

 FLORIDA ATLANTIC UNIVERSITY	NEW COURSE PROPOSAL Graduate Programs		UGPC Approval _____ UFS Approval _____ SCNS Submittal _____ Confirmed _____ Banner Posted _____ Catalog _____
	Department PHYSICS College CHARLES E. SCHMIDT COLLEGE OF SCIENCE <i>(To obtain a course number, contact erudolph@fau.edu)</i>		
Prefix RAT Number 6204	<i>(L = Lab Course; C = Combined Lecture/Lab; add if appropriate)</i> Lab Code	Type of Course Lecture	Course Title RADIATION BIOLOGY
Credits <i>(Review Provost Memorandum)</i> 3	Grading <i>(Select One Option)</i> Regular <input checked="" type="radio"/> Sat/UnSat <input type="radio"/>	Course Description <i>(Syllabus must be attached; see Guidelines)</i> An overview of the effects of ionizing radiations on human and other biological systems. The course involves consideration of cell survival after exposure to ionizing radiations, repair of radiation damage, radiosensitizers and radioprotectors, doses and risks in diagnostic radiology, cardiology, nuclear medicine, and basic safety rules. A student seminar is required at the end of the course.	
Effective Date <i>(TERM & YEAR)</i> Fall 2019 FALL 2018	Prerequisites Prerequisites: Permission of Instructor		
Corequisites None		Registration Controls <i>(Major, College, Level)</i>	
<i>Prerequisites, Corequisites and Registration Controls are enforced for all sections of course</i>			
Minimum qualifications needed to teach course: Member of the FAU graduate faculty and has a terminal degree in the subject area (or a closely related field.)		List textbook information in syllabus or here in syllabus	
Faculty Contact/Email/Phone Theodora Leventouri LEVENTOU@FAU.EDU 561-297-2695		List/Attach comments from departments affected by new course No effect	

Approved by Department Chair _____ College Curriculum Chair _____ College Dean _____ UGPC Chair _____ UGC Chair _____ Graduate College Dean _____ UFS President _____ Provost _____	Date 9/20/18 10/29/18 10/11/18 11.14.18 11/14/18 11/15/18 11/
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Email this form and syllabus to UGPC@fau.edu one week before the UGPC meeting.

Professional Science Master in Medical Physics (PSMMP)

BSC 6834 INTRODUCTION TO RADIATION BIOLOGY

Course Syllabus

1. Course title/number, credit hours: BSC 6834 INTRODUCTION TO RADIATION BIOLOGY, 3 credit hours

2. Prereq/coreq: BSC 1010, PHY 2048, PHY 2049 and permission of instructor.

3. Course logistics

a. Fall Term 2018

b. Notation if online course: N/A

c. Class location and time: SE 101, Tuesday, Thursday 5:00-6:20 pm

4. Instructor contact information

a. Instructor's name: Charles Shang, B. Med., MS./Dr. Th. Leventouri

b. Office address: Science Bldg. 43, Room 112

c. Office hours: *Tue & Thurs from 6:20 to 7:00 pm* (in SE 101) and online via telephone

d. Phone number: office (561) 207-0621

e. E-mail address: cshang@brrh.com, leventou@fau.edu

5. Teaching Assistants N/A

6. Course description

It is an overview of the effects of ionizing radiations on human. The course involves consideration of cell survival after exposure to ionizing radiations, repair of radiation damage; radiosensitizers and radioprotectors; doses and risks in diagnostic radiology, cardiology, and nuclear medicine; basic applications in radiation and medical oncology; as well as radiation safety. A student seminar is required at the end of the course.

7. Course objectives/student learning outcomes

Upon completion of this course, students should:

- Understand the spatial scales and time-sequence of the important physical, chemical and biological events and processes underlying the formation of lethal and non-lethal genetic damage, cell death, and cancer.
- Understand basic mechanisms of radiation-induced biological responses, including DNA damage and repair, cell cycle arrest, apoptosis and clonogenic survival, neoplastic transformation and cancer.
- Understand how selected physical (e.g., oxygen and particle linear energy transfer) and biological processes (e.g., repair and cell division) modify molecular and cellular responses to ionizing radiation and influence the collective response of cancerous and normal tissue.
- Understand and be able to design biologically equivalent fractionation schedules for external beam radiation therapy and brachytherapy.

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- Understand and be able to quantify tissue and cellular responses to low and high doses of ionizing radiation.
- Understand the basic concepts of chemotherapy and other biologically targeted therapies which may be synergistically used with radiation therapy.

8. Required textbook

Radiobiology for the Radiologist, 8th ed., by Eric J. Hall and Amato J. Giaccia, Philadelphia, Lippincott, Williams and Wilkins (2018).

9. Supplementary/recommended readings

- IAEA: Radiation Biology: A Handbook for Teachers and Students, Training Course Series No. 42, 2010
- A.H.W. Nias, An Introduction to Radiobiology, Second Edition, John Wiley and Sons, 1998
 - (reprinted in 2000). Last updated: January 13, 2010 Spring 2010
- Kogel, Albert Van der., Joiner Michael. Basic Clinical Radiobiology. Fourth Edition. Edward Arnold. 2009.
- David Wigg, Applied Radiobiology and Bioeffect Planning. Medical Physics Publishing Corporation (July 1, 2001).
- Bushberg, Jerrold T., Seibert, J. Anthony, Leidholdt, Jr., Edwin M., Boone, John M. The Essential Physics of Medical Imaging. Second Edition. Lippincott Williams & Wilkins, 2002.
- Cember, Herman., Johnson, Thomas. Introduction to Health Physics. Fourth Edition. McGraw-Hill. 2008.
- Forshier, Steve. Essentials of Radiation Biology and Protection. Delmar. 2002.
- Hendee, William R., Ritenour, E. Russell, Medical Imaging Physics. Fourth Edition. Wiley-Liss, 2002
- National Research Council, BEIR VII. Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII ' Phase 2. National Academic Press. 2006.
- NCRP Report No. 128. Radionuclide Exposure of the Embryo/Fetus. NCRP 1998

Exam Dates: **Midterm Exam TBD**
 FINAL Exam, TBD

10. Course topical outline (15 weeks)

This course covers most of the material recommended by the American Association of Physicists in Medicine (AAPM) in Report 77 *Academic Program Recommendations for Graduate Degrees in Medical Physics* (2002). The course emphasizes *critical thinking and problem solving skills*.

Week	Chpt	Topic of Lecture	Home Work
1	Intro	Course Introduction and Overview Discovery of radiation, Definition of radiobiology Definition of radiobiology, cancer radiobiology	Familiarize the syllabus Review definitions
1	1	Physics and Chemistry of Radiation Absorption	Chapter review in details.

		Types of radiations; direct and indirect actions	Practice chapter questions.
		Absorption of x-rays, and radiation particles	
2	2	DNA and Chromosome Damage & Repair -1	Chapter review in details.
		Mammal cell structures and cell divisions	Practice chapter questions.
		DNA strand breaks, measurement, and repairs	
2	2	DNA and Chromosome Damage & Repair -2	Chapter review in details.
		DNA in cell divisions, Chromosome aberrations	Practice chapter questions.
		Role of telomeres in cell life	
3	3	Cell Survival Curves -1	Chapter review in details.
		Reproductive integrity	Practice chapter questions.
		In vitro survival curve, shape of survival curve	
3	3	Cell Survival Curves -2	Chapter review in details.
		Mechanisms of cell killing	Practice chapter questions.
		Radiosensitivity	
4	4	Radiosensitivity and Cell Age	Chapter review in details.
		X-rays on synchronously dividing cell cultures	Practice chapter questions.
		Molecular checkpoint genes, the age-response	
4	4	Oxygen for various phases of the cell cycle	Chapter review in details.
	5	Fractionation and the Dose-Rate Effect -1	Practice chapter questions.
		Radiation damage; Sublethal damage repair	
5	5	Fractionation and the Dose-Rate Effect -2	Chapter review in details.
		Radiation dose rate effect and Brachytherapy	Practice chapter questions.
		Radiolabeled immunoglobulin therapy	
5	6	Oxygen Effect and Reoxygenation	Chapter review in details.
		The time and concentration factors	Practice chapter questions.
		Hypoxia in tumor and reoxygenation	
6	7	LET and Relative Biologic Effectiveness	Chapter review in details.
		Linear Energy Transfer	Practice chapter questions.
		Relative Biologic Effectiveness	
6	8	Acute Radiation Syndrome	Chapter review in details.
		Early lethal effects, the prodromal syndrome	Practice chapter questions.
	13	Radiation Cataractogenesis	
7	9	Radioprotectors - discovery and its mechanism	Chapter review in details.
		Amifostine and dietary supplement	Practice chapter questions.
	14	Radiologic Terrorism	
7	10	Radiation Carcinogenesis	Chapter review in details.
		Assessing the risk, dose rate effectiveness	Practice chapter questions.
	11	Heritable Effects of Radiation	
8		Radiation effects on fertility, Mutation	Chapter review in details.
	12	Effects of Radiation on the Embryo and Fetus	Practice chapter questions.
		Cancer in childhood after irradiation in uterus	
8	Exam	Mid-term Exam	
		Subtotal Class Hours: 24	

9		Winter break	
10	17	Radiation Protection Radiation protection organizations Quantities and Units, Different exposure limits; ALARA	Chapter review in details. Practice chapter questions.
10	15	Molecular Imaging X-ray computed tomography Positron emission tomography	Chapter review in details. Practice chapter questions.
11	16	Doses and Risks in Diagnostic Radiology Natural background radiation Dose from diagnostic radiology - X-ray & NM	Chapter review in details. Practice chapter questions.
11	19	Dose–Response Relationships at Normal Tissue Types of cell death; Assays for dose-response relationships Clonogenic end points: Dose-response curves	Chapter review in details. Practice chapter questions.
12		Dose-response for functional end points Inferring the ratio of α/β from multifraction	Chapter review in details. Practice chapter questions.
	20	Clinical Response of Normal Tissues	
12		The volume effect; Growth factors Specific tissues and organs.	Chapter review in details. Practice chapter questions.
	24	Retreatment: The Possibilities & the Perils;	
13	21	Model Tumor Systems Apoptosis in tumors	Chapter review in details. Practice chapter questions.
	18	Cancer Biology	
13		Oncogene & Tumor suppressor genes Mutation of tumor suppressor genes Heritable syndromes; Signal transduction pass	Chapter review in details. Practice chapter questions.
14	22	Cell, Tissue, and Tumor Kinetics Cell cycle; Checkpoint pathways Growth factors and kinetics of human tumors	Chapter review in details. Practice chapter questions.
14	23	Time, Dose, and Fractionation in Radiotherapy The four Rs of radiobiology Fractionation and Effective dose in radiotherapy	Chapter review in details. Practice chapter questions.
15	26	The Biology and Exploitation of Tumor Hypoxia Hypoxia-inducible factor; Radiosensitizing Hypoxic cytotoxins; Targeting tumor metabolism	Chapter review in details. Practice chapter questions.
15	27	Chemotherapeutic Agents Introduction Biologic basis; classes of agents and action Relationships with radiotherapy	Chapter review in details. Practice chapter questions.
16	25	Alternative Radiation Modalities Fast neutron, Proton, Carbon ion therapy	Chapter review in details. Practice chapter questions.
	28	Hyperthermia	

16 Presentation & Discussion -1

17 Presentation & Discussion -2

17 Exam Final Exam

Total Class Hours for Spring Semester: 48

Note: Students are responsible for all material covered in the lectures as well as material from the textbook. The lectures are designed to supplement, and not replace, the materials covered in the textbook.

11. Course evaluation method

Grades will be based on class participation, research presentation, and the two exams. Students should expect to spend approximately **4-6 hour per week outside of class** reading the textbook and references for active class participation and preparation of research presentation.

12. Grading

Philosophy: All students that demonstrate mastery of the concepts and topics covered in this course will receive an "A" in the course. To demonstrate mastery of the material, students are required to preview the contents of each class, actively participate the class discussions, and answer teacher's questions.

Research Presentation

This assignment is composed of a comprehensive research for an oral presentation with slide show. The selected topic shall be sent to the Instructor for approval by March 20th, 2014. The presentation is to include the following sections:

- a) **Introduction:** In this section, you will give a brief overview of the topic.
- b) **Literature:** Present a concise but thorough synthesis of the key ideas included in the literature on your selected topic. This section should include analyses, comparative dimensions, multiple perspectives and implications for the selected topic.
- c) **Conclusion:** Summarize the conclusions you draw from what the literature says about this topic, including major findings, existing issues or controversies, and future direction or promises.
- d) **References/Bibliography:** They shall be displayed as direct references of the contents you presented.

Specifics: There will be two (2) exams, the mid-term and the final. Both are cumulative. Students are required to take both. The mid-term and the final will be in the format of multiple choices. 30% will be from the mid-term, 15% for class participation, 15% from a 15-minute seminar, and 40% from the final. Seminar participation will be evaluated and graded. No extra credit assignments will be given. An incomplete grade will not be given *in lieu* of an F. If there is justifiable reason for missing an exam (e.g. jury duty, death in the family, illness, etc) then a make-up exam will be given. Unjustifiable reasons for missing an exam will result in zero points for the exam missed.

Grade Scale

A (90 to 100%), A- (85 to 89%), B+ (80 to 84%), B (70 to 79%),
B- (60 to 69%), F (59% or lower)

13. Policy on makeup tests, late work, and incompletes

Appropriate documentation must be presented for justifiable absence from an exam.
Exams will be returned to the students for discussion.

Class Etiquette Policy:

Personal communications devices, such as cell phones are to be disabled during class sessions.

University Policies:

To avoid learner confusion or disappointment, the following are assumptions and expectations for this course:

***University Attendance Policy:** Students are expected to attend all of their scheduled classes and to satisfy all academic objectives outlined by the instructor. The effect of absences upon grades is determined by the instructor, and the University reserves the right to deal at any time with individual cases of nonattendance. Attendance includes active involvement in all class sessions, class discussions, and class activities, as well as professional conduct in class.*

Students are responsible for arranging to make up work missed because of legitimate class absence, such as illness, family emergencies, military obligation, court-imposed legal obligations, or participation in University-sponsored activities (such as athletic or scholastic team, musical and theatrical performances, and debate activities). It is the student's responsibility to give the instructor notice prior to any anticipated absence, and within a reasonable amount of time after an unanticipated absence, ordinarily by the next scheduled class meeting. Instructors must allow each student who is absent for a University-approved reason the opportunity to make up work missed without any reduction in the student's final course grade as a direct result of such absence.

Disability Policy:

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodation due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD)—in Boca Raton, SU 133 (561-297-3880) - and follow all OSD orders.

Honor Code Policy Statement:

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001 at http://www.fau.edu/regulations/chapter4/4.001_Honor_Code.pdf.

Counseling and Psychological Services (CAPS) Center

Life as a university student can be challenging physically, mentally and emotionally. Students who find stress negatively affecting their ability to achieve academic or personal goals may wish to consider utilizing FAU's Counseling and Psychological Services (CAPS) Center. CAPS provides FAU students a range of services – individual counseling, support meetings, and psychiatric services, to name a few – offered to help improve and maintain emotional well-being. For more information, go to <http://www.fau.edu/counseling/>

From: Theodora Leventouri leventou@fau.edu
Subject: RADIATION BIOLOGY
Date: September 6, 2018 at 12:55 PM
To: mkantoro@health.fau.edu

Hi Marc,

Last May (17th) we had a discussion in your office about the course BSC 6834 Introduction to Radiation Biology, which is a core course in the Medical Physics program offered in the Department of Physics by a Graduate Faculty (Charles Shang).

I am completing the forms to add/change this course to RAT 6204 Radiation Biology. Could you please send me an e-mail stating that your Department/ College is not affected by this addition/change?

Thank you!

Dora

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Director, Center for Biomedical
and Materials Physics (CBAMP)
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