# Academic Program Description Form

**University Name**: Al Nahrain University

**Faculty/Institute**: College .of Science

**Scientific Department**: Physics

**Academic or Professional Program Name**: B.Sc in Physics

**Final Certificate Name**: B.Sc

**Academic System**: Semester

**Description Preparation Date**: 2025–2026

**File Completion Date**: 2025\11\3

**Signature**: Saael N - Abood

**Head of Department Name**:

Prof.Dr Saad Naji Abood

**Date**: 2025/11/

**Signature**:

**Scientific Associate Name**: Manaf Adnan Saleh

**Date**: 3/ 11/ 2025

**The file is checked by**:

**Department of Quality Assurance and University Performance**

**Director of the Quality Assurance and University Performance Department**:

**Date**:

**Signature**:

Ministry of Higher Education and Scientific Research
Republic of Iraq
Al-Nahrain University / College of Science
Dean's office

**Approval of the Dean**

Prof.-Dr. Asmaa H. Mohammad

## 1. Program Vision

The student's ability to understand and apply a variety of physical, and acquire the ability to explain and understand many of the physical processes.

## 2. Program Mission

Qualifying students practically and scientifically through an intensive scientific curriculum of teaching and learning methods and preparing the student in an academic way that is compatible with the necessities of scientific development. Preparing distinguished students in the field of scientific research who hold graduate studies.

## 3. Program Objectives

Increasing the efficiency of students and raising their level of knowledge so that they are qualified to work in various state departments so that they can be effective and distinguished elements in their fields of work and scientific research.

## 4. Program Accreditation

Does the program have program accreditation? And from which agency?

From the Association of Arab Universities

## 5. Other external influences

Is there a sponsor for the program?

Ministry of Higher Education and Scientific Research

## 6. Program Structure

| Program Structure | Number of Courses | Credit hours | Percentage | Reviews* |
|---|---|---|---|---|
| Institution Requirements | 2 | | 100 | |

| | | | | |
|---|---|---|---|---|
| College Requirements | 2 | | 100 | |
| Department Requirements | 2 | | 100 | |
| Summer Training | – | | – | |
| Other | | | | |

* ممكن ان تتضمن الملاحظات فيما اذا كان المقرر أساسي او اختياري .

## 7. Program Description

| Credit Hours | | Course Name | Course Code | Year/Level |
|---|---|---|---|---|
| practical | theoretical | | | B.Sc |
| | 2 | Electricity | PHY | الاولى |
| | 2 | Calculus | PHY | الاولى |
| | 1 | computer | PHY | الاولى |
| | 2 | Mechanics and properties of materials | PHY | الاولى |
| | 2 | General astronomy | PHY | الاولى |
| | 1 | Democracy and human rights | PHY | الاولى |
| 2 | 2 | Calculus II | PHY | الاولى |
| 2 | 2 | Mechanics and properties of materials II | PHY | الاولى |
| 2 | 2 | Programming fundamentals | PHY | الاولى |
| | 2 | Arabic language | PHY | الاولى |
| | 2 | Introduction of chemistry | PHY | الاولى |
| | | Magnetism | PHY | الاولى |
| | 2 | Enghlish language | PHY | الاولى |
| | 2 | programming | PHY | الثانية |
| | 2 | Modern physics I | PHY | الثانية |
| | 2 | Analog electronics | PHY | الثانية |
| | 2 | Differential equation | PHY | الثانية |
| 2 | 2 | Analytical mechanics | PHY | الثانية |
| 2 | 2 | Heat and thermodynamic | PHY | الثانية |
| | 2 | جرائم نظام البعث | PHY | الثانية |
| | 2 | Thermodynamic and statical | PHY | الثانية |
| 2 | 2 | Modern physics II | PHY | الثانية |
| 2 | 2 | Linear algebra | PHY | الثانية |
| 2 | 2 | Sound and wave motion | PHY | الثانية |
| 2 | 2 | Analytical mechanicsII | PHY | الثانية |
| 2 | 2 | Enghlish language II | PHY | الثانية |
| | 2 | Arabic languageII | PHY | الثانية |

## 8.Expected learning outcomes of the program

| | |
|---|---|
| **Knowledge** | |
| Learning Outcomes 1 | The student acquires the ability to explain and understand many of the biological processes in primary and graduate studies that serve the labor market and scientific research. |
| **Skills** | |
| Learning Outcomes 2 | Preparing students who are scientifically empowered in the field of specialization and the labor market. |
| Learning Outcomes 3 | Identifying the most important advanced scientific and research materials that serve the fields of communications and modern technology. |
| **Ethics** | |
| Learning Outcomes 4 | Ability to apply principles of physics. |
| Learning Outcomes 5 | The ability to solve scientific problems and find possible alternatives to those solutions. |

## 9.Teaching and Learning Strategies

1. Solve various problems in different physics applications.
2. Giving homework to increase students' ability in problem-solving techniques.
3. Promote quick student response by asking conceptual questions during class.
4. Encouraging students in strategies to solve examples in class.
5. Encouraging students to publish research in graduate studies.
6. Encouraging students to use modern, advanced applications in the field of specialization.

## 10.Evaluation methods

1. Seminar.
2. Oral exams.

3. Quizzes.
4. Direct questions.
5. Homework.
6. Reports

## 11. Faculty

### Faculty Members

| Number of the teaching staff | | Special Requirements/Skills (if applicable) | | Specialization | | Academic Rank | |
|---|---|---|---|---|---|---|---|
| lecture | staff | | | Special | General | | |
| | 1 | | | فيزياء طبية | علوم الفيزياء | استاذ دكتور | أ.د.اسماء هادي محمد |
| | 1 | | | بصريات | علوم الفيزياء | استاذ دكتور | أ.د.سهى موسى خورشيد |
| | 1 | | | بصريات الكترون | علوم الفيزياء | استاذ دكتور | أ.د.عدي علي حسين |
| | 1 | | | صلبة | علوم الفيزياء | استاذ دكتور | أ.د.احمد عبد الرحمن |
| | 1 | | | فيزياء نظرية | علوم الفيزياء | استاذ دكتور | أ.د.سعد ناجي عبود |
| | 1 | | | صلبة | علوم الفيزياء | استاذ دكتور | أ.د.عماد خضير عباس |
| | 1 | | | معالجة صور رقمية | علوم الفيزياء | استاذ دكتور | أ.د.ليث عبد العزيز عباس |
| | 1 | | | بلازما | علوم الفيزياء | استاذ دكتور | أ.د.خالد عباس يحيى |
| | 1 | | | فلك | علوم الفيزياء | استاذ مساعد دكتور | أ.م.د.جزيل حسين |
| | 1 | | | بلازما | علوم الفيزياء | استاذ مساعد دكتور | أ.م.د.حسن ناصر |
| | 1 | | | صلبة | علوم الفيزياء | استاذ مساعد دكتور | أ.م.د.وسن علي موسى |
| | 1 | | | اشعاعية | علوم الفيزياء | استاذ مساعد دكتور | أ.م.د.مروة عبد المحسن |
| | 1 | | | احصائية | علوم الفيزياء | استاذ مساعد دكتور | أ.م.د ابراهيم عبدالمهدي |
| | 1 | | | بلازما | علوم الفيزياء | استاذ مساعد دكتور | ا.م.د.نيسان سعود |
| | 1 | | | صلبة | علوم الفيزياء | استاذ مساعد دكتور | ا.م.د سديم عباس |
| | 1 | | | نظرية | علوم الفيزياء | مدرس دكتور | م.د.احمد شاكر |
| | 1 | | | بصريات | علوم الفيزياء | استاذ مساعد | أ.م.نور محمد حسن |
| | 1 | | | نظرية | علوم الفيزياء | مدرس دكتور | م.د.عمر اياد |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| م.د.سلام اسماعيل | مدرس دكتور | علوم الفيزياء | فلك | | | 1 | |
| أ.م.د.زينب منذر | استاذ مساعد دكتور | علوم الفيزياء | الكترونيك | | | 1 | |
| أ.م.د.احمد صبيح | استاذ مساعد دكتور | علوم كيمياء | كيمياء | | | 1 | |
| م.د.فاطمة عبد الصاحب | مدرس دكتور | علوم رياضيات | رياضات | | | 1 | |
| م.عمر عدنان | مدرس | شريعة | شريعة | | | 1 | |
| م.د.منى صالح | مدرس دكتور | علوم رياضيات | رياضيات | | | 1 | |
| م.د.احمد نعمة | مدرس دكتور | اللغة عربية | اللغة العربية | | | 1 | |
| ا.م.ابتسام كامل | استاذ مساعد | علوم الرياضيات | رياضيات | | | 1 | |
| م.د.ايمان عبد الوهاب | مدرس دكتور | علوم رياضيات | رياضيات | | | 1 | |
| م.د.احمد ايوب | مدرس دكتور | علوم رياضيات | رياضيات | | | 1 | |

| **Professional Development** |
|---|
| **Mentoring new faculty members** |
| Assess teaching techniques and give the students surveys about those techniques. |
| **Professional development of faculty members** |
| Involve the new staff in teaching process and encourage them to develop the lecture with the supervision of the main lecturer. |

## 12.Acceptance Criterion

(**Setting regulations related to enrollment in the college or institute, whether central admission or others**)

## 13.The most important sources of information about the program

دليل اتحاد الجامعات العربية "ضمان الجودة والاعتماد للبرامج الاكاديمية في كليات الجامعات العربية الامانه العام /عمان/الاردن/2022

## 14.Program Development Plan

Involve more high level books and upgrade the lectures each year.

| Program Skills Outline | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Required program Learning outcomes | | | | | | | | | | | | | | | | |
| Ethics | | | | Skills | | | | Knowledge | | | | Basic or optional | Course Name | Course Code | Year/Level | |
| C4 | C3 | C2 | C1 | B4 | B3 | B2 | B1 | A4 | A3 | A2 | A1 | | | | | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Electricity | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Calculus | PHY | مرحلة اولى | بكالوريوس |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | computer | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Mechanics and properties of materials | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اختياري | General astronomy | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اختياري | Democracy and human rights | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Calculus II | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Mechanics and properties of materials II | PHY | مرحلة اولى | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Programming fundamentals | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اختياري | Arabic language | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Introduction of chemistry | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Magnetism | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اختياري | Enghlish language | PHY | مرحلة اولى | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | programming | PHY | مرحلة ثانية | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسي | Modern physics I | PHY | مرحلة ثانية | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسي | Analog electronics | PHY | مرحلة ثانية | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسي | Differential equation | PHY | مرحلة ثانية | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسي | Analytical mechanics | PHY | مرحلة ثانية | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Heat and thermodynamic | PHY | مرحلة ثانية | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اختياري | جرائم نظام البعث | PHY | مرحلة ثانية | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Thermodynamic and statical | PHY | مرحلة ثانية | |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Modern physics II | PHY | مرحلة ثانية | |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Linear algebra | PHY | مرحلة ثانية |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Sound and wave motion | PHY | مرحلة ثانية |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اساسى | Analytical mechanicsII | PHY | مرحلة ثانية |
| | | | | | | | | ✔ | ✔ | ✔ | ✔ | اختياري | Enghlish language II | PHY | مرحلة ثانية |

- **يرجى وضع اشارة في المربعات المقابلة لمخرجات التعلم الفردية من البرنامج الخاضعة للتقييم**

# الكورس الاول

# Course Description Form

| |
|---|
| 1. Course Name: |
| Radiation health physics |
| 2. Course Code: |
| |
| 3. Semester / Year: |
| 1\ 4th |
| 4. Description Preparation Date: |
| 2025 |
| 5. Available Attendance Forms: |
| Traditional attendance and electronic attendance |
| 6. Number of Credit Hours (Total) / Number of Units (Total) |
| 2\ 2 |
| 7. Course administrator's name (mention all, if more than one name) |
| Name: Dr. Asmaa Hadi Mohammed<br>Email: asmaa.hadi@nahrainuniv.edu.iq |
| 8. Course Objectives |

| | |
|---|---|
| **Course Objectives** | • **Understand the nature, types, and properties of ionizing and non-ionizing radiation.**<br>• **Describe and mathematically analyze key radiation interactions such as the photoelectric effect, Compton scattering, and pair production.**<br>• **Explain the generation of X-rays and radioactive decay processes.**<br>• **Apply radiation physics concepts to medical imaging modalities (X-ray, CT, PET, SPECT).**<br>• **Perform fundamental dosimetry calculations and interpret dose–response relationships.**<br>• **Discuss radiation protection principles (ALARA) and evaluate shielding and safety standards.**<br>• **Utilize laboratory techniques for radiation detection and measurement.** |

| 9. Teaching and Learning Strategies | |
|---|---|
| **Strategy** | **1. Deep Understanding Approach**<br>Connecting physics concepts to health and medical applications, such as understanding radiation effects on living tissues.<br>Using real-world examples to illustrate the role of physics in healthcare.<br>**2. Active and Interactive Learning**<br>Group discussions: Engaging in conversations about radiation safety.<br>**3. Utilizing Modern Technology**<br>Using interactive presentations and 3D visualizations to explain radiation interactions with the human body.<br>**4. Collaborative Learning**<br>Forming team-based studies on topics like radiation detection devices or X-ray imaging techniques.<br>**5. Continuous Assessment**<br>Conducting regular quizzes that include analytical and application-based questions. |

| | |
|---|---|
| | Assigning students to deliver short presentations explaining specific topics in a simplified manner. |

## 10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| First | 2 | Definition, types, and sources of radiation (α, β, γ, X-rays, neutrons). | Introduction to Radiation Physics | 1.Lectures and theoretical presentations. 2. Interactive learning: Engaging in group discussions, Q&A sessions to strengthen understanding and link concepts together. 3. Assessments and tests: Conducting short quizzes or projects to evaluate deep understanding of the learned concepts. | 1.Quizzes. 2.Assignments and seminars. 3. Final exams. 4.Class discussions. 5.Formative assessment. |
| Second | 2 | Half-life, activity, decay series, nuclear transformations. | Radioactive Decay | | |
| Third | 2 | Charged particles: ionization, excitation, stopping power. | Interaction of Radiation with Matter I | | |
| Fourth | 2 | Photons: photoelectric effect, Compton scattering, pair production. | Interaction of Radiation with Matter II | | |
| Fifth | 2 | Energy–momentum conservation, experimental verification, examples. | Compton Scattering Detailed Derivation | | |
| | | | | | |
| Sixth | 2 | Gas ionization detectors, scintillation detectors, semiconductor detectors. | Radiation Detection and Instrumentation | | |
| Seventh | 2 | Absorbed dose, equivalent dose, effective dose, ICRP recommendations. | Radiation Dosimetry | | |
| Eighth | 2 | X-ray tubes, accelerators, radioactive sources, radionuclides. | Radiation Sources and Production | | |

| | | | | | |
|---|---|---|---|---|---|
| Ninth | 2 | Radiation damage mechanisms, dose-response models, stochastic/deterministic effects. | Biological Effects of Radiation | | |
| tenth | 2 | ALARA, shielding, distance, time, regulatory limits. | Radiation Protection Principles | | |
| eleventh | 2 | Diagnostic radiology, CT, mammography. | Medical Applications I | | |
| Twelfth | 2 | Nuclear medicine (PET, SPECT), radiotherapy (Co-60, linacs, proton therapy). | Medical Applications II | | |
| Thirteenth | 2 | Calibration, standardization, patient safety, QA protocols. | Quality Assurance and Control | | |
| Fourteenth | 2 | Clinical dosimetry problems, imaging artifacts, ethics. | Review and Case Studies | | |
| Fifteenth | 2 | Comprehensive written | Final Exam | | |

## 11.Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

## 12.Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | |
| Main references (sources) | "Introduction to Radiological Physics and Radiation Dosimetry", Frank H. Attix |
| Recommended books and references (scientific journals, reports...) | "Radiation Therapy Physics", William R. Hendee & E. Russell Ritenour |
| Electronic References, Websites | |

# Course Description Form

1. Course Name: Elementary Particles

2. Course Code:

3. Semester / Year: First / 2025-2026

4. Description Preparation Date: September 2025

5. Available Attendance Forms: Attendance in class

6. Number of Credit Hours (Total) / Number of Units (Total): 35 hours /2 units

7. Course administrator's name (mention all, if more than one name)

Name: Prof. Dr. Saad Naji Abood
Email: Saad.Abood@nahrainuniv.edu.iq

8. Course Objectives

| | |
|---|---|
| **Course Objectives** | The objectives of teaching the subject of elementary particles to fourth-year students in the Physics Department include:<br><br>1. **Understanding Theoretical Foundations**: Introducing students to concepts of elementary particles, such as quarks and leptons, and the fundamentals of physical models.<br>2. **Developing Analytical Skills**: Enhancing the ability to analyze data and experiments related to elementary particles.<br>3. **Practical Applications**: Connecting theoretical concepts to practical applications in fields such as nuclear physics and particle physics.<br>4. **Critical Thinking**: Encouraging students to engage in critical thinking and explore complex questions about the structure of matter and the universe.<br>5. **Scientific Research**: Motivating students to participate in research and scientific projects related to elementary particles.<br>6. **Interaction with Technology**: Exposing students to the latest technologies and devices used in the study of elementary particles, such as particle colliders.<br><br>These objectives aim to prepare students well for their academic and professional fu in the field of physics. |

9. Teaching and Learning Strategies

| | |
|---|---|
| **Strategy** | **The teaching and learning strategy for the subject of elementary particles includes several key aspects:**<br><br>1. **Active Learning**: Encouraging students to participate actively through discussions, workshops, and interactive activities.<br><br>2. **Project-Based Learning**: Assigning students research projects related to elementary |

| | |
|---|---|
| | particles, which enhances their deep understanding of the subject.<br><br>3. **Technology in Education**: Utilizing computer simulations and educational applications to enhance visual understanding of complex concepts.<br><br>4. **Collaborative Learning**: Forming small work groups to promote collaboration among students and knowledge sharing.<br><br>**5. Continuous Assessment**: Implementing diverse assessment methods, such as quizzes, presentations, and self-assessments, to ensure understanding of concepts.<br><br>**6. Interaction with Experts**: Inviting guest lecturers or organizing visits to research centers or particle physics laboratories to enhance the educational experience.<br><br>**7. Providing Diverse Resources**: Offering a variety of educational resources, such as books, articles, and videos, to deepen understanding.<br><br>These strategies aim to enhance the learning experience and make it more interactive and suitabl students' needs in the field of elementary particles. |

## 10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| 1 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Particle and anti particles | Theoretical | Written exams and homework |
| 2 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Four Forces and Examples | Theoretical | Written exams and homework |
| 3 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Classification of Elementary Particles | Theoretical | Written exams and homework |
| 4 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Properties of Elementary Particles | Theoretical | Written exams and homework |
| 5 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Properties of Elementary Particles | Theoretical | Written exams and homework |
| 6 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Conservation Laws of Elementary Particles | Theoretical | Written exams and homework |

| | | | | | |
|---|---|---|---|---|---|
| 7 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Conservation Laws of Elementary Particles | Theoretical | Written exams and homework |
| 8 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Strange Particles | Theoretical | Written exams and homework |
| 9 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Quarks | Theoretical | Written exams and homework |
| 10 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Quarks | Theoretical | Written exams and homework |
| 11 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Quark Models | Theoretical | Written exams and homework |
| 12 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Quark Models | Theoretical | Written exams and homework |
| 13 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Quantum field for describing mutually interacting particles | Theoretical | Written exams and homework |
| 14 | **2** | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Quantum Chromodynamics | Theoretical | Written exams and homework |
| 15 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Cosmic Rays | Theoretical | Written exams and homework |
| 16 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Cosmic Rays | Theoretical | Written exams and homework |

| | | | | | |
|---|---|---|---|---|---|
| 17 | 2 | Gain the knowledge and skills necessary to understand the subject and apply it effectively in different contexts. | Cosmic Rays | Theoretical | Written exams and homework |

## 11.Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

## 12.Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | Introduction to Elementary Particles by David Griffiths |
| Main references (sources) | Particle Physics: A Very short Introduction by: Frank Close |
| Recommended books and references (scientific journals, reports...) | |
| Electronic References, Websites | |

# Course Description Form

1. Course Name:

**Mathematical Physics**

2. Course Code:

3. Semester / Year:

4th year physics / 1st semester

4. Description Preparation Date:

12/10/2025

5. Available Attendance Forms:

Attendance is mandatory

6. Number of Credit Hours (Total) / Number of Units (Total)

30 hours / 2 hours weekly

7. Course administrator's name (mention all, if more than one name)

Name: **Assist. Prof. Dr. Hassan N. Hashim**
Email: hassan.hashim@nahrainuniv.edu.iq

8. Course Objectives

| | |
|---|---|
| **Course Objectiv** | • Teaching the students the principles of Mathematical Physics.<br>• Give the Students the ability and experience to solve and discuss the problems related with Mathematical Physics.<br>• Make a connection between the theoretical principles and the experimental applications. |

9. Teaching and Learning Strategies

| | |
|---|---|
| **Strategy** | 1. Discussing the topics of the methodological book and auxiliary references.<br>2. Theoretical lectures including problem solving and discussion of homework<br>3. Asking students for a set of thinking questions during lectures on specific topics.<br>4. Giving students homework requires finding solutions on their own.<br>5. |

10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| 1 | 2 | | **Introduction**<br>**Special functions:**<br>**The Factorial Function** | Theoretical | |
| 2 | 2 | | **Gamma Function** | Theoretical | Quiz |
| 3 | 2 | | **The Gamma function of negative number** | Theoretical | Quiz |
| 4 | 2 | | **Some important formulas involving Gamma Function** | Theoretical | Quiz |
| 5 | 2 | | **Solutions of some Examples** | Theoretical | Quiz |
| 6 | 2 | | **Beta Function** | Theoretical | Quiz |
| 7 | 2 | | **Other forms of Beta Function** | Theoretical | Quiz |
| 8 | 2 | | **The Relation between Gamma and Beta functions** | Theoretical | Quiz |
| 9 | 2 | | **Test #1** | Theoretical | Written Exam |
| 10 | 2 | | **The Error function** | Theoretical | Quiz |
| 11 | 2 | | **Series: Solutions of Differential Equations** | Theoretical | Quiz |
| 12 | 2 | | **Legendre's Equation** | Theoretical | Quiz |
| 13 | 2 | | **Test #2** | Theoretical | Written Exam |
| 14 | 2 | | **Summary** | Theoretical | Quiz |
| 15 | 2 | | **Preparatory Week** | Theoretical | |
| 16 | 3 | | **Final Exam** | Theoretical | Written Exam |

## 11.Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

## 12.Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books if any) | ✓ Mathematical Methods in the Physical Sciences"<br>By: Mary L. Boas, 3rd Edition, 2006.<br>https://www.christs.cam.ac.uk/sites/default/files/inline-files/0a187866618ca3049030ec5014860ae8-original.pdf |
| Main references (sources) | **Advanced Calculus**, 3rd Edition,<br>Angus E. Taylor, and W. Robert Mann, 1983. |
| Recommended books and references (scientific journals, reports...) | Any Book entitled "Mathematical Physics" |
| Electronic References, Websites | Any website dealing with math. Physics or the subjects that covered in the course |

# Course Description Form

| |
|---|
| 1. Course Name: |
| Solid State Physics I |
| 2. Course Code: |
| PHYS4102 |
| 3. Semester / Year: |
| 1st course / 4th year |
| 4. Description Preparation Date: |
| 1/9/2025 |
| 5. Available Attendance Forms: |
| In person or Online |
| 6. Number of Credit Hours (Total) / Number of Units (Total) |
| 7 hours weekly (3 H theoretical + 4 H practical ) |
| 7. Course administrator's name (mention all, if more than one name) |
| Name: Dr. Mohammed Tariq<br>Email: Mohammed.albaidhani@nahrainuniv.edu.iq |

| 8. Course Objectives | |
|---|---|
| **Course Objectives** | • Teach the student the basic concepts of solid state physics.<br>• Providing the student with the skills to discuss and solve applied problems related to solid state physics.<br>• Linking theoretical concepts with practical applications. |

| 9. Teaching and Learning Strategies | |
|---|---|
| **Strategy** | • Discussing the topics of the methodological book and auxiliary references<br>• Theoretical lectures including problem solving and discussion of homework<br>• Asking students for a set of thinking questions during lectures on specific topics.<br>• Giving students homework that requires finding solutions on their own. |

## 10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| 1 | 3 | Learning | Introduction | Theoretical | Oral and writ |
| 2 | 3 | Learning | Condensed matter | Theoretical | Oral and written |
| 3 | 3 | Learning | Crystal structure Primitive cell | Theoretical | Oral and written |
| 4 | 3 | Learning | Bravais lattice Primitive Wigner Seitz | Theoretical | Oral and written |
| 5 | 3 | Learning | Amorphous, poly and single phases | Theoretical | Oral and written |

| | | | | | |
|---|---|---|---|---|---|
| 6 | 3 | Learning | Symmetry operation | Theoretical | Oral and written |
| 7 | 3 | Learning | Lattice types and Miller Indices | Theoretical | Oral and written |
| 8 | 3 | Learning | Inter planer distance | Theoretical | Oral and written |
| 9 | 3 | Learning | Properties of cubic systems | Theoretical | Oral and written |
| 10 | 3 | Learning | Planes in Hexagonal crystal | Theoretical | Oral and written |
| 11 | 3 | Learning | Direction in crystal | Theoretical | Oral and written |
| 12 | 3 | Learning | Filling factor | Theoretical | Oral and written |
| 13 | 3 | Learning | Some structures diamond, Nacl, ZnS | Theoretical | Oral and written |
| 14 | 1 | Learning | Test | Theoretical | Oral and written |
| 15 | 3 | Learning | Summary | Theoretical | Oral and written |
| 16 | 3 | exam | Final Examination | Theoretical | Oral and written |

## 11.Course Evaluation

40 points (10 laboratory + 10 homework + 20 mid exam)
60 points (10 laboratory exam + 50 final exam)

## 12.Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | 1. Introduction to Solid State Physics (Wiley, Global Edition)<br>By: Charles Kittel ISBN: 978-1-119-45620-9 (August 2018) (712 Pages).<br>2. Introduction to Solid State Physics (Wiley, India Edition)<br>By: Charles Kittel ISBN-13: 978-8-126-57843-6 (2019) (712 Pages). |
| Main references (sources) | Solid State Physics (Revised Edition, Cengage Learning Asia Pte Ltd)<br>By: Neil W. Ashcroft ISBN-13: 978-981-4369-89-3 (2016) (1294 Pages). |
| Recommended books and references (scientific journals, reports...) | Einfuhrung in die Festkorperphysik (6th Edition, Teubner GmbHWiesbaden)<br>By: K. Kopitzki ISBN:978-3-8351-0144-9 (2007) (483 Pages). |
| Electronic References, Websites | Any website with the above titles.<br>View solid state physics courses at reputable universities. |

Solid State Physics Laboratory:

1. Lecturer Wsan Ali Khudair
2. Lecturer Zina Mowafaq Qaddouri
3. Assistant Lecturer Norhan Sabah Juma'a

# Course Description Form

| |
|---|
| 1. Course Name: |
| Electromagnetic Theory |
| 2. Course Code: |
| PHY 313 |
| 3. Semester / Year: |
| 1ST Semester/ 2025-2026 |
| 4. Description Preparation Date: |
| 1/10/2025 |
| 5. Available Attendance Forms: |
| Mandatory attendance |
| 6. Number of Credit Hours (Total) / Number of Units (Total) |
| 3 hours every week/ 3 units |
| 7. Course administrator's name (mention all, if more than one name) |
| Name: Prof. Dr. Ahmed H. Flayyih<br>Email: ahmed.hmood@alnahrainuniv.edu.iq |
| 8. Course Objectives |

| | |
|---|---|
| **Course Objectives** | **• Understand the basics of electromagnetic potential**<br>**• skill in mathematical skills in vector algebra**<br>**• Understand the behavior of electromagnetic transmissions and the fields generated in all media** |
| 9. Teaching and Learning Strategies | |
| **Strategy** | 1. Building the theoretical foundations of the subject and applications<br>2. Discussion sessions and homework<br>3. Daily and semester exams<br>4. Motivating students to participate in scientific activities |

10. Course Structure

| Week | Hours | Learning method | Unit or subject name | Required Learning Outcomes | Evaluation |
|---|---|---|---|---|---|

| | | | | | **method** |
|---|---|---|---|---|---|
| 1 | 3 | Whiteboard | VECTOR CALCULUS | Enable the student to perfo mathematical operatio related to vectors | Oral and written exams |
| 2 | 3 | Whiteboard | Dot product, cros product, triple Product. Gradien divergence, curl o vector | Enable the student perform mathemati operations related to vectors | Oral and written exams |
| 3 | 3 | Whiteboard | COULOMB'S LA ELECTRIC FIE INTENSITY: POINT CHARG SEVERAL POI CHARGE | Enable students understand Coulomb's la and calculate the electric field strength resulting from a single point charge or multiple charges. | Oral and written exams |
| 4 | 3 | Whiteboard | ELECTRIC FIELDS DUE TO CONTINUOU S CHARGE DISTRIBUTION A Line Charge, Surface Charge, Volume Charge | Enable the student calculate the electric fi strength for different char distributions. | Oral and written exams |
| 5 | 3 | Whiteboard | ELECTRIC FL DENSITY, GAUSS'S LAW MAXWELL'S EQUATION | To enable the student calculate the electric flux density and understand Gauss's law. | Oral and written exams |
| 6 | 3 | Whiteboard | APPLICATIO NS OF GAUSS'S LAW: A. Point Charge, B. Infinite L Charge, | Apply Gauss's law to find t electric field of a point char for a linear char distribution. | Oral and written exams |
| 7 | 3 | Whiteboard | C. Infinite Sheet of Charge D. Uniformly Charged Sphere | Calculating the electric fi for a plane and spheri charge distribution | Oral and written exams |
| 8 | 3 | Whiteboard | ELECTRIC POTENTIAL, | To enable the student to know how to calculate the | Oral and written exams |

| | | | | | |
|---|---|---|---|---|---|
| | | | RELATIONSHIP BETWEEN E AND MAXWELL'S EQUATION,AN ELECTRIC DIPOLE AND FLUX LINES | electric potential and calculate the electric field from the electric field strength, and calculate the potential and electric field a dipole. | |
| 9 | 3 | Whiteboard | ENERGY DENSITY IN ELECTROSTAT FIELDS | To enable the student to calculate energy and power density in an electrostatic field. | Oral and written exams |
| 10 | 3 | Whiteboard | PROPERTIES OF MATERIALS, CONVECTIO N AND CONDUCTIO N CURRENTS, CONDUCTORS | Enable the student to distinguish between materials according to thei electrical properties | Oral and written exams |
| 11 | 3 | Whiteboard | POLARI TION I DIELECT CS | To enable the student to define and understand polarization in insulating materials. | Oral and written exams |
| 12 | 3 | Whiteboard | DIELECTRIC CONSTANT AND STRENGTH, LINEAR, ISOTROPIC, AND HOMOGENEO US DIELECT CS, | Enable students to recogni the types of insulating materials | Oral and written exams |
| 13 | 3 | Whiteboard | CONTINUITY EQUATION AN RELAXATION TIME, | Enable students to understand the continuity equation | Oral and written exams |
| 14 | 3 | Whiteboard | Dielectric-Dielec Boundary Conditions | To enable the student to calculate the electric field strength between two different mediums: insulator-insulator | Oral and written exams |
| 15 | 3 | Whiteboard | Conductor-Dielectric Bound Conditions, Conductor-Free | To enable the student to calculate the electric field intensity between two | Oral and written exams |

| | | | | | |
|---|---|---|---|---|---|
| | | | Space Boundary Conditions | different media: conductor insulator and conductor-ai | |

| 11.Course Evaluation |
|---|
| Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc |

| 12.Learning and Teaching Resources | |
|---|---|
| Required textbooks (curricular books, if any) | |
| Main references (sources) | |
| Recommended books and references (scientific journals, reports...) | |
| Electronic References, Websites | |

# Course Description Form

## 1. Course Name:

Nanoscience

## 2. Course Code:

## 3. Semester / Year:

First Sem./ Fourth Year

## 4. Description Preparation Date:

1/10/2025

## 5. Available Attendance Forms:

Physical Attendance

## 6. Number of Credit Hours (Total) / Number of Units (Total)

2 hours per week/ 2 units

## 7. Course administrator's name (mention all, if more than one name)

Assis. Prof. Dr. Jazeel Hussein Azeez Email: Jazeel.azeez@nahrainuniv.edu.iq

## 8. Course Objectives

| | |
|---|---|
| **Course Objectives** | • Introduce fundamental concepts of nanoscience and nanotechnology, including size-dependent properties at the nanoscale.<br>• Explain the history and development of nanoscience, from early theoretical predictions to modern applications.<br>• Understand the differences between nanoscience (basic study) and nanotechnology (practical applications).<br>• Explore synthesis methods of nanomaterials (top-down and bottom-up approaches).<br>• Analyze characterization techniques (e.g., SEM, TEM, AFM, XRD, spectroscopy) used to study nanostructures.<br>• Examine the unique physical, chemical, optical, and electronic properties of nanoscale materials.<br>• Discuss applications of nanoscience in electronics, medicine, energy, environment, and materials science. |

## 9. Teaching and Learning Strategies

| | |
|---|---|
| **Strategy** | • **Lectures and Interactive Discussions**: Use lectures to introduce foundational concepts, while incorporating discussions and Q&A sessions to encourage student engagement and deepen understanding of complex topics.<br>• **Report-Based Learning**: Assign group reports or individual research on real-world applications of nanotechnology. This promotes teamwork, problem-solving, and critical thinking as students explore innovative uses of nanotechnology. |

## 10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| 1 | 2 | students will be able to:<br>1. Define nanoscience and explain its scope in relation to other scientific disciplines. | -Definition of nanoscience<br>-History of nanoscience and nanotechnology | Whiteboard and LCD | Oral and written exams |

| | | | | | |
|---|---|---|---|---|---|
| | | 2. Describe the historical development of nanoscience and nanotechnology, including key milestones and contributions (e.g., Feynman's vision, early experiments, and technological advances).<br>3. Differentiate clearly between nanoscience and nanotechnology, highlighting their roles in fundamental research and practical applications. | - Differences between nanoscience and nanotechnology | | |
| 2 | 2 | students will be able to:<br>1. Explain the concept of quantum confinement and its impact on the electronic, optical, and magnetic properties of materials.<br>2. Describe different types of quantum-confined systems (quantum wells, quantum wires, and quantum dots) and their size-dependent behavior. | -Quantum confinement<br>-Surface-to-volume ratio effects | Whiteboard and LCD | Oral and written exams |
| 3 | 2 | Students will be able to:<br>1. Describe the electrical properties of nanostructures and how quantum effects influence conductivity and charge transport.<br>2. Analyze optical properties of nanoscale materials, including absorption, scattering, photoluminescence, and plasmonic effects.<br>3. Discuss magnetic properties at the nanoscale, including phenomena such as superparamagnetism.<br>4. Evaluate mechanical properties of nanomaterials, including strength, hardness, flexibility, and their dependence on structure and size. | -Fundamental Properties at the Nanoscale (Electrical, optical, magnetic, and mechanical properties) | Whiteboard and LCD | Oral and written exams |
| 4 | 2 | students will be able to:<br>1. Classify nanomaterials into zero-dimensional (0D), one-dimensional (1D), two-dimensional (2D), and three-dimensional (3D) nanostructures. | Nanomaterials I – Types (Zero-, one-, two-, and three-dimensional nanostructures | Whiteboard and LCD | Oral and written exams |
| 5 | 2 | students will be able to:<br>1. Identify and classify carbon-based | Nanomaterials II – Carbon-based Nanostructures | Whiteboard and LCD | Oral and written exams |

| | | | | | |
|---|---|---|---|---|---|
| | | nanostructures, including fullerenes, carbon nanotubes (CNTs), graphene, nanodiamonds, and related forms. | | | |
| 6 | 2 | students will be able to:<br>1. Explain the principles of top-down fabrication and its importance in nanotechnology.<br>2. Describe the working principles of lithography techniques, including optical lithography and electron-beam lithography.<br>3. Differentiate between optical and electron-beam lithography in terms of resolution, cost, scalability, and applications. | Fabrication Methods I (Top-Down)<br>-Lithography (optical, electron beam)<br>-Etching and milling techniques | Whiteboard and LCD | Oral and written exams |
| 7 | 2 | students will be able to:<br>1. Explain the principles of bottom-up fabrication and compare it with top-down approaches.<br>2. Describe the working mechanism of Chemical Vapor Deposition (CVD) and its role in producing thin films and nanostructures.<br>3. Differentiate between types of CVD processes (thermal CVD, plasma-enhanced CVD, atomic layer deposition, etc.) and their applications. | Fabrication Methods II (Bottom-Up)<br>-Chemical vapor deposition (CVD)<br>-Sol-gel techniques | Whiteboard and LCD | Oral and written exams |
| 8 | 2 | Evaluate the Students | First Mid Exam | | written exams |
| 9 | 2 | students will be able to:<br>**1.** Explain the fundamental principles of electron microscopy and scanning probe microscopy at the nanoscale.<br>**2.** Describe the working mechanism of Scanning Electron Microscopy (SEM), including electron–sample interactions and image formation.<br>**3.** Identify the major components of SEM (electron gun, lenses, detectors) and their functions.<br>**4.** Explain the working principle of Scanning Tunneling Microscopy | Characterization techniques: Electron microscopy - SEM, STM. | Whiteboard and LCD | Oral and written exams |

| | | | | | |
|---|---|---|---|---|---|
| | | (STM) and the concept of quantum tunneling.<br>**5.** Differentiate between SEM and STM in terms of resolution, sample requirements, and applications. | | | |
| 10 | 2 | students will be able to:<br>**1.** Explain the working principle of TEM, including electron transmission through ultrathin samples<br>**2.** Explain the working principle of AFM, including probe–surface interactions.<br>**3.** Describe the principle of EDX as an analytical technique for elemental composition analysis. | Characterization techniques: TEM, EDX, AFM. | Whiteboard and LCD | Oral and written exams |
| 11 | 2 | students will be able to:<br>Describe the applications of nanomaterials in electronic devices, such as transistors, sensors, and memory storage. | Applications of Nanoscience I (Physics & Electronics) | Whiteboard and LCD | Oral and written exams |
| 12 | 2 | students will be able to:<br>1. Explain the role of nanoscience in medicine and biotechnology, emphasizing nanoscale interactions with biological systems.<br>2. Describe the use of nanomaterials in drug delivery, targeted therapy, and controlled release systems. | Applications of Nanoscience II (Medicine & Biotechnology) | Whiteboard and LCD | Oral and written exams |
| 13 | 2 | Students will be able to:<br>Describe the application of nanomaterials in solar cells, photocatalysis, and thermoelectric devices. | Applications of Nanoscience III (Energy & Environment) | Whiteboard and LCD | Oral and written exams |
| 14 | 2 | Evaluate the Students | Second Mid Exam | | written exams |
| 15 | 2 | Develop confidence in public speaking | Seminar | Whiteboard and LCD | Oral exams |

## 11.Course Evaluation

- The coursework grade is out of 40 points and includes (monthly tests, homework assignments, and daily quizzes).
- The final exam grade is out of 60 points.

## 12.Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | |
| Main references (sources) | - Introduction to nanoscience<br>2010- S.M. LINDSAY |
| Recommended books and references (scientific journals, reports...) | |
| Electronic References, Websites | |

# Course Description Form

1. Course Name: Nuclear physics

2. Course Code: physics

3. Semester / Year: Quarterly 2025/2026

4. Description Preparation Date: 2025/2026

5. Available Attendance Forms: mandatory attendance

6. Number of Credit Hours (Total) / Number of Units (Total) :3/3

7. Course administrator's name (mention all, if more than one name)

Name: Prof.Dr.Kareem Khalaf Mohammad
Email: karee.mohammad@nahrainuniv.edu.iq

8. Course Objectives

| | |
|---|---|
| **Course Objectives** | **The main objectives of this course is hopefully be achieved in the following steps:**<br>• **An overview of the history of physics of the nucleus.**<br>• **A review of elements of quant mechanics necessary to understa nuclear physics.**<br>• **Introduction of the liquid drop mo and shell model**<br>• **Applications to the study of natu radioactivity and nuclear reactions.** |

9. Teaching and Learning Strategies

| | |
|---|---|
| **Strategy** | a- knowledge and understanding<br>To provide students with an opportunity to develop knowledge and understanding of the key principles applications of Nuclear Physics, and their relevance to current developments in physics.<br>b - Subject-specific skills<br><br>c- Teaching and learning methods<br>- Theoretical lectures<br>- Asking students a set of thinking questions during the lectures for specific topics.<br>- Giving students homework that requires finding self-solutions.<br>d- Evaluation methods<br>- daily tests<br>- Monthly exams<br>- Homework and student interaction in discussion sessions<br>-Thinking skills: Scientific problem solving skills<br>Giving students problems that need to be solved by referring to external references that can be found via Internet<br>- General and transferable skills (other skills related to employability and personal development).<br>- Follow up on the scientific development of curricula for international universities via the Internet |

## 10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| 1 | 3 | Background and basic nu properties | Historical review and ge introduction The atomic mass Energy unit Basic nuclear prope | (theoretical) | Oral and written exan |
| 2 | 3 | Basic nuclear properties | The size of the nucleus, Nu energy level, Intrinsic an momentum of the nucleus, Nu electromagnetic moment, Electric Quadra pole moment, Pa | (theoretical) | Oral and written exa |
| 3 | 3 | Yukawa's mesons field the Nuclear binding energy, ave binding energy | Yukawa's mesons field the Nuclear binding energy | (theoretical) | Oral and written exan |
| 4 | 3 | Nuclear forces, Separation ener nuclear particle | Nuclear forces, Separation ener nuclear particle (alpha neu proton), Abundance systematic c stable nuclides | (theoretical) | Oral and written exan |
| 5 | 3 | Nuclear models | Nuclear models, Electron pr hypothesis, Prout hypothesis | (theoretical) | Oral and written exan |
| 6 | 3 | Liquid drop model, mass parab | Liquid drop model, Mass parab | (theoretical) | Oral and written exan |
| 7 | 3 | Mid Exam-1 | Mid Exam | | |
| 8 | 3 | Shell model | Shell model , potential, Finite infinite square potential, harm | (theoretical) | Oral and written exan |
| 9 | 3 | Shell model and optical model | potential Spin orbit potential, Prediction | (theoretical) | Oral and written exan |
| 10 | 3 | Interaction of radiation with ma | shell model, Optical mo Interaction of radiation with | (theoretical) | Oral and written exan |
| 11 | | Interaction of radiation with ma | matter, Statistical nature of radia Heavy charge particles, Light ch | (theoretical) | Oral and written exan |
| 12 | 3 | Interaction of radiation with ma | particles, Neutrons, Electromagnetic radia | theoretical) | Oral and written exan |
| 13 | 3 | Exposure and dose | Exposure and dose principles, | (theoretical) | Oral and written exan |
| 14 | 3 | | | | |
| 15 | 3 | Shielding Mid Exam-2 | Shielding principles Mid Exam-2 | (theoretical) | Oral and written exan |

## 11.Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

## 12.Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | Walter E. Meyerhof: elements of nuclear physics |
| Main references (sources) | Walter E. Meyerhof: elements of nuclear physics |
| Recommended books and references (scientific journals, reports...) | •Kenneth S. Krane: Introductory nuclear physics<br>•Henry Semat and John R. Albright: Introduction to atomic and nucle physics<br>•Beiser: Concept of modern physics<br>•Irving Kaplan: Nuclear physics<br>•Cohen: Concepts of Nuclear Physics<br>•Kupta: Concepts of Modern Physics |
| Electronic References, Websites | Internet |

Nuclear physics Laboratory:

1. Lecturer Isam Mohammed Rasheed
2. Assistant Lecturer Suhaib Qusay Abdullah
3. Assistant Lecturer Saja Hazem Mohammed

# الكورس الثاني

# Course Description Form

| |
|---|
| 1. Course Name: |
| **Mathematical Physics II** |
| 2. Course Code: |
| |
| 3. Semester / Year: |
| 2nd semester / 4th year Physics |
| 4. Description Preparation Date: |
| 1/2/2026 |
| 5. Available Attendance Forms: |
| Immanence |
| 6. Number of Credit Hours (Total) / Number of Units (Total) |
| 30hr( 2 hours per week) / 2unit |
| 7. Course administrator's name (mention all, if more than one name) |
| **Name: Assist. Prof. Dr. Hassan N. Hashim**<br>Email: hassan.hashim@nahrainuniv.edu.iq |
| 8. Course Objectives |

| | |
|---|---|
| **Course Objectives** | • Teaching the students the principles of Mathematical Physics.<br>• Give the Students the ability and experience to solve and discuss the problems related with Mathematical Physics.<br>• Make a connection between the theoretical principles and the experimental applications. |
| 9. Teaching and Learning Strategies | |
| **Strategy** | - Discussing the subject's syllabus of the textbook and the related references.<br>- The attendance lectures contain solving problems and discussions for homework.<br>- Asking the students different thinking questions throughout the lectures in a specific subjects related to mathematical Physics.<br>- Giving the students homework that needs self-solutions. |

## 10. Course Structure

| Week | Hours | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|
| 1 | 2 | Higher Derivatives and Leibniz' rule for differentiating a product | Theoretical | Quizzes |
| 2 | 2 | Rodriges Formula | Theoretical | Quizzes |
| 3 | 2 | Generalized Power series, or the Method of Frobenius | Theoretical | Quizzes |
| 4 | 2 | Bessel's Equation and the Bessel's Function | Theoretical | Quizzes |
| 5 | 2 | The Second Solution of Bessel's Function | Theoretical | Quizzes |
| 6 | 2 | Notes on Tables, Graphs, and Zeros of Bessel's Function | Theoretical | Quizzes |
| 7 | 2 | Recursion Relations with Bessel's Function | Theoretical | Quizzes |
| 8 | 2 | Integral Transform | Theoretical | Quizzes |
| 9 | 2 | The uses of Integral Transform | Theoretical | Quizzes |
| 10 | 2 | **Test #1** | Theoretical | Writing Test |
| 11 | 2 | Laplace's Transform / Some Theorems | Theoretical | Quizzes |
| 12 | 2 | Inverse Laplace's Transform | Theoretical | Quizzes |
| 13 | 2 | Solution of Differential Equations by Laplace's Transform | Theoretical | Writing Test |
| 14 | 2 | **Test #2** | Theoretical | Writing Test |
| 15 | 2 | **Summary** | Theoretical | |
| 16 | 3 | **Final Examination** | Theoretical | Writing Exam |

## 11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc.

## 12. Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | ✓ "**Mathematical Methods in the Physical Sciences**", By: Mary L. Boas, 2nd Edition, 1983. |
| Main references (sources) | ✓ **Advanced Calculus**, 3rd Edition, Angus E. Taylor, and W. Robert Mann, 1983. |
| Recommended books and references (scientific journals, reports…) | Any Book related with the following titles:<br>1. Mathematical Methods<br>2. Applied Mathematics for Physicists and Engineers.<br>3. Mathematical Physics. |
| Electronic References, Websites | Any website with the above titles. |

# Course Description Form

| 1. Course Name: | |
|---|---|
| Plasma physics | |
| 2. Course Code: | |
| | |
| 3. Semester / Year: | |
| 2026/2nd Semester / 4th year | |
| 4. Description Preparation Date: | |
| 2026 | |
| 5. Available Attendance Forms: | |
| Mandatory attendance | |
| 6. Number of Credit Hours (Total) / Number of Units (Total) | |
| 2 hours per week /2units | |
| 7. Course administrator's name (mention all, if more than one name) | |
| Name: Dr. Wildan Mohammed Awad<br>Email: wildan.awad@nahrainuniv.edu.iq | |
| 8. Course Objectives | |
| **Course Objectives** | ***Enable students to know the basics of plasma physics**<br>***Enabling students to understand how to use plasma sources**<br>• |
| 9. Teaching and Learning Strategies | |
| **Strategy** | - Discussion of the topics covered in the textbook and supplementary references.<br>- Theoretical lectures including problem-solving and discussion of homework assignments.<br>- Asking students to pose a series of critical thinking questio during lectures on specific topics.<br><br>Assigning homework assignments that require independe problem-solving. |
| 10. Course Structure | |

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| 1 | 2 | Study Introduction to Plasma | Introduction to Plasma | Theoretical | Daily oral and written exam |
| 2 | 2 | Understand Plasma Parameters | Plasma Parameters | Theoretical | Daily oral and written exam |
| 3 | 2 | Understand Debye Shielding | Debye Shielding | Theoretical | Daily oral and written exam |
| 4 | 2 | Understand Saha equation | Saha equation | Theoretical | Daily oral and written exam |
| 5 | 2 | Understand Single Particle Motion | Single Particle Motion | Theoretical | Daily oral and written exam |
| 6 | 2 | Understand Plasma Drifts | Plasma Drifts | Theoretical | Daily oral and written exam |
| 7 | 2 | Understand Non-uniform B-Field | Non-uniform B-Field | Theoretical | Daily oral and written exam |
| 8 | 2 | Understand Magnetic Mirrors | Magnetic Mirrors | Theoretical | Daily oral and written exam |
| 9 | 2 | Understand Adiabatic invariants | Adiabatic invariants | Theoretical | Daily oral and written exam |
| 10 | 2 | Understand Classical Treatments | Classical Treatments | Theoretical | Daily oral and written exam |
| 11 | 2 | Understand the Types of Plasma | Types of Plasma | Theoretical | Daily oral and written exam |
| 12 | 2 | Understand Plasma generation | Plasma generation | Theoretical | Daily oral and written exam |
| 13 | 2 | Understand Plasma application | Plasma application | Theoretical | Daily oral and written exam |
| 14 | 2 | Summary | Summary | Theoretical | Daily oral and written exam |
| 15 | 2 | Final Examination | Final Examination | Theoretical | Daily oral and written exam |

## 11. Course Evaluation

40/100 (25 monthly exams + 5 homework assignments + 10 daily tasks)
60/100 Final exam

## 12. Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | |
| Main references (sources) | Chen, Francis F. Introduction to plasma physics. Springer Science & Business Media, 2012. |
| Recommended books and references (scientific journals, reports…) | Boenig, Herman. Plasma science and technology. Cornell University Press, 2019. |
| Electronic References, Websites | |

# Course Description Form

1. Course Name:

Ethics

2. Course Code:

3. Semester / Year:

Second/ 2026

4. Description Preparation Date:

28/1/2026

5. Available Attendance Forms:

Physical attendance

6. Number of Credit Hours (Total) / Number of Units (Total)

1 hour weekly (15 total)/ 1 unit

7. Course administrator's name (mention all, if more than one name)

Name: Assist. Prof. Dr. Sadeem Abbas Fadhil
Email: sadeemfadhil@yahoo.com

8. Course Objectives

| | |
|---|---|
| **Course Objectives** | 1. Enable students to understand the fundamental principles and values of scientific research ethics.<br>2. Distinguish between ethical scientific practices and research misconduct (plagiarism, fabrication, falsification).<br>3. Understand the professional responsibilities of a physicist regarding data accuracy, laboratory safety, and environmental impact.<br>4. Develop skills in proper citation, authorship, and publication ethics. |

9. Teaching and Learning Strategies

| | |
|---|---|
| **Strategy** | • **Lectures:** Direct instruction on ethical concepts and codes of conduct.<br>• **Case Studies:** Analyzing real-world examples of ethical failures and scientific disasters to understand consequences. |

| | |
|---|---|
| | • **Discussions:** Open dialogue on hypothetical scenarios relevant to physics research. |

## 10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| 1 | 1 | Definitions, importance ethics science, and difference between mor and professional ethics. | **Introduction to Scientific Research Ethics** | Whiteboard | Oral and written exams |
| 2 | 1 | In-depth discussion on Objectivity, Accuracy, and Neutrality in scientific inquiry | **The Researcher's Value System** | Whiteboard | Oral and written exams |
| 3 | 1 | Plagiarism – definition, types, and the boundary between legitimate quotation and theft. | **Research Misconduct (Part 1)** | | Oral and written exams |
| 4 | 1 | Fabrication and Falsification – The dangers of inventing data or altering results to fit a hypothesis. | **Research Misconduct (Part 2)** | Whiteboard | Oral and written exams |
| 5 | 1 | Integrity in physics experiments, handling raw data, and the ethics of digital image/signal processing. | Ethics of Data & Measurement | Whiteboard | Oral and written exams |
| 6 | 1 | How to cite sources properly, writing | **Citation & Intellectual Property** | Whiteboard | Oral and written exams |

| | | | | | |
|---|---|---|---|---|---|
| | | references, and respecting copyright. | | | |
| 7 | 1 | Writing the Introduction, Methods, and Results sections honestly and clearly. | **Structure of Ethical Research** | | |
| 8 | 1 | Who qualifies as an author? (Ghost vs. Honorary authorship), duplicate submission, and slicing. | **Publication Ethics & Authorship** | Whiteboard | Oral and written exams |
| 9 | 1 | - | 1st Midterm exam | | |
| 10 | 1 | The physicist's duty toward society, environmental sustainability, and laboratory safety ethics. | **Social & Environmental Responsibility** | Whiteboard | Oral and written exams |
| 11 | 1 | Ethics of teamwork, the supervisor-student relationship, and peer review integrity. | **Professional Relationships** | Whiteboard | Oral and written exams |
| 12 | 1 | Identifying and disclosing financial or personal conflicts in research. | **Conflict of Interest** | Whiteboard | Oral and written exams |
| 13 | 1 | Analysis of historical scientific failures caused by unethical behavior or negligence. | **Case Studies** | Whiteboard | Oral and written exams |

| | | | | | |
|---|---|---|---|---|---|
| 14 | 1 | Interactive session resolving hypothetical ethical dilemmas in a physics lab. | **Scenario Discussions** | Whiteboard | Oral and written exams |
| 15 | 1 | Comprehensive review of course material. | **Final Review** | Whiteboard | Oral and written exams |

## 11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc
-Daily exams and attendance 10 Marks
-Mid term exams 25 Marks
-Home works and reports 5 Marks
- Final exam 60 Marks

## 12. Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | نبيل عبد الرزاق جاسم، *قواعد وأخلاقيات ممارسة مهنة الهندسة*، الطبعة الأولى، دار ومكتبة البصائر للطباعة والنشر والتوزيع، بيروت، 2013. |
| Main references (sources) | Resnik, D. B., "What is Ethics in Research & Why is it Important?", National Institute of Environmental Health Sciences (NIEHS). |
| Recommended books and references (scientific journals, reports…) | American Physical Society (APS), "Guideline on Ethics: Fabrication of Data". |
| Electronic References, Websites | Online resources on Academic Integrity and COPE (Committee on Publication Ethics) guidelines. |

# Course Description Form

## 1. Course Name:

Environment and Pollution

## 2. Course Code:

## 3. Semester / Year:

Fourth Class/2nd Sem. 2025-2026

## 4. Description Preparation Date:

30/1/2026

## 5. Available Attendance Forms:

Physical Attendance

## 6. Number of Credit Hours (Total) / Number of Units (Total)

2 Hours

## 7. Course administrator's name (mention all, if more than one name)

Name: Assis. Prof. Dr. Jazeel Hussein Azeez

Email: Jazeel.azeez@nahrainuniv.edu.iq

## 8. Course Objectives

| | |
|---|---|
| **Course Objectives** | • Providing basic knowledge about environmental pollution and its impact on ecosystems.<br>• Introducing the different types and sources of pollution, including water, air, soil, and thermal pollution.<br>• Exploring methods to control pollution and strategies to mitigate it.<br>• Highlighting the importance of ecological balance and sustainability. |

## 9. Teaching and Learning Strategies

| | |
|---|---|
| **Strategy** | • Theoretical lectures<br>• Scientific discussion<br>• Assignments and Homework |

## 10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| 1 | 2 | Introduction to Environment and Pollution (Concept of environment – pollution – pollutants) | To define the concepts of environment, pollution, and pollutants. | Whiteboard and LCD | Oral and written exams |
| 2 | 2 | Types of Pollution and Their General Sources (Air, water, soil, noise, thermal, radiation) | To distinguish between different types of pollution and their sources. | Whiteboard and LCD | Oral and written exams |

| | | | | | |
|---|---|---|---|---|---|
| 3 | 2 | Air Pollution: Concept and Sources (Particulate and gaseous pollutants) | To identify the sources and types of air pollutants. | Whiteboard and LCD | Oral and written exams |
| 4 | 2 | Effects of Air Pollution and Control Methods (Industrial and traffic control | To explain the effects of air pollution and methods of control | Whiteboard and LCD | Oral and written exams |
| 5 | 2 | Water Pollution: Sources and Types | To explain the causes and types of water pollution | Whiteboard and LCD | Oral and written exams |
| 6 | 2 | Thermal Pollution | To clarify the impact of thermal pollution | Whiteboard and LCD | Oral and written exams |
| 7 | 2 | First Mid Exam | Evaluate the Student | | written exams |
| 8 | 2 | Wastewater Treatment and Water Recycling | To explain the stages of wastewater treatment and the importance of reuse | Whiteboard and LCD | Oral and written exams |
| 9 | 2 | Soil Pollution and Its Sources (Solid waste, pesticides, fertilizers | To identify the sources of soil pollution and its environmental effects | Whiteboard and LCD | Oral and written exams |
| 10 | 2 | Control of Soil Pollution and Waste Management (Vermicomposting, treatment, plastic reduction) | To explain methods for controlling soil pollution and waste management | Whiteboard and LCD | Oral and written exams |
| 11 | 2 | Noise Pollution: Sources, Effects, Measurement and Control | To explain the sources of noise pollution and its health and environmental effects | Whiteboard and LCD | Oral and written exams |
| 12 | 2 | Global Warming and Ozone Hole (Causes and effects | To explain the causes and effects of global warming and ozone depletion | Whiteboard and LCD | Oral and written exams |
| 13 | 2 | Radiation Pollution: Sources and Hazards (Types of radiation, dose, biological effects) | To identify the sources of radiation pollution and its environmental hazards | Whiteboard and LCD | Oral and written exams |
| 14 | 2 | Second Mid Exam | Evaluate the Student | | written exams |
| 15 | 2 | Seminar | To develop confidence in public speaking | Whiteboard and LCD | Oral and written exams |

## 11. Course Evaluation

40 Marks (Mid exam + Homework+ Quizzes+ Seminar)
60 Marks Final Exam

## 12. Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | Environmental and Pollution Science THIRD EDITION<br>Mark L. Brusseau, Ian L. Pepper, and Charles P. Gerba<br>Academic Press |
| Main references (sources) | |

| | |
|---|---|
| Recommended books and references (scientific journals, reports…) | |
| Electronic References, Websites | |

# Course Description Form

| |
|---|
| 1. Course Name: |
| Solid State Physics II |
| 2. Course Code: |
| PHYS4202 |
| 3. Semester / Year: |
| 2nd course / 4th year |
| 4. Description Preparation Date: |
| 1/2/2026 |
| 5. Available Attendance Forms: |
| In person or Online |
| 6. Number of Credit Hours (Total) / Number of Units (Total) |
| 6 hours weekly (3 H theoretical + 3 H practical ) |
| 7. Course administrator's name (mention all, if more than one name) |
| Name: Asst. Prof. Dr. Mohammed Tariq<br>Email: Mohammed.albaidhani@nahrainuniv.edu.iq |

| 8. Course Objectives | |
|---|---|
| **Course Objectives** | • Teach the student the basic concepts of solid state physics.<br>• Providing the student with the skills to discuss and solve applied problems related to solid state physics.<br>• Linking theoretical concepts with practical applications. |
| 9. Teaching and Learning Strategies | |
| **Strategy** | • Discussing the topics of the methodological book and auxiliary references<br>• Theoretical lectures including problem solving and discussion of homework<br>• Asking students for a set of thinking questions during lectures on specific topics.<br>• Giving students homework that requires finding solutions on their own. |

## 10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| 1 | 3 | Learning | Summery for the first semester | Theoretical | Oral and written |

| | | | | | |
|---|---|---|---|---|---|
| 2 | 3 | Learning | Introduction to Diffraction X-ray, neutron, electron | Theoretical | Oral and written |
| 3 | 3 | Learning | Methods of diffraction Laue, Rotating method, Powder method | Theoretical | Oral and written |
| 4 | 3 | Learning | Bragg diffraction law | Theoretical | Oral and written |
| 5 | 3 | Learning | Calculation of hkl for cubic systems from XRD patters | Theoretical | Oral and written |
| 6 | 3 | Learning | Brillouin zone Bragg plane | Theoretical | Oral and written |
| 7 | 3 | Learning | Crystal Binding Ionic, electronegativity Covalent, Metallic, Van der Waals, Hydrogen bonds | Theoretical | Oral and written |
| 8 | 3 | Learning | Bulk modulus | Theoretical | Oral and written |
| 9 | 3 | Learning | Compressibility, ductility, malleability, hardness | Theoretical | Oral and written |
| 10 | 3 | Learning | Crystal imperfection (defects) | Theoretical | Oral and written |
| 11 | 3 | Learning | Defects classification All types of defects | Theoretical | Oral and written |
| 12 | 3 | Learning | Lattice vibration Diatomic lattice Acoustic and optic modes | Theoretical | Oral and written |
| 13 | 3 | Learning | Origin of optic and acoustic branches Displacement patterns | Theoretical | Oral and written |
| 14 | 1 | Learning | Test | Theoretical | Oral and written |
| 15 | 3 | Learning | Summary | Theoretical | Oral and written |
| 16 | 3 | exam | Final Examination | Theoretical | Oral and written |

## 11. Course Evaluation

40 points (10 laboratory + 10 homework + 20 mid exam)
60 points (10 laboratory exam + 50 final exam)

## 12. Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | 1. Introduction to Solid State Physics (Wiley, Global Edition) By: Charles Kittel ISBN: 978-1-119-45620-9 (August 2018) (712 Pages). 2. Introduction to Solid State Physics (Wiley, India Edition) By: Charles Kittel ISBN-13: 978-8-126-57843-6 (2019) (712 Pages). |

| | |
|---|---|
| Main references (sources) | Solid State Physics (Revised Edition, Cengage Learning Asia Pte Ltd)<br>By: Neil W. Ashcroft ISBN-13: 978-981-4369-89-3 (2016) (1294 Pages). |
| Recommended books and references (scientific journals, reports…) | Einfuhrung in die Festkorperphysik (6th Edition, Teubner GmbHWiesbaden)<br>By: K. Kopitzki ISBN:978-3-8351-0144-9 (2007) (483 Pages). |
| Electronic References, Websites | Any website with the above titles.<br>View solid state physics courses at reputable universities. |

Solid State Physics Laboratory:

1. Assistant Lecturer Wsan Ali Khudair
2. Assistant Lecturer Zina Mowafaq Qaddouri
3. Assistant Lecturer Norhan Sabah Juma'a
4. Assistant Lecturer Mais Atallah Wahsh

# Second Course- Nuclear physics- Course description

This course explores elements of nuclear physics for physics students. It covers nuclear decay, (alpha , beta, and gamma decay), Nuclear reactions, nuclear fission, nuclear fusion, nuclear reactors The lecture course will be integrated with problem solving classes.


أ. Pro. Dr. Kareem Khalaf Mohammad (theoretical)

ب. Essam. mohamed Rasheed (practical )

ت. Ammar abd al satter (practical )

ث. Saja hazem( practical )

ج. Suhaeeb abd allha( practical )


| | |
|---|---|
| 1. Educational Institution | University Al-Nahrain- College Science |
| 2. University Department / Center | Department Physics |
| 3. Course name/code | Nuclear Physics |
| 4. Programs in which it enters | - |
| 5. Forms of attendance available | mandatory attendance |
| 6. Semester/year | Quarterly |
| 7. Number of hours of study ((total | hours per week total 60 hours 3 |
| 8. Date this description was prepared | 2025-2026 |
| 9. Course objectives | |

The main objectives of this course is hopefully to be achieved in the following steps:

- An overview of the history of the physics of the nucleus.
- A review of elements of quantum mechanics necessary to understand nuclear physics.
- Introduction of the liquid drop model and shell model
- Applications to the study of natural radioactivity and nuclear reactions.

| |
|---|
| 10. Learning outcomes and methods of teaching, learning and assessment |
| أ- knowledge and understanding<br>To provide students with an opportunity to develop knowledge and understanding of the key principles and applications of Nuclear Physics, and their relevance to current developments in physics. |
| ب - Subject-specific skills |
| Teaching and learning methods |
| - Theoretical lectures<br>- Asking students a set of thinking questions during the lectures for specific topics.<br>- Giving students homework that requires finding self-solutions. |
| Evaluation methods |
| - daily tests<br>- Monthly exams<br>- Homework and student interaction in discussion sessions |
| -Thinking skills: Scientific problem solving skills<br>Giving students problems that need to be solved by referring to external references that can be found via the Internet |
| - General and transferable skills (other skills related to employability and personal development).<br>- Follow up on the scientific development of curricula for international universities via the Internet |

## Course Structure .11

| Evaluation method | education method | Unit/course or topic name | Required learning outcomes | Hours | Week |
|---|---|---|---|---|---|
| Oral and written exam | theoretical) ( | Theory of alpha decay | Alpha Decay | 3 | 1 |
| Oral and written exam | theoretical) ( | Decay constant, average life | Alpha Decay | 3 | 2 |
| Oral and written exam | theoretical) ( | Conservation law Conservation of angular momentum, Conservation of liner momentum | Beta Decay | 3 | 3 |
| Oral and written exam | theoretical) ( | Conservation of energy<br>Energy release in beta decay<br>Classification of beta decay | Beta Decay | 3 | 4 |
| Oral and written exam | theoretical) ( | Energy release in gamma Decay<br>Selection rules for gamma decay | Gamma Decay | 3 | 5 |
| Oral and written exam | theoretical) ( | Selection rules for gamma decay | Gamma Decay | 3 | 6 |
| | | Mid Exam-1 | Mid Exam | | 7 |
| Oral and written exam | theoretical) ( | Transmutation equation and Q value of a nuclear reactions<br>Conservation laws and Q value of a nuclear reactions<br>Threshold energy | Nuclear Reaction | 3 | 8 |
| Oral and written exam | theoretical) ( | Type of nuclear reaction<br>Reaction cross section<br>Compound nucleus reaction<br>Direct reaction | Nuclear Reaction | 3 | 9 |
| Oral and written exam | theoretical) ( | Time independent Schrodinger wave equation. One Dimension and 3 Dimension | Schrodinger wave equation | 3 | 10 |
| Oral and written exam | theoretical) ( | Schrodinger wave equation, radial wave, angular and spherical harmonics | Quantum theory of hydrogen atom | 3 | 11 |
| Oral and written exam | (theoretical | The essential components of Reactor Core, Reactor Moderator Reactor Reflector, Reactor, Coolant, Reactor Control, Material, Reactor Shielding Effective Multiplication Factor: | Nuclear Reactor | 3 | 12 |
| Oral and written exam | theoretical) ( | Distribution of Fission Energy, Fission Mechanism, Effects of a 100-kt nuclear bomb and | Nuclear Fission and fusion | 3 | 13 |
| Oral and written exam | theoretical) ( | Exposure and dose | Exposure and dose principles, | 4 | 14 |
| | | Mid Exam-2 | Mid Exam-2 | 4 | 15 |

| Infrastructure | |
|---|---|
| ➢ Text Book:<br>• Walter E. Meyerhof: elements of nuclear physics<br>• Kenneth S. Krane: Introductory nuclear physics<br>• Henry Semat and John R. Albright: Introduction to atomic and nuclear physics<br>• Beiser: Concept of modern physics<br>• Irving Kaplan: Nuclear physics<br>• Cohen: Concepts of Nuclear Physics<br>• Kupta: Concepts of Modern Physics | :Required readings<br>Basic Texts<br>Course Books<br>Other ▪ |
| / | Special requirements (including, for example, workshops, courses, software (and websites |
| NON | Social services (including guest lectures, professional training (and field studies |

| Acceptance .12 | |
|---|---|
| NON | Prerequisites |
| 10 | Less number of students |
| 40 | More number of students |

On successful completion of the course students will be able to:

1. Have acquire knowledge and understanding about the electronic and nuclear structure of atoms.

2. Have solved problems related to the structure of atoms and the effect of ionizing radiation on the body and the environment.

3. Have an appreciation of the influence of atomic and nuclear physics on modern scientific development.

4. Have the foundations for examining in more detail various aspects of experimental and theoretical physics which relate to both atomic and nuclear physics.

5. Be able to explain the key areas in which Atomic and Nuclear Physics affects everyday living.

# Course Description Form

| |
|---|
| 1. Course Name: |
| Electromagnetic Theory |
| 2. Course Code: |
| PHY 323 |
| 3. Semester / Year: |
| 2nd Semester- 2025/ 2026 |
| 4. Description Preparation Date: |
| 2-1-2026 |
| 5. Available Attendance Forms: |
| |
| 6. Number of Credit Hours (Total) / Number of Units (Total) |
| Total 45 hours/ |
| 7. Course administrator's name (mention all, if more than one name) |
| Name: Prof. Dr. Ahmed H. Flayyih<br>Email: ahmed.hmood@alnahrainUniv.edu.iq |
| 8. Course Objectives |

**Course Objectives**

- Defining the magnetic field and understanding its calculation.
- Calculating the magnetic field produced by a stationary charge, a moving charge, and a different current distribution.
- Applying the boundary condition for calculating magnetic fields between two different media.
- Identifying methods for generating an electric field from a magnetic field, its types, and determining the direction of the generated current.

9. Teaching and Learning Strategies

**Strategy**

**Note-taking**

Learners rely on note-taking to enhance their understanding and comprehensi of the educational content presented to them. This strategy is used in traditio classrooms or in virtual learning, where distractions are reduced and interacti is increased.

**Summarizing**

Summarizing reflects the learner's understanding and comprehension of t educational content by rewriting it in a concise, simplified, and clearer manner. importance is highlighted when simplifying complex concepts, which in turn he them remember the content effectively.

**Memorization**

When the content presented to learners is simple and easy to memorize, they r on repeated memorization of the information to solidify it in their minds. They u various techniques for memorizing information, including dividing it into sm groups of information or using modern technologies such as memory devic

Mind Maps

This strategy relies on organizing content in the form of an organizational cha diagram, or table. It is effective for complex information, as it connects relat concepts, which helps organize ideas and information visually and bet understand complexities.

Quiz Tests

This recall strategy relies on the learner's ability to remember and focus on t information presented. These tests measure the learner's ability to remember a concentrate while receiving the information.

10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| 1 | 3 hours | General theory of solving the electrostatic problems | Chapter One: Electrostatic Boundary-Value Problems Poisson's and Laplace's Equations UNIQUENESS THEOREM | White Board and smart screen | Discuss And information Test |
| 2 | 3 hours | Procedure | General Procedure for Solving Poisson's or Laplace's | White Board and smart screen | Home work |
| 3 | 3 hours | Application | RESISTANCE AND CAPACITANCE Parallel-Plate Capacitor Coaxial Capacit Spherical Capac | White Board and smart screen | Discuss And information Test |
| 4 | 3 hours | Skills enhancement | PRACTICE EXERCISE | White Board and smart screen | Quiz |
| 5 | 3 hours | General information on the Electromagnetic theory | Chapter TWO: Magneto static Fields Biot-Savart's Law PRACTICE EXERCISE | White Board and smart screen | Home work |

| | | | | | |
|---|---|---|---|---|---|
| 6 | 3 hours | Physical law in electromagnetic theory | Ampere's Circuit Law—Maxwell's Equation<br>Applications of Ampere's Law | White Board and smart screen | Seminar |
| 7 | 3 hours | Electromagnetic Fields | Magnetic Flux Density—Maxwell's Equation<br>MAXWELL'S EQUATIONS FOR STATIC EM FIELDS<br>Magnetic Scalar and Vector Potentials<br>PRACTICE EXERCISE | White Board and smart screen | Exam |
| 8 | 3 hours | The mathematical form of EM Law | Derivation of Biot-Savart's Law and Ampere's Law | White Board and smart screen | Discuss And information Test |
| 9 | 3 hours | Fundamentals of EM fields in conduction materials | Chapter three: Magnetic Forces, Materials, and Devices<br>Forces due to Magnetic Fields<br>Force on a Charged Particle<br>Force on a Current Element<br>Force between Two Current Elements<br>PRACTICE EXERCISE | White Board and smart screen | Discuss And information Test |
| 10 | 3 hours | applications | MAGNETIC TORQUE AND MOMENT<br>A Magnetic Dipole<br>Magnetization in Materials<br>PRACTICE EXERCISE | White Board and smart screen | Home work |
| 11 | 3 hours | General information on the Magnetization in materials | Magnetization in materia<br>classification of magnetic materials, magnetic boundary conditions, | White Board and smart screen | Oral test |
| 12 | 3 hours | Skills Development | Inductors and Inductances<br>MAGNETIC ENERGY<br>PRACTICE EXERCISE<br>Magnetic Circuits<br>Force on Magnetic Mater | White Board and smart screen | Quiz |

| | | | | | |
|---|---|---|---|---|---|
| 13 | 3 hours | General information on the Electromagnetic theory | Chapter Four WAVES AND APPLICATIONS Faraday's law, transforme and motional emfs, movi loop in static b field (motional emf), moving l in time-varying field | White Board and smart screen | Discuss |
| 14 | 3 hours | applicati | Displacement current, Maxwell's equations in fi forms, time-varying potentials, and time-harmonic fields. | White Board and smart screen | Exam |
| 15 | 3 hours | | Review | White Board and smart screen | |

## 11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

## 12. Learning and Teaching Resources

| | |
|---|---|
| Required textbooks (curricular books, if any) | **Elements of Electromagnetics**, by Maththew N.O. Sadiku,New York, Oxford, 5th ed., 2011.<br>**Foundations of Electromagnetic Theory**<br>by Frederick J. Milford, John R. Reitz, and Robert W. Christy. 4th ed. |
| Main references (sources) | **Engineering Electromagnetics,** by William H.Hayt, McGraw Hill, ed.,2001 |
| Recommended books and references (scientific journals, reports…) | |
| Electronic References, Websites | Books site in Google search |

# Course Description Form

| |
|---|
| 1. Course Name: |
| Bio-Physics |
| 2. Course Code: |
| |
| 3. Semester / Year: |
| 2\ 4th |
| 4. Description Preparation Date: |
| 2026 |
| 5. Available Attendance Forms: |
| Traditional attendance and electronic attendance |
| 6. Number of Credit Hours (Total) / Number of Units (Total) |
| 2\ 2 |
| 7. Course administrator's name (mention all, if more than one name) |
| Name: Dr. Asmaa Hadi Mohammed<br>Email: asmaa.hadi@nahrainuniv.edu.iq |
| 8. Course Objectives |

| | |
|---|---|
| **Course Objectives** | **At the end of the course, the students will be able to:**<br>**• Explain the scope of biology and physics.**<br>**• Describe life activities from biophysics point of view.**<br>**• Manipulate basic biological tool, record data and draw conclusions**<br>**• Develop scientific attitude, skill and conduct biophysics experiments using scientific procedures.**<br>**• Understand the basic concepts of the relation between physics and biology.** |

| |
|---|
| 9. Teaching and Learning Strategies |

| | |
|---|---|
| **Strategy** | **1. Deep Understanding Approach**<br>Mechanics and Motion: Linking physical laws to Skeletal System mechanics and muscular function (Bio-levers).<br>Pressure and Heat: Understanding Fluid Physics within the body (Hemodynamics) and therapeutic applications of Cryotherapy and Thermotherapy.<br>Senses (Hearing and Vision): Studying the ear as an Acoustic Receptor and the eye as an integrated Optical System for vision correction.<br>**2. Active and technological learning** |

| | |
|---|---|
| | Digital Simulation: Utilizing illustrations to understand Bioelectricity (ECG and EEG) and X-ray attenuation paths.<br>Laser and Light Applications: Interactive presentations on Surgical Laser usage and Ultraviolet (UV) radiation in sterilization.<br>**3. Collaborative and Skill-Based Learning**<br>Teamwork: Dividing students into groups to study Medical Instrumentation (Sphygmomanometers, Ultrasound/Sonar, and X-ray tubes).<br>Problem-Solving: Discussing Radiation Protection protocols and the physiological effects of High Pressure.<br>**4. Continuous Assessment**<br>Conducting regular quizzes that include analytical and application-based questions.<br>Assigning students to deliver short presentations explaining specific topics in a simplified manner. |

## 10. Course Structure

| Week | Hours | Required Learning Outcomes | Unit or subject name | Learning method | Evaluation method |
|---|---|---|---|---|---|
| First | 2 | Understand sound wave properties and frequencies.<br>Explain ultrasound imaging mechanisms.<br>Clarify hearing physics and ear function. | Sound in medicine | 1.Lectures and theoretical presentations.<br>2. Interactive learning: Engaging in group discussions, Q&A sessions to strengthen understanding and link concepts together.<br>3. Assessments and tests: Conducting | 1.Quizzes.<br>2.Assignments and seminars.<br>3. Final exams.<br>4.Class discussions.<br>5.Formative assessment. |
| Second | 2 | Understand laser beam properties and production.<br>Explain laser-tissue interactions. | Laser in medicine | | |
| Third | 2 | Analyze mechanical forces within the body.<br>Understand energy consumption and metabolism.<br>Clarify muscle and limb work efficiency. | Power, energy and work of the body | | |
| Fourth | 2 | Understand the physical properties of bones.<br>Analyze bone response to stress and pressure.<br>Clarify skeletal functions as biomechanics. | Physics of the Skeleton | | |

| | | | | | |
|---|---|---|---|---|---|
| Fifth | 2 | Understand body heat exchange mechanisms. Explain therapeutic applications of heat and cold. | Heat and cold in medicine | short quizzes or projects to evaluate deep understanding of the learned concepts. | |
| Sixth | 2 | Understand fluid physics and blood pressure. Analyze pressure change effects on body organs. | Pressure in the body | | |
| Seventh | 2 | Understand bioelectric signals (ECG & EEG). Explain tissue electrical properties and impulse transmission. | Electricity in human body | | |
| Eighth | 2 | Comprehensive written | Mid exam | | |
| Ninth | 2 | Clarify sound wave transduction within the ear. Analyze physical properties of hearing and hearing loss. | Physics of hearing and ear | | |
| tenth | 2 | Describe the eye as an optical system and light refraction. Understand accommodation mechanism and image formation. | Physics of eye and vision part 1 | | |
| eleventh | 2 | Diagnose vision defects and physical correction methods. Analyze physical functions of light and color receptors. | Physics of eye and vision part 2 | | |
| Twelfth | 2 | Understand physical properties of light and UV radiation. | Light and UV in medicine | | |
| Thirteenth | 2 | Understand X-ray production and tissue interaction. | x-ray in medicine part 1 | | |
| Fourteenth | 2 | Analyze radiographic imaging techniques and radiation protection. | x-ray in medicine part 2 | | |
| Fifteenth | 2 | Comprehensive written | Final Exam | | |

## 11. Course Evaluation

Distributing the score out of 100 according to the tasks assigned to the student such as daily preparation, daily oral, monthly, or written exams, reports .... etc

| 12. Learning and Teaching Resources | |
|---|---|
| Required textbooks (curricular books, if any) | |
| Main references (sources) | "Medical Physics by John R. Cameron, International Publication. |
| Recommended books and references (scientific journals, reports…) | Elements of Biophysics Randall 1998 |
| Electronic References, Websites | |