Course Specification
(Bachelor)

Course Title:	Modern Physics
Course Code:	PHYS 0241
Program:	BSc in Physics and BSc in Physics of Renewable Energy and Environment
Department:	Physics Department
College:	College of Science
Institution:	Majmaah University
Version:	1
Last Revision Date:	6/12/2024

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A. General information about the course:

1. Course Identification

1. Credit hours: 3 (3, 0, 0)

2. Course type

A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		

3. Level/year at which this course is offered: (Level 4/ Year 2)

4. Course General Description:

This course covers the modern phenomena of physics such as: Special relativity and its applications; the failure of classical mechanics and the success of quantum mechanics in explaining some phenomena; the particle nature of waves, photoelectric, Compton effect, Pair production, X-ray, the wave nature of particles; the dual nature of the material, the structure of the atom and its properties, the quantum theory of the electromagnetic waves, differentiate between relativity, Galileo & Lorentz transformations, Michelson experiment, Time dilation and length contraction, Relativistic mass, energy and momentum, Black body radiation and Photoelectric effect, X-ray generation and properties, Compton effect and Pair production, De Broglie wavelength, wave packets Particle in a box and Uncertainty principle of Heisenberg, Atomic structure, Rutherford model, Bohr atomic model for Hydrogen, Energy levels and spectra, Atomic excitation.

5. Pre-requirements for this course (if any)**:**

PHYS 0222 Electricity and Magnetism 2

6. Co-requisites for this course (if any)**:**

no

7. Course Main Objective(s):

1	To introduce postulates of special relativity in order to Construct Galilean and Lorentz transformations.
2	To apply the relation of length contraction and time dilation along with the concept of simultaneity.
3	To demonstrate the energy – momentum relationship in relativistic terms.
4	To teach relation between light frequency to photon energy and apply the wave particle complementarity.
5	To introduce light quantization through black body radiation catastrophe.
6	To provide simple and clear explanations of main physical concepts and theories of the 20-th century.
7	To clarify these concepts and theories through a broad range of current applications and examples.

8	Structure of the Atom and Wave Properties of Matter

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		
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 PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	List different types of atomic spectra and related instrumentation.	**K1**	Lecture Exercise Quizzes Problem Solving	Standard Exams Assignments
1.2	Describe theories explaining the structure of atoms and	**K1**		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	the origin of the observed spectra.			
…	Identify atomic effects such as space quantization and Zeeman effect.	**K2**		
	Describe molecular bonding and molecular energies.	**K2**		
	Memorize different techniques used in laser and applications.	**K2**		
2.0	**Skills**			
2.1	Collect general information about some atomic spectra related topics.	**S2**	Lecture Exercise Quizzes Problem Solving Group Discussion	Standard Exams Assignments Supervisor evaluation
2.2	Use mathematical modelling and experimental work in understanding physics phenomena.	**S2**		
…	Apply the gained mathematical and experimental knowledge in any physical related topic.	**S2**		
	Operate questions and communicate with teachers through solving problems and working in groups.	**S4**		
3.0	**Values, autonomy, and responsibility**			
3.1	Work in a group and learn time management.	**V1**	Making students aware of time management in completing their assignments	Internal evaluation
…	Present a short report in a written form and orally using appropriate scientific language.	**V3**		

C. Course Content

No	List of Topics	Contact Hours
1.	**Unit1:** Special theory of relativity ➢ Galileo relativity ➢ Michelson and Morley experiment ➢ Einstein's relativity postulates ➢ Time dilatation ➢ Length contraction ➢ Twins' paradox ➢ Energy and momentum transformation in four-dimensional space ➢ Mass and energy	12
2.	**Unit2:** Particle aspects of electromagnetic radiation ➢ Black body radiation ➢ Photoelectric effect ➢ Compton effect ➢ Pair production and Annihilation	12
3	**Unit3**: Wave aspects of material particles ➢ De Broglie – matter- waves ➢ Davisson and Germer experiment ➢ Electron diffraction ➢ Heisenberg uncertainty principle ➢ Correspondence principle ➢ Probabilistic interpretation of De Broglie waves	9
4	**Unit4:** Atomic structure ➢ Introduction, planetary model ➢ Electron orbits ➢ Atomic spectra ➢ Bohr's model for Hydrogen atom ➢ Energy levels and spectra ➢ Nuclear motion ➢ Atomic excitation	12
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid- term 1*	6th or 7th week	15
2.	HW	Every unit of Topics	10
3.	Mid-term 2*	11th or 12th week	15
4	Quiz	5 and 10 week	10
5	Small project	13 week	10

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
6	Final exam *	15 or 16 week	40
	total		100

*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	**Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, Sixth Edition**
Supportive References	Modern Physics, K. Krane, Wiley, 1118061144
Electronic Materials	Saudi Digital Library (SDL)
Other Learning Materials	Excel software for drawing graphs.

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	*Classrooms, data show, Smart Board, software*
Technology equipment (projector, smart board, software)	Computer Lab. and internet lab.
Other equipment (depending on the nature of the specialty)	Library, Wi-Fi internet connections

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	*Internal Reviewer committee*	*Direct*
Effectiveness of Students assessment	*Students*	*Indirect*
Quality of learning resources	*Peer Reviewer*	*Direct*
The extent to which CLOs have been achieved	*Internal Reviewer committee*	*Direct*
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**DEPARTMENT COUNCIL**
REFERENCE NO.	**16**
DATE	**30/12/2024**