

Syllabus for Radiological Physics and Dosimetry PHYS 659 Fall 2020

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Course Materials: Faiz Kahn, “The Physics of Radiation Therapy”
Johns and Cunningham, “The Physics of Radiology”

Grading for the course

The course grade will consist of graded HW assignments, approximately 8 for the semester and a final exam. The weighting will be 80% for HW and 20% for final exam.

Week 1 & Week 2	Interactions of X-rays in matter (10 keV to 20 MeV) Generators for diagnostic and therapeutic x-rays (50KeV-20 MeV) Relativistic kinematics and energy units for charged particles Interactions of charged particle beams in matter, Bethe Bloch Equation for energy loss by charged particles. Reading Ch 3 and 5, Faiz Khan
Week 3	Definitions and derivations of exposure for X-rays, Kerma and absorbed dose from photon fluence. Chapter 6 and Chapter 7
Week 4 & Week 5	Bragg-Gray cavity theory and measurement of dose with air ionization chambers. The depth vs. dose curves for X-rays and charged particles in water. Reading in Faiz Khan, Sections 8.1-8.4.
Week 6 & Week 7	Relativistic kinematics for electron and proton therapy beams, Bethe-Block (energy loss) equation for electrons and protons, Janni tables for proton range and energy loss Particle range calculations in water for electrons (1 to 20 MeV), protons (50-250 MeV), and heavier ions, (100 – 400 meV/amu). electron(Ch 14.1 – 14.4) and proton depth vs. depth curves for megavoltage proton beams (Ch. 27)
Week 8 & 9	Chapter 9 and 10 - A system of Dose Calculations, TMR, TAR, Percent depth dose (PDD) Inverse square correction to depth vs. dose curves, monitor unit calculations
Week 10	Treatment planning and dose distributions for cancer and normal tissues. Dose Volume Histograms and Normal tissue Complication Probability (NTCP)

- Week 11 Radiation biology: Cell survival curves; cell survival vs. dose for tumor cells and normal tissues. Linear Energy Transfer and Relative Biological Effectiveness (RBE), reading Ch. 17 John and Cunningham, The Physics of Radiology. Dose fractionation Schedules.
- Week 12 Radiation biology - Normal Tissue dose tolerances, Cellular and tissue response to radiation. Tumor Control Probability radiation toxicity- Normal Tissue Complication Probability
- Week 13 Intensity Modulated (x-ray) Radiation Therapy (IMRT), Ch. 20.
- Week 14 IMRT-- Continued
- Week 15 Review for final exam