

November 23, 2021

TO: The Faculty of the College of Engineering
FROM: The Faculty of the Weldon School of Biomedical Engineering
RE: New Graduate Course, BME 51500, Practical MRI and Applications

The Faculty of the School of Biomedical Engineering has approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM:

BME 59500: Functional MRI Applications

Term Offered: Spring, 8 weeks, Lecture 0.5, Lab 0.5, Cr. 1
Restriction: Instructor Permission

TO:

BME 51500: Practical MRI and Applications

Term Offered: Spring, 8 weeks, Lecture 0.5, Lab 0.5, Cr. 1
Restriction: Instructor Permission

Description: This course covers basic theory and practical training for magnetic resonance imaging (MRI). Students gain hands-on experience with, and train to become independent operators on, a scanner within the Purdue MRI Facility. Weekly lectures are provided on a broad range of applied and relevant topics, including image formation and contrast, pulse sequence basics, artifacts, advanced sequences, and safety. Weekly labs allow students to directly train on an MRI system. The course is ideally designed for students who want to make use of MRI to advance their research.

Reason: This course provides an overview of magnetic resonance imaging, including both lecture and hands-on laboratory components. The College of Engineering and the College of Health and Human Sciences recently invested in two 3-tesla human scanners that, together with the 7-tesla small animal scanner located in Bindley, comprise the Purdue MRI Facility. This course imparts knowledge applicable to all of Purdue's MRI scanners, and provides a solid foundation for graduate students to become primary operators capable of running the systems independently. Labs require imaging time on MRI systems that typically cost \$100-\$500/hour, meaning enrollment needs to be limited to students using MRI for their research. This explains the need for Instructor Permission.

This course was originally developed by Dr. Corey Neu and was previously co-taught by Dr. Thomas Talavage, but is currently being offered by Dr. Craig Goergen and Dr. Joseph Rispoli. It has been offered annually since 2014 under a temporary course number (BME 59500). As one of the only MRI offerings at Purdue that allows students to operate the magnets themselves, this course has facilitated greater interaction across departments and colleges, drawing students primarily from biomedical engineering (BME), electrical engineering (ECE), and health sciences

(HSCI). Enrollment was 8 in 2016, 10 in 2017, 5 in 2018, 9 in 2019, 20 in 2020, and 10 students in 2021.

A handwritten signature in black ink, appearing to read "David M. Umulis". The signature is fluid and cursive, with the first name "David" being the most prominent.

David M. Umulis
Dane A. Miller Head and Professor
Weldon School of Biomedical Engineering

BME 51500 – Practical MRI and Applications

Purdue University, Weldon School of Biomedical Engineering, Spring 2022

Format

8 week (1 credit, lecture + lab) intensive practical training course for magnetic resonance imaging (MRI)

Lecture: 9:30 – 10:20 AM, Fridays, Jan 14 – March 6, MJIS 1083

Lab: 2 hours each week on Fridays (specific time TBD), Jan 21 – March 6,
Bindley Biosciences Addition or Purdue MRI Facility (750 S University Street)

Description

This course covers basic theory and practical training for magnetic resonance imaging. Students will gain hands-on experience with, and work to become independent operators on, current MRI equipment within the Purdue MRI Facility. Weekly lectures will be provided on a wide range of applied and relevant topics, including image formation and contrast, pulse sequence basics, artifacts, advanced sequences, and safety. Weekly labs will allow students to directly train on a 7 tesla (T) animal system (Bindley Biosciences), a 3T GE human system (MRI Facility), or a 3T Siemens human system (MRI Facility). The course is ideally designed for students who want to make use of MRI to advance their research.

Optional Text

Principles of Magnetic Resonance Imaging, Dwight Nishimura

Lulu.com: <http://www.lulu.com/shop/dwight-nishimura/principles-of-magnetic-resonance-imaging/paperback/product-6355103.html>

Additional information: <https://ee.stanford.edu/~dwight/book.html>

Prerequisites

None required.

Instructors

- Vitaliy L. Rayz, MJIS 3029, vrayz@purdue.edu
Available by email appointment
- Joseph V. Rispoli, MJIS 2098, jrispoli@purdue.edu
Available by appointment: www.calendly.com/jrispoli
- Greg Tamer, PMRI 101, gtamer@purdue.edu
Available by email appointment
- Xiaopeng Zhou, PMRI 111, zhou857@purdue.edu
Available by email appointment
- Nathan Ooms, PMRI 103, naooms@purdue.edu
Available by email appointment

Learning Objectives

By the end of the course, the students will be able to:

- 1) Describe the fundamentals of magnetic resonance imaging.
- 2) Understand safety concerns associated with operating an MR scanner.
- 3) Make strides in becoming a fully independent operator of one of the magnets on campus.

Enrollment

Instructor permission required for course registration. Please email vrayz@purdue.edu or irispoli@purdue.edu if interested in course.

Grading

Laboratory assignments100%

Grading Scale

A	≥ 90%
90% > B	≥ 80%
80% > C	≥ 70%
70% > D	≥ 60%
F	< 60%

Notes

- The tenets of Purdue's Academic Code will be followed.
- Material presented in class will be supplemented with additional instructor notes/material available online (via Brightspace).
- The syllabus will be as closely followed as possible, but necessary changes will be made as the need arises.
- In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Additional information about changes in this course will be available via: 1) Brightspace, and 2) email contact with the Instructors.

Course Outline

Week	Date	Topics
1	Jan 22	Instrumentation, Equipment, and Safety
2	Jan 29	Basic Principles, Image Formation
3	Feb 5	Image Weighting and Contrast: T1, T2, proton density, TR, TE
4	Feb 12	Parameters and Trade-offs: SNR, CNR, spatial resolution, scan time
5	Feb 19	Pulse Sequence Basics: Spin Echo and Gradient Echo
6	Feb 26	Artifacts and their Compensation
7	Mar 5	Advanced Techniques: Water/Fat Imaging, Fast Imaging, Diffusion Imaging
8	Mar 12	fMRI and wrap up – (Greg Tamer and others)

Special Information

- A final check out exam is required to gain independent user access to the MR equipment. All students are encouraged to participate in a check out exam.
- Students will be trained on the Purdue 7T small animal MRI system, 3T GE human MRI system, or 3T Siemens human MRI system.

Attendance

Students are expected to be present for every meeting of the classes in which they are enrolled. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts or absences can be anticipated, such as for many University sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, or by contacting the main office that offers the course. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, the student or the student's representative should contact the Office of the Dean of Students.

Grief Absence Policy for Students

Purdue University recognizes that a time of bereavement is very difficult for a student. The University therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). GAPS Policy: Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for missed assignments or assessments in the event of the death of a member of the student's family.

Violent Behavior Policy

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.

Students with Disabilities

Purdue University is required to respond to the needs of the students with disabilities as outlined in both the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 through the provision of auxiliary aids and services that allow a student with a disability to fully access and participate in the programs, services, and activities at Purdue University. If you have a disability that requires special academic accommodation, please make an appointment to speak with me within the first three (3) weeks of the semester in order to discuss any adjustments. It is important that we talk about this at the beginning of the semester. It is the student's responsibility to notify the Disability Resource Center (<http://www.purdue.edu/drc>) of an impairment/condition that may require accommodations or classroom modifications.

Nondiscrimination

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in [Executive Memorandum No. D-1](#), which provides specific contractual rights and remedies. Any student who believes they have been discriminated against may visit www.purdue.edu/report-hate to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.

Emergencies

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

EMERGENCY PREPAREDNESS

EMERGENCY NOTIFICATION PROCEDURES are based on a simple concept – if you hear a fire alarm inside, proceed outside. If you hear a siren outside, proceed inside.

- **Indoor Fire Alarms** mean to stop class or research and immediately evacuate the building.
 - Proceed to your Emergency Assembly Area away from building doors. **Remain outside** until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.

- **All Hazards Outdoor Emergency Warning Sirens** mean to immediately seek shelter (**Shelter in Place**) in a safe location within the closest building.
 - “Shelter in place” means seeking immediate shelter inside a building or University residence. This course of action may need to be taken during a tornado, a civil disturbance including a shooting or release of hazardous materials in the outside air. Once safely inside, find out more details about the emergency*. **Remain in place** until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave.

**In both cases, you should seek additional clarifying information by all means possible...Purdue Emergency Status page, text message, email alert, TV, radio, etc...review the Purdue Emergency Warning Notification System multi-communication layers at http://www.purdue.edu/ehps/emergency_preparedness/warning-system.html*

EMERGENCY RESPONSE PROCEDURES:

- Review the **Emergency Procedures Guide**
 - https://www.purdue.edu/emergency_preparedness/flipchart/index.html

- Review the **Building Emergency Plan** for:
 - evacuation routes, exit points, and emergency assembly area
 - when and how to evacuate the building.
 - shelter in place procedures and locations
 - additional building specific procedures and requirements.
 - https://www.purdue.edu/ehps/emergency_preparedness/