RADIATION BIOLOGY (RADR 2313 – 1A2)

LAMAR INSTITUTE OF TECHNOLOGY

INSTRUCTOR CONTACT INFORMATION

Instructor: Brenda A. Barrow, M.Ed., R.T.

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Office Location: 232 Multipurpose Center

Office Hours: office hours posted outside door and in Starfish

CREDIT

3 Semester Credit Hours (3 hours lecture, 0 hours lab)

MODE OF INSTRUCTION

This course will be taught in 8 weeks and delivered in a hybrid format utilizing Black Board LMS. A hybrid course replaces some in-class time with online learning activities completed outside of class. The on-campus class is scheduled on Monday, however, there will occasionally be events and classes that the student will be required to attend on campus on Wednesdays.
This course will be taught in a multimedia format. Lectures, demonstrations, lab experiments and discussion will be utilized to enhance the cognitive learning process. Students will have outside reading and out of class homework assignments periodically in the semester. The student will be required to utilize both reading and listening skills.

PREREQUISITE/CO-REQUISITE:

RADR 2305 Principles of Radiographic Imaging II

COURSE DESCRIPTION

Effects of radiation exposure on biological systems, includes typical medical exposure levels, methods for measuring and monitoring radiation, and methods for protecting personnel and patients from excessive exposure.

COURSE OBJECTIVES

Upon completion of this course, the student will be able to

A. Describe the biophysical mechanisms of radiation damage on humans
B. Indicate typical dose ranges for routine radiographic procedures
C. Describe basic methods and instruments for radiation monitoring, detection, and measurement
D. Implement appropriate radiation protection practices
E. List and describe the quantities and units of radiation

F. State the NCRP Effective Dose Limits for patient exposure, technologist exposure, and equipment standards

G. Discuss the use of radioisotopes and radioactive materials

REQUIRED TEXTBOOK AND MATERIALS

- A computer with internet access. The computer must be able to run current programs and platforms such as Windows 10 and the internet must be reliable and robust. The course has an online component and will move to a fully online format if necessary. The computer must have a camera and microphone for online conferencing.
- Statkiewicz, Mary & Visconti, Paula, *Radiation Protection In Medical Radiography*, 9th edition, Multi-Media Publishing, Inc., 2022. ISBN#978-0-323-82503-0

REFERENCE Books: (these publications can be checked out from Mrs. Barrow)

- Bushong, Stewart C. *Radiologic Science for Technologists,* 12h edition, ISBN: 978-0-323-66134-8, Elsevier, Mosby Publishing 2021.
- NCRP # 102 Medical X-ray, Electron Beam, and Gamma-Ray Protection.
- NCRP # 105 Radiation Protection for Medical & Allied Health Personnel.
- NCPR # 54 Medical Radiation Exposure of Pregnant and Potentially Pregnant Women.
- NCRP #184 Medical Radiation Exposure of Patients in the US
- CFR-21 Code of Federal Regulations #21

COURSE REQUIREMENTS:

- Three major tests.
- Quizzes will be utilized in this course. All quiz and homework will be administered through BlackBoard. No late work will be accepted. Students will be allowed to drop their **lowest** quiz grade at the end of the semester. If more than one quiz/homework is missed a zero (0) will be given.
- Assignments will be made through BlackBoard LMS.
- Exams will be administered through BlackBoard on campus in computer lab. There will be a **ten (10) point** reduction for make-up exams.

GRADING SCALE: Numeric Letter to Grade Conversion

A = 93 - 100
B = 84 - 92
C = 77 - 83
D = 60 - 76
F = 0 - 59

*** A minimum of 77% is required for successful completion of this course!**

LIT does not use +/- grading scales

COURSE EVALUATION

Written Exams (3) .....25% each
Quiz average 25%

This course will not have the regular Comprehensive Final Exam. This will be administered as part of the RADR 2335 Radiology Seminar course.

ATTENDANCE and COURSE POLICIES

- No food, drinks, or use of tobacco products in class.
- Phones, headphones, and any other electronic devices must be turned off while in class.
- Recording devices may be used except during test reviews and when otherwise stated by the instructor.
- Lap top computers, I-pad… may be used to take notes during class but may not be used to "surf" the internet, look-up answers, nor anything not directly related to note taking.
- It shall be considered a breach of academic integrity (cheating) to use or possess on your body any of the following devices during any examination unless it is required for that examination and approved by the instructor: Cell phone, smart watch/watch phone, laptop, tablet, electronic communication devices (including optical), and earphones connected to or used as electronic communication devices.
    - *This is a violation of the Radiologic Technology Student Handbook and will result in dismissal from the program.*

  Students with special needs and/or medical emergencies or situations should communicate with their instructor regarding individual exceptions/provisions. It is the student's responsibility to communicate such needs to the instructor.
- Do not bring children to class.
- If you wish to drop a course, the student is responsible for initiating and completing the drop process. If you stop coming to class and fail to drop the course, you will earn an 'F' in the course.

- **Attendance Policy:** Class attendance is important to ensure that a student receives the knowledge and skills necessary to be successful in the Radiologic Technology program. Students are expected to be in class on time. If a student is tardy they may enter only if they do so quietly.

  When it becomes necessary to miss a session, it is the responsibility of the *student* to contact the instructor and to inquire about assignments. I will *not* distribute the PowerPoints missed. The student must get the notes from a classmate. If a major test is missed, the test will be administered at the first day the student returns to class or at a time designated by the instructor. There will be a **ten (10) point** reduction for make-up exams.

  To encourage class attendance, students that miss two (2) or more class sessions in a unit will have a five (5) point reduction on that test. Students who are tardy four (4) times will equal one (1) absence.

- If a student misses an assignment for *any* reason **it may not** be made up. Quiz/homework grades will be averaged for one (1) test grade. Students will be allowed to drop their **lowest** quiz/homework grade at the end of the semester. If more than one quiz is missed a zero (0) will be given. This is already configured in Black Board gradebook
- Any student who fails to pass a Unit test will be required to attend mandatory tutorial. This may be done before or after class or at lunch break. The tutorial may be individual or in a group session. There will be remediation assignments in Clover Learning Student Plan/RadTechBootCamp. ***These must be successfully completed or the student will not be allowed to take the next unit exam.***

DROP POLICY

If you wish to drop a course, you are responsible for initiating and completing the drop process by the specified drop date as listed on the Academic Calendar. If you stop coming to class and fail to drop the course, you will earn an "F" in the course.

STUDENT EXPECTED TIME REQUIREMENT

For every hour in class (or unit of credit), students should expect to spend at least two to three hours per week studying and completing assignments. For a 3-credit-hour class, students should prepare to allocate approximately six to nine hours per week outside of class in a 16-week session OR approximately twelve to eighteen hours in an 8-week session. Online/Hybrid students should expect to spend at least as much time in this course as in the traditional, face-to-face class.

COURSE CALENDAR: all dates are tentative

Course Schedule: 9:45 – 12:45

MONDAY FACE-TO-FACE CLASS	**HYBRID**	**ASSIGNMENT**
(Jan 15) MLK DAY no class	**Jan 17** Introduction to course	
Jan 22 CH 1----Introduction to Radiation Protection CH 2 ---- Radiation Types, Sources, and Doses & NCRP # 184	**Jan 24** CH 3----Interactions of X-radiation with Matter	ASRT Safety Video – Homework due 1-22
Jan 29 CH 4 ----Radiation Quantities and Units CH 10 ---- Dose Limits for Exposure to Ionizing Radiation	**Jan 31** Wednesday 8:00 am – 8:00 pm BlackBoard ***TEST I***	Unit 1 Homework due 1-29 Bonus due 1-29
Feb 5 go over test CH 7----Molecular and Cellular Radiation ---- Radiation Sensitivity CH 8---Early Tissue Reactions & Their Effects on Organ Systems	**Feb 7** CH 6 ---Overview of Cell Biology Decision To Declare & Biologic Effects videos	
Feb 12 CH 9--- Stochastic Effects and Late Tissue Reactions of Radiation in Organ Systems	Wednesday **Feb. 14** 8:00 am – 8:00 pm BlackBoard ***TEST II***	Unit 2 Homework (Articles) due 2-12
Feb 19 go over test CH 11---- Equipment Design for Radiation Protection CH 12 ---- Management of Patient Protection During Diagnostic X-ray Procedures NCRP # 54	**Feb 21** CH 13 Special Considerations of Safety in CT CH 14 X-Ray Breast Imaging: Methods and Radiation Safety Aspects video (Humorous Protection)	Ergonomics article (Work Related Disorder) Homework due 2-19
Feb 26 CH 15---- Management of Imaging Personnel During Diagnostic X-ray Procedures NCRP # 102 CH 5----Radiation Monitoring	**Feb 28** CH 16----Radioisotopes and Radiation Protection	Radiation Hormesis Report due 2-26 Unit 3 Homework due 2-28 ASRT Radiation Protection video (module 10) Homework due 2-28
Mar. 4 8:00 am – 8:00 pm Black Board ***TEST III***		

ACADEMIC DISHONESTY

Students found to be committing academic dishonesty (cheating, plagiarism, or collusion) may receive disciplinary action. Students need to familiarize themselves with the institution's Academic Dishonesty Policy available in the Student Catalog & Handbook at http://catalog.lit.edu/content.php?catoid=3&navoid=80#academic-dishonesty.

ADDITIONAL COURSE POLICIES/INFORMATION

Course Outline:

I. Introduction to Radiation Protection
   A. Explain the need for radiation protection procedures
   B. Define ionizing radiation
   C. Determine who is responsible for radiation protection
      1. radiologist
      2. primary physician
      3. radiographer
   D. Define ALARA
   E. Define BERT
   F. Image Gently, Pause and Pulse, and Image Wisely

II. Radiation: Types, Sources, & Doses
   A. Identify the different sources of ionizing radiation
      1. NCRP 184
      2. natural
         a. Terrestrial
         b. Human Body
         c. Atmosphere
      3. artificial
         a. Medical
         b. Other

III. Interactions of X-radiation with Matter
   A. Distinguish parts of the x-ray beam
      1. primary
      2. remnant
      3. scatter
      4. attenuation
   B. Describe the different types of interactions that occur between ionizing radiation and matter
      1. coherent
      2. compton
      3. photoelectric
      4. pair production
      5. photodisintegration
   C. Visualize the steps that take place during interaction between the x-ray photon and the matter in each type of interaction

IV. Radiation Quantities and Units
   A. Describe the history of radiation quantities and units

B. Identify the different SI and Traditional radiological units for the following quantities
1. exposure
2. absorbed dose
3. equivalent dose
4. activity
5. air kerma

C. Convert from SI to Traditional units using mathematical calculations

D. Define linear energy transfer

V. Radiation Monitoring

A. State why personal radiation monitors should be worn

B. Identify the appropriate location on the radiographer's body to wear a monitoring device
1. personal monitor
2. fetal monitor

C. List the characteristics of a personal monitoring device

D. Compare and contrast various personnel monitoring devices
1. pocket ionization chamber
2. thermoluminescent dosimeter
3. Luxel badge
4. digital ionization chamber

E. Explain the use various radiation survey instruments for area monitoring
1. ionization chamber
2. ionization chamber with rate meter
3. cutie pie
4. proportional counter

VI. Overview of Cell Biology

A. Explain the need to understand cell composition and function as a foundation for radiation biology

B. Describe the functions of the organic and inorganic compounds in a cell

C. Describe the structure of DNA and explain how it functions in a cell

D. Describe the function of the components of a cell

E. Distinguish between the two types of cell division
1. Mitosis
2. Meiosis

VII. Molecular and Cellular Radiation Biology

A. Discuss various radiation energy transfer determinants
1. physical factors
    a. LET
    b. RBE
    c. fractionation
    d. protracted
2. biologic factors
    a. sex
    b. age
    c. OER
3. misc. factors

a. dose
b. stress
c. area exposed
d. weight

B. Distinguish between the different effects of ionizing radiation
1. direct effect
2. indirect effect

C. Describe the effects of ionizing radiation on various parts of a cell

D. Describe the target theory

E. State the Law of Bergonie and Tribondeau

F. Discuss cell radiosensitivity
1. radiosensitive cells
2. radioresistant cells

VIII. Early Tissue Reactions & Their Effects on Organ Systems

A. Draw diagrams of various dose-response relationships
1. linear vs nonlinear
2. threshold vs non-threshold

B. Discuss the early somatic effects of ionizing radiation
1. prodromal stage
2. latent period
3. manifest illness
a. hematopoietic
b. gastrointestinal
c. CNS
4. recovery or death

IX. Stochastic Effects and Late Tissue Reactions of Radiation in Organ Systems

A. Demonstrate knowledge of the late somatic effects of ionizing radiation
1. cancer
2. cataract formation
3. life span shortening
4. teratogenic effects

B. Describe the genetic effects of ionizing radiation

C. Given a specific dose of radiation the student should evaluate and organize the information and determine what acute symptoms will probably occur

X. Dose Limits for Exposure to Ionizing Radiation

A. Identify different regulatory agencies that evaluate radiation
1. state agencies – TMB
a. limited license
b. non-certified technician
c. general technologist
2. federal agencies

B. Discuss the Radiation Control for Health and Safety Act of 1968

C. Discuss the ALARA concept

D. Discuss the Consumer Patient Radiation Health and Safety Act of 1981

E. Determine cumulative effective dose limits using the NCRP formula using mathematical calculations

F. List the annual dose limits for occupational and non-occupational exposure
1. annual occupational dose to whole body
2. annual occupational dose to hands
3. life time dose
4. annual dose to student radiographer
5. annual dose to public
a. frequent exposure
b. infrequent exposure

XI. Equipment Design for Radiation Protection

A. Describe the types of beam limiting devices
1. cone and cylinder
2. automatic collimator

B. Describe the function of x-ray beam filtration in diagnostic tubes

C. Describe how digital imaging affects patient exposure

XII. Management of Patient Radiation Dose During Diagnostic X-ray Procedures

Understand why the radiographer is responsible for reducing the patient's exposure

B. State the reason for reducing the number of repeat radiographs

C. Understand the need for effective communication between the radiographer and patient

D. Understand the benefit of immobilizing patient during diagnostic exam

E. State the reason for gonadal shielding and discuss the types used
1. flat contact shield
2. shaped shield
3. shadow shield
4. specific area shield

F. List the proper exposure factors to use to reduce patient absorbed dose
1. high kVp
2. low mAs

G. Selects which combination of technique and equipment will decrease patient exposure

H. Discuss the ways a repeat analysis program can benefit a radiology department

I. List some unnecessary radiological exams
1. routine pre-op chest
2. pre-employment exams
3. mass screening for TB

J. Discuss the relationship between digital imaging and patient exposure

K. Understand the methods used to protect a patient during mobile radiologic exams
1. shield
2. collimate
3. technique

L. Understand the methods used to protect a patient during fluoroscopic exams
1. intermittent fluoroscopy
2. automatic brightness stabilization
3. five minute cumulative timer
4. collimation

5. last image hold

M. Describe the danger of High-Level Control Interventional Procedures

N. Be familiar with the methods used to determine patient dose: organ dose, skin dose, and entrance skin exposure

O. Discuss recommendations from NCRP #54 on "Medical Radiation Exposure of Pregnant & Potentially Pregnant Women"

P. Discuss patient exposure in other areas: mammography, computed tomography, and pediatrics

XIII. Special Considerations of Safety in CT

A. Methods of Reducing Patient Dose in CT

1. CT skin dose
2. shielding
3. pitch ratio
4. dose parameters

B. X-Ray Breast Imaging: Methods and Radiation Safety Aspects

XIV. Methods of Reducing Patient Dose in Mammography

1. dose reduction
2. screening
3. filtration

XV. Management of Imaging Personnel during Diagnostic X-ray Procedures

A. List the three cardinal principles of radiation protection

1. time
2. distance
3. shielding

B. Distinguish between types of barriers

1. primary
2. secondary

C. Discuss the factors that determine a barrier's thickness

1. kVp
2. time of occupancy
3. use
4. workload
5. distance

D. Describe the methods of reducing technologist exposure during diagnostic procedures

1. use of shielding
    a. barriers
    b. protective apparel
2. distance
3. equipment

E. Describe the methods of reducing technologist exposure during fluoroscopic procedures

1. protective apparel
2. distance for patient
3. Inverse Square Law
4. stand behind radiologist

F. Describe methods of reducing technologist exposure during mobile procedures

1. protective apparel

2. distance for patient

G. Distinguish where each type of warning sign should be posted
1. Caution Radiation Area
2. Caution High Radiation Area
3. Caution Radioactive Particles Area

XVI. Radioisotopes and Radiation Protection

A. Define radioisotope
B. Discuss the use of radioisotopes in radiation therapy
1. brachytherapy
2. iodine 125
3. iodine 131
4. strontium 89

C. Discuss the use of radioisotopes in nuclear medicine
1. iodine 123
2. technetium 99

D. Discuss the use of radioisotopes and protection in PET
1. fluorine 18

E. Describe the potential use of radioactive materials as terrorist weapon
1. dirty bomb

F. Describe clean up from radioactive contamination
1. internal contamination
2. surface contamination

XVI. Design of a Radiology Facility

A. Discuss recent trends in radiography department designs
B. Define ergonomics
C. Describe methods of reducing workplace injuries

TECHNICAL REQUIREMENTS

The latest technical requirements, including hardware, compatible browsers, operating systems, etc. can be online at https://lit.edu/online-learning/online-learning-minimum-computer-requirements. A functional broadband internet connection, such as DSL, cable, or WiFi is necessary to maximize the use of online technology and resources.

DISABILITIES STATEMENT

The Americans with Disabilities Act of 1990 and Section 504 of the Rehabilitation Act of 1973 are federal anti-discrimination statutes that provide comprehensive civil rights for persons with disabilities. LIT provides reasonable accommodations as defined in the Rehabilitation Act of 1973, Section 504 and the Americans with Disabilities Act of 1990, to students with a diagnosed disability. The Special Populations Office is located in the Eagles' Nest Room 129 and helps foster a supportive and inclusive educational environment by maintaining partnerships with faculty and staff, as well as promoting awareness among all members of the Lamar Institute of Technology community. If you believe you have a disability requiring an accommodation, please contact the Special Populations Coordinator at (409)-951-5708 or email

specialpopulations@lit.edu. You may also visit the online resource at Special Populations - Lamar Institute of Technology (lit.edu).

STUDENT CODE OF CONDUCT STATEMENT

It is the responsibility of all registered Lamar Institute of Technology students to access, read, understand and abide by all published policies, regulations, and procedures listed in the *LIT Catalog and Student Handbook*. The *LIT Catalog and Student Handbook* may be accessed at www.lit.edu. Please note that the online version of the *LIT Catalog and Student Handbook* supersedes all other versions of the same document.

STARFISH

LIT utilizes an early alert system called Starfish. Throughout the semester, you may receive emails from Starfish regarding your course grades, attendance, or academic performance. Faculty members record student attendance, raise flags and kudos to express concern or give praise, and you can make an appointment with faculty and staff all through the Starfish home page. You can also login to Blackboard or MyLIT and click on the Starfish link to view academic alerts and detailed information. It is the responsibility of the student to pay attention to these emails and information in Starfish and consider taking the recommended actions. Starfish is used to help you be a successful student at LIT.