

Medical Biophysics 3503G

1. Course Information

Medical Biophysics 3503G: Fundamentals of Digital Imaging

Fall/Winter 2014/2015

Basic concepts of digital images relevant to all imaging modalities. Image formation and capture including digital cameras and the eye, pixels, resolution, contrast, window/level, dynamic range, colour models. Image compression and quality, sensitivity, specificity, receiver operating characteristic curves, quantitative analysis based on imaging software and the implementation of digital image processing concepts in MATLAB.

Lectures:

Tuesdays and Thursdays, 10:30-11:30 MSB-384

Tutorials:

Tuesdays 11:30-12:30 PAB-34

Wednesdays 11:30-12:30 KB-K103

Requisites:

Prerequisite(s): Calculus 1000A/B or 1100A/B plus one of Calculus 1301A/B or 1501A/B , or Applied Mathematics 1413 or the former Mathematics 030; 1.0 course from Physics 1020 , 1024 , 1028A/B and 1029A/B , or the former Physics 022 or 025.

Antirequisite(s): Medical Biophysics 3302E.

Extra Information: 2 lecture hours, 1 tutorial hour, 0.5 course. Typically taken in third or fourth year, this course is also open to second-year students with an overall average of at least 70% in first year.

Senate regulation regarding the student's responsibility regarding requisites:

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. James Lacefield	jlacefie@uwo.ca	TEB 371	519-661-2111 x84303	To be announced
Dr. Aaron Ward	aaron.ward@uwo.ca	A3-121, LRCP	519-685-8500 x56846	By appointment
Dr. Timothy Scholl (Course Coordinator)	scholl@uwo.ca	RRI 2241B	519-931-5777 x20019	Tu, Th 11:30-12:30
Seyyed Hesabgar (TA)	shesabga@uwo.ca			

WebCT:

Students with WebCT issues should contact the Computer Support Centre at 519 661-3800 or fill out the WebCT webform:

<https://servlet.uwo.ca:8081/vistahelpdesk/controller.jsp>

3. Course Syllabus Medical Biophysics 3503G

This course replaces the second half of the former Medical Biophysics 3302E with tutorials and extra assignments instead of the laboratories. It is used together with Medical Biophysics 3501G and 3970Z (lab) to replace 302E in the Medical Biophysics modules. This course is also cross-listed with Biomedical Engineering 9503A and serves as a Medical Biophysics graduate course.

COURSE OBJECTIVES: - To enable students to:

- Describe the basic concepts of images and what they represent.
- Assess image quality and information content in terms of dynamic range and resolution and determine how reliably images represent objects in terms of sensitivity and specificity.
- Understand how image sensors collect information to form digital images, including color images
- Use image processing software to enhance and analyze images
- Characterize the eye as a digital camera

APPROACH:

Lecture-discussion periods: Presentation of material supported by class discussion and demonstrations. Assignments are provided to help students and lecturers assess progress.

Tutorials: Review of lecture material and discussion of assignments.

TERM WORK BASED ON LECTURES:

Regular ASSIGNMENTS based on lecture material will be given out approximately biweekly and will be due on the Friday of the next week of classes. Marks will be deducted for assignments submitted late and those handed in after the marked assignments have been returned may not be marked. If you anticipate any exceptional difficulty in meeting a particular deadline, please see

the instructor beforehand and request an 'extension'. Students are encouraged to collaborate, but the assignment *must be written up independently*.

EVALUATION:

Assignments - 30%, Midterm Test - 30%, Final Exam - 40%

To pass the course, a passing mark must also be obtained on the final exam.

LECTURERS:

Dr. James Lacefield

Dr. Tim Scholl (Course Coordinator)

Dr. Aaron Ward

TEACHING ASSISTANTS:

Seyyed Hesabgar (Medical Biophysics)

VENUE:

Lectures: 10:30 - 11:30 am Tuesdays and Thursdays MSB-384

Tutorials: 11:30 – 12:30 am Tuesdays PAB-34 and Wednesdays KB-K106

Course Schedule:

Medical Biophysics 3503G

2015 DATES	INSTRUCTOR	LECTURE TOPICS MSB-M384 Tu & Th 10:30-11:20	ASSIGNMENTS & TUTORIALS PAB-34 Tu 11:30-12:30 KB-K208 W 11:30-12:30
January 5 & 7	JL	Intro to imaging science, image quality metrics	
January 12 & 14	JL	Evaluation of lesion detectability and diagnostic accuracy	Assignment #1 , Imaging science
January 19 & 21	JL	Comparing imaging technologies	
January 26 & 28	JL	Cost-benefit analysis of cancer screening using imaging	Assignment #1 , Due Jan 28
February 2 & 4	TS	Image sensors, photon detection, saturation linearity, dynamic range, resolution	
February 9 & 11	TS	Analyzing images with digital tools (ImageJ) Digital cameras, what do the settings mean?	Assignment #2 , Analyzing Digital Images with ImageJ
February 16 & 20	None	Reading Week	
February 23 & 25	TS	Contrast and brightness, window and leveling Colour models and colour balance Image compression	Assignment #2 , Due Feb 25
March 1 & 3	TS	The eye as a camera	
March 8 & 10	JL & TS	March 8th: Q & A Session March 10th: In-class Midterm (50 min.)	
March 15 & 17	AW	Introduction to MATLAB	
March 22 & 24	AW	Displaying images, plots, and histograms and image segmentation in MATLAB	Assignment #3 , MATLAB Programming Assignment
March 29 & 31	AW	Filtering, morphological operations in MATLAB Medical Image Data Processing	
April 5	AW	Measuring segmentation algorithm performance in MATLAB	Assignment #3 , Due Apr 7th
FINAL EXAM PERIOD: April 9-30 (exact date and time to be set by Registrar's Office) - 2 hours (covers all topics)			

4. Course Materials

There is no formal text for the course. Instructional material will be provided electronically (probably via WebCT OWL) and students may be directed to on-line references.

5. Evaluation

Component	% of Final Mark
Midterm test	30
Assignments	30 (3 x 10)
Final exam	40

To pass the course, a passing mark must also be obtained on the final exam.

6. Additional Information/Statements

Academic Offences

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following web site: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com <http://www.turnitin.com>

In this course, there are a number of written assignments required for evaluation. We feel strongly that students should work together, sharing raw data and ideas. Reports submitted for marking, however, must be written independently. After working together, go away and write them up without looking at anyone else's work. It's easy for us to spot material with a common source. Remember, the same material is likely to show up on an exam so you must be able to do it on our own.

Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

General information:

“Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.”

A Special Examination may be given on the basis of compassionate or medical grounds with appropriate supporting documents.

A Special Examination must be written at the University or an Affiliated University College no later than 30 days after the end of the examination period involved. To accommodate unusual circumstances, a date later than this may be arranged at the time permission is first given by the

Dean of the Faculty. The Dean will consult with the instructor and Department Chair and, if a later date is arranged, will communicate this to Registrarial Services. If a student fails to write a scheduled Special Examination, permission to write another Special Examination will be granted only with the permission of the Dean in exceptional circumstances and with appropriate supporting documents. In such a case, the date of this Special Examination normally will be the scheduled date for the final exam the next time the course is offered.

Support Services:

Office of the Registrar: <http://www.registrar.uwo.ca>

Academic Counselling: http://www.schulich.uwo.ca/biophysics/undergraduate/academic_counselling.html

Student Development Services: <http://www.sdc.uwo.ca>

Student Health Services: <http://www.uwo.ca/health/services/students/index.html>

Absence from course commitments

Students must familiarize themselves with the Policy on Accommodation for Students with Disabilities:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf

Statement from the Dean's Office

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

A student requiring academic accommodation due to illness, should use the Student Medical Certificate when visiting an off-campus medical facility or request a Record's Release Form (located in the Dean's Office) for visits to Student Health Services. The form can be found at: https://studentservices.uwo.ca/secure/medical_document.pdf

For medical illness affecting work worth less than 10% of the total course grade, evaluation may be re-weighted.

B. Absence for non-medical reasons:

Material submitted for evaluation (assignments, lab reports) after the due date will be subjected to a late penalty of 10%/day but will not be accepted after marked material has been returned to the class. Missed midterm tests will be given 0% unless accommodation is made through the Office of the Dean of Science.

C. Special Examinations

*****Please Note: There will not be any mid-term make-up exams. For students who do not write the mid-term test (based on medical or compassionate grounds), the final exam will be worth 70% of the course grade. The following only applies to students who miss the final examination*****

A Special Examination is any examination other than the regular examination, and it may be offered only with the permission of the Dean of the Faculty in which the student is registered, in consultation with the instructor and Department Chair. Permission to write a Special Examination may be given on the basis of compassionate or medical grounds with appropriate supporting documents.

A Special Examination must be written at the University or an Affiliated University College no later than 30 days after the end of the examination period involved. To accommodate unusual circumstances, a date later than this may be arranged at the time permission is first given by the Dean of the Faculty. The Dean will consult with the instructor and Department Chair and, if a later date is arranged, will communicate this to Registrarial Services. If a student fails to write a scheduled Special Examination, permission to write another Special Examination will be granted only with the permission of the Dean in exceptional circumstances and with appropriate supporting documents. In such a case, the date of this Special Examination normally will be the scheduled date for the final exam the next time the course is offered.