NRE4407 Syllabus

**[Introduction to Radiobiology and Oncology, Section A, 3 Credits]**

**[Class Day(s)** T/Th**, Time** MWF 12:20 - 1:10 PM**, Location** Howey S107**]**

**Instructor Information**

|  |  |  |
| --- | --- | --- |
| Instructor | Email | Office Hours & Location |
| Professor C-K Chris Wang | [chris.wang@me.gatech.edu](mailto:chris.wang@me.gatech.edu) | By appointment  Boggs building 3-86 |
| **Teaching Assistant(s)** | **Email** | **Office Hours & Location** |
| None | None | None |

**General Information**

**Description**

This course will provide the student a base knowledge of radiation biology as it pertains to oncology and radiotherapy. It can be divided into three parts. Part 1 examines the mechanisms of how ionizing radiation produce/induce various types of DNA damage, which in turn result in gene mutations, chromosome aberrations, and cell death. Part 2 examines the two major health effects caused by radiation: the stochastic effects including cancer and hereditary effects, and the deterministic effects due to the functional loss of tissues. Part 3 presents human cancer facts and statistics and how radiation can be used to treat cancer.

## Pre- &/or Co-Requisites

NRE 3301 (prerequisite)

NRE 3316 (prerequisite with concurrency)

## Course Goals and Learning Outcomes

Upon successful completion of this course, students should be able to:

1. Demonstrate knowledge of radiation biology as it pertains to the application of radiotherapy for cancer.
2. Demonstrate knowledge of radiation biology as it pertains to the application of radiation protection.
3. Demonstrate knowledge of radiation dosimetry within a radiotherapy environment.

**Course Requirements & Grading**

|  |  |  |
| --- | --- | --- |
| Assignment | Date | Weight (Percentage, points, etc) |
| Final Exam (Comprehensive) | Final Exam Schedule | 40% of total grade |
| Midterm Exam 1 | Week 6 | 30% of total grade |
| Midterm Exam 2 | Week 11 | 30% of total grade |
|  |  |  |

**Description of Graded Components**

**Homework/Lecture Notes**: A few homework sets will be assigned, but submission of the homework is not required. Solutions to the homework as well as the lecture notes will be provided on Canvas.

**Exams:** Two midterm exams and a final will be given during the semester. The final exam will be comprehensive. The exams will cover ALL relevant lecture notes, class handouts, and assigned book chapters.

**Grading Scale**

Your final grade will be assigned as a letter grade according to the following scale:

A 90-100%

B 80-89%

C 70-79%

D 60-69%

F 0-59%

No curve is anticipated in this course.

**Course Materials**

**Course Text**

“Radiobiology for the Radiologist”, by Eric J. Hall, 7th edition, Lippincott Williams & Wilkins, 2012, ISBN 978-1-60831-193-4.

## Additional Materials/Resources

### Books

1. “Basic Clinical Radiobiology”, edited by Michael Joiner and Albert van der Kogel, 4th edition, CRC Press, Taylor & Francis Group, 2009.

2. “Radiation Biology: A Handbook for Teachers and Students”, IAEA Training Courses Series 42, May,2010. The pdf of the text is available at the IAEA web site: http://www-pub.iaea.org/MTCD/publications/PDF/TCS-42\_web.pdf

3. “DNA Repair, Genetic Instability, and Cancer”, [Qingyi Wei, Lei Li, and David J. Chen](http://www.amazon.com/s/ref=ntt_athr_dp_sr_2?_encoding=UTF8&sort=relevancerank&search-alias=books&field-author=Qingyi%20Wei%3B%20Lei%20Li%3B%20David%20J.%20Chen) (Eds.), World Scientific Publishing Co., 2007.

4. “The Basic Science of Oncology”, edited by Ian F. Tannock et. al., 4th edition, McGraw-Hill, 2005.

5. “Radiobiological modeling in radiation oncology”, R.G. Dale, B. Jones (Eds.), The British Institute of Radiology, London, 2007.

6. “Basic Concepts in Cell Biology and Histology”, by J. C. McKenzie and R. M. Klein, McGraw-Hill Companies, Inc., 2000.

7. “Radiation Pathology”, by L. F. Fajardo L-G, M. Berthrong, and R. E. Anderson, Oxford University Press, Inc., 2001.

8. “Radiation Chemistry: Principles and Applications”, edited by Farhataziz and Michael A. J. Rodgers, VCH Publishers, Inc., 1987.

9. “Radioprotectors: Chemical, Biological, and Clinical Perspectives”, edited by E. A. Bump and K. Malaker, CRC Press, 1998.

Periodicals

1. International Journal of Radiation Biology

2. International Journal of Radiation Oncology, Biology, and Physics

3. Physics in Medicine and Biology

4. Radiation Research

5. Radiotherapy and Oncology

6. Medical Physics

7. Radiation and Environmental Biophysics

8. Radiation Protection and Dosimetry

9. Health Physics

10. Mutation Research

## Course Website and Other Classroom Management Tools

Canvas will be used as the course website to communicate with the students.

**Course Expectations & Guidelines**

## Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or <http://www.catalog.gatech.edu/rules/18/>.

Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

## Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or [http://disabilityservices.gatech.edu/,](http://disabilityservices.gatech.edu/) and <http://disabilityservices.gatech.edu/content/welcome-accommodate> as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

## Attendance and/or Participation

Attendance will not be mandatory, however, in-class activity, quizzes will inform a portion of the grade as described in the description of graded components.

## Collaboration & Group Work

Students are expected to turn in their own work for assignments and quizzes, however, discussion among students on understanding of the subjects and topics is encouraged. At all times students are expected to follow the Academic Honor Code (http://www.catalog.gatech.edu/policies/honor-code/)

## Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Late assignments will not be accepted and missed exams will not be rescheduled without an Institute approved absence (e.g. field trips and athletic events). Students with medical or family emergencies should contact the Dean of Students. See <http://catalog.gatech.edu/rules/4/> for an articulation of the Institute rules.

## Student-Faculty Expectations Agreement

At Georgia Tech we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See <http://www.catalog.gatech.edu/rules/22/> for an articulation of some basic expectation that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

## Student Use of Mobile Devices in the Classroom

Use of portable technology during class time is not permitted unless prior arrangement has been made with the course instructor. Please leave your laptop in your bag, turn off your cell phone, and resist the urge to text your mom.

## Additional Course Policies

The materials used in this class, including, but not limited to, exams, quizzes, homework assignments, and lectures are copyright protected works. Any unauthorized copying of the class materials is a violation of federal law and may result in disciplinary actions being taken against the student. This includes, among other things, uploading class materials to websites for the purpose of sharing those materials with other current or future students.

**Campus Resources for Students**

**Academic Advisors** (advising.gatech.edu/) in each school help students navigate degree requirements and take advantage of campus resources to ensure their success.

The **Center for Academic Success** (success.gatech.edu/) offers a variety of academic support services to help students succeed academically at Georgia Tech (e.g. tutoring, peer-led study groups, study skills, etc.).

The **Communication Center** (communicationcenter.gatech.edu/) provides support for students with respect to developing competency and excellence in written, oral, visual, electronic, and nonverbal communication.

The **Library** (library.gatech.edu/) provides students with many services besides borrowing privileges including access to technology and technical assistance, online access to many journals and databases, and subject and personalized research assistance.

The **Office of Disability Services** (disabilityservices.gatech.edu/) ensures that students with disabilities have equal access to all programs and activities offered at Georgia Tech. They provide documentation and officially sanctioned requests for accommodation for students

**OMED: Educational Services** (omed.gatech.edu/) is the unit charged by Georgia Tech with the retention, development, and performance of the complete student learner who is traditionally underrepresented: African American, Hispanic, and Native American. OMED’s programming and academic support services are aimed at equipping all students with strategies to navigate the Georgia Tech environment.

The **Division of Student Life** (studentlife.gatech.edu/) – often referred to as the Office of the Dean of Students – offers resources and support for all students in our community.

Counseling Center counseling.gatech.edu/ 404-894-2575

Dean of Students studentlife.gatech.edu/ 404-385-8772

GT Police police.gatech.edu/ 404-894-2500

Stamps Health Services health.gatech.edu/ 404-894-1420

**Course Schedule**

**Week Date Topics Text Chapters**

1 8/21 Introduction/course survey Notes

8/23 Physics and chemistry of radiation absorption Ch. 1

8/25 Spatial and temporal aspects of radiation biology Notes

2 8/28 Radiation chemistry of water and free radicals Notes

8/30 Subcellular target – DNA and chromosomes Notes

9/1 Intra- and inter-cellular signaling Notes

3 **9/4 no class (school official holiday)**

9/6 Radiation-induced chromosomal aberrations Ch. 2

9/8 Radiation-induced cell death and transformation Ch. 2

4 9/11Clonogenic assays/cell survival curves/target theoryCh. 3

9/13 Micro- and nano-dosimetry Notes

9/15 Cell cycle and radiosensitivity Ch. 4

**(Term paper topic due)**

5 9/18 Repair of radiation damage and dose-rate effect Ch. 5

9/20 Bystander and non-targeted effects notes

9/22 Oxygen effect and OER Ch. 6

6 9/25 LET and RBE Ch. 7

**9/27 Exam #1**

9/29 The whole-body acute radiation effects Ch. 8

7 10/2 Radiation carcinogenesis Ch. 10

10/4 Heritable effects of radiation Ch. 11

10/6 Effect of radiation on embryo & fetus Ch. 12

Radiation cataractogenesis Ch. 13

8 **10/9 no class (student recess)**

10/11 Doses and risks in diagnostic radiology Ch. 16

10/13 Radiation protection Ch. 17

9 10/16 Cancer/tumor biology Ch. 18

10/18 Continue Notes

10/20 Multi-stage Darwinian theory of cancer Notes

**Week Date Topics Text Chapters**

10 10/23 Hall marks of cancer Notes

10/25 Tumor microenvironment and cellular hypoxia responses Notes

10/27 Cancer stem cells and epithelial-mesenchymal

Transition (EMT) Notes

11 10/30 Cancer facts and treatment methods Notes

11/1 Continue

11/3 Continue

12 **11/6 Exam #2**

11/8 Dose-response relationships for model normal tissues Ch. 19

11/10 Volume effects in normal tissues

13 11/13 Clinical response of normal tissues Ch. 20

11/15 Tumor growth rate & kinetics Ch. 22

11/17 Time, dose, and fractionation in radiotherapy, and Ch. 23/notes

the linear-quadratic (L-Q) approach

14 11/20 Tumor control probability (TCP) vs normal tissue Notes

complication probability (NTCP)

**11/22 no class (school official holiday)**

**11/24 no class (school official holiday)**

15 11/27 Second cancers after radiotherapy Notes

11/29Term paper presentation

12/1 Term paper presentation

16 12/4 Term paper presentation

**12/8** **(Term paper due)**

# Final Exam: As per Registrar’s Schedule