

**UNIVERSITY OF FLORIDA**  
**COLLEGE OF MEDICINE SYLLABUS**  
**NEUROSCIENCE**

**GMS 6082 Introduction to Functional Magnetic Resonance Imaging**  
**(1 credit hour)**

Fall: 2020 (module 2, Sep. 29-Nov. 3)

Delivery Format:Online

Instructor Name: Marcelo Febo  
Room Number: Department of Psychiatry, MBI Room L4-100F  
Phone Number: 352-294-4911  
Email Address: febo@ufl.edu  
Office Hours: Monday and Friday 2-3PM from September 29-November 3, 2020  
Graduate Assistant: Matteo Grudny, MBI L1-135, 352-294-4955, [mgrudny@ufl.edu](mailto:mgrudny@ufl.edu)

Preferred Course Communications: Canvas message board and email. A discussion board will be available on the UF e-Learning support services: <https://elearning.ufl.edu/>. For urgent matters, students may also contact professor directly by email.

Prerequisites: Consent of instructor. There are no prerequisite courses and an introductory overview of magnetic resonance will be provided at the beginning of the course. GMS 6082 will follow conceptual paths in discussions of functional magnetic resonance imaging and as it specifically applies to studies in neuroscience. In some instances, quantitative concepts deemed important for in class discussions and for understanding functional MRI may be used. Thus, it is recommended that students take GMS 6080 (Basic Magnetic Resonance Imaging) for an in-depth introduction to nuclear magnetic resonance and image formation.

**Purpose and Outcome:** Introduction to functional magnetic resonance imaging methods and applications, with a focus on understanding the methods and how these are applied in studies of brain function in relation to behavior and cognition.

**Course Overview:** Introduction to Functional MRI will provide students with the basic and practical principles underlying fMRI as applied in the fields of basic, medical and cognitive neuroscience. Students will complete the course having an in-depth introduction to neurophysiological mechanisms that couple magnetic resonance phenomenon to task- or stimulus-dependent changes in neuronal activity and cerebral metabolism. An emphasis of the course is a comprehension of how fMRI is applied to advance our understanding of neural activity in relation to behavioral and cognitive brain function.

**Relation to Program Outcomes:** This course is designed to provide or solidify background knowledge and instruction on the principles and applications of fMRI as applied to basic and medical research.

**Course Objectives and/or Goals:** Upon completion students will be able to (i) critically formulate methodological considerations for using fMRI in neuroscience studies, (ii) discriminate between various forms of fMRI, including methods to measure blood flow, BOLD, task based studies and resting state functional connectivity, and (iii) prescribe neurophysiological and neurovascular principles governing the fMRI signal and will be able to critically formulate potential mechanisms that are important in interpreting the fMRI data.

**Instructional Methods:** Learning in the course is intended to be a product of interactive and dynamic discussions, with introductory lectures and discussions by the instructor combined with student presentations on assigned material, critical thinking questions and one hands-on session. Expert faculty/researcher guests may be invited to supplement class lectures/discussions.

**Description of Course Content:**

**Topical Outline/Course Schedule\***

Week	Date(s)	Topic(s)	Readings
1	Sept. 29	MRI Basics: from hydrogen nuclei to MR signal recovery: Historical perspectives, introduction to MRI, physical principles of signal generation and the basis for contrast in MR images	Ch. 1-3
2	Oct. 1	MRI Basics: from MR signal to image formation: Use of slice, frequency and phase encoding gradients to generate images from the MR signal	Ch. 4-5
3	Oct. 6	Neurobiological principles: from neuronal to hemodynamic activity: Relation between neuronal activity and energetic demands, role of supporting cells in neural hemodynamics, neurovascular coupling (how cerebral blood flow responds to local energetic metabolic demand of neurons	Ch. 6
4	Oct. 8	BOLD fMRI: origins and properties: Link between neuronal activity and BOLD fMRI, origin of BOLD, properties of the BOLD signal	Ch. 7
5	Oct. 13	BOLD fMRI: signal, noise and processing: Noise, noise	Ch. 8

		sources, preprocessing strategies for fMRI	
6	Oct. 15	BOLD fMRI: experimental design: Principles of experimental design to study the brain and its relationship with behavior, and paradigms to get around the constraints of the MR environment	Ch. 9
7	Oct. 20	BOLD fMRI: basic analysis: Basic analysis of fMRI data: Analysis of fMRI data (part 1 and 2), spatial/temporal limits, spatial localization of neuronal activity, linking subject behavior/thought with specific patterns of BOLD activity	Ch. 10
8	Oct 22	BOLD fMRI: advanced analysis and methods (functional connectivity): Functional connectivity processing and analysis, combining fMRI with other techniques to probe brain activity, translational fMRI.	Ch. 10-11
9	Oct. 27	Applications of fMRI: Task based BOLD and cognitive function	Ch. 12
10	Oct. 29	Applications in fMRI: Functional connectivity and cognitive function	Ch. 13-14
11	Nov. 3	Final Exam	

\*Disclaimer: Topics outlined in the schedule above are subject to change. The present syllabus represents the instructor's current plans and objectives. As the course progresses, scheduled topics and the instructor's considerations of relevant topics may change in order to enhance the student's learning. Such changes will be communicated clearly and in a timely fashion and is not unusual or unexpected.

### **Course Materials and Technology:**

**REQUIRED TEXT(S):** Scott a. Huettel, Allen W. Song and Gregory McCarthy, Functional Magnetic Resonance Imaging 3rd Edition 2014 Sinauer. **ISBN:** 0878936270, 9780878936274

### **RECOMMENDED TEXT(S):**

Richard B. Buxton, Introduction to Functional Magnetic Resonance Imaging: Principles and Techniques, 2<sup>nd</sup> Edition, Cambridge University Press, 2009. **ISBN:** 1139481304, 9781139481304

Michael Gazzaniga, Richard B. Ivry. Cognitive Neuroscience: Biology of the Mind, 4<sup>th</sup> Edition, W.W. Norton, 2013. **ISBN:** 0393922286, 9780393922288

**ADDITIONAL RESOURCES:** The professor will assign literature to complement discussions of specific textbook chapters. Representative papers are below.

### **Representative Readings:**

Malonek, D., Dirnag I,U., Lindauer, U., Yamada, K., Kanno, I.,and Grinvald, A.(1997).Vascular imprints of neuronal activity: relationships between the dynamics of cortical blood flow, oxygenation, and volume changes following sensory stimulation. Proc. Natl. Acad. Sci. U.S.A. 94, 14826–14831.

Thompson, J.K.,Peterson,M.R., and Freeman,R.D.(2003).Single neuron activity and tissue oxygenation in the cerebral cortex. Science 299, 1070–1072.

Kasischke, K.A.,Vishwasrao, H.D., Fisher,P.J., Zipfel, W.R., and Webb, W.W.(2004). Neural activity triggers neuronal oxidative metabolism followed by astrocytic glycolysis. Science 305, 99–103.

Fox, P.T., and Raichle, M.E.(1986). Focal physiological uncoupling of cerebral blood flow and oxidative metabolism during somatosensory stimulation in human subjects. Proc. Natl. Acad. Sci. U.S.A. 83, 1140–1144.

Lee,S.P., Duong, T.Q., Yang,G., Iadecola, C.,and Kim,S.G.(2001). Relative changes of cerebral arterial and venous blood volumes during increased cerebral blood flow: implications for BOLD fMRI. Magn. Reson.Med. 45, 791–800.

Logothetis, N.K., Pauls,J., Augath, M., Trinath,T., and Oeltermann,A. (2001). Neurophysiological investigation of the basis of the fMRI signal. Nature 412, 150–157.

Davis, T.L., Kwong, K.K., Weisskoff, R. M., and Rosen, B.R. (1998). Calibrated functional MRI: mapping the dynamics of oxidative metabolism. Proc. Natl. Acad. Sci. U.S.A. 95, 1834–1839.

Attwell, D., and Iadecola, C. (2002). The neural basis of functional brain imaging signals. Trends Neurosci. 25, 621 - 625.

Buckner RL, Kelley WM, Petersen SE (1999) Frontal cortex contributes to human memory formation. Nature Reviews in Neuroscience, 2: 311-314.

For technical support for this class, please contact the UF Help Desk at:

- [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu)
- (352) 392-HELP - select option 2
- [UF eLearning](#)

### **Academic Requirements and Grading:**

**Assignments:** Final exam will be multiple choice and will cover all topics discussed in class. The final exam will correspond to 40% of the final grade. The remaining 60% of the grade will be based on in class and take home assignments (assigned by the instructor) and expected at the pre-determined due date (see table below). Each assigned paper or topic will be graded based on the rubric below. Each student is responsible for timely return of the assignment. Please note that assignments are individual and the instructor will check for plagiarism or copying.

**Grading:** Take home or in class assignments will be graded according to the table below. In each assignment the student should: (1) summarize the background and rationale of the study

(3%), (2) explain methods in detail (4%), (3) indicate potential mechanisms or otherwise, bring up questions that directly pertain to the study (3%) for a total of 10% of the total grade.

Requirement	Due date	Points or % of final grade (% must sum to 100%)
Chapters 1-3 Summary Questions	Oct. 6	10%
Ch. 7 paper	Oct. 8	10%
Ch. 8-9 paper	Oct. 13	10%
Ch. 10 paper	Oct. 20	10%
Ch. 11 paper	Oct. 22	10%
Applications discussion papers	Oct. 29	10%

**Point system used (i.e., how do course points translate into letter grades).**

Percentage Earned	Letter Grade
93-100	A
90-92	A-
87-89	B+
83-86	B
80-82	B-
77-79	C+
73-76	C
70-72	C-
67-69	D+
63-66	D
60-62	D-
Below 60	E

Please be aware that a C- is not an acceptable grade for graduate students. The GPA for graduate students must be 3.0 based on 5000 level courses and above to graduate. A grade of C counts toward a graduate degree only if based on credits in courses numbered 5000 or higher that have been earned with a B+ or higher.

Letter Grade	Grade Points
A	4.0
A-	3.67
B+	3.33
B	3.0
B-	2.67
C+	2.33
C	2.0
C-	1.67
D+	1.33
D	1.0
D-	0.67
E	0.0
WF	0.0
I	0.0
NG	0.0
S-U	0.0

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

**Exam Policy:** Exams will be given either as take-home tests to be handed in on specific dates or in class exams. Assignment policies are consistent with university policies. In general, acceptable reasons for absence from or failure to participate in class include illness, serious family emergencies, special curricular requirements (e.g., judging trips, field trips, professional conferences), military obligation, severe weather conditions, religious holidays and participation in official university activities such as music performances, athletic competition or debate. Absences from class for court-imposed legal obligations (e.g., jury duty or subpoena) must be excused. Other reasons also may be approved.

**Policy Related to Make up Exams or Other Work:** Students may take missing exams. The student will need to coordinate with the professor to take the exam outside of the normal class hours. A reasonable excuse consistent with University Policies listed above under ‘Assignment Policy’ will be requested from the student.

Please note: Any requests for make-ups due to technical issues MUST be accompanied by the UF Computing help desk (<http://helpdesk.ufl.edu/>) correspondence. You MUST e-mail me within 24 hours of the technical difficulty if you wish to request a make-up.

**Policy Related to Required Class Attendance:** Attendance is important. Absence may occur due to personal or health reasons. The student should meet with the professor to discuss and obtain the missed class materials.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at:

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

Excused absences must be consistent with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>). Additional information can be found here:

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

### **Student Expectations, Roles, and Opportunities for Input:**

**Expectations Regarding Course Behavior:** Academic honesty and integrity are fundamental values of the University community. Students should be sure that they understand the UF Student Honor Code at <http://www.dso.ufl.edu/students.php>.

**Communication Guidelines:** All members of the class are expected to follow rules of common courtesy in all email messages, threaded discussions and chats.

<http://teach.ufl.edu/docs/NetiquetteGuideforOnlineCourses.pdf>

**Academic Integrity:** Students are expected to act in accordance with the University of Florida policy on academic integrity. As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge:

**“We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.”**

You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit 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.”**

It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For additional information regarding Academic Integrity, please see Student Conduct and Honor Code or the Graduate Student Website for additional details:

<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>

<http://gradschool.ufl.edu/students/introduction.html>

**Please remember cheating, lying, misrepresentation, or plagiarism in any form is unacceptable and inexcusable behavior.**

### **Online Faculty Course Evaluation Process:**

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/>.

### **Support Services:**

#### **Accommodations for Students with Disabilities:**

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. The College is committed to providing reasonable accommodations to assist students in their coursework.

#### **Counseling and Student Health:**

Students sometimes experience stress from academic expectations and/or personal and interpersonal issues that may interfere with their academic performance. If you find yourself facing issues that have the potential to or are already negatively affecting your coursework, you are encouraged to talk with an instructor and/or seek help through University resources available to you.

- The Counseling and Wellness Center 352-392-1575 offers a variety of support services such as psychological assessment and intervention and assistance for math and test anxiety. Visit their web site for more information: <http://www.counseling.ufl.edu>.



On line and in person assistance is available.

- You Matter We Care website: <http://www.umatter.ufl.edu/>. If you are feeling overwhelmed or stressed, you can reach out for help through the You Matter We Care website, which is staffed by Dean of Students and Counseling Center personnel.
- The Student Health Care Center at UF Health is a satellite clinic of the main Student Health Care Center located on Fletcher Drive on campus. Student Health at UF Health offers a variety of clinical services. The clinic is located on the second floor of the Dental Tower in the Health Science Center. For more information, contact the clinic at 392-0627 or check out the web site at: <https://shcc.ufl.edu/>
- UF Health Emergency Room / Trauma Center: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32698, [ufhealth.org/emergency-room-trauma-center](http://ufhealth.org/emergency-room-trauma-center).
- University Police Department: Visit [police.ufl.edu/](http://police.ufl.edu/) or call 352-392-1111 (or 9-1-1 for emergencies).
- Crisis intervention is always available 24/7 from:

Alachua County Crisis Center:

(352) 264-6789

<http://www.alachuacounty.us/DEPTS/CSS/CRISISCENTER/Pages/CrisisCenter.aspx>

Do not wait until you reach a crisis to come in and talk with us. We have helped many students through stressful situations impacting their academic performance. You are not alone so do not be afraid to ask for assistance.

## Academic Resources

**E-learning technical support:** Contact the UF Computing Help Desk at 352-392-4357 or via e-mail at [helpdesk@ufl.edu](mailto:helpdesk@ufl.edu).

**Career Connections Center:** Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services [career.ufl.edu/](http://career.ufl.edu/).

**Library Support:** [cms.uflib.ufl.edu/](http://cms.uflib.ufl.edu/) ask various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center:** Broward Hall 352-392-2010 or to make an appointment 352 392-6420. General study skills and tutoring. [teachingcenter.ufl.edu/](http://teachingcenter.ufl.edu/)

**Writing Studio:** 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers. [writing.ufl.edu/writing-studio/](http://writing.ufl.edu/writing-studio/)

**Student Complaints On-Campus:** [sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/](http://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/)

**On-Line Students Complaints:** [distance.ufl.edu/student-complaint-process](http://distance.ufl.edu/student-complaint-process)