The Hashemite University
Faculty of Allied Health Sciences
Department of Medical Imaging
Course Syllabus

Course information	
Course Title	Quantitative Analysis of Medical Images
Course Code	110508341
Prerequisites	70 credit hours
Credit hours	3 (2 theory + 3 Lab hours)

Course Description
This course is intended to introduce the student what computers can do on various medical images rather than explaining the mathematical concepts of digital image processing DIP science. The course will explain the potential of various aspects of DIP on medical images. Applying the DIP aspects provides clinicians with more accurate picture of disease state. Also, it allows clinicians to extract quantitative information from images in an effort to help identify disease earlier, predict prognosis, and assess treatment efficacy as well. The course is supplied with many figures of various medical images that show the potential of computer to manipulate the original medical image in which it improves the diagnosis process taking by the radiologist. The departmental image analysis lab provides hands-on further practical demonstrations. So, this course is planned to offer the student with the various image processing and analysis methods commonly (and commercially) used in medical imaging applications such as histogram processing, image smoothing, image sharpening, spatial co-registration, segmentation, and feature extraction. Furthermore, different quantitative analysis methods such as region volume of interest, and algorithms of object recognition and classifications (i.e. the computer aided detection or diagnosis of lesions), and measurements on images will also be introduced in this course.

Course Objectives By the end of this course, student is expected to:
To understand the potential of computers on medical images.
To understand the common and commercial DIP aspects installed in medical imaging systems such as: filtering, smoothing, sharpening, dealing with images interactively to extract regions and make measurements.
To understand the common digital image terminology used in medical image systems such as: histogram, types of 3-D visualization, restoration and registration.
To understand the computers algorithms provided by manufacturers and vendors for medical image analysis such as: computer aided detection; computer aided diagnosis, and automated measurements.
To build up familiarity with computers as they are part of all digital medical imaging systems (i.e. Digital Radiography).

Recommended Textbook	
Title	Digital Image Processing for Medical Applications: An introduction
Author	Geoff Dougherty
Publisher	CAMBRIDGE
Year	2009,
Edition	First, reprinted with corrections 2011
Book website	
Other References	
Title	Biomedical Image Processing
Author	Thomas M. Deserno
Publisher	SPRINGER
Year	2011
Edition	First

Course Contents

PART I : Introduction to Image Processing

1. Review of Medical images obtained with ionizing and non-ionizing radiation
2. The DIP System
3. Medical Applications of DIP
4. Colour Images
5. Medical Image Formats

PART II : Fundamentals Concepts of Image Processing

1. Histogram Processing: Definition, Equalization, Matching
2. Image enhancement in the spatial domain
    - Image Intensity Transformations
    - Image Smoothening and Sharpening
3. Image enhancement in the frequency domain
    - Basic Principle
    - Image Frequency filters
4. Image restoration
    - Image degradation
    - Noise reduction filters
    - Geometric degradation.

PART III Image Analysis

1. Image segmentation
    - Thresholding.
    - Region Based Segmentation
    - Boundary based Segmentation (Edge Detection)
    - Other Methods
2. Feature recognition and classification
    - Features
    - Objects recognition and classifications
    - Application in medical image analysis
    - Common Classifiers
3. Three-dimensional visualization
    - Image visualization
    - Surface rendering
    - Volume rendering
    - Virtual reality
4. Statistical metrics on Medical Images
    - Receiver Operating characteristics Curves
    - Statistical Parametric Model

PART IV:. Medical applications

1. Computer Aided detection
2. Computer Aided diagnosis
3. Tumour Imaging and treatment
4. Angiography
5. Bone strength and osteoporosis
6. Tortousity

Assessment	
First Exam	**20**
Second Exam	**20**
Final Exam	**40**
Lab and in course assessment	**20**