هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TPG-153

Course Specification

(Postgraduate Programs)

Course Title:	**Particle Physics**
Course Code:	**PHYS661**
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)					
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 advanced training for students in particle physics phenomenology and experimental methods, to enable them to take part in theoretical particle physics 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:

- **Outline the symmetries of gauge field theory.**
- **Evaluate the interaction between cross-sections and energy losses in media.**
- **Describe the difference between weak and electroweak interaction.**
- **Identify the foundations of the Standard Model and physics beyond it.**
- **Describe the Lagrangian of the Standard Model.**

2. Teaching Mode: (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		

No	Mode of Instruction	Contact Hours	Percentage
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** Symmetries and groups in physics, Hadron structure, electron-proton scattering, Noether's theorem, Gluon emission cross-section, Parity violation, Cabibbo angle, Weak mixing angle, CP invariance, CP violation, weak isospin and hypercharge, Feynman rules for electroweak interactions, Standard model and beyond, Grand unification.	PLO 1.1	Lectures and Discussions.	**Direct:** Quiz and mid-term & final Exams. **Indirect**: student survey
1.2	**Identify** various quark states using group, Lagrangian of single particle wave equations, Structure of hadrons through electron-electron scattering, Quarks, and gluons within the proton.	PLO 1.1	Lectures and Discussions.	**Direct:** Quiz and mid-term & final Exams. **Indirect**: student survey
1.3	**Discuss** SU(2)&SU(3) groups, Isospin states, and Quark states, Hadron Masses, Local gauge invariance, spontaneous symmetry breaking,		Lectures and Discussions.	**Direct:** Quiz and mid-term & final Exams.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	Parton model and Bjorken scaling, QCD and e^+e^- annihilation, Beta decay, Muon decay, Pion decay, Neutrino-electron scattering, Neutrino-quark scattering, Electro-weak interference of electron-electron annihilation, Higgs field, Dark matter.	PLO 1.2		**Indirect**: student survey
2.0	**Skills: Upon completing the course students will be able to**			
2.1	**Apply** the quark model idea to derive various quark states, the Parton model idea to scattering, and Feynman rules for electroweak interaction.	PLO 2.1	Lectures and Discussions.	**Direct:** Quiz and mid-term & final Exams. **Indirect**: student survey
2.2	**Solve** problems related to symmetries and groups, gauge invariance, Noether's theorem, electron-proton scattering, Parton model, weak interaction, electro-weak interactions, and QCD Lagrangian.	PLO 2.1	Lectures and Discussions.	**Direct:** Quiz and mid-term & final Exams. **Indirect**: student survey
2.3	**Use** the idea of the quark model to derive various hadron states, gauge invariance, electron-proton scattering to understand the structure of hadrons, Parton model to understand the structure of hadrons.	PLO 2.3	Lectures and Discussions.	**Direct:** Quiz and mid-term & final Exams. **Indirect**: student survey
3.0	**Values, autonomy, and responsibility: Upon completing the course students will be able to**			
3.1	Adopt long-life learning in particle physics and its application through group assignments and seminars.	PLO 3.2	Seminar, Group discussions.	Group Assignments, Seminars.

C. Course Content:

No	List of Topics	Contact Hours
1.	**Gauge Symmetries and Quarks**: Symmetries in Physics, Symmetries and Groups, SU (2) and SU (3) Gauge Groups, Isospin, Quark States, Hadron Masses, Color Factors, The Lagrangian and Single-Particle Wave Equations, Noether's Theorem, U (1) Local Gauge Invariance, Non-Abelian Gauge Invariance, Spontaneous Symmetry Breaking.	10.5
2.	**The Structure of Hadrons**: Electron-Proton Scattering, Inelastic Electron-Proton Scattering, Partons and Bjorken Scaling, Quarks within Partons, Gluons.	**7.5**

3	**QCD**: QCD Lagrangian, Gluon Emission Cross-section, QCD and e^+e^- Annihilation.	**6**
4	**Weak Interactions**: Parity Violation, Interpretation of Coupling, Beta Decay, Muon Decay, Pion Decay, Neutrino-Electron Scattering, Neutrino-Quark Scattering, Cabibbo Angle, Weak Mixing Angles, CP Invariance, CP Violation.	**7.5**
5	**Electroweak Interactions**: Weak Isospin and Hypercharge, Basic Electroweak Interaction, Effective Current-Current Interaction, Feynman Rules for Electroweak Interaction, Electroweak Interference of electron-electron Annihilation.	**6**
6	**Standard Model and Beyond:** Higgs Field, Masses of the Gauge Bosons, Masses of the Fermions, Lagrangian of the Standard Model, Grand Unification, Dark matter.	**7.5**
Total		**45**

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.	Activities (home-works, tests, class activities)	Over the semester	30
3.	Second mid-term exam	12	10
...	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	F. Halzen and A. D. Martin, Quarks and Leptons: An Introductory Course in Modern Particle Physics, Wiley,1984.
Supportive References	David Griffiths, Introduction to Elementary Particles, 2nd edition, Wiley-VCH, 2008. Ian Aitchison and Anthony Hey, Gauge Theories in Particle Physics V1, IOP, 2003. Ian Aitchison and Anthony Hey, Gauge Theories in Particle Physics V2, IOP, 2004. B.R. Martin and G. Shaw, Particle Physics, Manchester, 2008.
Electronic Materials	https://pdg.lbl.gov/ http://arxiv.org/ http://inspirehep.net/help/easy-search
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms.
Technology equipment (Projector, smart board, software)	Smartboard and projector.
Other equipment (Depending on the nature of the specialty)	

F. Assessment of Course Quality:

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students, Peers, and program leader	Direct assessment of CLOs, Indirect surveys.
Effectiveness of students assessment	Students, Faculty.	Direct / Indirect.
Quality of learning resources	Students, Faculty members	Indirect
The extent to which CLOs have been achieved	Instructor	Direct / Indirect.
Other		

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**