The University of Jordan

Accreditation & Quality Assurance Center

Course Syllabus

Course Name:
Nuclear Physics 1

1	Course title	Nuclear Physics 1
2	Course number	0332763
3	Credit hours (theory, practical)	(3,0)
	Contact hours (theory, practical)	(3,0)
4	Prerequisites/co-requisites	None
5	Program title	Physics
6	Program code	
7	Awarding institution	The University of Jordan
8	Faculty	Science
9	Department	Physics
10	Level of course	Master Degree
11	Year of study and semester (s)	Second semester 2016/2017
12	Final Qualification	
13	Other department (s) involved in teaching the course	
14	Language of Instruction	English
15	Date of production/revision	May 2017

16. Course Coordinator:

Office numbers, office hours, phone numbers, and email addresses should be listed.
Prof. Nidal M. Ershaidat
Office : Department of Physics – 011
Office Hours: Sun. 11:30-1:00, Mon. and Wed. 15:30-17:00
Phone: 00962-6-535000
E-mail: N.Ershaidat@ju.edu.jo

17. Other instructors:

18. Course Description:

As stated in the approved study plan.
Hadrons: Nucleons, Pions, Isospin, Strangeness and Hypercharge. Properties of Nuclear Forces; Two-Nucleon System: Electrostatic Multipoles, Properties of the Deuteron, Partial Wave Expansion, Low Energy Scattering, Effective Range Expansion. General Properties of Nuclei. Nuclear Models: Shell Model; Magnetic Dipole and Electric Quadrupole Moments, Fermi-Gas Model. Radioactivity: Decay Chains, Secular Equilibrium, Theory of Alpha Emission.

19. Course aims and outcomes:

A- Aims:

1. Introduce students to the elementary particles and the Standard Model.
2. Introduce the students to the properties of the nuclear force.
3. Enable students to interpret nuclear structure in terms of the underlying nuclear force.
4. Introduce students to experimental scattering results having led to nuclear models.
5. Introduce students to three nuclear models: Shell Model, Vibrational and Rotational Models.
6. Introduce students to stable and unstable nuclei, radioactivity and alpha decay.

B- Intended Learning Outcomes (ILOs): Upon successful completion of this course students will be able to …

1) Manage and understand modern physics concepts.
2) Recognize and know the basic properties of the elementary particles and the hadrons composed of quarks.
3) Study the basic properties of the nuclear force by studying the simplest nuclear system: deuteron.
4) Understand and derive the different multipole moments and deal with their corresponding operators.
5) Use of the Fermi (independent particles) Gas Model and estimate the value of the Fermi energy and the dimensions (width and depth) of the nuclear potential.
6) Determine the spin and parity of different nuclei in their ground state.
7) Understand the characteristics and energy levels of excited nuclei.
8) Determine the number of a given species of an unstable nucleus in a radioactive decay chain.
9) Understand decay schemes and branching ratios.
10) Study the kinematics of nuclear reactions in general and that of alpha emission.
11) Study the systematics of alpha decay and the quantum theory of alpha decay (The Gamow's theory). This theory is a remarkable application of basic concepts in quantum mechanics.

20. Topic Outline and Schedule:

Topic	Week	Instructor	Achieved ILOs	Evaluation Methods	Reference
Hadrons	1-3	Prof. Nidal Ershaidat	1,2	Continuous assessment through: Home works, Discussions.	Textbook and references
General Properties of Nuclei	4-7	Prof. Nidal Ershaidat	1,3,4	Exams	
Nuclear Models	8-10	Prof. Nidal Ershaidat	1,6,7		
Radioactivity	11-12	Prof. Nidal Ershaidat	1,8,9		
Alpha Decay	13-end of semester	Prof. Nidal Ershaidat	1,10		

21. Teaching Methods and Assignments:

Development of ILOs is promoted through the following teaching and learning methods:

1) Lectures.
2) Use of (animated) PowerPoint presentations
3) Discussion.

22. Evaluation Methods and Course Requirements:

Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements:

- A set of 6 assignments (weight 30% of the total grade) covering the major concepts of the course.
- A mid-term exam: 30% of the total grade
- A final exam: 40% of the total grade
- Examinations and follow on discussions of their answers.

23. Course Policies:

A- Attendance policies: According to the University policies.

B- Absences from exams and handing in assignments on time: According to the University policies.

C- Health and safety procedures: According to the University policies.

D- Honesty policy regarding cheating, plagiarism, misbehavior: According to the University policies.

E- Grading policy: Midterm Exam 30%, Continuous Assessment 30%, Final Exam 40%.

F- Available university services that support achievement in the course:

24. Required equipment:

White board

Data Show

Laptop

25. References:

A- Nuclear Physics in a Nutshell, C. A. Bertulani, Princeton University Press, 2007

B- Recommended books, materials, and media:

- Introductory Nuclear Physics, K.S. Krane, John Wiley and Sons, 1988. (Excellent for revising the Undergraduate material).
- Nuclear Structure from a simple Perspective, R. F. Casten, 2nd edition, Oxford Science, 2000.
- Introductory Nuclear Physics, P. Hodgson, E. Gadioli and E. Gadioli-Erba, Clarendon Press, Oxford, 1997.

Use of major databases in Nuclear Physics

1- An extensive use of *Tables of Nuclear Data* of the Nuclear Data Center (NDC) of the Japan Atomic Energy Agency (JAEA).

26. Additional information: