FLORIDA ATLANTIC UNIVERSITY

NEW/CHANGE PROGRAM REQUEST
Graduate Programs

Department Biomedical Science

College Medicine

UGPC Approval _____
UFS Approval _____
Banner _____
Catalog _____

Program Name
Master of Science with Major in Biomedical Science

☐ **New Program***

☑ **Change Program***

Effective Date
(TERM & YEAR)
Spring 2022

Please explain the requested change(s) and offer rationale below or on an attachment.

The College of Medicine Master of Science Biomedical Science program would like to list the College of Science ~~Engineering~~ Medical Physics courses as part of our electives:
RAT 6204 Radiation Biology
RAT 6310 Radiation Protection and Safety

We think these programs are good addition to our elective options to give our students a variety of classes to choose from.

*All new programs and changes to existing programs must be accompanied by a catalog entry showing the new or proposed changes.

Faculty Contact/Email/Phone
Marc Kantorow mkantoro@health.fau.edu 561-297-2910

Consult and list departments that may be affected by the change(s) and attach documentation
N/A

Approved by	***Date***
Department Chair Janet D Robishaw	8/30/21
College Curriculum Chair Marc Kantorow	8/24/2021
College Dean	8/31/2021
UGPC Chair	
UGC Chair	
Graduate College Dean	
UFS President	
Provost	

Email this form and attachments to UGPC@fau.edu 10 days before the UGPC meeting.

Master of Science with Major in Biomedical Science

Students interested in pursuing advanced studies in biomedical science may obtain a degree of Master of Science (M.S.) with Major in Biomedical Science, taking either the thesis or non-thesis option. The thesis option is oriented toward those students interested in pursuing biomedical research or careers in academia. The non-thesis program is an option for students seeking to solidify their knowledge base in order to apply to appropriate professional schools or pursue careers in the biomedical sciences industry.

Top

Admission Requirements
All program applicants must have an undergraduate grade point average of 3.0 in the last 60 credits and competitive Graduate Record Exam (GRE) scores (scores are valid for five years). These are minimum requirements that are necessary for consideration for admission to the program. Higher scores will increase applicants' chances for admission. Prerequisites of the master's degree program include one year each of biology, chemistry and physics; one semester each of biochemistry and organic chemistry; and at least two upper-division biology classes. A personal statement explaining career goals is required as well as three letters of recommendation, at least two of which must be from former professors.

Recency of Credits
No credit that is more than seven years old at the time the M.S. in Biomedical Science degree is awarded may be counted toward the degree.

Degree Requirements
Non-Thesis Option
This option requires a minimum of 30 graduate-level credits. With their advisor's approval, students design a course of study courses offered in the Charles E. Schmidt College of Medicine as well as courses in related departments and colleges chosen from the following list.

Thesis Option
This option requires a minimum of 30 credits consisting of coursework chosen from the list below, a minimum of 6 thesis credits, 3 thesis-related research credits. Students design a course of study and research with the guidance and approval of the advisors and thesis committees. Thesis students are required to make a formal research proposal to their committees within their first year prior to enrollment in thesis credits. In addition, upon completion of their research, they must make a formal thesis presentation and defense in the semester they plan to graduate. All thesis students must also receive certification of completion of the Responsible Conduct of Research program. The RCR program, which is offered jointly through the Graduate College and Division of Research, covers the nine instructional areas of RCR. All four components are mandatory in order to receive certification of completion.

Students wishing to change their admission from the thesis option to the non-thesis option must submit to the Graduate Program Committee a letter of request that states the justification for the change and a letter from the thesis advisor in support of the request. An interview with the Graduate Program Committee may be required. A maximum of 6 credits from the thesis career can be applied toward the non-thesis career upon approval by the Graduate Program Committee. PCB 6974 and PCB 6971 credits are non-transferable.

Core -9 credits		
Advanced Molecular and Cellular Biology	PCB 5532	3
Human Genetics	PCB 6665	3
Special Topics (such as Biomedical Writing, Intensive Biomedical Writing)	PCB 6933	3
Thesis Requirements - 9 credits (minimum)		
Master's Thesis *(may be taken multiple times; 6 credits minimum; 12 credits maximum)*	PCB 6971	1-12
Thesis-Related Research *(may be taken* only twice; *3 credits minimum; 6 credits maximum)*	PCB 6974	2-3

Electives		
Integrated Morphology 1	BMS 6102C	4
Integrated Morphology 2	BMS 6104C	4
Clinical Microbiology	BMS 6303	3
Autonomic Function and Diseases	BMS 6523	3
Fundamentals of General Pathology	BMS 6601	3
Brain Diseases: Mechanism and Therapy	BMS 6736	3
Bioinformatics	BSC 6458C	3
Biomedical Data and Informatics	BSC 6459	3
Cognitive Neuroscience	ISC 5465	3
Biomedical Science Core Technologies Laboratory	GMS 6091C	3
Macromolecules and Human Disease	GMS 6301	3
Molecular Basis of Disease and Therapy	GMS 6302	3
Pharmacology	GMS 6513	3
Biomedical Concepts and Translational Applications	GMS 6841	3
Host Defense and Inflammation	MCB 6208	3
Advanced Molecular Genetics of Aging	PCB 5245	3
Neurobiology of Addiction	PCB 5844	3
Advanced Cell Physiology	PCB 6207	3
Molecular Basis of Human Cancer	PCB 6235	3
Advanced Immunology	PCB 6236	3
Problem-Based Immunology	PCB 6238	3
Tumor Immunology	PCB 6239	3
Molecular Biology of the Cardiovascular System and Cardiac Disease	PCB 6705	3
Adult Neurogenesis	PCB 6848	3
Physiology of the Heart	PCB 6885	3
Directed Independent Study *(maximum of 6 credits allowed)*	PCB 6905	1-3
Special Topics *(general)*	PCB 6933	1-8
Graduate Seminars	PCB 6934	1
Biological Vision	PSB 5117	3
Principles of Neuroscience	PSB 6037	3
Cellular and Molecular Neuroscience	PSB 6345	3
Systems and Integrative Neuroscience	PSB 6346	3
Developmental Neurobiology	PSB 6515	3
Radiation Biology	RAT 6204	3
Radiation Protection and Safety	PAT 6310	3

Biomedical Science Certificate

Biomedical Science is a broad and interdisciplinary field focused on understanding and improving human health. It incorporates diverse areas of specialized investigation that share this common goal, including anatomy, biochemistry, genetics, immunology, microbiology, pharmacology and others. The Biomedical Science certificate is offered to provide master's and Ph.D. students an integrated background in the biomedical sciences. To achieve this, the 12-credit program is designed with flexibility. Although the program is centered on the Charles E. Schmidt College of Medicine, faculty from other colleges and institutions contribute to the program's success, and students are welcomed from many departments, centers and colleges throughout the University.

Admission Requirements

Admission to and completion of this program is organized by the Graduate Program Office in the College of Medicine. For admission, the applicant must satisfy the following criteria:

1. Enrollment in an FAU master's or Ph.D. training program in any of the following: Biomedical Science, Biological Sciences, Chemistry and Biochemistry, Complex Systems and Brain Sciences, Integrative Biology and Psychology. Students must have approval of their graduate program to enroll and must remain in good standing with their graduate program to continue in this certificate.

2. Demonstrate competency in life science, mathematics and other courses related to the certificate program, such as by achieving at least a "B" in these courses.

3. Interview with the certificate director or graduate committee chair to discuss program goals and requirements and obtain permission to enroll.

Program Requirements

The certificate curriculum provides students opportunities to survey different areas of the biomedical sciences and to focus on areas of particular interest. Program requirements are designed to be tailored to the individual student with previous coursework and future goals in mind.

1. Students must achieve a minimum grade of "B" in four of the courses below for a total of 12 credits:

Choose four courses from the list below (12 credits)		
Integrated Morphology 1	BMS 6102C	4
Integrated Morphology 2	BMS 6104C	4
Clinical Microbiology	BMS 6303	3
Autonomic Function and Diseases	BMS 6523	3
Fundamentals of General Pathology	BMS 6601	3
Brain Diseases: Mechanism and Therapy	BMS 6736	3
Macromolecules and Human Disease	GMS 6301	3
Molecular Basis of Disease and Therapy	GMS 6302	3
Host Defense and Inflammation	MCB 6208	3
Advanced Molecular and Cellular Biology	PCB 5532	3
Neurobiology of Addiction	PCB 5844	3
Advanced Cell Physiology	PCB 6207	3
Molecular Basis of Human Cancer	PCB 6235	3

Problem-Based Immunology	PCB 6238	3
Tumor Immunology	PCB 6239	3
Human Genetics	PCB 6665	3
Molecular Biology of the Cardiovascular System and Cardiac Disease	PCB 6705	3
Adult Neurogenesis	PCB 6848	3
Physiology of the Heart	PCB 6885	3
Special Topics	PCB 6933	3
Developmental Neurobiology	PSB 6515	3

2. Students must participate in the College of Medicine Research Day each year showcasing graduate student research in the College.

No credit that is more than seven years old at the time the graduate certificate in Biomedical Science is awarded may be counted toward the certificate.

Genomics and Predictive Health Certificate

The Genomics and Predictive Health certificate is offered to provide master's and Ph.D. students an integrated background in the field of genomics and predictive health. The certificate program covers advancements in the field of personalized medicine, DNA sequencing technologies and commercial applications of genetic research. A minimum of 12 graduate credits of coursework is required to provide core experiences in the various predictive health domains (disease discovery, customized therapies and prevention). Although the program is centered within the Charles E. Schmidt College of Medicine, faculty from other FAU colleges and institutions contribute to the program's success, and students from many departments and colleges throughout the University are welcomed.

Genomics and predictive health is a broad, interdisciplinary field focused on understanding and improving human health. It incorporates diverse areas of specialized investigation that share this common goal including anatomy, biochemistry, cell biology, clinical sciences, cognitive sciences, development, genetics, immunology, medical sciences, microbiology, molecular biology, pathology, pharmacology, psychology and others.

Admission Requirements

Admission to and completion of this program is overseen by the Graduate Program Office in the Charles E. Schmidt College of Medicine. For admission, the applicant must satisfy the following criteria:

1. Must be enrolled in an FAU master's or Ph.D. program including, but not limited to, Biomedical Science, Biology, Biochemistry, Complex Systems and Brain Sciences, Integrative Biology, Psychology and Bioengineering. Students must have approval of their graduate program to enroll and must remain in good standing with their graduate program to continue in the certificate program;

2. Must meet with the Office of Graduate Programs' advisor to discuss program goals and requirements and obtain permission to enroll.

Program Requirements

The certificate program requires 12 credits that are designed to be tailored to the individual student with previous coursework and future goals in mind.

Required courses - 9 credits		
Human Genetics	PCB 6665	3
Special Topics (Integrating Genomics into Predictive Health)	PCB 6933	3
Graduate Seminars (1 credit per semester on a continuous basis for total of 3 credits)	PCB 6934	3
Complete one of the following elective courses - 3 credits		

Special Topics (Communicating in the Age of Predictive Health)	PCB 6933	3
Special Topics (Emerging Applications in Oncology and Pharmacogenomics)	PCB 6933	3
Special Topics (Implementing Learning Health Systems)	PCB 6933	3

Program Name:
PSM Medical Physics

Professional Science Master in Medical Physics (PSMMP)

RAT 6204 - RADIATION BIOLOGY

Course Syllabus

Institution: FLORIDA ATLANTIC UNIVERSITY

Course Title: RADIATION BIOLOGY

Course No.: RAT 6204

Instructor(s): Charles Shang

Textbook:
Radiobiology for the Radiologist, 8th ed., by Eric J. Hall and Amato J. Giaccia, Philadelphia, Lippincott, Williams, and Wilkins (2019). ISBN-13: 978-1496335418 ISBN-10: 1496335414

Credit Hours: 3

Recommended References:
IAEA: Radiation Biology - A Handbook for Teachers and Students, Training Course Series No. 42, 2010
Basic Radiotherapy Physics and Biology 2nd ed. 2021 by David S. Chang, Foster D. Lasley, Indra J. Das, et al. ISBN-13: 978-3030618988 ISBN-10: 3030618986
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
Evaluation Metrics:
1 mid-term test at 35 points, 1 final exam at 40 points, 1 research presentation at 20 points, and class participation at 5 points for a total 0f 100 points.
Grade Scale: A (≥ 90%), A- (≥ 85%), B+ (≥ 80%), B (≥ 70%), B- (≥ 60%), F (< 60%)

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. 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.

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.
e) **Submission:** The presentation shall be submitted on time for further review before receiving grade.

Philosophy: All students that demonstrate mastery of the concepts and topics covered in this course will receive a high grade in the course. To demonstrate mastery of the material, in addition to perform well in the tests, students are required to preview the contents of each class, actively participate the class discussions, and demonstrate the literature review ability via the assigned research presentation.

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.

Learning Objectives:

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, cell 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.

• 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.

Course logistics

Program Name:
PSM Medical Physics

Fall Term 2020
Class time: SE 101 Tuesday, Thursday 3:00-4:20 pm

Instructor contact information

a. Instructor's name: Dr. Charles Shang
b. Office address: Science Bldg. 43, Room 335
c. Office hours: *Tue & Thurs from 4:20 to 5:00 pm* (in SE 335) and online
d. Phone number: office (561) 207-0621
e. E-mail address: cshang@sfpti.com

Teaching Assistants N/A

Course 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*. The schedule may be altered by instructor.

Week	Topic of Lecture	Home Work
1	Course Introduction and Overview	Familiarize the syllabus
	Discovery of radiation, Definition of radiobiology	Review definitions
	Definition of radiobiology, cancer radiobiology	
	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	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	
	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	Cell Survival Curves -1	Chapter review in details.
	Reproductive integrity	Practice chapter questions.
	In vitro survival curve, shape of survival curve	
	Cell Survival Curves -2	Chapter review in details.
	Mechanisms of cell killing	Practice chapter questions.

	Radiosensitivity	
	Radiosensitivity and Cell Age	Chapter review in details.
4	X-rays on synchronously dividing cell cultures	Practice chapter questions.
	Molecular checkpoint genes, the age-response	
	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	
	Fractionation and the Dose-Rate Effect -2	Chapter review in details.
	Radiation dose rate effect and Brachytherapy	Practice chapter questions.
	Radiolabeled immunoglobulin therapy	
	Oxygen Effect and Reoxygenation	Chapter review in details.
	The time and concentration factors	Practice chapter questions.
	Hypoxia in tumor and reoxygenation	
	LET and Relative Biologic Effectiveness	Chapter review in details.
6	Linear Energy Transfer	Practice chapter questions.
	Relative Biologic Effectiveness	
	Acute Radiation Syndrome	Chapter review in details.
	Early lethal effects, the prodromal syndrome	Practice chapter questions.
	Radiation Cataractogenesis	
	Radioprotectors - discovery and its mechanism	Chapter review in details.
	Amifostine and dietary supplement	Practice chapter questions.
7	Radiologic Terrorism	
	Radiation Carcinogenesis	Chapter review in details.
	Assessing the risk, dose rate effectiveness	Practice chapter questions.
	Heritable Effects of Radiation	
	Radiation effects on fertility, Mutation	Chapter review in details.
	Effects of Radiation on the Embryo and Fetus	Practice chapter questions.
	Cancer in childhood after irradiation in uterus	
	Mid-term Exam	
8	Radiation Protection	Chapter review in details.
	Radiation protection organizations	Practice chapter questions.
	Quantities and Units, Different exposure limits; ALARA	
	Molecular Imaging	Chapter review in details.
9	X-ray computed tomography	Practice chapter questions.
	Positron emission tomography	
10	Doses and Risks in Diagnostic Radiology	Chapter review in details.
	Natural background radiation	Practice chapter questions.
	Dose from diagnostic radiology - X-ray & NM	
11	Dose–Response Relationships at Normal Tissue	Chapter review in details.

	Types of cell death; Assays for dose-response Clonogenic end points: Dose-response curves	Practice chapter questions.
	Dose-response for functional end points	Chapter review in details.
	Inferring the ratio of α/β from multifraction	Practice chapter questions.
12	Clinical Response of Normal Tissues	
	The volume effect; Growth factors	Chapter review in details.
	Specific tissues and organs.	Practice chapter questions.
	Retreatment: The Possibilities & the Perils; Model Tumor Systems	Chapter review in details.
	Apoptosis in tumors	Practice chapter questions.
	Cancer Biology; Oncogene & Tumor suppressor genes	Chapter review in details.
	Mutation of tumor suppressor genes	Practice chapter questions.
	Heritable syndromes; Signal transduction pass	
13	Cell, Tissue, and Tumor Kinetics	Chapter review in details.
	Cell cycle; Checkpoint pathways	Practice chapter questions.
	Growth factions and kinetics of human tumors	
	Time, Dose, and Fractionation in Radiotherapy	Chapter review in details.
	The four Rs of radiobiology	Practice chapter questions.
	Fractionation and Effective dose in radiotherapy	
	The Biology and Exploitation of Tumor Hypoxia	Chapter review in details.
	Hypoxia-inducible factor; Radiosensitizing	Practice chapter questions.
	Hypoxic cytotoxins; Targeting tumor metabolism	
14	Chemotherapeutic Agents Introduction	Chapter review in details.
	Biologic basis; classes of agents and action	Practice chapter questions.
	Relationships with radiotherapy	
15	Alternative Radiation Modalities:	Chapter review in details.
	Fast neutron, Proton, Carbon ion, hyperthermia	Practice chapter questions.
	Final Exam	Total Hours: 45

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.

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.

RAT 6310, Radiation Protection and Safety

Institution: Florida Atlantic University
Course Title: Radiation Protection and Safety
Course No.: RAT 6310
Instructor(s): Dr. Wazir Muhammad
Text: Radiation protection & Dosimetry, Michael G. Stabin, Springer 2007.
Credits: 3 Hours of Instruction: 3 hours
Recommended References: https://www.nrc.gov/ Sources of Journal Articles
American Association of Physicist in Medicine (AAPM)
Evaluation Metrics:
Learning Objectives:
This course will provide the students the knowledge and technical background to understand the calculation methodology, compliance with the safety standards, and use of quantitative risk assessment
for radiation protection & safety.
At the end of this course the students are expected to have a good understanding of safety calculation
methodology, compliance with the safety standards, and use of quantitative risk assessment for radiation
protection & safety.
Course Outline (List of topics by week):
W1-2: Radiation protection and safety
Introduction and historical perspective
Interaction physics applied to radiation protection
W3-4: Protection principles (time, distance, shielding)
Handling radiation and radioactive sources
W5-6: Radiation survey/contamination equipment
Personnel monitoring
Radiation dose limits
Protection regulations

W7-8: Shielding Principles: beams and sources
Application of statistics
W9-10: External exposure
Internal exposure
W11-12: Environmental dispersion
Radioactive waste