UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
DEPARTMENT OF PHYSICS AND ASTRONOMY
COURSE OUTLINE

1. **Course:** MDPH 638 **Term**: Fall 2020

Instructor:
Dr. Michael Roumeliotis | 403-521-3789 | CCB05 | michael.roumeliotis@ahs.ca | Office Hours: Upon request
Dr. Kundan Thind | 403-521-3088 | CCB06 | kundan.thind@ahs.ca | Office Hours: Upon request

Lecture Sections: L01 | Tuesday & Thursday 13:00 - 14:30 | MPR & HSC room. As an alternative plan, virtual lectures using Zoom video to be used in case lectures in person are restricted.

Course Website: d2l.ucalgary.ca

Departmental Office: SB 605, 403-220-5385, phasugrd@ucalgary.ca

2. **Prerequisites:** None.

3. **Grading:** The University policy on grading and related matters is described in sections F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Quizzes	15%
Assignments	25%
Presentation	10%
Midterm exam	25%
Final exam	25%

Percentage to letter grade conversion scale:

> = 93 %	A +	> = 75 %	B +	> = 60 %	C +	> = 45 %	D +
> = 86 %	A	> = 70 %	B	> = 55 %	C	> = 40 %	D
> = 80 %	A -	> = 65 %	B -	> = 50 %	C -	< 40 %	F

Assignments are due on time as announced. Late assignments will be considered only in well-documented emergencies (e.g. a doctor's note should be provided in case of illness).

4. **Missed Components of Term Work:** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in Section 3.6. It is the student's responsibility to familiarize himself/herself with these regulations. See also Section E.6 of the University Calendar

5. **Scheduled out-of-class activities:** There are no scheduled activities outside of class time.

6. Course Materials:
    - i The essential physics of Medical Imaging, 3rd edition, Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidholdt, Jr., John M. Boone.
    - ii Hendee's Physics of Medical Imaging, 5th edition, Eshan Samei, Donald J. Peck.
    - iii MRI from Picture to Proton, 3rd edition, Donald W. McRobbie, Elizabeth A. Moore, Martin J. Graves, Martin R. Prince.

7. Examination Policy: The midterm and final exam are in oral examination format. Students should also read the Calendar, Section G, on Examinations.

8. Course fees: none

9. Writing across the curriculum: In this course, the quality of the student's writing in laboratory reports will be a factor in the evaluation of those reports. See also Section E.2 of the University Calendar.

10. Human studies statement: Students in this course are not expected to participate as subjects or researchers. See also Section E.5 of the University Calendar.

11. OTHER IMPORTANT INFORMATION FOR STUDENTS:

(a) Academic Misconduct: Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under Section K. Student Misconduct to inform yourself of definitions, processes and penalties.

(b) Assembly Points: In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on assembly points.

(c) Student Accommodations: Students needing an Accommodation because of a Disability or medical condition should contact Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities available at http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf. Students needing an Accommodation in relation to their coursework or to fulfill requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to the Associate Head of the Department of Physics and Astronomy, Dr. Ann-Lise Norman, by email (alnorman@ucalgary.ca) or by phone (403.220.5405).

(d) Safewalk: Campus Security will escort individuals day or night (http://www.ucalgary.ca/security/safewalk/). Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

(e) Freedom of Information and Privacy: This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information see also http://www.ucalgary.ca/secretariat/privacy.

(f) Student Union Information: VP Academic Phone: 220-3911 Email: suvpaca@ucagary.ca.
SU Faculty Rep: Phone: 220-3913 Email: science1@su.ucalgary.ca, science2@su.ucalgary.ca and science3@su.ucalgary.ca
Student Ombuds Office: 403 220-6420
Email: ombuds@ucalgary.ca; http://ucalgary.ca/provost/students/ombuds

(g) Internet and Electronic Device Information: You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop

computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.

(h) **U.S.R.I.:** At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses (www.ucalgary.ca/usri). Your responses make a difference - please participate in USRI Surveys.

12. OTHER COURSE RELATED INFORMATION:

(a) Course Description

An overview of the imaging modalities used in Radiation Oncology including: CT, MRI, planar X-ray, nuclear medicine and ultrasound. The course will cover basic physics, instrumentation and applications.

(b) Course Learning Outcomes

At the end of the course, students should have a clear understanding of the fundamentals of medical imaging. Beyond practical knowledge of the major imaging modalities, students should understand the physical principles that provide the foundation of these imaging techniques. Students will also have an opportunity to observe image acquisition and functionality during in-class demonstrations.

(c) Course Learning Incomes

This course will require undergraduate knowledge of mathematics and physics.

(d) Syllabus & Lab Schedule

Lecture	*Date*	*Topic*	*Instructor*
1	8-Sept	Overview of Medical Imaging	MR
		➢ History of Medical Imaging ➢ Basic interactions	
2	10-Sept	Image Quality and Background Mathematics 1	KT
		➢ Sample theorem, Nyquist frequency, signal processing, Fourier domain	
3	15-Sept	Image Quality and Background Mathematics 2	KT
		➢ Spatial Resolution, Convolution, Frequency Domain, CNR, SNR, ROCs	
4	17-Sept	X Ray Production	KT
		➢ X Ray Tube, Filtration ➢ Bremsstrahlung	
5	22-Sept	Computed Tomography 1	MR
		➢ Instrumentation, History, Mathematics	
6	24-Sept	Computed tomography 2	MR
		➢ Image reconstruction, Artifacts	

7	29-Sept	Computed Tomography 3	MR
		➢ Radiation Oncology applications (treatment planning, dose calculation)	
8	1-Oct	Radiography 1	ES
		➢ Grids, Scatter ➢ Image Detectors (Digital)	
9	6-Oct	Radiography 2	ES
		➢ Mammography ➢ Fluoroscopy ➢ OBI	
10	8-Oct	Ultrasound 1	MR
		➢ Fundamental Physics and Transducers	
11	13-Oct	Ultrasound 2	MR
		➢ Image Formation	
12	15-Oct	Midterm Review	MR/KT
13	20-Oct	Midterm	MR/KT
14	22-Oct	Nuclear Medicine 1	MR
		➢ Radioactivity, scintillation camera	
15	27-Oct	Nuclear Medicine 2	MR
		➢ SPECT, PET, Image Formation, Instrumentation	
16	29-Oct	MRI 1	KT
		➢ Magnetic Fields, Instrumentation, Nuclear Magnetic Characteristics Precession	
17	3-Nov	MRI 2	KT
		➢ Tissue contrast, image acquisition	
18	5-Nov	MRI 3	KT
		➢ Advanced imaging acquisition, artifacts, spectroscopy, safety	
19	17-Nov	Image Processing and Registration	KT
		➢ Filtering, smoothing, affine registration, non-linear registration, registration metrics	
20	19-Nov	Special Techniques in Medical Imaging	AS

		➢ Doppler and colour flow imaging ➢ 4DCT, dual energy CT ➢ fMRI, functional and metabolic imaging	
21	24-Nov	Verification Imaging and Radiation Oncology applications (MRI, Nuc Med)	MR
		➢ CBCT, 2D kV, EPID ➢ MRI, Nuc Med in Radiation Oncology	
22	26-Nov	Student Presentations	MR/KT
23	1-Dec	Imaging Department Tour	ES
24	3-Dec	Final Exam Review	MR/KT
25	8-Dec	Final Exam	MR/KT