Faculty: Faculty of Science	
Department: Physics	**Program: M. Sc. Program**
Semester: First semester	**Academic year: 2024/2025**

Course Plan

First: Course Information

Course Name	**Advanced Nuclear Physics**			***Course NO:* 0302781**	
Credit Hours	***3 hours***	***Theoretical***	***3***	***Practical***	***0***
Level in JNQF	***9***				
Prerequisite:	***SectionNumber:1***			***Lecture Time:***	
Type Of Course:	☐ ***Obligatory Faculty Requirement*** ☐ ***Elective University Requirement*** ☐ ***Obligatory University Requirement*** ☐ ***Faculty Requirement*** ☐ ***Course Elective Specialty Requirement*** ■ ***Obligatory Specialization requirement***				
Type Of Learning :	☐ ***Face-to-Face Learning*** ■ ***Blended Learning(2 Face-to-Face + 1Asynchronous)*** ☐ ***Online Learning (2 Synchronous+1 Asynchronous)***				

Second: Instructor's Information

Course coordinator:		
***Name:* :**	***Office Number:***	***Email:***
Instructor:		
***Name* :**	***Office Number:***	***Email:***
Office Hours:		

Third: Course Description

Nuclear structure, Nuclear properties, Nuclear forces, Nuclear Models, Ground-state properties of nuclei: the shell model. The magnetic dipole moment of the nucleus, The electric quadrupole moment

of the nucleus, Electron scattering by the nuclear charge distribution, Fermi gas model, Radiation activity: Radioactive decay, Alpha decay, Beta Decay, Fermi theory, The reaction of the radiation of the with matter(alpha, Beta, Gama), Nuclear energy and the stability of nuclear, Fusion and Fission reactions..

Fourth: Course Aims

- Introduce the general properties of nucleus and the nuclear force to the students .
- To apply nuclear structure to find properties of a nucleus.
- Enable students to interpret nuclear structure in terms of the underlying nuclear force.
- Introduce students to scattering problem and results having led to nuclear models.
- Introduce students to three nuclear models: Shell Model, Vibrational and Rotational Models.
- Introduce students to stable and unstable nuclei, radioactivity and alpha decay.

Fifth: Learning Source

Designated Book:	, Concepts of Nuclear Physics,	***1st Edition***
Author: B. L. Cohen	***Print:*** Mc-Graw Hill, New York	***Year:*** 1971
Additional Sources: ***Website:***	Nuclear Physics in a Nutshell, C. A. Bertulani, Princeton University Press, 2007 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.	
Teaching Type:	■ ***Classroom*** □ ***Laboratory*** □ ***Workshop*** ■ **MS Teams** ■ **Moodle**	

Sixth: Learning Outcomes

Level descriptor according to (JNQF)	*CILOs Code*	*Course learning output*	*Associated Program Outcome Code*	*Assessment method*** *Choose at least two methods*	*Scores out of 100* State the total score identified for each CILO	*Minimum acceptable Score/percentage (%)* *The percentage should not be less than 50%* ***
Knowledge	**K1	To memorize the advanced knowledge of nucleus properties, nuclear binding energy, nuclear models, nuclear reactions, scattering, and nuclear decay. To understand decay schemes and branching ratios. State the basic properties of the nuclear force	*PK1	Quiz Assignment Mid Exam	10	10%
	K2	Define spin, parity, ground state, cross section, differential cross section, nuclear reaction, angular momentum, dipole moments and nuclear decay.	PK2	Quiz Assignment Mid Exam Final	10	10%
	K3	Write down Schrödinger equation for scattering problems, Shel model, and other nuclear problems.	PK3	Quiz Assignment Mid Exam Final	10	10%
Skills	***S1	Translate a physical description of a advanced-level nuclear problems into the mathematical equation necessary to solve it. Applying quantum techniques to solve known nuclear problems	PS1	Quiz Assignment Mid Exam Final	20	20%

		Investigate the basic properties of the nuclear force by studying the simplest nuclear system: deuteron. Determine the spin and parity of different nuclei in their ground state.				
	S2	Study the kinematics of nuclear reactions in general and that of alpha emission.) Study the systematics of alpha decay and the quantum theory of alpha decay (The Gamow's theory).	PS2	Assignment	10	10%
	S3	Recognize when approximations are useful, and to use them effectively (e.g.magnetic dipole moment, scattering, and decay)	PS3	Quiz Assignment Mid Exam Final	10	10%
	S4	Recognize symmetries and be able to take advantage of them in order to choose the appropriate method for solving a problem in Shell model decay ad scattering models . Logical thinking and reasoning (Identifying Relevant Information, Formulating a Clear Strategy, Applying Fundamental Principles, Critical Evaluation of Solutions	PS4	Quiz Assignment Mid Exam Final	10	10%
Competencies	****C1	Self-evaluation and responsibility for self-learning.	PC1	Assignments	10	10%
	C2	Work effectively and taking responsibility for the team work.	PC2	Assignments	10	10%

Seventh: Course Structure

Lecture Date	**Covered** (ILOs)	Topics	Teaching Procedures*	Teaching Methods***	References****
Week1	K1	Some Introductory Terminology, Nuclear Properties, Units and Dimensions,	Face- to-face	Lecturing, Whiteboard, DataShow	Text 3-8
Week2	K1,K5	Quantum Behavior, Problems in One Dimension, Theory of Angular Momentum, The Nuclear Radius	Asynchronous	Videos, Homework Self reading Quizz	Text10-25
Week3	K1	Semiprimal mass formula, Nuclear Binding Energy,	Face- to-face	Lecturing, Whiteboard, DataShow	Text 44-50
Week4	K1,S1	Nuclear Angular Momentum and Parity, Nuclear Electromagnetic Moments.	Asynchronous	Videos, Homework Self reading Quizz	Text 50-59
Week5	K1,	The Deuteron	Face- to-face	Lecturing, Whiteboard, DataShow	Text 60-65
Week6	K1	The Shell Model	Asynchronous	Videos, Homework Self reading Quizz	Text 65-70
Week7	K1	Nucleon-Nucleon Scattering Proton-Proton and Neutron-Neutron Interactions, Properties of the Nuclear Force.	Face- to-face	Lecturing, Whiteboard, DataShow	Text 65-70
Week8	K5,S1	The Structure of Complex Nuclei: Spherical Even-Even Nuclei, Odd-A Spherical Nuclei , Spherical Odd-Odd Nuclei	Asynchronous	Videos, Homework Self reading Quizz	Text 70-72
Week9	K1,K3,S1	The Radioactive Decay Law, Production and Decay of Radioactivity	Face- to-face	Lecturing, Whiteboard, DataShow	Text 72-75
Week10	K2,K4	Growth of Daughter Activities Production and Decay of Radioactivity	Asynchronous	Videos Homework Self reading	Text 75-77
Week11	K2,K4	Beta Decay	Face- to-face	Lecturing, Whiteboard, DataShow	Text 80-85
Week12		Gamma Decay	Asynchronous	Videos Homework Self reading	

				Quizz	
Week13	K1,K2,	Alpha Decay	Face- to-face	Lecturing, Whiteboard, DataShow	Text 90-96
Week14	K1,K2,	Nuclear Reactions, Types of Reactions and Conservation Laws Compound nuclear reactions	Asynchronous	Videos Homework Self reading Quizz	Text 86-90
Week15	K1,K3	Nuclear Reactions, Types of Reactions and Conservation Laws: Direct nuclear reactions	Face- to-face	Lecturing, Whiteboard, DataShow	Text 96-100

* Learning procedures: (Face-to-Face, synchronous, asynchronous). * * Teaching methods: (Lecture, video…..). ** * Reference: (Pages of the book, recorded lecture, video….).

Eighth: Assessment methods

Methods	Fully Electronic Education	Integrated Teaching	Face to Face Teaching	Specific Course Output to be measured *State the score identified for each CILO for each method of assessment out of 100 **If any CILO will not be assessed in the course, mark NA.								
				K1	K2	K3	S1	S2	S3	S4	C1	C2
Mid-term Exam		30		**4**	**4**	**4**	**4**	**5**	**5**	**5**		
Final Exam		40		**4**	**4**	**4**	**12**	**5**	**5**	**5**		
Quizzes		10		**2**	**2**	**2**	**0**	**0**	**0**	**0**	**2**	**2**
Assignments		20		**0**	**0**	**0**	**4**	**0**	**0**	**0**	**8**	**8**
Total out of 100		100		**10**	**10**	**10**	**20**	**10**	**10**	**10**	**10**	**10**

Ninth: Course Polices

- All course policies are applied on all teaching patterns (online, blended, and face-to-face Learning) as follows:
  a. Punctuality.
  b. Participation and interaction.
  c. Attendance and exams.
- Academic integrity: (cheating and plagiarism are prohibited).

Approval.	Name	Date	Signature
Head of Department			
Faculty Dean			