Course Description of Medical Physics
First Year Class, Second Semester

Medical Physics introduces students to the fundamental physical principles that support modern medical and laboratory practice. The course integrates thermodynamics, pressure, heat, radiation, diffusion and rheology with the principles and applications of important medical instruments and diagnostic devices. It prepares students to understand the physical basis, safe use, and medical applications of technologies such as ECG, EEG, X-ray, MRI, CT, radiotherapy and blood glucose monitoring.

1. Educational Institution	Al-Zahrawi University - Ministry of Higher Education and Scientific Research
2. University Department / Center	Clinical Laboratory Sciences
3. Course Name / Code	Medical Physics
4. Programs in which it is included	Bachelor Program
5. Available Forms of Attendance	Classroom attendance
6. Semester / Year	Second Semester / First Year
7. Total Number of Study Hours	30 Hours (2 hours/week × 15 weeks)
8. Total Credits	2 Credits (1 Theory + 1 Practical)
9. Date of preparing this description	2026

Course Objectives: This course aims to enable students to:

- Understand fundamental concepts of physics and their relevance to medicine and clinical laboratory sciences.
- Use physical terminology, units, standards, and common abbreviations correctly in medical applications.
- Explain basic principles of thermodynamics, pressure, temperature, heat, work, power, gases, diffusion, and rheology.
- Describe the physical principles and clinical applications of selected medical instruments and devices.
- Explain the basic principles of ECG, EEG, X-ray, MRI, CT scan, radiotherapy, and radioactive iodine.
- Recognize the medical and biological effects of radiation and the importance of radiation safety.

Learning Outcomes, Teaching and Learning Methods, and Evaluation

Knowledge and Understanding

- Describe basic physical quantities, units, standards, and methods used in medical physics.
- Explain thermodynamic systems, conservation of energy, pressure, temperature scales, gas laws, heat transfer, and radiation.
- Understand the physical principles underlying major diagnostic and therapeutic medical devices.

Subject-Specific Skills

- Relate physical principles to blood glucose monitoring, infusion devices, cardiac output measurement, pacemakers, ECG and EEG.
- Differentiate the basic operating principles of X-ray, MRI, CT scan, and radiotherapy.
- Apply basic concepts of diffusion and rheology to biological and medical systems.

Teaching and Learning Methods

- Theoretical lectures, PowerPoint presentations, demonstrations, practical examples, device-based learning, calculations, small-group discussions, and laboratory-oriented activities.

Evaluation Methods

- Written examinations, quizzes, assignments, practical exercises, device identification, calculations, oral questions, reports, and class participation.

Thinking Skills

- Interpret simple physical relationships and apply them to medical and biological problems.
- Compare medical imaging and monitoring technologies according to their underlying physical principles.

• Analyze basic safety considerations related to radiation and medical devices.

General and Transferable Skills

• Develop scientific reasoning, quantitative problem-solving, teamwork, communication, and safe laboratory practice.

11. Course Structure

Weeks	Hours	Required Learning Outcomes	Unit Name / Course or Topic	Learning Methods	Evaluation Method
1	2 HOURS	Knowledge and practical application	General Concepts and Thermodynamics Method of physics and standards; thermodynamic systems and system properties; conservation of energy principle.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
2	2 HOURS	Knowledge and practical application	Pressure, Temperature and Gas Laws Pressure; Celsius, Fahrenheit and Kelvin scales; equation of state; ideal and real gases; general gas law.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
3	2 HOURS	Knowledge and practical application	Heat, Energy, Work and Power Heat and energy; work and mechanical forms of work; power; first law of thermodynamics; Boyle's and Charles's laws.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
4	2 HOURS	Knowledge and practical application	Blood Glucose Monitoring Devices Physical principles of blood glucose monitoring; measurement concepts; device components and clinical applications.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
5	2 HOURS	Knowledge and practical application	Parenteral Infusion Devices and Cardiac Output Measurement Principles and operation of infusion devices; flow concepts; basic physical principles of cardiac output measurement.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
6	2 HOURS	Knowledge and practical application	Implantable Cardiac Pacemakers Basic electrical principles; pacemaker components, function and clinical applications.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
7	2 HOURS	Knowledge and practical application	Electrocardiogram (ECG) Electrical activity of the heart; ECG leads, signal recording, basic waveform principles and medical applications.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
8	2 HOURS	Knowledge and practical application	Electroencephalography (EEG) Electrical activity of the brain; electrodes, signal acquisition, recording principles and clinical applications.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
9	2 HOURS	Knowledge and practical application	Thermal Radiation and Heat Transfer Kirchhoff's law; Planck's law; Stefan-Boltzmann law; Wien's law; black body and albedo; radiation, convection and conduction.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
10	2 HOURS	Knowledge and practical application	X-Ray and X-Ray Spectra Production of X-rays; X-ray spectra; absorption of X-rays; principles of medical X-ray imaging.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
11	2 HOURS	Knowledge and practical application	UV, IR and Biological Effects of Radiation Ultraviolet and infrared effects; medical and biological effects of radiation; basic radiation safety concepts.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
12	2 HOURS	Knowledge and practical application	Radiotherapy and Radioactive Iodine Physical principles of radiotherapy; therapeutic radiation; radioactive iodine and its medical applications.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
13	2 HOURS	Knowledge and practical application	Magnetic Resonance Imaging (MRI) Basic principles of magnetism, resonance, image formation, clinical applications and safety considerations.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment
14	2 HOURS	Knowledge and practical application	Computed Tomography (CT Scan) Basic principles of CT imaging; X-ray attenuation, image reconstruction concepts and clinical applications.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment

15	**2 HOURS**	Knowledge and practical application	Diffusion and Rheology Diffusion principles in biological systems; viscosity, flow behavior and basic rheological concepts in medical applications.	PowerPoint presentations, explanation, demonstration, discussion and practical examples	Quizzes, assignments, oral questions, practical exercises and written assessment

Name of the Instructor: Dr. Mariam Raheem

12. Infrastructure

Required Readings / References	1. Physics for Biology and Medical Students, 2nd ed. 2. Schreiner, Steven. Medical Instruments and Devices: Principles and Practices. CRC Press, 2015.
Special Requirements (Workshops, Journals, Software, Websites)	Medical device demonstrations, laboratory equipment, audiovisual materials, scientific references, and appropriate simulation or teaching resources.
Social Services (Guest Lectures, Professional Training, Field Studies, Others)	Guest lectures, demonstrations of medical equipment, laboratory activities, and field visits where applicable.
Prerequisites	Admission according to the central academic plan
Minimum Number of Students	Not specified
Maximum Number of Students	According to the approved admission capacity

Dr. Mariam Rahem