

# Medical Biophysics 3503G

## 1. Course Information

### Medical Biophysics 3503G:

Fundamentals of Digital Imaging

### Winter Term 2016/17

Basic concepts of images relevant to all imaging modalities. Image formation and capture including digital cameras and the eye, pixels, aliasing, resolution, contrast, sensitivity, specificity, ROC, window/level, dynamic range, RGB, spectroscopy. Image compression and quality, quantitative analysis based on imaging software and the implementation of digital image processing concepts in Matlab.

### Lectures:

Tu, Th 10:30-11:30 DSB 2016

### Tutorials:

Tu 11:30-12:30 NS 7

Wed 11:30-12:30 NS 7

### 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. Greg Marsh (Course Coordinator)	gdmarsh@uwo.ca	4163 Thames Hall	519 661-3408 x83408	by appoint.
Dr. Jonathan Thiessen	jthiess5@uwo.ca			by appoint.
Dr. Aaron Ward	aaron.ward@uwo.ca	A3-121, LRCP	519- 685-8500 x 56846	by appoint.
Dr. Tim Scholl	<a href="mailto:scholl@uwo.ca">scholl@uwo.ca</a>	RRI 2241B	519 931-5777 x20019	Tu, Th 11:30-12:30
GTA (TBA)				
GTA (TBA)				

### 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 packages to enhance and analyze images
- Characterize the eye as a digital camera, including biological image enhancement
- Examine information content in medical images of different modalities

### 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 - 40%, Midterm Test - 20%, Final Exam - 40%

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

**LECTURERS:**

Dr. Greg Marsh, (Course Coordinator)

Dr. Jonathan Thiessen

Dr. Tim Scholl

Dr. Aaron Ward

**TEACHING ASSISTANTS:**

????(Medical Biophysics)

????(Biomedical Engineering)

**VENUE:** Lectures: 10:30 - 11:30 am Tuesdays and Thursdays DSB 2016

**Medical Biophysics 3503G**

<b>DATE 2017</b>	<b>Instructor</b>	<b>LECTURE TOPICS</b> DSB 2016 Tu Th 10:30-11:20	<b>ASSIGNMENTS &amp; TUTORIALS</b> NS 7 Tu 11:30-12:30 NS 7 2016 W 11:30-12:30
Jan 5 10	JT	Intro to imaging science, image quality metrics	
12 17	JL	Evaluation of lesion detectability and diagnostic accuracy	Assignment #1, Imaging science
19 24	JL	Cost-benefit analysis of cancer screening using imaging	
26 31	TS	Image sensors, photon detection, saturation linearity, dynamic range	Assignment #1, Due
Feb.2 7	TS	Digital cameras, what do the settings mean? Effects on contrast, resolution, noise	
9 14	TS	Improving images with digital tools Color, contrast, brightness, filters	Assignment #2, Digital Images
16		<b>In Class Mid-Term Exam</b>	
24 26		<b>No Lectures, Reading Week</b>	
Feb. 28 Mar. 2	AW	Introduction to Matlab	Assignment #2, Due Assignment #3, Matlab Programming Assignment
7 9	AW	Displaying images, plots, and histograms and image segmentation in Matlab	
14 16	AW	Filtering, morphological operations in Matlab	Assignment #3, Due
21 23	GM	Medical Image Data Processing Spectral Analysis, Artifacts - aliasing	Assignment #4, Visual Angle
28. 30	GM	The eye as a camera, optics, resolution, Perception; Sensitivity; Optical Illusions	
Apr. 4 6	GM	Space Perception and 3D Image creation; Depth Cue Theory	Assignment #4, Due

**FINAL EXAM April 9-30 (time set by Registrar) - 2 hours (covers all topics)**

*\* Assignments handed out - due by 5:00 pm on the Thursday*

## 4. Course Materials

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

## 5. Evaluation:

Component	% of Final Mark
Midterm test	20
Assignments	40 (4 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: <http://www.uwo.ca/univsec/handbook/appeals/scholoff.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:** (from <http://www.uwo.ca/univsec/handbook/> )  
“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:**

Registrarial Services: <http://www3.registrar.uwo.ca/index.cfm>

Academic Counselling (Science and Basic Medical Sciences):  
<http://www.uwo.ca/sci/counselling/index.html>

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

Student Health Services: <http://www.shs.uwo.ca/>

**Additional Information/Statements**

**Statement on 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 website:

[http://www.uwo.ca/univsec/handbook/appeals/scholastic\\_discipline\\_undergrad.pdf](http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf) .”

**Absence from course commitments**

***A. Absence for medical illness:***

Students must familiarize themselves with the Policy on Accommodation for Medical Illness: <https://studentservices.uwo.ca/secure/index.cfm>

***Statement from the Dean’s Office, Faculty of Science***

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 UWO Policy on Accommodation for Medical Illness, see:

[http://www.uwo.ca/univsec/handbook/appeals/accommodation\\_medical.pdf](http://www.uwo.ca/univsec/handbook/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](https://studentservices.uwo.ca/secure/medical_document.pdf)

Students seeking academic accommodation on medical grounds for any missed tests, exams, participation components and/or assignments worth 10% or more of their final grade must apply to the Academic Counseling office of their home Faculty and provide documentation. Academic accommodation cannot be granted by the instructor or department.

### ***B. Special Examinations***

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.

### ***C. Support Services:***

Registrarial Services: <http://www3.registrar.uwo.ca/index.cfm>

Academic Counseling (Science and Basic Medical Sciences):

<http://www.uwo.ca/sci/counselling/index.html>

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

Student Health Services: <http://www.shs.uwo.ca/>

### ***D. Accommodations for Religious Holidays***

When scheduling unavoidably conflicts with religious holidays which a) require an absence from the University or b) prohibit or require certain activities (i.e., activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), no student will be penalized for absence because of religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and instructor involved, they should consult the appropriate department chair and, if necessary, the student's Dean. It is the responsibility of such students to inform themselves concerning the work done in classes from which they are absent and to take appropriate action. A student who, for either of the situations outlined in paragraph one above (A or B), is unable to write examinations and term tests on a Sabbath or Holy Day in a particular term shall give notice of this fact in writing to his or her Dean as early as possible, but not later than November 15 for mid-year examinations and March 1 for final examinations, i.e., approximately two weeks after the posting of the mid-year and final examination schedule respectively. In the case of mid-term tests, such notification is to be

given in writing to the instructor within 48 hours of the announcement of the date of the mid-term test. If a Special Examination is offered as an alternative means to satisfy the academic requirements, the instructor(s) in the case of mid-term tests and the dean in the case of mid-year and Spring final examinations will arrange for special examination(s) to be written at another time. In the case of midyear and Spring final examinations, the accommodation must occur no later than one month after the end of the examination period involved. It is mandatory that students seeking accommodations under this policy give notification before the deadlines and that the Faculty accommodate these requests. For purposes of this policy the University has approved a list of dates which are recognized religious holidays which require members of those religions to be absent from the University; this list is updated annually and is available at Departmental, Deans' and Faculty advising offices.

***E. Accessibility***

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to 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.