# INSTRUCTIONS FOR COMPLETION OF THE UAMS GRADUATE SCHOOL COURSE APPROVAL FORM

1. Please save this PDF to your computer for editing.

2. The form has been designed with fields for your responses, and these are indicated in blue and gray shading. Please complete all fields. Use the "tab" key to move between fields. A 'beep' will sound if you attempt to enter a response that contains more characters than is permitted. IF YOU NEED HELP IN ANY OF THE FIELDS, PRESS THE F1 KEY AND A HELP WINDOW WILL OPEN.

3. Print the document, and then obtain the appropriate signatures before submitting the form to the Graduate Office.

**COURSE APPROVAL FORM, Graduate School**
**University of Arkansas for Medical Sciences**

This form and attached materials are due in the Graduate School Office on the first Monday of the month. All forms will be submitted to the UAMS Graduate Council Curriculum Committee for review and approval prior to consideration by the Graduate Council.

This form is not required for minor stylistic or editorial corrections to the title or course descriptions. These may be made when revising the catalog copy.

1. **Program:** Department of Biomedical Informatics (*Department*) | B | I | O | M | | | | | (*Alpha (Department) Code*)

2. **Action proposed** (indicate one or more items): Effective term: Fall 2017

| | | | | |
|---|---|---|---|---|
| [X] | Add course | [ ] | Change title | |
| [ ] | Eliminate course (No outline needed) | [ ] | Change credit hours from: | to |
| | | [ ] | Change course number from: | to |
| | | | Change description | |

3. **Course ID, title and description:**

| B | I | O | M | | | | | Research Imaging Info |
|---|---|---|---|---|---|---|---|---|
| prefix | | | | number | | | | title (20 characters) |

Research Imaging Informatics
catalog name (40 characters)

Scheduled offering: [X] Fall [X] Spring [ ] Summer [ ] On demand

To cross list a course, use the Course Cross Listing Form.

Describe the course in sentence form using 50 words or less **as it is to appear in the catalog**. List prerequisites, co-requisites and possible off-site instructional opportunities or requirements.

This graduate course will explore in depth the use of advanced radiology and pathology imaging techniques and quantitative analysis approaches in biomedical research. The focus is distinct from clinical imaging and standard clinical practice. Pre-clinical and advanced imaging techniques not yet approved for the clinic will be explored.

4. **Justification:**

Justify this change in terms of course needs or curriculum improvement. State the effect of this change on any degree programs. Identify the courses to be eliminated, if any, if this course is approved. (Course Approval Forms must also be submitted for these courses) Identify any existing course or courses that would extensively overlap or be duplicated if the proposed curricular change occurs. Provide statements of concurrence with the change from the chairperson(s) and dean(s) of the programs/areas offering the affected courses.

There will be no change to degree programs.

# SYLLABUS

**COURSE NUMBER:** ?????

**COURSE TITLE:** **Research Imaging Informatics**

**COURSE DESCRIPTION:**

This graduate course will explore in depth the use of advanced radiology and pathology imaging techniques and quantitative analysis approaches in biomedical research. The focus is distinct from clinical imaging and standard clinical practice. Pre-clinical and advanced imaging techniques not yet approved for the clinic will be explored. Image creation, quantitative analysis and management technologies will be presented drawing on the primary literature and making full use of unique imaging resources at UAMS such as the Cancer Imaging Archive.

**PRE-REQUISITES:**

BIOM____ Anatomy for Imaging and PHYO 5013 General Physiology or equivalent.
BIOM _____ Introduction to BMI
BIOM _____ Methods in BMI
BIOM _____ Clinical Imaging Informatics

**GENERAL INFORMATION:**

**CREDITS:** 3

**SEMESTER:** Spring

**LOCATION:** Campus and Online (hybrid)

**FACULTY:** Fred Prior

**SPECIAL ASSISTANCE:** Students who believe they may need accommodations in this class based on mental or physical impairments must contact the Students with a disability that need accommodations should contact the Associate Dean for Academic Affairs at (501) 686-5730 to schedule an appointment to discuss your needs. Please make arrangements as soon as possible so accommodations can be made in a timely manner.

**COURSE OBJECTIVES:**

Upon successful completion of this course, the student is able to:

- Have a basic understanding of the differences between research and clinical imaging and imaging informatics
- Understand the differences between qualitative and quantitative image analysis
- Be aware of state of the art imaging research topics
- Understand the concepts of Radiomics and Pathomics
- Know where to find open source image analysis tools
- Know how to access open access image repositories
- Understand data quality issues in imaging and imaging based clinical trials
- Be able to read and discuss the primary literature in the field

## MAJOR TOPICS:

**Novel Imaging Modalities**
Advanced MRI
EEG/MEG imaging
Optical Imaging
PET/CT, PET/MR
Preclinical Imaging
Tracers

**Quantitative Image Analysis**
Quantitative vs. qualitative image analysis
Introduction to Radiomics
Image segmentation
Feature extraction
Mining feature space
Pathomics
Open Source Analysis tools

**Image Management**
Research data formats
Curation and data quality
Information management systems
Imaging in clinical trials
Data Mashups and information fusion
Managing features

## TEXTBOOK:

**Medical Image Analysis, 2nd Edition by** Atam P. Dhawan
ISBN: 978-0-470-62205-6

**Papers will be assigned from the primary literature**

## STUDENT EVALUATION & GRADING

**Journal Club** **30%**

Students will present and critique selected articles in the field. The grade will be based on how well the students have critiqued the figures in the paper, as well as the quality of their presentation.

**Project** **40%**

Students will form small teams and select an image analysis project that will require them to define a research question and testable hypothesis, select appropriate data from a public repository, select appropriate image analysis tools, perform the analysis and test their hypothesis. The result of the project will be a properly constructed scientific manuscript suitable for publication. Grading will be based on quality of the manuscript, including formatting, clarity, as well as understanding of the underlying concepts.

**Final Take-home exam** **30%**

There will be one take-home exam, allowing the students opportunities to prove their excellence and understanding of the lectures.

## TOPICS AND ASSIGNMENTS BY WEEK:

Week 1: Introduction to Research Imaging – clinical and pre-clinical
*Reading*: Chapter 1 from textbook - "Introduction"
Chapter 2 from textbook - "Image Formation"
*Assignment*: Set up image analysis environment

Week 2: CT and PET
*Reading*: Chapter 3 from textbook - "Interaction Of Electromagnetic Radiation With Matter In Medical Imaging."
Chapter 4 from textbook - "Medical Imaging Modalities: X-Ray Imaging."
Chapter 6 from textbook - "Nuclear Medicine Imaging Modalities."
*Assignment*: Discuss possible projects

Week 3: fMRI, DTI, and MR Spectroscopy
*Reading*: Chapter 5 from textbook - "Medical Imaging Modalities: Magnetic Resonance Imaging."
Review paper on state of the art in fMRI
*Assignment*: Discuss how to read and analyze the primary literature

Week 4: EEG/MEG and Optical Imaging
*Reading*: Review paper on EEG/MEG source space reconstruction
Review paper on state of the art in Optical Imaging
*Assignment*: Decide on project and group of students to work together.

Week 5: Introduction to Quantitative Image Analysis & Radiomics
*Reading*: Chapter 9 from textbook - "Image Processing and Enhancement"

Review paper on state of the art in Radiomics
*Assignment*: Reading and displaying imaging on your computer

Week 6: Segmentation and Feature Extraction
*Reading*: Chapter 10 from textbook - "Image Segmentation"
Chapter 11 from textbook - "Image Representation, Analysis, And Classification."
*Assignment*: Image segmentation and feature extraction exercise

Week 7: Mining Feature Space
*Reading*: Selected primary literature on Radiomics and Pathomics
*Assignment*: Student led journal club

Week 8: Graph analysis techniques in Radiomics
*Reading*: Selected primary literature on Radiomics and Pathomics
*Assignment*: Student led journal club

Week 9: Open Source Tools and Information Resources
*Reading*: Review papers on Open Source Software Process (ITK)
*Assignment*: Find OS tools and Image sources on the Internet

Week 10: Research Information Systems and Data formats
*Reading*: Review papers on TCIA, ConnectomeDB
*Assignment*: Access image data from an on-line repository for student project

Week 11: Data Quality for Image Repositories and Clinical Trials
*Reading*: Selected primary literature
*Assignment*: Student led journal club

Week 12: Data Mashups and FeatureBases
*Reading*: Selected primary literature
*Assignment*: Student led journal club

Week 13: Student Project Working Session
*Assignment*: Status report on each project

Week 14: Final Examination

Week 15: Project Presentations

6. **Program Approvals:**

Fred Prior, PhD
(Print or type) Chairperson, Academic Department or Area

Fred Prior 10/26/16
(Signature) Chairperson, Academic Department or Area Date

College Dean (Dean McGehee for College of Medicine) Date 11/17/2016

7. **Graduate School Approvals**

Eric C Peterson 11/17/2016
Chairperson, Graduate Council Date

Dean of the Graduate School Date 11/17/2016