

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

Students: **General Medicine**  
Course Title: **Medical Physics**  
Class Time: **Sunday, 10:15-12:15**  
Teacher Name: **Dr. Nima Rostampour**

**Course Main Objective:** Understanding the physical laws and their application in medical diagnostic and therapeutic systems

**Main Objectives of the Sessions:**

**Session 1:** To understanding the nature of Electromagnetic radiations, light theories and their applications in medicine

**Session 2:** To understanding the structure of the eye and mechanism of vision

**Session 3:** To understanding the method of diagnosis and correction of refractive errors in hyperopia and myopia

**Session 4:** To understanding the method of diagnosis and correction of different types of astigmatism

**Session 5:** To understanding the method of diagnosis and correction of different types of strabismus

**Session 6:** To understanding the high frequency currents and their application in medicine

**Session 7:** To understanding the high-frequency wave diathermy methods and their effects on the human body

**Session 8:** To understanding the ultrasound waves and methods of their production and detection

**Session 9:** Mid-term exam

**Session 10:** To understanding of different imaging methods using ultrasound waves and their biological effects on human body

**Session 11:** To understanding the methods of x-rays production and their interactions with matter

**Session 12:** To understanding the physical and dosimetric principals in radiography

**Session 13:** To understanding the different methods of radiography

**Session 14:** To understanding the physical basis of radiation therapy and its application in treatment

**Session 15:** To understanding the physical basis of nuclear medicine

**Session 16:** To understanding the application of radioactive materials in diagnosis and treatment

**Session 17:** To understanding the basics of radiation biology and radiation protection

**Behavioral Objectives of each Session:**

**Session 1:** To understanding the nature of Electromagnetic radiations, light theories and their applications in medicine

**1-1:** To define electromagnetic waves

**1-2:** To explain concepts and theories of light

**1-3:** To explain the application of infra-red waves in diagnosis and treatment

**1-4:** To explain the application of ultra-violet waves in diagnosis and treatment

**1-5:** To explain the method of laser production and its applications in medicine

**Session 2:** To understanding the structure of the eye and mechanism of vision

**2-1:** To explain the physical structure of the eye

**2-2:** To explain the laws of absorption, refraction, and transfer of light in human eye

**2-3:** To explain geometric properties and optical performance of spherical, cylindrical, and elliptical lenses

**2-4:** To determine convergence and divergence power of the lenses

**2-5:** To explain the physical properties of diopters of the eye

**2-6:** To classify physiological and pathological eye problems

**Session 3:** To understanding the method of diagnosis and correction of refractive errors in hyperopia and myopia

**3-1:** To explain accommodation phenomena in order to see nearby objects

**3-2:** To explain the causes of myopia and the way it is diagnosed

**3-3:** To explain the methods of myopia correction

**3-4:** To explain the causes of hyperopia and different types of hyperopia

**3-5:** To explain the method of diagnosis of hyperopia

**3-6:** To explain the correction methods of different types of hyperopia

**Session 4:** To understanding the method of diagnosis and correction of different types of astigmatism

- 4-1: To explain the causes of astigmatism
- 4-2: To explain different types of astigmatism
- 4-3: To explain the diagnosis method of different types of astigmatism
- 4-4: To explain the correction methods of different types of astigmatism
- 4-5: To understand the structure of ophthalmoscope and retinoscope and explain their role and performance in ophthalmology

**Session 5:** To understanding the method of diagnosis and correction of different types of strabismus

- 5-1: To define different type of strabismus
- 5-2: To understand the cause of strabismus
- 5-3: To explain the diagnosis method of different types of strabismus
- 5-4: To explain the correction method of different types of strabismus
- 5-5: To explain field of vision, sharpness, presbyopia, and color vision

**Session 6:** To understanding the high frequency currents and their application in medicine

- 6-1: To describe the history of the use of high frequency currents in medicine
- 6-2: To explain the reason for the use of electricity in the production of heat within the tissue
- 6-3: To describe different methods of production of high frequency currents
- 6-4: To define method of capacitive current and inductive coil to produce current

**Session 7:** Understanding the high-frequency wave diathermy methods and their effects on the human body

- 7-1: To explain the physiological properties of high frequency currents in different tissues of the body
- 7-2: To describe tissue excision by high-frequency current and electrosurgical properties
- 7-3: To explain the application of diathermy or microwaves
- 7-4: To explain safety tips in electric surgery
- 7-5: To explain effective factors that increase the risk of electric currents for the body
- 7-6: To describe physiological effects of high frequency currents on human body

**Session 8:** To understanding the ultrasound waves and methods of their production and detection

- 8-1: To define mechanical waves and to explain their difference with electromagnetic waves
- 8-2: To explain how ultrasound wave is produced
- 8-3: To understand how to calculate the physical parameters associated with ultrasound
- 8-4: To describe the relationships between frequency, wavelength, period, amplitude, and energy of sound waves
- 8-5: To explain the different interactions of ultrasound with tissues and their related equations
- 8-6: To explain the factors affecting the absorption and reflection of ultrasound
- 8-7: To explain the acoustic impedance and its effects on wave reflection
- 8-8: To calculate the rate of attenuation in dB and HVL
- 8-9: To explain echo-ranging method in ultrasound imaging with its associated physical relationships
- 8-10: To explain axial resolution and lateral resolution with its associated equations

**Session 9:** Mid-term exam

**Session 10:** To understanding of different imaging methods using ultrasound waves and their biological effects on human body

- 10-1: To explain A-mode and its applications
- 10-2: To explain B-mode and its applications
- 10-3: To explain M-mode and its applications
- 10-4: To explain Doppler method and its applications
- 10-5: To explain duplex and its applications
- 10-6: To explain the therapeutic applications of ultrasound
- 10-7: To explain the biological hazards of ultrasound waves

**Session 11:** To understanding the methods of x-rays production and their interactions with matter

- 11-1: To describe the history of x-ray production and its application in radiology
- 11-2: To explain the electromagnetic nature of the x-ray
- 11-3: To describe the structure and physical principles of the x-ray tube
- 11-4: To describe the methods of producing the characteristic x-ray
- 11-5: To explain the factors affecting the quality and quantity of produced x-ray
- 11-6: To draw and explain the spectrum of general and characteristic x-rays

**Session 12:** To understanding the physical and dosimetric principals in radiography

**12-1:** To explain the interactions of photoelectric, compton, pair production, and annihilation with their mathematical relations

**12-2:** To explain the different units of radiation, absorbed dose, and equivalent human dose along with its mathematical relationships

**12-3:** To describe the factors affecting x-ray absorption in different samples

**Session 13:** To understanding the different methods of radiography

**13-1:** To explain the physical principles of image formation on radiology film

**13-2:** To explain the characteristics of the radiological film and the radiographic film characteristic curve

**13-3:** To explain the physical and geometrical factors affecting contrast enhancement in radiology

**13-4:** To explain the method of fluoroscopy and the characteristics of optical amplification tubes

**13-5:** To explain cross-sectional imaging by CT and its application

**Session 14:** To understanding the physical basis of radiation therapy and its application in treatment

**14-1:** To explain the purpose of radiation therapy

**14-2:** To explain the causes of the tumor being sensitive or resistant to radiation

**14-3:** To explain the physical principles and properties of the radiation used in radiation therapy

**14-4:** To explain the different types of radiation therapy (teletherapy and brachytherapy)

**14-5:** To explain the radiation generators used in radiation therapy

**14-6:** To explain the methods of radiation therapy for different tumors

**14-7:** To describe the method of calculating the total tumor dose

**14-8:** To explain treatment planning

**Session 15:** To understanding the physical basis of nuclear medicine

**15-1:** To define atomic units used in nuclear medicine

**15-2:** To explain Einstein's relation to mass-energy equivalence

**15-3:** To explain the concept of nucleon stability by means of graphs

**15-4:** To classify all types of radioactive materials

**15-5:** To explain the concept of radioactivity and the associated physical phenomena

**15-6:** To explain physical relationships of factors affecting radioactivity using formula and graph

**15-7:** To explain different methods of producing synthetic radioactivity

**15-8:** To explain the principles of generator operation

**Session 16:** To understanding the application of radioactive materials in diagnosis and treatment

**16-1:** To explain how to label body molecules with the help of radioisotopes

**16-2:** To explain the use of labeled molecules in diagnosis and treatment

**16-3:** To list the types of detectors used in nuclear medicine (well, scintillator, gas, solid state) and describe the characteristics and functions of each

**16-4:** To describe the function of gamma camera, PMT and collimator in the diagnosis of diseases

**16-5:** To describe the SPECT imaging method

**16-6:** To describe the PET imaging method

**Session 17:** To understanding the basics of radiation biology and radiation protection

**17-1:** To classify the biological effects of ionizing radiation

**17-2:** To explain the factors affecting on the radiation sensitivity of cells (physical, biological, intrinsic)

**17-3:** To explain the effect of oxygen on the sensitivity of the beam

**17-4:** To explain the differences between differentiated and non-differentiated cells in terms of radiation sensitivity

**17-5:** To explain the conditions of cell repair and regeneration

**17-6:** To explain the law of Bergonié and Tribondeau

**17-7:** To describe the cell survival curve

**17-8:** To describe the carcinogenicity of ionizing radiation and its developmental stages

**17-9:** To describe the dose response curve and hazard estimation

**17-10:** To explain the effect of radiation on the fetus

**17-11:** To explain different methods of protection against ionizing radiation

**17-12:** To explain protective methods to prevent internal and external radiation

**Main Teaching Sources:**

1. Medical physics, John R. Cameron, James G. Skofronick
2. Special Texts in Medical Physics
3. Complementary Materials from the teacher's

**Student Participation:**

Active Class Participation and Cooperation:

Asking and Answering Questions Through Presentation

**Teaching Method & Media:**

Communicative Approach—Video Projector, Power Point, White Board

**Assessment Methods:**

Mid-Term and Final Exams:

Multiple-Choice/ Complementary

Class Participation and Activity + An oral Presentation