Course Specification

(Postgraduate Programs)

Course Title:	**Nuclear Structure and Spectroscopy**
Course Code:	**PHYS650**
Program:	Master of Science in Physics
Department:	**Physical Sciences**
College:	**Science**
Institution:	**Jazan University**
Version:	
Last Revision Date:	**20/4/2024**

Table of Contents

A. General information about the course:

1. Course Identification:

1. Credit hours: (3 hours)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (level 2 or 3/ year 1 or 2)					
4. Course general Description:					
This course is designed to provide knowledge and understanding of the properties of nuclei and current experimental techniques at a level appropriate to postgraduate research.					
5. Pre-requirements for this course (if any)**: Non**					
6. Co-requirements for this course (if any)**:Non**					
7. Course Main Objective(s):					
The main objectives of this course are focused on the following: 1. **Outline the single-particle aspects of the properties of nuclei.** 2. **Describe the experimental techniques used to measure the properties of nuclei.** 3. **Discuss the collective properties of nuclei** 4. **Explain the nuclear structure under the different nuclear models and especially the shell model.** 5. **Evaluate the importance of laser spectroscopy, γ-ray spectroscopy and the experimental techniques.**					

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%

No	Mode of Instruction	Contact Hours	Percentage
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours: (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)……**	
	Total	45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods:

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding: **Upon completing the course students will be able to**			
1.1	Describe the nuclear structure, nuclear models, types of mechanisms of nuclear reactions, nuclear angular momentum, nuclear electric quadrupole moment, shell model and liquid drop model	PLO1.1	Lectures, discussion	-In-class quizzes - Midterms and final exam
1.2	Identify relationships relevant to ground state spins and parities , pairing, nuclear	PLO1.1		-In-class quizzes - Midterms and final exam

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	moments, nuclear deformation.		Lectures, discussion	
1.3	**Discuss** nuclear magnetic moments: single-particle model and nuclear quadrupole moments.	**PLO1.2**	Lectures, discussion	-In-class quizzes - Midterms and final exam
2.0	Skills: **Upon completing the course students will be able to**			
2.1	Apply gamma spectra analysis method: to deduce the energy configuration	**PLO2.1**	Lectures, discussion	Quizzes, mid-term Exams and final exam
2.2	Solve problems related to topics of Liquid drop model, spins and parities, nuclear potential and collective aspects	**PLO2.1**	Lectures, discussion	Quizzes, mid-term Exams and final exam
3.0	Values, autonomy, and responsibility: **Upon completing the course students will be able to**			
3.1	Adopt some practices of self and long-life learning in the field of nuclear structure and its important applications through some essays and case studies	**PLO3.2**	Group activities	Quizzes, mid-term Exams and final exam
...				

C. Course Content:

No	List of Topics	Contact Hours
1	**Review of the properties of nuclei:** -Describe some introductory terminology -Use a nuclear symbol to express the composition of an atomic nucleus -Review nuclear properties	9

2	**Nuclear models**: Liquid drop model, Fermi gas, deviance of the nuclear structure, Shell model (in more details). Single-particle aspects. The nuclear potential and single-particle levels.	9
3	**The filling of shells**: ground state spins and parities; pairing.	7.5
4	**Nuclear magnetic moments and nuclear quadrupole moments**: single-particle model and experiment, nuclear quadrupole moments of single-particle states and experimentally observed deviations, multi-particle configurations and residual interactions.	7.5
5	**Collective states**	6
6	**Spectroscopy and analysis techniques**: Vibrations of spherical nuclei. Residual interactions correlations- deformation. Rotations and vibrations of deformed even-even nuclei. Nilsson model. Rapidly rotating nuclei: moments of inertia, pairing, alignment, super deformation. Laser spectroscopy, γ-ray spectroscopy. Ge detectors; γ-ray arrays; coincidence techniques. The measurement of excited state lifetimes. Internal conversion.	6
Total		33

D. Students Assessment Activities:

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**First mid-term exam**	**6**	**10**
2.	**Quizzes**	**4,8**	**10**
3.	**Activities (home-works, tests, class activities)**	**Over the semester**	**20**
4.	**Second mid-term exam**	**12**	**10**
5.	**Final Exam**	**16**	**50**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

E. Learning Resources and Facilities

1. References and Learning Resources:

Essential References	Introductory Nuclear Physics, 3rd Edition, Kenneth S. Krane, ISBN: 978-0-471-80553-3, November1987, ©1987 Nuclear Structure From A Simple Perspective, R. F. Casten , ISBN 0-19-504599-8 Published by Oxford University Press, Inc., 1990

	Radiation detection and measurement , 4th Edition , Glenn F Knoll , ISBN: 978-0-470-13148-0 , Publisher: John Wiley & Sons, Inc., 2010
Supportive References	Nuclear Physics: Principles and Applications, 3rd Edition, John Lilley ISBN: 978-0-471-97935-7, April 2001 The elements of Nuclear Power, Bennet, D.J.: Thomson, J.R., ISBN 13:9780582022249, Publisher: Longman , 1989
Electronic Materials	http://hyperphysics.phy-astr.gsu.edu http://www.wikipedia.org/
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Lecture room(s) for groups of 10 students
Technology equipment (Projector, smart board, software)	Smart board each for groups of 10 students
Other equipment (Depending on the nature of the specialty)	

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peer and program leader	Indirect (CES)-Indirect peer evaluation
Effectiveness of students assessment	Students, Program assessment committee	Direct/Indirect
Quality of learning resources	Students, Faculty members	Indirect
The extent to which CLOs have been achieved	Instructor	Direct/Indirect
Strategies for Obtaining	Student Feedback	Student assessment of Teaching Quality (NCAAA form).
Processes for Improvement of Teaching	Faculty members	Revision of course contents, course specifications, and teaching strategies every 5 years

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

COUNCIL /COMMITTEE	Department Council
REFERENCE NO.	Psci2415
DATE	1/10/2024