BROWARD COMMUNITY COLLEGE
COURSE OUTLINE

LAST REVIEW: 2006-07 *(i.e. 2003-2004)* NEXT REVIEW: 2011-12 *(i.e. 2008-2009)* STATUS: A *(A, I, D)*

COURSE TITLE: Advanced Radiation Therapy Physics

COMMON COURSE NUMBER: RAT 2617

CREDIT HOURS: 3

CONTACT HOUR BREAKDOWN *(per 16 week term)*

CLOCK HOURS: *(Voc. Course ONLY)*

Lecture: *48* Lab:

Clinic: Other:

PREREQUISITE(S):

COREQUISITE(S):

PRE/COREQUISITE(S): RAT 2021, RAT 2023, RAT 2814

COURSE DESCRIPTION *(750 character smaximum)*: The fundamentals of x-ray, gamma, and corpuscular radiation as applied to radiation therapy. Teletherapy units and nuclear reactors are also discussed.

General Education Requirements – Associate of Arts Degree (AA), meets Area(s):	Area
General Education Requirements – Associate in Science Degree (AS), meets Area(s):	Area
General Education Requirements – Associate in Applied Science Degree (AAS), meets Area(s):	Area

UNIT TITLES

1. Matters and Energy
2. Nature of Radiation
3. X-ray Production
4. Interaction of Radiation with Matter
5. X-ray Quantities
6. X-ray Qualities
7. Detection of Radiation
8. Linear Electron Accelerators
9. Cobalt 60 Teletherapy Units
10. Other High Energy Treatment Units
11. Nuclear Reactors

ASSESSMENT:

Please provide a brief description (250 characters maximum) that details how students will be assessed on the course outcomes.

Assignments, comprehensive/cumulative unit exams, and comprehensive/cumulative final

*** *Complete the following only if course is seeking general education status* ***

GENERAL EDUCATION Competencies and Skills *:

Please highlight in green font all Competencies/Skills from the list below that apply to this course. In the box to the right of the Competency/Skill, enter all specific learning outcome numbers (i.e. 1.1, 2.7, 5.12) that apply.

Read with critical comprehension	
Speak and listen effectively	
Speak and listen effectively	
4. Think creatively, logically, critically, and reflectively (analyze, synthesize, apply, and evaluate)	
Demonstrate and apply literacy in its various forms: *(highlight in green ALL that apply)* (1. technological, 2. informational, 3. mathematical, 4. scientific, 5. cultural, 6. historical, 7. aesthetic and/or 8. environmental)	
Apply problem solving techniques to real-world experiences	
Apply methods of scientific inquiry	
Demonstrate an understanding of the physical and biological environment and how it is impacted by human beings	
Demonstrate an understanding of and appreciation for human diversities and commonalities	
Collaborate with others to achieve common goals.	
Research, synthesize and produce original work	
Practice ethical behavior	
Demonstrate self-direction and self motivation	
Assume responsibility for and understand the impact of personal behaviors on self and society	
Contribute to the welfare of the community	

* *General Education Competencies and Skills endorsed by '05-'06 General Education Task Force*

Common Course Number: RAT 2617

UNITS

Unit 1 Matter and energy

General Outcome:

1.0 The student shall: understand the relationship between matter and energy at the molecular, atomic, and subatomic levels.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

1.1 Define matter, force, energy, and work

1.2 Discuss fundamental and derived units

1.3 Discuss electrostatic force

1.4 Explain the formulas for potential and kinetic energy

1.5 Discuss the law of conservation of energy

Common Course Number: RAT 2617

UNITS

Unit 2

General Outcome:

2.0 The student shall: be able to accurately describe the nature of radiation and relate it specifically to radiation therapy.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

2.1 Describe the Bohr atomic model and its components

2.2 Discuss the mass and charge of protons, neutrons, and electrons

2.3 Define different types of radiation including electromagnetic and particulate radiation such as alpha particles, negatrons, positrons, neutrons, gammas, and x-rays.

2.4 Describe ionization and exitation processes

2.5 Discuss linear energy transfer

Common Course Number: RAT 2617

UNITS

Unit 3 X-ray Production

General Outcome:

3.0 The student shall: the student should be able to accurately discuss the history of x-rays, and accurately identify the conditions required for x-ray production, and the components of an x-ray tube.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

3.1 Discuss the historical background of x-ray discovery and use

3.2 Describe the components of an x-ray tube

3.3 Define the conditions required for x-ray production

3.4 Discuss the electron interaction with a target

3.5 Discuss the efficiency of x-ray production and the properties of x-rays

3.6 Compare the production of Bremsstrahlung with the production of characteristic radiations

3.7 Define the generation and regulation of x-rays

3.8 Define the regulation of tube current

3.9 Discuss rectification and cables.

3.10 Discuss the effect of filters

Common Course Number: RAT 2617

UNITS

Unit 4 Interaction of Radiation with Matter

General Outcome:

4.0 The student shall: to describe the interaction of radiation with matter and its relationship to the treatment of patients.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

4.1 Discuss coherent scatter in matter

4.2 Describe the production of photoelectrons and its probability

4.3 Explain the conditions of Compton Scattering and calculate the energy loss.

4.4 Describe the production of a negatron/positron pair and explain the reason for a threshold energy.

4.5 Discuss the annihilation of positrons in matter

4.6 Explain the process of photodisintegration and how neutrons are shielded.

4.7 Compare various photon interactions in terms of description of interaction, relation to atomic number and applications.

4.8 Discuss energy absorption coefficients

Common Course Number: RAT 2617

UNITS

Unit 5 X-ray Quantities

General Outcome:

5.0 The student shall: be able to explain the different intensities of x-ray radiation.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

5.1 Explain the terminology related to radiation quantity

5.2 Define the Roentgen and how it is measured

5.3 Define KERMA and Absorbed Dose, and their difference.

5.4 Discuss the relationship between kinetic energy released in the medium (KERMA), exposure and absorbed dose.

5.5 Explain the difference between dose to air and dose to tissue.

5.6 Calculate air dose to absorbed dose conversions in tissue, including but not limited to energy considerations, applicable conversion factors, necessary instrumentation and methods.

5.7 Discuss Bragg-Gray cavity theory as it applies to megavoltage beam calibration.

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UNITS

Unit 6 X-ray Qualities

General Outcome:

6.0 The student shall: explain the difference in x-ray energies.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

6.1 Discuss the effect of the Inverse Square Law on radiation beam intensity.

6.2 Describe attenuation and attenuation coefficients

6.3 Calculate the transmission through any thickness of known attenuator

6.4 Discuss and define half-value layers.

6.5 Calculate half value layer (HVL).

6.6 Explain the purpose of *homogeneity coefficient*

6.7 Describe the quality of a gamma-ray (γ) beam in terms of HVL, γ energy or mean γ energy/nuclide of origin

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UNITS

Unit 7 Detection of Radiation

General Outcome:

7.0 The student shall: be familiar with the equipment used to detect and measure radiation and the principles on which they operate.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

7.1 Describe the construction of gas ionization chambers and their efficiency.

7.2 Explain the differences between cutie pies, Farmer chambers, and Geiger counters and their respective uses.

7.3 Discuss the proper steps in conducting a radiation survey.

7.4 Describe the principles behind scintillation detectors

7.5 Discuss film, TLD, and Luxel® dosimetry principles

7.6 Discuss the purpose and importance of the National Institute of Standards and Technology (NIST)

7.7 Discuss the purpose and importance of the Accredited Dosimetry Calibration Labs (ADCL).

7.8 Choose the appropriate type of radiation detector for given clinical applications.

7.9 Explain how correction factors for chamber calibration, temperature, pressure and other factors are used to correct a chamber reading

Common Course Number: RAT 2617

UNITS

Unit 8 Linear Electron Accelerators

General Outcome:

8.0 The student shall: become familiar with the different high energy treatment units utilized in radiation therapy.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

8.1 Explain the disadvantages of low-energy treatment machines

8.2 Discuss beam penetration and depth dose

8.3 Describe geometric penumbra and physical penumbra

8.4 Describe the major components of an electron linear accelerator and their purposes.

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UNITS

Unit 9 Cobalt 60 Units

General Outcome:

9.0 The student shall: become familiar with Cobalt 60 Teletherapy units utilized in radiation therapy

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

9.1 Identify the gamma energies and average gamma energy of Cobalt-60 (^{60}Co).

9.2 Define specific activity and discuss the maximum and average specific activity of a typical ^{60}Co source

9.3 Describe the beam and beam edge characteristics of a ^{60}Co beam.

9.4 Describe the basic components of a ^{60}Co unit.

9.5 Describe the production and construction of a ^{60}Co source

9.6 Compare the characteristics of an isotope beam and an artificially produced beam.

9.7 Describe the advantages and operation of Cobalt-60 teletherapy units

9.8 List the decay products of Cobalt-60 disintegration

9.9 Discuss timer error and written directives

Common Course Number: RAT 2617

UNITS

Unit 10 Other High Energy Treatment Units

General Outcome:

10.0 The student shall: be familiar with the different high energy treatment units utilized in radiation therapy.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

10.1 Discuss the historical development of external beam radiation therapy

10.2 Discuss the differences between linear electron accelerators and betatrons, cyclotrons, synchro-cyclotrons, and electrostatic generators

10.3 Compare the characteristics of other radiation therapy beams (betatron, cyclotron, microtron and other accelerated particles).

Common Course Number: RAT 2617

UNITS

Unit 11 Nuclear Reactors

General Outcome:

11.0 The student shall: be familiar Nuclear reactors and the principles on which they operate.

Specific Measurable Learning Outcomes:
Upon successful completion of this unit, the student shall be able to:

11.1 Identify nuclear reactions by recognizing the projectile and radiation emitted

11.2 Define fission and fusion

11.3 Discuss the activation of nuclides in terms of yield, probability, activity growth and saturation activity.

11.4 Describe methods of artificial production of radionuclides and their use in medical applications

11.5 Discuss the purpose of the major components of a nuclear reactor