هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد NCAAA T4 2020

# Course Specifications

| | |
|---|---|
| **Course Title:** | **Nuclear Physics 1** |
| **Course Code:** | **PHY3601** |
| **Program:** | **BSc. Physics** |
| **Department:** | **Physics** |
| **College:** | **Applied Sciences** |
| **Institution:** | **Umm AL-Qura University** |

## Table of Contents

## A. Course Identification

| |
|---|
| **1. Credit hours:** |
| **2. Course type**<br>**a.** University ☐ College ☐ Department ☑ Others ☐<br>**b.** Required ☑ Elective ☐ |
| **3. Level/year at which this course is offered:** Level 7 /3st Year |
| **4. Pre-requisites for this course** (if any):<br>**Modern Physics (2)** |
| **5. Co-requisites for this course** (if any):<br>Not applicable (N. A) |

6. Mode of Instruction (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 40 | 100 % |
| 2 | Blended | - | |
| 3 | E-learning | - | |
| 4 | Distance learning | - | |
| 5 | Other | - | |

7. Contact Hours (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | **Lecture** (Class Quizzes and Homework solving, Class Test Exams, oral discussion, student oral presentation) | 40 |
| 2 | **Laboratory/Studio** | |
| 3 | **Tutorial** | |
| 4 | **Others** (specify) | |
| | **Total** | 40 |

## B. Course Objectives and Learning Outcomes

| |
|---|
| 1. **Course Description**<br>The course will cover the principles of nuclear physics and will provide a conceptual and background in nuclear physics sufficient to enable students to understand and use the knowledge concerned with nuclear properties, nuclear models, and radioactivity. |
| 2. Course Main Objective<br>To provide the technical background needed to proper understanding of nuclear properties, nuclear models, and radioactivity. |

3. Course Learning Outcomes

| | CLOs | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge:**<br>On successful completion of this course it is expected that students will be able to: | |
| 1.1 | Demonstrate the fundamentals and basic concepts in nuclear physics in nuclear structure and properties, nuclear models, nuclear decay and radioactivity. | K1(I)<br>K2(I) |
| 2 | **Skills:**<br>On successful completion of this course it is expected that students will be able to: | |
| 2.1 | To know how to assess, evaluate, or calculate the following: nuclear density, binding energy, proton and neutron configuration as well as spin and parity, and radioactive decay calculations. | S1(I) |
| 2.2 | Effectively communicates physics concepts, processes, and results, both orally and in writing related to nuclear physics | S2(I) |
| 3 | **Values:**<br>On successful completion of this course it is expected that students will be able to: | |
| 3.1 | Works responsibly and effectively within the work team to practice and interact with the principles and concepts of nuclear physics | V1(I)<br>V2(I) |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | **Nuclear Properties:**<br>- Definitions & Nuclear radius<br>- Nuclear Mass<br>- Nuclear Isomères. | 4 |
| 2 | **Liquid Drop Model**<br>Nuclear Mass-Binding Energy -<br>Sem-emperical Formula -<br>Separation energies of P-n- | 4 |
| 4 | **Radioactivity**<br>- The Radioactive Decay Law<br>Production and Decay of Radioactivité-<br>Half- life and rate of decay -<br>- Series decay<br>- Radioactive series | 8 |

| | | |
|---|---|---|
| 3 | **Nuclear Shell Model**<br>Single Particle model -<br>Magic Numbers-<br>Energy Levels -<br>Spin, Angular Momentum, Parity and symmetry. -<br>Excited rootes nuclear magnetic moments- | 6 |
| 4 | **Alpha Transitions**<br>Why Alpha Decay Occurs-<br>Basic Alpha Decay processes-<br>Alpha Decay systematics-<br>-Theory of Alpha Emission<br>-Angular Momentum and Parity in Alpha Decay | 6 |
| 5 | **Beta Transitions**-<br>Energy Release in Beta Decay-<br>Fermi Theory of Beta Decay-<br>Angular Momentum and Parity Sélection -<br>-Comparative Half-Lives and Forbidden Decays | 6 |
| 6 | **Gamma Transitions**<br>Energetics of Gamma Decay-<br>Classical Electromagnetic Radiation-<br>Transition to Quantum Mechanics -<br>Angular Momentum and Parity Sélection Rules -<br>Internal Conversion -<br>- Lifetimes for Gamma Emission | 6 |
| **Total** | | 40 |

## D. Teaching and Assessment

**1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods**

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| 1.0 | **Knowledge and Understanding** | | |
| 1.1 | Demonstrate the fundamentals and basic concepts in nuclear physics in nuclear structure and properties, nuclear models, nuclear decay and radioactivity. | 1.Lecture method: Board and PowerPoint.<br>2.Begin the lecture with a brief idea of the topic.<br>3.Demonstrate the basic principles.<br>4.Discussing phenomena with illustrating pictures and diagrams. | • Midterm exam.<br>• Final exam.<br>• Homework.<br>• Oral Questions. |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| | | 5.Solve problem<br>6.Brain storming | |
| **2.0** | **Skills** | | |
| 2.1 | To know how to assess, evaluate, or calculate the following: nuclear density, binding energy, proton and neutron configuration as well as spin and parity, and radioactive decay calculations. | 1. Lecture method: Board and PowerPoint.<br>2. Interactive group work<br>3. Demonstrate the basic principles.<br>4. Discussing phenomena with illustrating pictures and diagrams.<br>5. Solve problem<br>6. Brain storming | • Midterm exam.<br>• Final exam.<br>• Homework.<br>• Oral Questions.<br>• Group output |
| 2.2 | Effectively communicates physics concepts, processes, and results, both orally and in writing related to nuclear physics | | |
| **3.0** | **Values** | | |
| 3.1 | Works responsibly and effectively within the work team to practice and interact with the principles and concepts of nuclear physics | 1.Give students tasks of duties as a teamwork.<br>2.Asking the teamwork to write scientific reports or project.<br>3.Asking the teamwork to demonstrate the results of the scientific reports or project.<br>4. Interactive Drills | Evaluate:<br>• the scientific reports,<br>• the teamwork,<br>• the efforts of each student in preparing the report.<br>• Drill Assessment |

**2. Assessment Tasks for Students**

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| 2 | Term Works | All weeks | 20% |
| 3 | Mid-term exam | 5th week | 30% |
| 4 | Final exam | End of the term | 50% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**

4 office hours per week

## F. Learning Resources and Facilities

1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | 1. Krane,K.S., "Introductory Nuclear Physics", John Wiley and Sons Inc., India, 2008.<br>2. Richard Dunlap, An Introduction to the Physics of Nuclei and Particles |

| | |
|---|---|
| **Essential References Materials** | 1. Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg. Modern Nuclear Chemistry. 2nd Ed. 2006 by John Wiley & Sons, Inc.<br>2. Nuclear and Particle Physics B. R. Martin. 2006. John Wiley & Sons, Ltd. ISBN: 0-470-01999-9 |
| **Electronic Materials** | https://world-nuclear.org/<br>http://www.lnhb.fr/nuclear-data/nuclear-data-table/<br>https://www.nrc.gov/reading-rm/basic-ref/students/for-educators.html |

**2. Facilities Required**

| Item | Resources |
|---|---|
| **Accommodation**<br>(Classrooms, laboratories, demonstration rooms/labs, etc.) | • Lecture room for 40 students, with data show.<br>• Library |
| **Technology Resources**<br>(AV, data show, Smart Board, software, etc.) | • (AV, data show, Smart Board, software, etc.)<br>• data show + Board |
| **Other Resources**<br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | (NO) |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Effectiveness of Teaching | • Students<br>• Classroom Observation<br>• Professional Development Unit<br>External Reviewers such as the ASIIN Accreditation Agency | • Student Surveys<br>Formal Classroom Observation |
| Effectiveness of Assessment | • Curriculum and Test Development Unit<br>• Curriculum Committee<br>• Assessment Committee<br>External Reviewers such as the ASIIN Accreditation Agency | • Item Analysis Data<br>• Teacher Feedback<br>• Student Feedback<br>Course Reports |
| Extent of Achievement of Course Learning Outcomes | • Quality Assurance Unit<br>Curriculum and Test Development Unit | • Item Analysis Data<br>• Course Reports<br>Annual Program Review |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | |

| | |
|---|---|
| **Reference No.** | |
| **Date** | |