

**Kermanshah University of Medical Sciences**  
**Faculty of Pharmacy**  
**Department of Medical Physics**  
**Lesson plan**

Course Title: **Physics in Pharmacy**  
Students: **Physics in Pharmacy**  
Teacher Name: **Dr. Tinoosh Almasi**

**General purpose of the lesson:**

Familiarity of students with the scientific application of physics in pharmacy and how different radiation devices work in relation to pharmaceutical sciences

**General goals:**

1. Introducing X-ray generating device
2. Interaction of photons with matter and basics of imaging in radiology
3. Familiarity with the basics of nuclear physics
4. Activity and familiarity with related concepts
5. Concepts related to absorbed dose, equivalent dose and effective dose
6. Radiobiology and radiation protection
7. Protection against ionizing rays
8. Familiarity with SPECT and PET imaging system
9. Physical principles of ultrasound imaging
10. Bioelectricity and methods of electrocardiography, electroencephalography and electromyography
11. Imaging by magnetic resonance imaging of MRI nucleus
12. Physical principles of CT scan imaging
13. Physics of light and its laws and applications of light in medicine
14. Electromagnetic wave physics, related properties and laws, polarization, production method and its applications in medical sciences
15. Laser physics, types and characteristics of laser light and related laws
16. Familiarity with laser applications in medical sciences and protection against it

**The general purpose of the first session:**

Familiarity with how to produce X-rays and the structure of X-ray tubes

**Specific objectives of the first session:**

At the end the student will be able to

1. To Explain the mechanisms of X-ray production.
2. To Explain their energy spectrum.
3. To Explain the components of X-ray tube and their mechanism of action.
4. To Explain the Inverse-square law.

**The general purpose of the second session:**

Interaction of photons with matter and basics of imaging in radiology

**Specific objectives of the second session:**

At the end the student will be able to

1. To Explain the different mechanisms of Interaction of photons with matter (Coherent Scattering, photoelectric, Compton scattering, and even production).
2. To Explain how to attenuate radiation and explain linear and mass attenuation coefficients.
3. To Explain the half layer (HVL) and one tenth layer (TVL).

**The general purpose of the third session:**

Familiarity with the basics of nuclear physics

**Specific objectives of the third session:**

**At the end the student will be able to**

1. To Explain the structure of the atom and the reasons for its stability.
2. To Explain the instability of elements, decay methods, and the properties of nuclear radiation.
3. To Explain fission and fusion reactions.

**The general purpose of the fourth session:**

Activity and familiarity with related concepts

**Specific objectives of the fourth session:**

**At the end the student will be able to**

1. To Explain the reasons and calculation of the remaining activity.
2. To Explain biological, physical and effective half-lives and know their relationships.
3. To Explain the properties of the radioactive material suitable for clinical applications.

**The general purpose of the fifth session:**

Concepts related to absorbed dose, equivalent dose and effective dose

**Specific objectives of the fifth session:**

**At the end the student will be able to**

1. To Explain the absorption dose and know its relationship.
2. To Explain the equivalent dose, explain the weighting factor of the beam.
3. To Explain the effective dose, explain the tissue weighting factor and know its relationship.

**The general purpose of the sixth session:**

Radiobiology and radiation protection

**Specific objectives of the sixth session:**

**At the end the student will be able to**

1. To Explain the effects and physical properties of ionizing radiations.
2. To Explain the chemical effects of ionizing radiations.
3. To Explain the factors affecting the effects of cell radiation including absorption dose, dose rate, oxygen presence and mitosis.
4. To Explain the cell survival curve and its parameters and express the sensitivities of different tissues and the effect of different radiations.

**The general purpose of the seventh session:**

Protection against ionizing radiation

**Specific objectives of the seventh session:**

**At the end the student will be able to**

1. To Explain the principles of radiation protection.
2. To Explain the organizations related to radiation protection.
3. To Explain the 3 basic principles in protection.
4. To Recognize radiation dosimetry units such as Roentgen, Gray and Sievert.
5. To Explain the allowable dose limit for radiation employees and members of the community.
6. To Explain the effect of X-rays during pregnancy.

**The general purpose of the eighth session:**

Familiarity with SPECT and PET imaging system

**Specific objectives of the eighth session:**

**At the end the student will be able to**

1. Be familiar with the general principles of radiopharmaceuticals.
2. To Explain the basics of SPECT imaging and be familiar with the working mechanism of the device simply.
3. To Explain the basics of PET imaging and be familiar with the working mechanism of its device simply.

**The general purpose of the ninth session:**

Physical Principles of Ultrasound Imaging

**Specific objectives of the ninth session:**

**At the end the student will be able to**

1. To Explain the physical principles of sound and the equations of energy, velocity and frequency in different materials.
2. To Explain acoustic impedance, reflection coefficient, refraction, wave interference.
3. To Explain the physical effects of ultrasound waves on the body.
4. To Explain the production and detection of ultrasound.

**The general purpose of the tenth session:**

Bioelectricity and methods of electrocardiography, electroencephalography and electromyography

**Specific objectives of the tenth session:**

**At the end the student will be able to**

1. Nervous system and nerve cell, explain the electrical messages from the muscles, how to measure the electrical signals of the muscles.
2. To Explain the electrical structure of the heart, the action potential in the heart and the action potentials of the heart at different levels, the methods of measuring it.
3. To Explain the electrical messages of the brain and the method of measuring electroencephalography.

**The general purpose of the eleventh session:**

Magnetic resonance imaging of the MRI nucleus

**Specific objectives of the eleventh session:**

**At the end the student will be able to**

1. To Explain the magnetic dipole of the nuclei, the transient rotation of the nuclei, and the frequency of Larmor.
2. To Explain the magnetic resonance of the nucleus, the relaxation time of T1, T2 and the attenuation of free induction.
3. To Explain the magnetic image of the nucleus based on the proton density.

**The general purpose of the twelfth session:**

Physical principles of CT scan imaging

**Specific objectives of the twelfth session:**

**At the end the student will be able to**

1. To Explain the collision of X-rays with the body and the method of measuring the attenuation coefficient.
2. To Explain the structure of the CT scan machine, including X-ray tubes, counters.
3. To Explain how the image is formed in CT.

**The general purpose of the thirteenth session:**

Light physics and its laws and applications of light in medicine

**Specific objectives of the thirteenth session:**

**At the end the student will be able to**

1. To Explain the Yang experiment and the Michelson-Morley interferometer.
2. To Explain the applications of these concepts in medical sciences.
3. To Explain the light of a wave and know its physics.
4. To Explain the general laws of geometric light, reflection and refraction.
5. To Explain the use of light and its rules in medicine.

**The general purpose of the fourteenth session:**

Electromagnetic wave physics, properties and related laws, polarization, production and applications in medical sciences

**Specific objectives of the fourteenth session:**

**At the end the student will be able to**

1. To Explain the physical nature of light and electromagnetic waves and the sources of its production.
2. To Explain the hypotheses of wave-particle light and its relations.
3. To Explain the application of each electromagnetic wave.
4. To Explain polarization by Prisms and Brewster law.
5. To Explain Malus's law and its formula.
6. To Explain the diffraction and interference of light by apertures.
7. To Explain the Nicole Prism and polarization by reflection and birefringence.

**The general purpose of the fifteenth session:**

Laser physics, types and specifications of laser light and related laws

**The special purpose of the fifteenth session:**

**Be able to student at the end**

1. To Explain the history and method of producing laser light and its difference with natural light.
2. To Explain the basic components of the laser can express the production of the laser and the atomic structure of its molecules.
3. It made the concept of population inversion and energy pump worse.
4. To Explain the physical nature of laser light, its properties and energy.
5. To Explain laser light transmission systems and how to focus

**The general purpose of the sixteenth session:**

Familiarity with the applications of lasers in medical sciences and protection against it

**Specific objectives of the sixteenth session:**

**At the end the student will be able to**

1. To Explain the three important lasers in medical sciences with its specifications
2. To Explain the applications of important medical lasers.
3. To Explain the interaction of laser light with tissue and its medical applications.
4. To Explain the safety tips of laser and protection against it.

**References:**

- 1- Medical Physics , by John R. Cameron, Translated by Dr. Mohammad Taghi Bahreini et al., Royan Pajooh Publishing, latest edition.
- 2- General Physics in Pharmacy, Dr. ahmad shanei and Dr. Ameneh Sazegarnia, Mashhad University of Medical Sciences Publications, latest edition

**Teaching method:**

- 1- Teaching virtually through PowerPoint and records and educational videos.
- 2- Homework in each session for students to participate in related topics.

**Educational tools :**

Computer, PowerPoint software