BME 527: Integration of Medical Imaging Systems Fall 2016

1. Basic Course Information

Course name: Integration of Medical Imaging Systems
Units: 3.0
Place and time: OHE 100B; (Fri, 9:00-11:50 am)
Instructor: Brent J. Liu, Ph.D., Department of Biomedical Engineering
brentliu@usc.edu, DRB 264, (213) 821-1912

Relevant reading material and exercises will be provided by the instructor

2. Course Overview and Learning Objectives

Overview: This course will introduce the concepts related to Imaging Informatics systems utilized within the clinical environment including the Picture Archiving and Communication System (PACS), the Radiology Information System (RIS), and the Electronic Medical Record (EMR). The primary focus will be on concepts surrounding the PACS but will cover integration with other clinically relevant systems. Topics will include medical imaging quality, compression, data standards such as DICOM (Digital Imaging and Communications in Medicine) and HL7 (Health Level 7), workflow analysis and protocols such as IHE (Integrating the Healthcare Enterprise), networks, image security, fault tolerance, image database and backup. The course will take an in-depth view of each of the sub-components of the PACS and the impact to overall clinical workflow. In addition, there will be a hands-on LAB component where students will interact with a PACS Simulator to observe data and clinical workflow, downtime scenarios, and troubleshooting. The course will be designed with the intention to prepare, in part, for certification exams currently available to students looking to further or expand their career goals in the Imaging Informatics industry as well as healthcare institutions.

Course Objectives: Students will be able to:

- Understand the current engineering techniques and their applications in clinical systems for medical imaging informatics.
- Learn the basic concepts of Medical Imaging, Imaging Informatics, clinical workflow, and clinical information systems.
- Identify the major subcomponents of a PACS and how it integrates with other clinical information systems within the healthcare enterprise.
- Develop skills in written communications.
3. Course Plan

The course plan is designed to introduce basic concepts of Medical Imaging Informatics with an introduction to clinical information systems (eg, PACS, RIS, EMR). The timeline is subject to change, at the instructor's discretion.

Aug 26  Course Introduction Overview and Outline

Sep 2  Introduction
   Medical Images
   Clinical System Fundamentals
   Introduction to Radiology Workflow
Medical Imaging Fundamentals
   Image Quality
   Spatial and Frequency Domains
   Image Transformation

Sep 9  Imaging Informatics of Modality Systems:
   Projection Radiography: CR, DR, Digital Mammography

Sep 16 Imaging Informatics of Modality Systems:
   Sectional Imaging: CT, MR, US, NM/PET/SPEC

Sep 23 Medical Image Compression
   Lossless
   Lossy
   Cosine Transform
   Wavelet Transform

Sep 30  Health Care Information Industrial Standards & Workflow Protocols
   DICOM (Digital Imaging and Communication in Medicine)
   HL - 7 (Health Level 7)
   IHE (Integrating the Healthcare Enterprise)

Oct 7  Picture Archiving and Communication System (PACS) Overview
   Concept
   Components
   Data Flow

Oct 14 System Gateways:
   Image Acquisition Gateway
   Healthcare Data Gateway
Display Workstations:
   Components
Types
Functions
GUI

Oct 21  Midterm Exam Closed Book

Oct 28  PACS Controller and Archive Server
        Components
        Software Design
        Data Flow
        Fault-Tolerance
Communication Networks
        LAN and WAN, Internet and Intranet
        TCP/IP Protocols
        Internet 2
        PACS Networks
        Teleradiology Networks

Nov 4   Implementation of PACS in a Clinical Environment
        PACS Acceptance Testing Design & Implementation

Nov 11  Telemedicine and Teleradiology
        Components
        Trade-off Parameters
        Operation
        Radiology & Clinical Impact

Nov 18  Integration of HIS/EMR, RIS, PACS, and ePR
        HIS: Hospital Information System
        EMR: Electronic Medical Record
        RIS: Radiology Information System
        ePR: electronic Patient Record

Nov 25  Thanksgiving Holiday: NO CLASS

Dec 2   Special Guest Lecture/Seminar

Dec 7-14 TAKE HOME FINAL
4. Assignments

**Homework:** There will be 4-5 homework sets which will be assigned a week before they are due. Assignments are due on the specified date at the beginning of class.

**Midterm Exam:** A midterm exam will cover the topics up to the midterm and will be assigned a week before it is due. There will be no make-up exam.

**Take Home Final Exam:** A Take Home Final exam will be administered to cover all the topics of the course.

5. Grades

Final grades will be based on homework assignments (30%), a mid-term exam (30%), and a take home final exam (40%).

**Statement for Students with Disabilities**

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information for DSP: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

**Statement on Academic Integrity**

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one’s own academic work from misuse by others as well as to avoid using another’s work as one’s own. All students are expected to understand and abide by these principles. SCampus, the Student Guidebook, (www.usc.edu/scampus or http://scampus.usc.edu) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

**Emergency Preparedness/Course Continuity in a Crisis**

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.