

**BPhy8293 Directed Study – Advanced Topics in Biomedical
Magnetic Resonance Imaging and Spectroscopy
Fall Semester, 2006**

Instructors

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The class is scheduled to meet Tuesday/Thursday 10:20 am – 11:20 am at the CMRR (Room 107, Seminar Room). Updated schedules, supplemental readings and any information related to the class will be posted on the course website: <http://www.cmrr.umn.edu/class/BPhy8293>.

Pre-requisites

Basic understanding of MRI or NMR, examples of expected knowledge: difference between spin echo and gradient echo, T_1 and T_2 contrast.

Course Description

Lecture-based course covering a series of five topics in detail: functional MRI, diffusion tensor imaging, use of MR in oncology, spectroscopy techniques and spectroscopy applications. Each topic will include lectures, review of the current literature and student presentations.

Students will be asked to give 2 oral presentations, write 4 reports based on research papers, attend lectures, and participate in class discussion. There will be no final examination.

Grading Policy

The course is offered for three credits, graded on an A-F basis (93 – 100 A, 90 – 92 A-, 88 – 89 B+ ... <60 F).

- Class participation and attendance will comprise 30% of the course grade.
- Written reports will comprise 40% of the course grade.
- Oral presentation(s) will contribute 30% of the course grade.

Textbooks and Other Readings

No required textbook. Copies of relevant materials will be made available. Suggested texts:

- *Magnetic Resonance Imaging* by M. T. Vlaardingerbroek and J. A. den Boer
- *Handbook of MRI Pulse Sequences* by M. A. Bernstein, K. F. King, and X. J. Zhou
- *Spin Dynamics* by M. Levitt
- *In Vivo Spectroscopy* by R. de Graaf
- *Introduction to Functional Magnetic Resonance Imaging* by R. B. Buxton
- *Functional Magnetic Resonance Imaging* by S. A. Huettel, A. W. Song and G. McCarthy

Day	Date	Topic - Lecturer	Lecture	Detailed description
Tuesday	5-Sep	ST - MM	Spectroscopy Techniques	Review of characteristics of different nuclei, chemical shift and <i>J</i> -coupling. Overview of localization techniques and both homonuclear and heteronuclear editing techniques. Chemical shift imaging for different nuclei.
Thursday	7-Sep	ST - MM	Spectroscopy Techniques	
Tuesday	12-Sep	ST - MM	Spectroscopy Techniques	
Thursday	14-Sep	ST - MM	Spectroscopy Techniques	
Tuesday	19-Sep	ST - MM	Spectroscopy Techniques	
Thursday	21-Sep	ST - students	Student presentations	
Tuesday	26-Sep	DTI - CC	DTI	Physics of diffusion. Apparent diffusion coefficient and diffusion anisotropy in tissues. SE and STE diffusion weighting. DWT, clinical applications. DTI, fiber tracking in brain.
Thursday	28-Sep	DTI - CC	DTI	
Tuesday	3-Oct	DTI - CC	DTI	
Thursday	5-Oct	DTI - CC	DTI	
Tuesday	10-Oct	DTI - students	Student presentations	
Thursday	12-Oct	SA - PGH	Spectroscopy Applications	Measurement of metabolic rates in vivo: ¹³ C, ¹⁷ O and ³¹ P. Metabolic modeling from glucose to neurotransmission. Glucose transport. Brain glycogen. Neurodegenerative disorders. Genetically modified mice.
Tuesday	17-Oct	SA - PGH	Spectroscopy Applications	
Thursday	19-Oct	SA - PGH	Spectroscopy Applications	
Tuesday	24-Oct	SA - PGH	Spectroscopy Applications	
Thursday	26-Oct	SA - students	Student presentations	
Tuesday	31-Oct	onco - PJB	Oncology	We will review the variety of MRI and MRS methods used for diagnosing cancers, monitoring response to treatment, and guiding interventions. Specific applications in brain, breast, and prostate cancer will be covered.
Thursday	2-Nov	onco - PJB	Oncology	
Tuesday	7-Nov	onco - PJB	Oncology	
Thursday	9-Nov	onco - PJB	Oncology	
Tuesday	14-Nov	onco - PJB	Oncology	
Thursday	16-Nov	onco - students	Student presentations	
Tuesday	21-Nov	fMRI - PFVDM	fMRI	Basic mechanisms, temporal characteristics and spatial distribution of the Blood Oxygenation Level Dependant signal (BOLD).
Thursday	23-Nov	Thanksgiving		
Tuesday	28-Nov	fMRI - PFVDM	fMRI	Impact of MR sequences (Gradient Echo versus Spin Echo) and of static magnetic field (high field versus low field) on measured BOLD signal. Modeling the hemodynamic response to neuronal activity (oxygen consumption, blood flow, venous blood volume). Detecting brain activation with non-BOLD techniques (perfusion, exogenous contrast agents).
Thursday	30-Nov	fMRI - PFVDM	fMRI	
Tuesday	5-Dec	fMRI - PFVDM	fMRI	
Thursday	7-Dec	fMRI - PFVDM	fMRI	
Tuesday	12-Dec	fMRI - students	Student presentations	