مركز الاعتماد وضمان الجودة
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Course Syllabus

1	**Course title**	Modern Physics	
2	**Course number**	0302261	
3	**Credit hours**	3	
	Contact hours (theory, practical)	3,0	
4	**Prerequisites/corequisites**	0302102	
5	**Program title**	B.Sc.	
6	**Program code**		
7	**Awarding institution**	University of Jordan	
8	**School**	Science	
9	**Department**	Physics	
10	**Course level**	Bachelor	
11	**Year of study and semester(s)**	2022-2023, First Semester	
12	**Other department(s) involved in teaching the course**		
13	**Main teaching language**	English	
14	**Delivery method**	☐Face to face learning ☒Blended ☐Fully online	
15	**Online platforms(s)**	☐Moodle ☒Microsoft Teams ☐Skype ☒Zoom ☐Others…………	
16	**Issuing/Revision Date**	Oct 8, 2022	

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17 Course Coordinator:

Name: Riad Shaltaf	Contact hours: *Sun, Tuesday 12:00-1:00, Wed 10-11*
Office number: 200A	Phone number: 22067
Email:r.shaltaf@ju.edu.jo	

18 Other instructors:

Name:

Office number:

Phone number:

Email:

19 Course Description:

As stated in the approved study plan. Modern Physics is a one-semester course covering major concepts of twentieth-century physics; the modern concepts in physics and their applications: relativity, blackbody radiation, the Bohr atom, particles and waves, quantum mechanics, atoms, molecules, solids, statistical mechanics, radioactivity, nuclei, and elementary particles. While classical physics is generally concerned with matter and energy on the normal scale of observation, much of modern physics is concerned with the behavior of matter and energy under extreme conditions or on the very large (the universe) or very small (sub-atomic level) scale.

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20 Course aims and outcomes:

A- Aims:

The aim of this course is to enhance student learning and understanding of 20th century theories in physics - including special relativity, the old quantum mechanics theories and their impact on most areas of physics, De Broglie's wave-particle dualism, Heisenberg's uncertainty relation, Schrödinger's wave mechanical approach to atomic energies. Applying Schrödinger equation for a particle in a box, finding the expectation values and probabilities. Applying Schrödinger equation for finding harmonic oscillator eigen energies and eigen functions.

In addition to all of that, this course aims to introduce some important experiment to students, for example, Michelson-Morley ether wind experiment, Black body radiation experiments in both Planck and Einstein views, temperature dependent specific heats, the photoelectric effect, Rutherford scattering, Compton scattering, optical emission and absorption spectra of atoms, X-ray emission spectra, diffraction of electrons.

The topics covered during the course are:

Special relativity: Experiments on the nature and the speed of light. Failure of the ether theory. Galileo and Lorentz transforms for coordinates and velocities. Relativistic Doppler effect. Linear momentum, forces, energy and energy-momentum relation.

The quantum point of view: Black body radiation and Planck's interpretation. Cathode rays, the photoelectric effect and Einstein's light quanta. Light quanta and the black body spectrum. Boltzmann's distribution.

Electronic structure of the atom: Failure of the Plum pudding model and the planetary model. Rutherford scattering and the size of the nucleus. Drawbacks of the planetary model and Balmer's formula for the spectral lines of Hydrogen. Stationary states and Born's atomic model. Correspondence principle and the Rydberg constant: reduced mass effect. Many electron atoms: X-ray emission spectra.

Matter waves: De Broglie wavelength and the pilot wave. Stationary states and stationary waves. The Davisson-Germer experiment. Single and double slit experiments using waves, classical particles and quantum particles. Particles, wave packets and the basic requirements of the new theory: probability waves and the uncertainty principle.

Quantum mechanics: The classical wave Equation. Schrödinger's Equation: Time-Dependent and Steady-State Form. Expectation Values. Operators. Some applications in Quantum mechanics system.

Nuclear physics: The nuclear models; the shell model; nuclear reactions; nuclear decay; radioactivity; nuclear fission and fusion

B- Students Learning Outcomes (SLOs):

For purposes of mapping the course SLOs to the physics program SLOs, at the successful completion of the physics program, graduates are expected to be able to:

SLO (1) Master professionally a broad set of knowledge concerning the fundamentals in the basic areas of physics: Quantum Mechanics, Classical Mechanics, Electrostatics and Magnetism, Thermal Physics, Optics, Theory of Special Relativity, Mathematical Physics, Electronics.

SLO (2) Apply knowledge of mathematics and fundamental concepts in the basic areas of physics to identify and solve physics related problems.

SLO (3) Utilize computers and available software in both data collections and data analysis.

SLO (4) Utilize standard laboratory equipment, modern instrumentation, and classical techniques to design and conduct experiments as well as to analyze and interpret data.

SLO (5) Develop a recognition of the need and ability to engage in life-long learning.

SLO (6) Demonstrate ability to use techniques, skills, and modern scientific tools necessary for professional practice.

SLO (7) Communicate clearly and effectively in both written and oral forms.

SLO (8) Apply proficiently team-work skills and employ team-based learning strategies.

SLO (9) Apply professional and ethical responsibility to society.

Upon successful completion of this course, students will be able to:

Program SLOs / Course SLOs	SLO (1)	SLO (2)	SLO (3)	SLO (4)	SLO (5)	SLO (6)	SLO (7)	SLO (8)	SLO (9)
1. Have acquired knowledge of the fundamental experiments which have led to the quantum/relativistic revolution and understanding why classical physics was inadequate and how the new theories should be built.	✓	✓			✓	✓	✓		
2. Understand and apply Einstein's theory of special relativity to relativistic mechanics.	✓	✓			✓	✓			
3. Understand the elements of quantum mechanics: matter waves and wave functions, uncertainty relations, Schrodinger equation, and the particle in the box problem etc.	✓	✓			✓	✓			
4. Understand the Bohr model of the hydrogen atom and the quantization of atomic energy levels.	✓	✓			✓	✓			
5. Understand the nuclear structure and radioactivity	✓	✓			✓	✓			

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21. Topic Outline and Schedule:

Week	Topic	Intended Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
1	The Principle of Galilean Relativity; The Michelson–Morley Experiment; Einstein's Principle of Relativity	ILO(2)	Blended	Teams	Synchronous and Asynchronous Lecturing		
2	Consequences of the Special Theory of Relativity; The Lorentz Transformation Equations; The Lorentz Velocity Transformation Equations	ILO(2)	Blended	Teams	Synchronous and Asynchronous Lecturing		
3	Relativistic Linear Momentum and energy and general theory of relativity	ILO(2)	Blended	Teams	Synchronous and Asynchronous Lecturing		

4	Blackbody Radiation and Planck's Hypothesis; The Photoelectric Effect;	ILO(1,3)	Blended	Teams	Synchronous and Asynchronous Lecturing		
5	The Compton Effect; The Wave Properties of Particles the quantum particle;	ILO(1,3)	Blended	Teams	Synchronous and Asynchronous Lecturing		
6	The electron diffraction in double-Slit Experiment; The Uncertainty Principle;	ILO(1,3)	Blended	Teams	Synchronous and Asynchronous Lecturing		
7	The Wave Function; Analysis Model: Quantum Particle Under Boundary Conditions;	ILO(3)	Blended	Teams	Synchronous and Asynchronous Lecturing		
8	Schrödinger equation; Particle in a box	ILO(3)	Blended	Teams	Synchronous and Asynchronous Lecturing		
9	Particle in finite potential, Tunneling effect;	ILO(3)	Blended	Teams	Synchronous and		

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	Harmonic osscillator				Asynchronous Lecturing		
10	Atomic Spectra of Gases; Early Models of the Atom;	ILO(3,4)	Blended	Teams	Synchronous and Asynchronous Lecturing		
11	Rutherford model; Bohr's Model of the Hydrogen Atom	ILO(1,3,4)	Blended	Teams	Synchronous and Asynchronous Lecturing		
12	Nuclear Physics: Some Properties of Nuclei; Nuclear Binding Energy; Nuclear Model	ILO(5)	Blended	Teams	Synchronous and Asynchronous Lecturing		
13	Radioactivity; The Decay Processes; Natural Radioactivity; Nuclear reactions	ILO(5)	Blended	Teams	Synchronous and Asynchronous Lecturing		
14	Nuclear interaction involving neutrons, nuclear fission and fusion	ILO(5)	Blended	Teams	Synchronous and Asynchronous Lecturing		

15	Review	ILO(1-5)	Blended	Teams	Synchronous and Asynchronous Lecturing		

22 Evaluation Methods:

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

Evaluation Activity	Mark	Topic(s)	SLOs	Period (Week)	Platform
First Midterm	30%	Special relativity and QM	ILO 1,2,3	6th	
2nd midterm	30%	QM and atomic physics	ILO 3,4	11th	
Final exam	40%	All subjects	ILO 1-5	15th	

23 Course Requirements

(e.g: students should have a computer, internet connection, webcam, account on a specific software/platform…etc):

The students are expected to have internet connection and a calculator

24 Course Policies:

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A-Attendance policies:

Students are expected to attend all class sessions. If a student cannot attend a class session, the teacher must be notified prior to that. For the university's rules and regulations, the student's total absences must not exceed 15 % of the total class hours. Please refer to the University of Jordan student Handbook for further explanation.

B-Absences from exams and handing in assignments on time:

a. Failure in attending a course exam other than the final exam will result in zero mark unless the student provides an official acceptable excuse to the instructor who approves a make up exam.
b. Failure in attending the final exam will result in zero mark unless the student presents an official acceptable excuse to the Dean of his/her faculty who approves an incomplete exam, normally scheduled to be conducted during the first two weeks of the successive semester.

C-Health and safety procedures:

We don't have any policy at the moment considering the safety procedures, nevertheless, the instructor in each session has to give a general safety instructions for the student.

D-Honesty policy regarding cheating, plagiarism, misbehavior:

Cheating, plagiarism, misbehavior are attempts to gain marks dishonestly and includes; but not limited to:

- Copying from another student's work.
- Using materials not authorized by the institute.
- Collaborating with another student during a test, without permission.
- Knowingly using, buying, selling, or stealing the contents of a test.
- Plagiarism which means presenting another person's work or ideas as one's own, without attribution.
- Using any media (including mobiles) during the exam.

E- Grading policy:

Grades will be awarded based on the statistical distribution of marks out of 100%

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

- Faculty members website
- E-Learning website
- Teams

25 References:

A- Required book(s), assigned reading and audio-visuals:

1. Physics for Scientists and Engineering, Jewet and Serway, 7rd Edition, Thomson.

Recommended books, materials, and media:

2. Modern Physics, Kenneth S. Krane, 3rd Edition, 2012, John Wiley & Sons.
3. Concepts of Modern Physics, Arthur Beiser, McGraw-Hill, publisher, sixth edition.

26 Additional information:

Name of Course Coordinator: ----------------------------------Signature: ---------------------- Date: --------------------
Head of Curriculum Committee/Department: --------------------------- Signature: ------------------------------------
Head of Department: -- Signature: ------------------------------
Head of Curriculum Committee/Faculty: --------------------------------------- Signature: ---------------------------
Dean: -- Signature: --