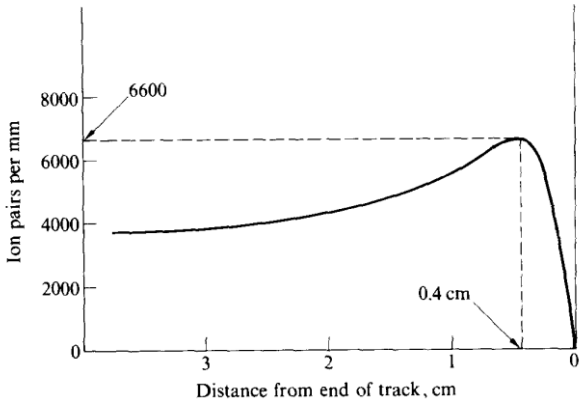
Essential learning outcomes of the Medical Physics course 2021-2022

In this document, an overview of essential learning outcomes of the medical physics course is given. The exam will be *ONLY* linked to the topics mentioned below.

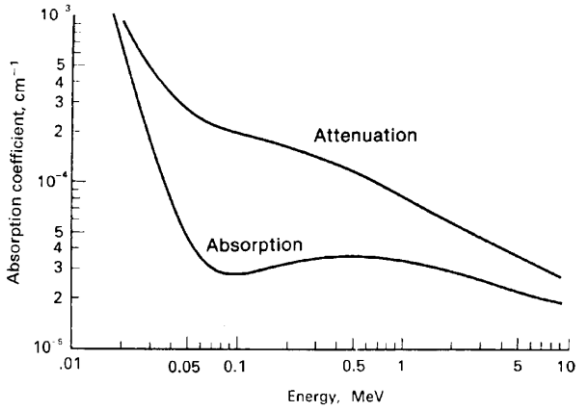
1. **Ionizing radiation**
   - To know what sources of ionizing radiation are used in medicine
   - To understand how ionizations are linked to DNA damage (and hence biologic effects)

2. **Interactions of ionizing radiation**

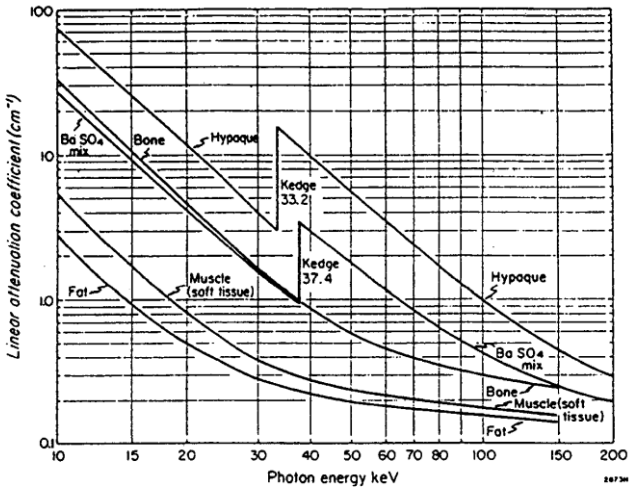
- To understand the fundamental differences in interactions of charged particles and photons
- To be able to explain qualitatively the Bragg curve (figure)



- To know the interaction principles of photons
- To be able to explain the difference between attenuation and absorption (figure)



- To understand the importance of scatter in medical imaging (influence of image quality, use of anti-scatter grid, radiation protection issues)
- To be able to explain the principle of X-ray imaging based on differential attenuation and the figure below



3. **X-ray production**
   - To understand the concept of X-ray production
   - To understand the heel effect and to know the influence of the heel effect on uniformity, field size, tube load and intrinsic resolution
   - To know the factors influencing the X-ray spectrum and X-ray intensity

4. **Basics of dosimetry**
   - To know the definitions/units of exposure, kerma, absorbed dose, equivalent dose, effective dose
   - To know and understand the difference in depth-dose curve for low energetic (->max dose at surface) and high energetic (->build-up) photon beams
   - To understand the link between exposure and equivalent dose (f-med conversion factor)
   - To understand why LET is important within dose quantities
   - To understand wR and wT and their limitations
   - To know the basic classification in biologic effects of ionizing radiation

5. **X-ray projection imaging**
   - To know/understand the function of AEC (automatic exposure control) and anti-scatter grid
   - To know the different types of digital detectors and to understand how they work
   - To understand the difference in dynamic range of film/digital systems

6. **Fluoroscopy**
   - To know why fluoroscopy is used in imaging
   - To understand how a magnified image is realized in fluoroscopy systems and to understand the impact of magnification on the radiation dose
   - To know/understand the principles of DSA and road-mapping

7. **New applications of digital systems**
   - To be able to explain briefly techniques such as dual energy imaging, digital tomosynthesis, cone beam CT
   - To understand the difference between cone beam CT and conventional CT

8. **CT**
    - To understand the function of a bow tie filter, slip ring
    - To be able to explain a filtered-back reconstruction
    - To know the definition of Hounsfield units, pitch
    - To understand the concept of window/level
    - To understand overscan, overbeaming, adaptive collimation

9. **Dosimetry in Projection imaging**
    - To know the concept of a DRL
    - To understand the working principle of a DAP meter and how this can be used for patient dosimetry (link with skin dose, effective dose)
    - To know the factors influencing patient dose in fluoroscopy

10. **Dosimetry in CT**
    - To understand why CT is delivering higher doses to patients as compared to radiography
    - To know the definitions of CTDI, DLP
    - To know the factors influencing the patient dose in CT

11. **Staff radiation exposure**
    - To understand the origin of the staff radiation exposure and how to protect against it
    - To understand the difference in levels of staff radiation exposure depending on
        - X-ray geometry
        - Position of staff member
        - Field size
        - X-ray filtration
        - Patient size

12. **Nuclear medicine imaging**
    - To know the difference between functional and anatomical imaging
    - To understand why Tc99m is often used in nuclear medicine and how it can be produced
    - To know/understand to principle of an Anger camera: collimator, crystal, PMT, anger logic, energy window in spectrum,…
    - To know the concept of PET imaging

13. **Internal dosimetry + dosimetry in in nuclear medicine**
    - To understand the difference between external and internal dosimetry
    - To know the concepts reference man, source/target organ
    - To understand the concept of a compartment analysis
    - To know the definition of cumulated activity and SEE
    - To understand the differences of internal dosimetry approaches for diagnostics and therapeutic applications

14. **Dosimetry in radiotherapy**
    - To understand the importance of the (steep) direct effect curve for healty tissue and tumors on the required dosimetric accuracy in radiotherapy
    - To understand the 3-step process in radiotherapy dosimetry
    - To be able to explain qualitatively beam profiles