

Bergen Community College  
Health Professions Division  
Radiation Therapy Technology Program

Course Syllabus  
RTT- 130-001 Radiation Biology and Protection

Date of Most Recent Syllabus Revision: Summer, 2018  
Course Typically Offered: Fall semester  
Syllabus last reviewed by: Curriculum Committee Date: 2005

**Course Description**

**RTT-130 Radiation Biology and Protection** - This course explores the cellular and systemic effects of radiation exposure. Radiation health, safety, and federal and state requirements will be enforced.  
3 lecture / 3 credits  
Prerequisites: None  
Co-requisites: RTT 110, RTT 120, RTT 121, RTT 150

**Student Learning Objectives:**

As a result of meeting the requirements in this course, students will be able to:

1. Integrate laws and principles of radiation biology to the clinical practice of radiation therapy.
2. Identify radiosensitive components of the cell and the influence of the physical, chemical and biologic factors on radiosensitivity.
3. Define target theory and differentiate between direct and indirect effects of ionizing radiation.

|     |   |
|-----|---|
|     |   |
| 4.  | Define linear energy transfer (LET) and discuss factors affecting relative biological effectiveness (RBE).  |
| 5.  | Compare somatic and genetic effects of radiation.   |
| 6.  | Describe factors influencing radiation response of cells and tissues.   |
| 7.  | Discuss the laws of Bergonié and Tribondeau.  |
| 8.  | Interpret cell survival curves to determine radiosensitivity under numerous conditions.   |
| 9.  | Describe radiation syndromes and factors influencing response.  |
| 10. | Differentiate between linear, nonlinear, and threshold and nonthreshold dose response curves.   |
| 11. | Describe the 5 Rs of radiobiology.  |
| 12. | Describe the clinical significance of TD5/5 and TD50/5.   |
| 13. | Discuss the concept of LD50/30.   |
| 14. | Compare the relationship of time, dose, fractionation, volume, distance and site to radiation effects.  |
| 15. | Distinguish between units of radiation quantities and radiobiologic measures: radiation for exposure, absorbed dose, dose equivalence and radioactivity.  |
| 16. | Differentiate between stochastic and nonstochastic effects of radiation exposure.   |
| 17. | Defend the concept of as low as reasonably achievable (ALARA) and apply this concept to legal and ethical radiation protection responsibilities of radiation workers Discuss the concept of negligible individual risk. |
| 18. | Explain the theory, operation, applications and limitations of radiation detection devices including methods used for personnel monitoring.   |
| 19. | State the authority, boundaries and regulations of the state and national regulatory agencies.  |
| 20. | Discuss the requirements and responsibilities of the radiation safety officer.  |
| 21. | State the exposure limits for occupational and nonoccupational individuals.   |
| 22. | Explain techniques used to reduce unnecessary dose to the patient.  |
| 23. | Discuss the principles of radiation protection room design factors.   |
| 24. | Describe the elements of a radiation protection survey for an inpatient undergoing brachytherapy.   |
| 25. | Demonstrate an understanding of cell biology and explain its importance in radiation therapy.   |
| 26. |   |

### **Means of Assessment:**

The Student Learning Objectives (SLO) in this course are intended to be aligned with the Radiation Biology and Radiation Protection accreditation requirements of The Joint Committee on Education in Radiologic Technology and the New Jersey Department of Environmental Protection. They are also correlated with the content specifications for the national registration examination in Radiation Therapy administered by The American Registry of Radiologic Technologists. Additional student learning objectives may be specified in particular units.

The major assessment types (means of assessment) utilized in this course are objective tests, quizzes, homework assignments and class participation.

### **Course Content:**

Content is designed to provide the student with underlying biological concepts for the justification of the administration of radiation in the therapeutic setting. Additionally, the course focuses on ethical and legal radiation protection and safety responsibilities required of the radiation therapist.

### **Course Website:**

**RTT-001 Radiation Biology and Protection** is a “web-enhanced” class. The class has its own website and each member of the class has an account for the website. The BCC online course management system is known as “Moodle”. This website will provide the student with review and assessment materials.

### **Course Texts and/or Other Study Materials:**

All text books are available through the Bergen Community College Bookstore.

Washington, Charles M., Leaver, Dennis. Principles and Practice of Radiation Therapy. St. Louis, MO: Mosby Elsevier Publishing, Inc., 4<sup>th</sup>.ed. 2015. ISBN: 978-0-323-28752-4

#### *Reference Material:*

Travis, Elizabeth LaTorre. Medical Radiobiology. St. Louis, MO: Mosby Elsevier Publishing, Inc., 2nd edition, 2000. ISBN 0-8151-8837-4. (out of print)

Khan, Faiz, M., The Physics of Radiation Therapy. Philadelphia, PA:Wolters Kluwer/Lippincott Williams & Wilkins. 4<sup>th</sup> ed. 2010. ISBN 978-0-7817-8856-4.

### **Course Requirements and Learning Assessment:**

A student’s final grade for the course is based primarily on his or her performance on the required work for the course (Quizzes/homework assignments, examinations and class participation).

#### **Quizzes** (25% of final grade)

Students are expected to be prepared for a quiz in each lecture session. Missed quizzes may not be made up.

**Homework Assignments** (10% of final grade)

Assignments will be used to reinforce classroom presentations. The assignments will be collected, graded and returned. Late assignments will not be accepted.

**Examinations** (60% of final grade)

Three examinations will be administered in class. Each test will be worth 20% of your final grade. The tests cover the major topics of the course: Radiation Biology (2) and Radiation

Protection and Safety (1). The test schedule will follow the classroom presentation and the content of the test will be based on the required textbook readings, classroom presentations and handouts. PowerPoint presentations and supplemental handouts are distributed in class. All tests are required. In the event that a test is missed, the student will be given a comparable test. A make-up test is at the discretion of the instructor of the course.

**Overall Class Participation** (5% of final grade)

In order to participate in particular lectures and discussions, all related reading and assignments must be completed prior to that class session. Please be advised that you must be present to participate, yet that alone does not constitute active participation.

The following behaviors will be utilized to assess class participation:

Positive Behaviors:

1. Attend class regularly and on time and not leave early.
2. Be well-prepared for class by doing assigned reading.
3. Participate appropriately with relevant comments, questions or answers to questions presented in class.
4. Show respect and value for the content of the course.
5. Take all online tests.

Negative Behaviors:

1. Being absent from or being late for class.
2. Leaving class early.
3. Walking out of and coming back into class.
4. Sleeping in class.
5. Devalue the content of the course.
6. Behaving inappropriately in class (e.g., acting silly, conducting private conversations in the back of the room, distracting behaviors such as eating, drinking or chewing gum in class; defacing classroom furniture; etc.)
7. Being impolite, rude, or discourteous to me or to your classmates.
8. Not being adequately prepared for class.
9. Speak without thinking – demonstrate a lack of reasoning and critical thinking skills.
10. Submit research paper late.
11. Be absent for testing.

**Grading Policy:**

The grading policy and course grade appeal policy of the program are stated in the Radiation Therapy Student Handbook. The program grading policy utilizes the standards of the American Registry of Radiologic Technologist national registry exam.

| Letter Grade | Numerical Range               | Conversion            |
|--------------|-------------------------------|-----------------------|
| A            | 92% to 100%                   | Excellent             |
| B+           | 89% to 91.9%                  | Very Good             |
| B            | 83% to 88.9%                  | Good                  |
| C+           | 80% to 82.9%                  | Marginal / Acceptable |
| C            | 77% to 79.9%                  | Poor / Failing        |
| I            | Incomplete                    |                       |
| E            | Unofficial withdrawal         |                       |
| W            | Official Withdrawal           |                       |
| D / F        | Does not apply to RTT courses |                       |

77% is the minimal passing cut-off score.

There is no extra credit opportunities in this course.

### **Attendance Policy:**

**BCC Attendance Policy:** All students are expected to attend punctually every scheduled meeting of each course in which they are registered. Attendance and lateness policies and sanctions are to be determined by the instructor for each section of each course. These are to be established in writing on the individual course outline. Attendance will be kept by the instructor for administrative and counseling purposes.

**Radiation Therapy Program Attendance Policy:** Classroom attendance policy for the Radiation Therapy Program is stated in the Radiation Therapy Student Handbook. The student is responsible for adherence to this policy.

**Attendance Policy in this Course:** Students are expected to attend class regularly and punctually and for the full class period. Attendance will be taken at each class session. In the event of a late arrival, the student is expected to enter quietly without disturbing the class. In the event of an absence, it is the responsibility of the student to acquire the missed material. The attendance policy of this course will adhere to the attendance policy of the Radiation Therapy Program as stated in the Radiation Therapy Student Handbook.

Absences, lateness and early departures will diminish your overall performance in the course and, subsequently, will increase your risk of diminished performance on the ARRT national registry exam and the administration of responsible patient care. Additionally, the BCC Radiation Therapy Program provides employment assistance upon graduation from the program and ARRT registration; your classroom attendance behavior may be used by your instructor as an indicator to your employment attendance behavior.

**Quizzes:** If late or absent from class, any quiz given, student will receive a 0 for that quiz.

## **Other College, Divisional, and/or Departmental Policy Statements**

The Radiation Therapy Program adheres to all Bergen Community College policies, including drug and alcohol use and smoking on campus, discrimination and harassment, rules and regulations governing conduct, rules governing academic integrity and acceptable use of information technology resources as stated in the BCC College Catalog – Policies.

The Bergen Community College Radiation Therapy Program adheres to a no cell phone policy in the classroom, laboratory and clinic.

## **Course Outline and Calendar**

**Note to Students:** The following Course Outline and Calendar is tentative and subject to change, depending upon the progress of the class.

| Week | Date(s)       | Topics/Activities/Assignments  | Readings          |                       |
|------|---------------|--|-------------------|-----------------------|
|      |               |  | W&L<br>Chapter(s) | Travis<br>Chapter(s): |
| 1    | Mon.<br>Wed.  | Principles of Pathology<br>Benign versus malignant classification of disease                             | 3<br>3            |                       |
| 2    | Mon.<br>Wed.. | Review of Cell Biology<br>Basic Biologic Interactions of Radiation                                       | 4                 | 1<br>2                |
| 3    | Mon.<br>Wed.  | Cellular Response to Radiation-Fate of Irradiated Cells<br>Survival Curves and Repair                    | 4                 | 3<br>3                |
| 4    | Mon.<br>Wed.  | Tissue Radiation Biology<br>Modification of Cell and Tissue Response to Radiation                        | 4                 | 4<br>5                |
| 5    | Mon.<br>Wed.  | Modification of Cell and Tissue Response to Radiation<br><i>Examination 1</i>                            | 4                 | 5                     |
| 6    | Mon.<br>Wed.  | Radiation Pathology<br>Total Body Radiation Response – Radiation Syndromes                               | 4                 | 6<br>7                |
| 7    | Mon.<br>Wed.  | Total Body Radiation Response – Embryo and Fetus<br>Late Effects of Radiation                            | 4                 | 7<br>8                |
| 8    | Mon.<br>Wed.  | Late Effects of Radiation con't<br>Clinical Radiobiology I: Diagnostic Radiology and Nuclear Medicine    | 4                 | 8<br>9                |
| 9    | Mon.<br>Wed.  | Clinical Radiobiology II: Therapeutic Radiology<br>Clinical Radiobiology II: Therapeutic Radiology con't | 4                 | 10<br>10              |
| 10   | Mon.<br>Wed.  | Review<br><i>Examination 2 (Radiation Biology comprehensive exam)</i>                                    |                   |                       |
|      |               |  | W&L<br>Chapter(s) | Khan<br>(Chapter(s))  |

|    |              |  |                |                   |
|----|--------------|--|----------------|-------------------|
| 11 | Mon.<br>Wed. | Why Radiation Protection?<br>Objectives of a Radiation Protection Program  | 17             | 16                |
| 12 | Mon.<br>Wed. | Units, Detection and Measurement Measurement<br>Devices  | 17             | 16                |
| 13 | Mon.<br>Wed. | Surveys, Regulatory Agencies and Regulations<br>Surveys, Regulatory Agencies and Regulations con't                     | 17             | 16                |
| 14 | Mon.<br>Wed. | Personnel Monitoring<br>Practical Radiation Protection: External Beam<br>Practical Radiation Protection: Brachytherapy | 17<br>17<br>14 | 16<br>16<br>16,15 |
| 15 | Mon.<br>Wed. | Review<br><i>Examination 3 (Radiation Protection and Safety)</i>   |                |                   |