** Tue. 5 and 6 (11:45a-1:40p), Thu. 6 (12:50p-1:40p)

**Location:** 270 FLG

**Academic Term:** Fall 2020

### **Instructor:**

David Gilland  
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265-0293

**Office Hours:** TBA, AG117-C, Shands Hospital

### **Teaching Assistant:**

Ana Heshmat (ana2012@ufl.edu)

### **Course Description:**

(3 credit hours) – This course covers medical imaging from a biomedical engineering perspective. Topics include the fundamental physics, mathematics, instrumentation and clinical applications of all common medical imaging modalities including x-ray radiography, computed tomography (CT), ultrasound imaging, positron emission tomography (PET), and magnetic resonance imaging (MRI).

### **Course Pre-Requisites / Co-Requisites:**

MAC 2313, MAP 2302 and PHY 2049 with minimum grades of C

### **Course Objectives:**

- Learn the **principles of operation** of medical imaging modalities used clinically—including x-ray/CT, nuclear medicine, ultrasound, and magnetic resonance imaging
- Develop understanding of **analytical methods and theory** that have general application across medical imaging modalities
- Develop competence in **analytical software tools** useful in medical imaging

### **Materials and Supply Fees:**

N/A

### **Professional Component (ABET):**

3 credits of engineering topics (no design component).

**Relation to Program Outcomes (ABET):**

Outcome	Coverage*
1. Apply knowledge	High
2. Engineering design that meets constraints	
3. Conduct experiments	
4. Communicate with range of audiences	
5. Demonstrate ethical principles in context	Low
6. Continuous learning	Low
7. Function on teams	

\*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not part of the course.

**Required Textbooks and Software:**

**Textbook:**

- Title: The Essential Physics of Medical Imaging  
Author: Bushberg, Seibert, Leidholt, Boone  
Publication date and edition: 2012, 3<sup>rd</sup> edition; Wolters Kluwer  
ISBN number: 978-1-4511-1810-0
- Additional reading material will be distributed in class.

**Software:**

- Matlab (mathworks.com)
- ImageJ (imagej.nih.gov)

**Recommended Materials**

N/A

**Course Schedule:**

Week	Topic
<u>PART 1: General principles</u>	
1	Overview of medical imaging, clinical modalities
2	Image display, spatial resolution, PSF
3	Convolution, MTF
4	Deconvolution filtering
5	Fourier Transform
6	Image contrast, noise
7	Contrast-to-noise ratio, ROC
8	Review, Exam 1
<u>PART 2: The Modalities</u>	
9	X-ray imaging
10	Computed Tomography
11	Image reconstruction
12	Nuclear medicine

- 13    Ultrasound
- 14    MRI
- 15    Review, Exam 2

**Online Course Recording**

Our 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.

**Attendance Policy, Class Expectations and Make-up Policy:**

- Class attendance is highly recommended. If you miss class, you are responsible for obtaining the information presented during class
- No cell phone disruptions or e-device distractions
- No make-up exams for an unexcused absence
- Late Problem sets:
  - < 1 day: 25% point deduction
  - < 2 day: 50% point deduction
  - > 2 day: not accepted
- Homework is to be done individually or within your chosen group. ***In this class it is a violation of the Student Honor Code to fail to acknowledge assistance on homework from individuals outside of your designated group.***
- Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

**Evaluation of Grades:**

- 55% Problem sets
- 20% Quiz 1
- 25% Quiz 2

**Grading Policy:**

Grade	Percent	Grade Points
A	93 – 100	4.00
A-	90 – 92.99	3.67
B+	87 – 89.99	3.33

B	83 – 86.99	3.00
B-	80 – 82.99	2.67
C+	77 – 79.99	2.33
C	73 – 76.99	2.00
C-	70 – 72.99	1.67
D	60 – 69.99	1.00
E	0 – 59.99	0.00

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

## **UF POLICIES**

### ***Students Requiring Accommodations***

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure 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](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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](mailto: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](mailto: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/>.

**Academic Resources**

**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://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

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