

MEDS3090, Medical Imaging: Science and Application

Please note that any material highlighted in red will be discussed during the first class to determine what will be most optimal for all class participants.

Instructor Contact Information

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[Use this link to provide anonymous feedback at anytime on your MEDS3090 experience.](#)

Formal Instruction Hours

Tuesdays and Thursdays 9:30-10:50am (we will need to wipe down our seating areas and desks with cleaner before and after each class, therefore if you can arrive a few minutes early or stay a few minutes late to help with that process it would be greatly appreciated!)

In-person sessions held in MSB 4051. A [zoom link](#) will be available if you are unable to attend due to a need to isolate or quarantine due to COVID. The zoom link is NOT intended for any uses beyond being able to attend class virtually when you might have an infectious disease. Because this course uses a flipped classroom style, learning for everyone in the course is more robust when everyone is present.

Office Hours

Dr. Haworth will hold online office hours via Zoom (or in office with prior notification) on dates to be mutually agreed upon during our first day of class or by appointment (please use email for scheduling). Please note that the office hours Zoom link will be different from any Zoom link associated with a class period. You may come and go any time during office hours. Office hours are your opportunity to meet and discuss your work, progress, and concerns. We can also go through assignments to provide more feedback or talk about other aspects of the class. Please read the [Zoom Getting Started Guide](#) before joining your first session (whether that be office hours or class).

Course Learning Management Software

Canvas will be the learning management software system for this course. A [student guide](#) is available.

Intellectual Foundation

Course Description and Learning Outcomes

MEDS3090 is a single-semester course designed for undergraduate students interested in the creation and use of medical images. The course will cover the major medical imaging modalities: magnetic resonance imaging, ultrasound, nuclear medicine imaging, x-ray, computed tomography, and optical imaging. For each imaging modality, students will learn about the fundamental physics associated with the radiation, how the radiation interacts with tissue, the hardware associated with acquiring image data, and the software and algorithms used to produce images. This information will be integrated together to develop an understanding of what tissue properties are imaged by each modality and how the imaging modalities are used clinically. Discussion of clinical application will be led by physicians in order to provide practical exposure. The major learning objectives of this course are:

- List the major medical imaging modalities used in clinical practice
- Identify and describe the underlying science associated with the production of medical images, including the nature of the associated radiation and how it interacts with tissue.
- Describe the basic hardware and software associated with major imaging modalities.
- Compare and contrast imaging modalities and describe how the differences impact their use in diagnosing specific diseases or conditions.

Pre-requisites

Students are expected to have successfully completed a course in calculus (i.e., MATH1044 or MATH1061). Although the course will not have extensive problems requiring the numerical implementation of calculus, concepts within calculus are essential to understanding the image formation process.

Baccalaureate Competencies

Baccalaureate competencies are the primary goals and desired outcomes to be achieved by all University of Cincinnati graduates. These goals and outcomes are pervasive components of all courses and experiences, and equip students with the knowledge, skills, and attitudes for a full and productive life. In this course, competencies in critical thinking, knowledge integration, and effective communication will be developed, and assessed. Critical thinking, which is the ability to analyze, synthesize, and evaluate information and ideas from multiple perspectives, will be developed and assessed through activities that compare and contrast different imaging modalities. Knowledge integration, which is the ability to fuse information and concepts from multiple disciplines, will be developed and assessed as you learn about different facets of each imaging modality, such as the physics and biology of image formation, which are coupled to clinical application. Effective communication will be developed and assessed through a group project. Working with your group will provide opportunities to develop effective communication with your peers and your final report will require effective communication to Dr. Haworth.

Course Structure

Class During a Time of Pandemic

Flexibility

We still (unfortunately) live in a time of great uncertainty due to COVID-19. To achieve the intellectual knowledge, growth, and learning objectives described above, this course will be run with an emphasis on maintaining the flexibility needed to maximize learning. In particular, a hybrid didactic learning approach (described in the Course Format section) may be used. Dr. Haworth will approach any issues with maximum flexibility in mind. However, there will be limitations to the available flexibility based on the need to provide a rigorous course. Nonetheless, if something needs to be modified to help you adapt to learning during a pandemic, please reach out.

Masks and Vaccinations

Medicine (and thus the related medical sciences) is based on the premise of maintaining and improving health. Thus, it is incumbent upon all of us to take necessary precautions during a pandemic to not just protect our own health but the health of those around us. We do not know what underlying co-morbidities those around us may have or those with whom they may live. Toward that end, it is important that we abide by the best science available. The data clearly bears out that vaccines are [safe and effective](#). Vaccination not only greatly reduces your risk of a serious illness, but it reduces the risk that you may transmit the virus to someone who could have underlying co-morbidities that put them in a high risk category. [You are strongly encouraged to become vaccinated](#). If you are vaccinated (with booster updates as applicable), it will not be necessary to quarantine if one member of the class tests positive. Additionally, even with the vaccine the data indicates (particularly with the omicron variant) that frequent hand washing and wearing a mask can work to dramatically reduce transmission of the sars-cov-2 virus. Per the Dean of the College of Medicine, it is a requirement that all individuals on the medical campus wear a mask.

Wellness Checks and Self-Reporting

Everyone should perform a [wellness self-check](#) before leaving their domicile to come to campus or interact with anyone on campus. If you have any [symptoms](#), you should self-isolate and use the [UC COVID Check app to report](#). If your symptoms are troublesome to you, contact University Health Services or your primary care physician. For [severe symptoms](#) that create an emergency situation, go to the nearest emergency department.

Course Format

MEDS3090 will be conducted using in-person campus-based sessions (note that if you have concerns about in-person instruction due to the pandemic, contact Dr. Haworth so that alternative arrangements can be made that will maximize your learning opportunities). Some classes, particularly when hearing from physicians, may be held virtually. All classes will be recorded and posted to the course site on Canvas. It may take 24-48 h for recordings to be posted due to server processing times. You are *expected to attend all classes in-person* and not just watch the recorded lectures. Because of the flipped classroom format of the course, everyone learns more when we are all present to participate in discussions and problem solving. You are encouraged to review the recorded session *after attending class* to help solidify

your mastery of course material and also if you have internet connectivity or bandwidth issues that cause you to have a disrupted learning experience. Watching the recorded sessions should not be considered a substitute for attending the live session because it does not enable you to interact with the instructor. That interaction is important as it enables the instructor to gauge your learning in real time and it allows you to ask questions. Of course, every reasonable effort will be made to support the learning of those students with poor access to the live lectures. When contributing to course discussions, please keep in mind that you will be recorded and therefore you should refrain from disclosing personal or restricted data about yourself or others, including health, financial, educational, or other sensitive information.

Many classes will have pre-work, which is detailed in the Course Calendar. Pre-work may include both assigned readings or videos. The goal of the pre-work is to provide background information and a conceptual framework so that during the live class periods you are able to spend more time learning at higher domains (see [link](#)). Pre-work will be posted at least one week in advance of a lecture. It will be your responsibility regularly check the course calendar on Canvas to identify necessary pre-work assignments (though course announcements will also be used when new posts are made). The pre-work will be coupled with a short pre-work quiz to be taken prior to the live class period.

Course Materials

As noted above, pre-work will be required of students. All reading and video assignments will be posted in the MEDS3090 Canvas course site. None of the pre-work material will require a fee. There is no required textbook for this course. The use of Zoom sessions and a required final written report will necessitate that you have access to a [IT@UC](#) and good [Wi-Fi](#) connection. Please ensure you have access to these technologies.

Course Assessment

Pre-work Quizzes

All students will need to complete a short pre-work quiz before most lectures (see the course calendar). Each quiz (nominally 3-10 questions) is intended to be completed in a short period of time (10 min or less). The purpose of these quizzes is multifold. 1) They are intended to ensure that the pre-work is done, which will facilitate a higher-quality learning experience during live class periods. 2) They provide feedback to the instructor to better understand the class' overall grasp of the material. 3) They provide a deadline and routine to help students stay focused and motivated, which can otherwise be difficult in hybrid/remote instruction formats.

Homework Assignments

For each of the five major imaging modalities covered (ultrasound, magnetic resonance imaging, optical, radiography, and nuclear imaging), there will be a homework assignment. The assignments are designed to have you evaluate, apply, and extend the knowledge that you learned in that module. They will also serve as an assessment tool that will be used when grading and provide each student an opportunity to determine their own knowledge and where they may need additional study in order to fully master the material. Reviewing graded homework assignments and understanding any mistakes made on the assignment is considered a critical part of the learning experience. Students may cooperatively work on

the homework assignments (i.e., study groups are fine). However, it will be considered a violation of the Student Code of Conduct for a student to copy another student's work. Furthermore, copying another's answer cheapens your learning experience and is a waste of your tuition dollars. Homework assignments are due at the start of the class period that is indicated on the Course Calendar.

Extra Credit

For each imaging modality, students may turn in a 1 page (single-spaced) report discussing either 1) the role that women or minority physicians or scientists played in the development or advancement of the imaging modality, 2) how the imaging modality is involved in health inequities (positively or negatively), or 3) how the imaging modality is involved in minority or women's health. Note that if your group project topic is on topic 3 (see below), you cannot submit an extra credit report on the same topic. Dr. Haworth will award between 0 and 10 points to the report based on its quality. These points will be added to the homework assignment score, thus amounting to a maximum score increase of 1 letter grade. The extra credit report should be attached to your regular homework assignment at the time it is submitted.

Exams

The course will have two non-cumulative exams. Exam 1 will cover non-ionizing imaging modalities (ultrasound, magnetic resonance imaging, and optical imaging). Exam 2 will cover ionizing imaging modalities (radiography and nuclear imaging). The exams will be open-note take-home exams. You will have at least 48 h to complete them after they are posted to Canvas.

Group Project

Over the course of the semester, students will work on a group project. Students have been randomly assigned to a group. Each group will then select a project topic on which they will perform research and analysis. Project topics will be in one of three areas: 1) a medical imaging case study, which will be carried out in conjunction with a medical resident or fellow, 2) a report on an advanced form of medical imaging not discussed in detail during lectures, or 3) a report on health inequities, health disparities, or minority health issues in the context of medical imaging. Additional details regarding the project and grading rubrics can be found on the course webpage. To facilitate the learning experience, each group will turn in a non-graded outline and draft written report during the semester (see the Course Calendar) for which they will receive feedback. At the end of the semester (see the Course Calendar), a final written report to be submitted and graded.

Class Policies

Attendance

As in all university courses, participation is important to student success. In this course, attendance will not be recorded for the purposes of grading. Your attendance and participation are still expected. Missing quizzes, exams, or other activities without previous approval will result in a failing grade for that activity. It is understood that during this time of pandemic increased flexibility is needed. If you are unable to attend a class (in-person or online) and you miss a graded activity you must contact Dr.

Haworth via email before class to make other arrangements for completing the activity. In the case of an emergency, please email Dr. Haworth as soon as possible.

Should Dr. Haworth be unable to attend class, a message will be posted through Canvas as soon as possible. In the unlikely circumstance that Dr. Haworth is not present within the first 15 minutes of class, students should consider that class to be cancelled and look for an email from Dr. Haworth with instructions for how the material will be covered in an alternate format.

Grading Policy

Students will be assigned a [letter grade](#) at the end of the semester. The letter grade will be based on your performance on pre-work quizzes, homework assignments, exams, and a semester-long group project report. The breakdown of the grade calculation will be:

Pre-work Quizzes*	15%
Homework Assignments	35%
Exam #1 (Non-ionizing Imaging Modalities)	15%
Exam #2 (Ionizing Imaging Modalities)	15%
Group project final report	20%

Homework assignments will be assigned an equal weight when computing the cumulative homework contribution to your final grade (i.e., each of the five homework assignments will be 7% of your final grade). Similarly, all pre-work quizzes will be weighted equally. However, your two lowest pre-work quiz scores will be dropped.

The conversion of a score percentage to a letter grade will be determined as:

A	93.33 to 100%
A-	90.00 to less than 93.33%
B+	86.66 to less than 90.00%
B	83.33 to less than 86.66%
B-	80.00 to less than 83.33%
C+	76.66 to less than 80.00%
C	73.33 to less than 76.66%
C-	70.00 to less than 73.33%
D+	66.66 to less than 70.00%
D	63.33 to less than 66.66%
D-	60.00 to less than 63.33%
F	less than 60.00%

The instructor reserves the right to use a curve to adjust the above percentages, but the curve will always be favorable to students (e.g., the lower bound for any letter grade may be changed to a lower percentage).

Late Assignments

Pre-work quizzes not completed before the assigned class period (see Course Calendar) will receive a grade of 0%. You must reach out to the instructor before the assigned class period if an accommodation is needed due to unforeseen circumstances, such as illness. Late homework assignments will have ten percentage points taken from the graded score for each 24 h they are late. Exams must be taken in the timeslot specified by the Course Calendar.

Pass/Fail, Audit, and Withdrawal Policy

Undergraduates are expected to complete this course for a letter grade. A pass/fail option will be made available to undergraduates only at the recommendation of the Provost or College of Medicine Dean's office due to unexpected and unusual circumstances. The reason for limiting the pass/fail option is to ensure all students are maximally engaged in the course material.

Pending seating availability, graduate students, postdoctoral research fellows, and other individuals in possession of a baccalaureate degree may audit the course. Individuals interested in this option should contact the instructor before the start of the semester.

You can look up [withdrawal deadline information](#). Students reach out to Dr. Haworth to obtain information to help them make an informed withdrawal decision based on their performance. Students considering withdrawal should review all relevant policies from the [Office of the Registrar](#). At the time of the withdrawal, students are assigned a grade of "W;" however, it is the instructor's right to change the "W" to an "F" if it is determined to be warranted through the final grading process.

Diversity, Equity, and Inclusion Statement

The University of Cincinnati embraces diversity, equity, and inclusion as core values that empower individuals to transform their lives and achieve their highest potential. The University of Cincinnati recognizes a very broad and inclusive concept of diversity that includes commonly recognized considerations such as race, ethnicity, gender, age, disability status, socioeconomic status, gender identity and expression, sexual identity, sexual orientation, religion, and regional or national origin. Inclusion authentically brings traditionally excluded individuals and/or groups into processes, activities, and decision making.

Dr. Haworth is committed to the fundamental principles of academic freedom and human dignity, especially within the above context. All participants in the course are asked to commit to creating and fostering a positive learning environment based on open communication, mutual respect, and inclusion. It is not the intent for any aspects of the course design, instruction, and/or experiences to result in barriers to your inclusion, participation, or the accurate assessment of your achievement. Should you feel like something is an impediment, please contact Dr. Haworth so that the situation can be remedied. This could include any unconscious bias you observe in any members of the class (faculty or student).

The University of Cincinnati and I [do not tolerate discrimination](#) on the basis of the above concept of diversity. If you feel that you are being discriminated against, please reach out for help from Dr. Haworth or the [Office of Equal Opportunity & Access](#).

Academic Integrity

As a student, you have many support structures. As the instructor, I will do my utmost to help assist you in your learning. Coupled with those rights and support structures are responsibilities. Although the pressure of grades may be very real, it never constitutes an excuse for academic dishonesty. The UC [Student Code of Conduct](#) and description of [Academic Misconduct](#) should be reviewed. While collaboration amongst students is encouraged, students must turn in work representing their individual efforts. Aiding and abetting misconduct, cheating, fabrication, and plagiarism may all trigger an [Academic Misconduct Process](#). When in doubt about whether an action may constitute a violation of academic integrity, contact Dr. Haworth to discuss the situation.

UC Student Resources

Students are expected to review the [UC Student Resources Canvas Page](#) and respect the [Community Standards](#) outlined there.

Classroom Procedures

Communication

The best way to contact Dr. Haworth is through Zoom Office Hours (described above) or via [email](#). When sending an email message, you can expect a response within 24 business hours. If you have not received a response, you should consider sending another email. You may try to contact Dr. Haworth via office phone, but responses will likely be delayed.

For email contact, please add the following to the subject line: "MEDS3090: <Student's last name, first name>". This will help ensure that your email does not get lost in the many emails received each day. Consider using proper and professional etiquette when communicating via email.

For communication from Dr. Haworth to students, announcements will either be made during live class sessions (which can be reviewed at a later time via recordings) or via a Canvas announcement. Please plan to check the Canvas course announcements multiple times per week. You can also configure your Canvas announcements to be sent to you via email.

In developing your critical thinking skills in this course, you may disagree with other students. Please note that you can disagree without being disagreeable. It is the expectation of the instructor that all communications will remain professional and not include ad hominem arguments.

Technology use during/for class

As a course with some hybrid components, the use of technology during and for class is essential. Whether you are attending in-person or remotely you will be expected to have access to online tools via a computer, tablet, or smart phone. The goal of technology use is to enhance your learning experience. Using the technology for other reasons (e.g., answering email, surfing the web, checking social media, individual or group messaging) is highly discouraged. In particular think about the individuals around you. If they can see you are not focused on the class, they may also become distracted.

Your success in this course is of paramount importance. If there are circumstances that may affect your performance in this class, please contact the instructor as soon as possible so that, together, strategies can be developed for adapting assignments to meet both your needs and the requirements of the course. Dr. Haworth will do his best to provide information in an accessible manner. However, please reach out to Dr. Haworth or the [Accessibility Office](#) if you need additional resources or assistance. Dr. Haworth will never consider it a burden to adapt course material to increase its accessibility.

Student Resources

There are [many resources available](#) to students. Below is a summary of a select number of them.

Counseling Services, Clifton Campus

Students have access to counseling and mental health care through the University Health Services (UHS), which can provide both psychotherapy and psychiatric services. In addition, Counseling and Psychological Services (CAPS) can provide professional counseling upon request; students may receive five free counseling sessions through CAPS without insurance. Students are encouraged to seek assistance for anxiety, depression, trauma/assault, adjustment to college life, interpersonal/relational difficulty, sexuality, family conflict, grief and loss, disordered eating and body image, alcohol and substance abuse, anger management, identity development and issues related to diversity, concerns associated with sexual orientation and spirituality concerns, as well as any other issue of concerns. After hours, students may call UHS at 513.556-2564 or CAPS Cares at 513-556-0648. For urgent physician consultation after-hours students may call 513-584-7777.

UC Police & Public Safety

If you are the victim of a crime contact the UC police at 513-556-1111. In an emergency dial 911. The UC Police have a dedicated [victim support team](#). Making a police report and ensuring that evidence is collected is important to preserving the option of prosecution, but it does not mean you have to prosecute. You can also request an investigation [online](#).

Women Helping Women

This is a non-university, community-based free, confidential support, accompaniment, and advocacy organization. Walk-in services are available at 215 East 9th St. on the 7th Floor or you can call their 24-hour crisis hotline at 513-381-5610. For more information visit the [Women Helping Women](#) website. The group also has a campus-based advocacy team located at 559 Steger Student Life Center.

Crisis Services

For students needing immediate support, telephone consultations and after hours support are available. Someone is available to answer the main line 24/7; call 513-556-0648 and select option 1. You can also find a number additional on-campus and off-campus support numbers through the [CAPS Emergent Services](#).

Title IX

Title IX is a federal civil rights law that prohibits discrimination on the basis of your actual or perceived sex, gender, gender identity, gender expression, or sexual orientation. Title IX also covers sexual violence, dating or domestic violence, and stalking. If you disclose a Title IX issue to any faculty member, we are required to forward that information to the Gender Equity & Inclusion (Title IX) Office. They will follow up with you about how the University can take steps to address the impact on you and the community and make you aware of your rights and resources. The Gender Equity & Inclusion Office priority is to make sure you are safe and successful at UC. You are not required to talk with the Gender Equity & Inclusion Office. If you would like to make a report of sex or gender-based discrimination, harassment or violence, or if you would like to know more about your rights and resources on campus, you can consult their [website](#) or contact the office at 556-3349. If you wish to speak with someone who is not required to report to the Gender Equity & Inclusion Office, you can visit the [Women Helping Women](#) office located at 559 Steger Student Life Center (513-431-1563).

Bearcats Pantry

The UC Bearcats Pantry provides free food, hygiene items, cleaning supplies, and professional clothing to students of all backgrounds with food and other insecurities. You can access these resources through their [website](#) or visiting the Pantry at Stratford Heights Building 16, Room 007.