

Course Outline (F2023)

BME704: Radiation Therapy Devices

Instructor(s)	Dr. Victor Yang [Coordinator] Office: EPH400Q Phone: (416) 979-5000 x 552143 Email: yangv@torontomu.ca Office Hours: TBA Tues after lecture
Calendar Description	The course will cover radiation producing equipment, character of photon and electron radiation beams, radiation dose functions, computerized radiation treatment planning, brachytherapy, special radiation treatment procedures, quality assurance, and radiation shielding of high energy facilities.
Prerequisites	BME 674 and BME 229 and MTH 410
Antirequisites	None
Corerequisites	None
Compulsory Text(s):	1. Radiation Oncology Physics: A Handbook for Students and Teachers, E.B. Podgorsak ed. (online book: http://www-pub.iaea.org/mtcd/publications/pdf/pub1196_web.pdf)
Reference Text(s):	
Learning Objectives (Indicators)	<p>At the end of this course, the successful student will be able to:</p> <ol style="list-style-type: none"> 1. Use numerical and analytical models to predict, control and design component, system and process behaviors. (1c) 2. Use physics and biology principles in simulation and Matlab to depict high energy X-ray photon and electron interactions in radiation detection and therapy devices. (1d) 3. Compare model predictions with real-world data. (2b) 4. Practice critical and continual assessment of experimental data and associated models. (3b) 5. Demonstrate iterative process in complex design engineering projects. (4c) 6. Work individually and in a team to organize and deliver clear and formal presentation following established guidelines (6a) 7. Summarize and paraphrase written work accurately with appropriate citations; Formulate and express ideas in clear and correct grammar. (7a) 8. Organize and deliver clear and formal presentation following established guidelines. (7b) 9. Consider economic, social and environmental factors in decisions. (9a) <p>NOTE:Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).</p>

Course Organization	3.0 hours of lecture per week for 13 weeks 2.0 hours of lab per week for 12 weeks 0.0 hours of tutorial per week for 12 weeks														
Teaching Assistants	TBA														
Course Evaluation	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Theory</th> </tr> </thead> <tbody> <tr> <td>Midterm</td> <td>25 %</td> </tr> <tr> <td>Final Exam</td> <td>35 %</td> </tr> <tr> <th colspan="2">Laboratory</th> </tr> <tr> <td>Term Project</td> <td>10 %</td> </tr> <tr> <td>Labs</td> <td>30 %</td> </tr> <tr> <td>TOTAL:</td> <td>100 %</td> </tr> </tbody> </table> <p>Note: In order for a student to pass a course, a minimum overall course mark of 50% must be obtained. In addition, for courses that have both "Theory and Laboratory" components, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the "Course Evaluation" section above for details on the Theory and Laboratory components (if applicable).</p>	Theory		Midterm	25 %	Final Exam	35 %	Laboratory		Term Project	10 %	Labs	30 %	TOTAL:	100 %
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Examinations	Midterm exam in Week 7, two hours, multiple-choice and short answers, closed book (covers Weeks 1-6). Final exam, during exam period, two hours, closed-book (covers all course material).														
Other Evaluation Information	Potential project topics will be posted in the BME704 course shell. In order to allow students the time to make a considered decision, final topic selection will occur in the 3rd week of the term. All topics are 5-6 student projects, where the team as a group will present their final design in the final week of the course. The presentation time will be 15 minutes. Student generated topics must be approved by the course coordinator, Dr. Khader. Specific details of the term project will be given during class and posted in the BME704 course shell.														
Teaching Methods	Lecture location: VIC501 PT Classroom (D2L Zoom link if conflict) Lecture slides will be posted on D2L. Lab location: ENG412 Lab materials and project guidelines will be posted on D2L.														
Other Information	None														

Course Content

Week	Hours	Chapters / Section	Topic, description

1	3	14	Introduction overview of radiation therapy process radiobiology
2	3	1	Interaction of radiation with matter atomic & nuclear structure electron and photon interactions
3	3	2	Concept of dose interaction coefficients cavity theory
4	3	3	Dose measurement with ionization chambers dosimeter design select
5	3	4	Area survey and individual monitoring
6	3	5	External beam radiation therapy (linear accelerators)
7	3	6	Inverse square law patient dosimetry planning
8-9	3	7	Conventional treatment planning Intensity modulated radiation therapy Protons and heavy ions Radiation Safety
9-10	3	8	Dosimetric parameters clinical considerations
11	3	10	Clinical quality assurance and principles of statistical process control
12	3	16	Radiation effects safety designs

Laboratory(L)/Tutorials(T)/Activity(A) Schedule

Week	L/T/A	Description
2	ENG412	Radiobiology (LAB)
3-4	ENG412	Interaction of radiation with matter (LAB)
5	ENG412	Ion chamber design (LAB)
6-7	ENG412	Linac design (LAB)
8-9	ENG412	Dose calculation algorithms (LAB)
10	ENG412	Image quality and dose (Diagnostic X-ray beam parameters) (LAB)
11	ENG412	Linac bunker design and radiation shielding calculation (LAB)

University Policies

Students are reminded that they are required to adhere to all relevant university policies found in their online course shell in D2L and/or on [the Senate website](#)

Important Resources Available at Toronto Metropolitan University

- [The Library](#) provides research [workshops](#) and individual assistance. If the University is open, there is a Research Help desk on the second floor of the library, or students can use the [Library's virtual research help service](#) to speak with a librarian.
- [Student Life and Learning Support](#) offers group-based and individual help with writing, math, study skills, and transition support, as well as [resources and checklists to support students as online learners](#).
- You can submit an [Academic Consideration Request](#) when an extenuating circumstance has occurred that has significantly impacted your ability to fulfill an academic requirement. You may always visit the [Senate website](#) and select the blue radio button on the top right hand side entitled: Academic Consideration Request (ACR) to submit this request.

For Extenuating Circumstances, Policy 167: Academic Consideration allows for a once per semester ACR request without supporting documentation if the absence is less than 3 days in duration and is not for a final exam/final assessment. Absences more than 3 days in duration and those that involve a final exam/final assessment, require documentation. Students must notify their instructor once a request for academic consideration is submitted. See Senate [Policy 167: Academic Consideration](#).

- If taking a remote course, familiarize yourself with the tools you will need to use for remote learning. The [Remote Learning Guide](#) for students includes guides to completing quizzes or exams in D2L Brightspace, with or without [Respondus LockDown Browser and Monitor, using D2L Brightspace](#), joining online meetings or lectures, and collaborating with the Google Suite.
- Information on Copyright for [Faculty](#) and [students](#).

Accessibility

- Similar to an [accessibility statement](#), use this section to describe your commitment to making this course accessible to students with disabilities. Improving the accessibility of your course helps minimize the need for accommodation.
- Outline any technologies used in this course and any known accessibility features or barriers (if applicable).
- Describe how a student should contact you if they discover an accessibility barrier with any course materials or technologies.

Academic Accommodation Support

Academic Accommodation Support (AAS) is the university's disability services office. AAS works directly with incoming and returning students looking for help with their academic accommodations. AAS works with any student who requires academic accommodation regardless of program or course load.

- Learn more about [Academic Accommodation Support](#).
- Learn [how to register with AAS](#).

Academic Accommodations (for students with disabilities) and Academic Consideration (for students faced with extenuating circumstances that can include short-term health issues) are governed by two different university policies. Learn more about [Academic Accommodations versus Academic Consideration](#) and [how to access each](#).

Wellbeing Support

At Toronto Metropolitan University, we recognize that things can come up throughout the term that may interfere with a student's ability to succeed in their coursework. These circumstances are outside of one's control and can have a serious impact on physical and mental well-being. Seeking help can be a challenge, especially in those times of crisis.

If you are experiencing a mental health crisis, please call 911 and go to the nearest hospital emergency room. You can also access these outside resources at anytime:

- **Distress Line:** 24/7 line for if you are in crisis, feeling suicidal or in need of emotional support (phone: 416-408-4357)
- **Good2Talk:** 24/7-hour line for postsecondary students (phone: 1-866-925-5454)
- **Keep.meSAFE:** 24/7 access to confidential support through counsellors via [My SSP app](#) or 1-844-451-9700

If non-crisis support is needed, you can access these campus resources:

- **Centre for Student Development and Counselling:** 416-979-5195 or email csdc@torontomu.ca
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osvse@torontomu.ca
- **Medical Centre:** call (416) 979-5070 to book an appointment

We encourage all Toronto Metropolitan University community members to access available resources to ensure support is reachable. You can find more resources available through the [Toronto Metropolitan University Mental Health and Wellbeing](#) website.