

University of Baghdad



جامعة بغداد

First Cycle – Bachelor's degree (B.Sc.) – Physics

بكالوريوس علوم - علم الفيزياء

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1. Overview

This catalogue is about the Levels (modules) given by the program of physics science to gain the Bachelor of Science degree. The program delivers (48) Modules with (6000) total student workload hours and 240 total ECTS. The module delivery is based on the Bologna Process.

نظره عامه

يتناول هذا الدليل المواد الدراسية التي يقدمها برنامج قسم الفيزياء للحصول على درجة بكالوريوس العلوم. يقدم البرنامج (49) مادة دراسية، على سبيل المثال، مع (٦٠٠٠) إجمالي ساعات حمل الطالب و ٢٤٠ إجمالي وحدات أوروبية. يعتمد تقديم المواد الدراسية على عملية بولونيا.

2. Undergraduate Levels 2023-2024

Module 1

Code	Level /Module Title	ECTS	Semester
PHY 1101	One /Mechanics (1)	8	1
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	106
Description			
<p>A- Theory (4ECTS):- Newtonian classical mechanics describes motion in terms of space and time. We define motion in one dimension which includes displacement, velocity, and acceleration. It's imperative that we study both graphical and algebraic properties of vectors, motion in two and three dimensions and laws of motion which deal with forces and masses.</p> <p>B- Experiments (4ECTS):- Experimental of mechanics provides knowledge about some physical ideas and skills in dealing with and laws with their applications such as terrestrial gravity, momentum of inertia of flying wheel, standing waves, force equilibrium, Hooke's law and simple harmonic oscillation.</p>			

Module 2

Code	Level /Module Title	ECTS	Semester
PHY 1102	One /Electricity	8	1
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	106
Description			
<p>A- Theory (4ECTS):- This Level aims to provide student with effective concepts and basic knowledge of electricity, including properties of the charge, electric field and electric force. As well as study and describe the laws of electricity such as Coulomb's law, Gauss's law and Ohm's law.</p> <p>B- Experiments (4ECTS):- Conducting practical experiments to achieve some basic electrical laws such as Ohm and Kirchhoff and other experiments to calculate electrical parameters such as resistances, current and heat coefficient, as well as the non-linear relationship between voltage and current as a result of heat and how an ammeter turns into an ohmmeter.</p>			

Module 3

Code	Level /Module Title	ECTS	Semester
UOB 103	One /Computer (1)	3	2
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
1	2/-/3	48	27
Description			
<p>Experiments (3ECTS):- This Level presents an overview of fundamental computer science topics and an</p>			

introduction to Windows operating systems. Overview topics include an introduction to computer hardware, operating systems, computer security, Internet, and e-mail. This Level also covers the essential concepts and skills relating to the use of devices, file creation and management. It help students to demonstrate the ability to use a Microsoft word processing application to accomplish small tasks associated with creating, formatting, finishing small-sized word processing documents, such as letters and other everyday documents. It also help students to demonstrate the ability to use a Microsoft power point application to accomplish tasks associated with creating, and formatting a presentation, and demonstrate the ability to use a Microsoft Excel application to accomplish a spreadsheet for tasks.

Module 4

Code	Level /Module Title	ECTS	Semester
UOB 104	One / Human Right and Democracy	2	2
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/-/3	33	17
Description			
<p>Theory (2ECTS):- This Level deals with the basic concept of human rights& democracy. Clarifying and training students on the most important principles of human rights and democracy. Organizing discussions and presentations on the most vital and basic topics affecting community building, related to human rights and democracy. Adopting teamwork with students to develop their cognitive abilities and create a spirit of cooperation, initiative, creativity and exchange of views in an effort to build the foundations of peaceful community coexistence. Providing society with conscious youth aware of the importance of its role in building society, its unity and cohesion through spreading the culture of human rights and establishing the rules of correct democracy. Human rights guarantee the protection and respect of an individual's interests, even when he or she is not a majority. In a democratic climate, sustainable democratic power cannot be conceived without respecting, protecting and fulfilling human rights.</p>			

Module 5

Code	Level /Module Title	ECTS	Semester
COS 1103	One /Mathematic (1)	5	1
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	62
Description			
<p>Theory (7ECTS):- The mathematics Level for the first stage typically covers a range of fundamental mathematical topics, including calculus, The Rate of change of function, limit, Derivatives of algebraic function and Applications. The Level aims to develop students' mathematical skills, including problem-solving, critical thinking, and analytical reasoning, and to prepare them for advanced study in mathematics and related fields.</p>			

Module 6

Code	Level /Module Title	ECTS	Semester
UOB101	One /Arabic Language (1)	2	2
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/-/3	33	17
Description			
<p>Theory (2ECTS):- يهدف هذا الدرس الى 1- تعلم مهارات الكتابة والاملاء والتعبير الصحيح خلال تطبيق قواعد اللغة العربية بشكل مفصل وتطبيقي على نصوص عربية.2-فهم الجمع وأنواع الاسماء وكيفية التعامل معها.3- فهم العدد واستعماله بشكل صحيح من حيث المطابقة والمخالفة للتفريق بين الضاد والطاء.4-التفريق ومعرفة استعمال التاء المربوطة والتاء الطويلة.5- التمييز بين العلامات الاصلية والفرعية. 6- تعلم استعمال الأدوات وعمل كل أداة ومعناها في التعبير.</p>			

Module 7

Code	Level /Module Title	ECTS	Semester
PHY 1207	One / Mechanics	7	2
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	81
Description			
<p>A- Theory (4ECTS):- We introduce work and kinetic energy, power, conservative force, potential energy, Linear Momentum, In rotation motion we are concerned with angular displacement, velocity, and acceleration. Rolling motion and simple harmonic motion are being studied. Properties of matter deal with concepts of stress, elasticity, tensile properties, as well as compressive, shear, and torsional deformation.</p> <p>B- Experiments (4ECTS):- Experimental of mechanics provides knowledge about some physical ideas and skills in dealing with and laws with their applications such as radius of gyration in rolling motion, surface tension, moment of inertia of a rod, speed of sound, force analysis on an inclined surface.</p>			

Module 8

Code	Level /Module Title	ECTS	Semester
PHY 1208	One /Magnetism	7	2
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	81
Description			
<p>A- Theory (4ECTS):- This Level aims to provide student with effective concepts and basic knowledge of magnetism, including Properties of the magnetic force on a charge moving in a magnetic field and differences between electric and magnetic forces. As well as study and describe the laws of magnetism such as Amperes' law Lenz's law and Faraday's law.</p> <p>B- Experiments (3ECTS):- Conducting practical experiments to show how to apply Ohm's law in electrical circuits that include coils, capacitors, and other experiments to calculate inductance, coil resistance,</p>			

dielectric constant, and the horizontal component of the Earth's magnetic field, as well as generating a regular magnetic field, as well as resonance in alternating current circuits.

Module 9

Code	Level /Module Title	ECTS	Semester
PHY 1211	One /Geometrical Optics	6	2
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- Because of the increasing use of concentric optics, as well as graphical methods of the tracing, these subjects (properties of light, lenses, mirrors, stops, image formation....etc.) have been introduced in chapters on geometrical optics. These chapters have been presented as optics 1 and optics 2 in level one in department of physics. The relationships between geometrical optics and particle mechanics will be considered as well.</p> <p>B- Experiments (3ECTS):- The student must cover the experimental parts of optics, these experiments include, Refractive Index via Different Methods, Focal length of the convex Lens, Focal length of the concave Lens, Aberrations in lenses, The prism and its dispersion and resolving powers, : Young's Experiment, Lloyd's mirror, Michelson Interferometer, Fabry – Perot Interferometer, Diffraction at a slit and Heisenberg uncertainty principle, Refractive index of a slide via Michelson interferometer, Newton's rings, Zone plate, Optical activity via the Penumbra polarimeter, Wedge interference and thickness measurements, Diffraction grating, and Photo voltaic cell.</p>			

Module 10

Code	Level /Module Title	ECTS	Semester
COS 1210	Two / Mathematics (2)	5	2
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	62
Description			
<p>Theory (4ECTS):- The mathematics Level typically covers a range of fundamental mathematical topics, including calculus, Infinite sequences and series, Vectors and geometry space and Partial derivatives. The Level aims to develop students' mathematical skills, including problem-solving, critical thinking, and analytical reasoning, and to prepare them for advanced study in mathematics and related fields.</p>			

Module 11

Code	Level /Module Title	ECTS	Semester
COS 1105	One /General Chemistry	5	1
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	64	61

Description
<p>A- Theory (2ECTS):- The objective of teaching General Chemistry is provide students with a comprehensive introduction to the field, including fundamental concepts and various branches. The Level aims to familiarize students with Chemistry and its applications, covering chemical analysis methods, concentration expressions, weight calculations, and analytical result treatment. Important topics covered in the syllabus include aqueous solutions chemistry, electrolyte classification, and acid-base theory.</p> <p>B- Experiments (1ECTS):- The Level aims to provide a solid foundation in Analytical Chemistry, enabling students to understand and apply principles, theories, and calculations essential for successful analysis and experimentation. By the end of the Level, students will have a solid understanding of volumetric analysis, especially titration, and its applications. They will be able to perform titration experiments, calculate pH values, and interpret results effectively.</p>

Module 12

Code	Level /Module Title	ECTS	Semester
UOB 102	One /English Language (1)	2	1
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/-/3	33	17
Description			
<p>Theory (2ECTS):- Understanding greetings and simple instructions, as well as extracting information from short spoken passages. Engaging in basic conversations, asking and answering questions about personal details, and participating in dialogues and role-plays. Comprehending simple texts and extracting information from them. Writing short sentences and paragraphs about personal information and filling out basic forms. Acquiring basic vocabulary and understanding grammatical structures. Develop an understanding of cultural customs and practices in English-speaking countries.</p>			

Module 13

Code	Level /Module Title	ECTS	Semester
PHY 2313	Two /Modern physics (1)	6	3
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
4	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- The Level aims to teach the student one of the most important basics of physics (atomic physics), which includes a lot of basics that must be seen and known by a student specializing in physics and making him able to understand these basics and logical and scientific analysis in the interpretation of physical phenomena, as well as enabling the student to solve issues related to vocabulary matter using the laws of atomic physics.</p> <p>B- Experiments (3ECTS):- The aim of the laboratory atomic physics is to conduct practical experiments on physical, optical and electrical (The back scattering For Beta particles ,Photoelectric Effect, Calculating the electron to mass ratio (e/m), Millikan's Oil Drop , Determination of Rydberg Constant,</p>			

Light Absorption coefficient by using photo cell, Determination of the first excitation potential for Helium , and The Characteristics of Geiger's Counter) and to graduate scientific cadres holding a bachelor's degree in physics who are able to work in the field of specialization.

Module 14

Code	Level /Module Title	ECTS	Semester
PHY 2314	Two / Heat and Thermodynamic	6	3
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- Thermodynamic is study the relation between work and heat. The first Level aims to define temperature by studying the zero law of thermodynamics and the scales used to measure temperature, the thermal expansion of solid. The work of different hydrostatic system first law of thermodynamics and applications of first law of thermodynamics, heat transfer mechanisms also the kinetic theory of gases is studied and explained.</p> <p>B- Experiments (3ECTS):- The thermodynamic laboratory aims to confirm the theoretical concepts of thermodynamics by conducting experiments that are a practical application of thermodynamic laws such as measuring the thermal expansion of water (the apparent and the real) solid materials, thermal conductivity of conducting and non-conducting materials, and measuring the atmospheric pressure using Boyle method.</p>			

Module 15

Code	Level /Module Title	ECTS	Semester
PHY 2315	Two / Analytical Mechanic (1)	6	3
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	87
Description			
<p>Theory (6ECTS):- In this Level content a brief introduction to a vector an algebra concepts of velocity and acceleration, newton's laws of motion, harmonic motion, resonance, the driven oscillator, motion of particle in three dimensions, potential of energy and conservative forces, the analysis of motion in a nonlinear farm of reference and fractions forces, Gravitation, Expanded discussion of central forces, expanded Discussion of orbital energy.</p>			

Module 16

Code	Level /Module Title	ECTS	Semester
PHY 2316	Two / Analog Electronics	6	3
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- Analog Electronics is the branch of science that deals with the study of flow and control of electrons (electricity) and the study of their behavior and effects in vacuums, gases, and semiconductors, and with devices using such electrons. This control of electrons is accomplished by devices (electronic components) that resist, carry, select, steer, switch, store, manipulate, and exploit the electron.</p> <p>B- Experiments (3ECTS):- Analog Electronics Lab aims to design and analyze various Electronic circuits such as diodes, applications of diodes, FET, oscillators, digital circuits etc. and give the ability to understand circuit theorems and concepts.</p>			

Module 17

Code	Level /Module Title	ECTS	Semester
UOB 205	Two / Baath regime Crime in Iraq	2	4
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/-/3	33	17
Description			
<p>Theory (2ECTS):- في البداية تتضمن نبذة تاريخية عن النظام السياسي في العراق من قبل بريطانيا وصولاً الوصول حزب البعث المقبور الى السلطة وكذلك دراسة جرايم حزب البعث منذ توليه السلطة والعبث بها كذلك توضيح ما اصاب العراق من اثار وكوارث على يد هذا النظام الدكتاتوري المجرم الذي جسد اقصى انواع التعسف والظلم والطغيان والاستبداد كذلك ارشاد الطلبة الى ان الظلم والاستبداد يدمر الشعوب ويجر الويلات عليها وبيان الاثار التي حدثت نتيجة الحروب العنيفة التي خلفت ورائها تدمير في كل مفاصل البلاد فدمرت البنى التحتية والتربة والمياه والسماء والاشجار وكل شئ في هذه البلاد والتي كانت من افضل بلدان الشرق الاوسط . كذلك تم تدمير حتى البيئة المائية من خلال تسريب النفط في حرب الكويت والخسائر الاقتصادية الهائلة وتضرر الابار النفطية والبنى التحتية والصناعة وفرض حصار دمر البيئة الاجتماعية والاقتصادية التي لازلنا الى يومنا هذا نرفع اثار النظام البائد على الصعيد الدولي والداخلي.</p>			

Module 18

Code	Level /Module Title	ECTS	Semester
UOB 206	Two /English language (2)	2	4
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/-/3	33	17
Description			
<p>Theory (2ECTS):- This approach to language learning emphasizes communication through interactive activities, group work, and discussions. It integrates all language skills and focuses on vocabulary expansion, grammar instruction, and the use of authentic materials. Cultural awareness, error</p>			

correction, technology integration, regular assessment, individualization, cooperative learning, and review sessions are also key components of this method.

Module 19

Code	Level /Module Title	ECTS	Semester
PHY 2419	Two /modern Physics (2)	6	4
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- Studying the laws of physics and explaining the concept of atomic physics and applying it practically by recognizing the importance of practical experiments in atomic physics and applying the most important laws in laboratory experiments. Mathematics students needed to solve the calculations required for the practical experiments of the atomic Physics Laboratory.</p> <p>B- Experiments (3ECTS):- Atomic physics The branch of physics that deals with the study of the atom and its structure of the nucleus and the electron shell. It is also concerned with the study of the effects between atoms and ions with neighboring atoms and ions. And conduct practical experiments on physical, optical and electrical (Stefan's Law, Inverse square law, The Plank's Constant, Cathode ray tube, The Spectrum of the Helium atom (He), Statistical Account, Specific charge (e/m) of electron (Schuster method), and Determination of the Ionization potential for Helium).</p>			

Module 20

Code	Level /Module Title	ECTS	Semester
PHY 2420	Two/Thermodynamic and Statistical mechanics	6	4
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- The second Level imply studying the performance of thermal machines and the refrigerator, which are the most important applications of the second law of thermodynamics. Universal entropy has been studied for different process The thermodynamic function as Enthalpy, Helmholtz and Gibbs to connection first and second law and Maxwell relations.</p> <p>B- Experiments (3ECTS):- measurements of equivalent joules, and measuring the specific heat of solid , measuring coefficient of thermal expansion of solid, measuring the latent heat of vaporization of water ,measuring thermal conductivity of glass , and measuring the change of viscosity coefficient of a liquid with temperature.</p>			

Module 21

Code	Level /Module Title	ECTS	Semester
PHY 2421	Two/ Analytical Mechanic (2)	5	4

Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	62
Description			
<p>Theory (6ECTS):- In this Level content a many particle systems, Lagrangian points, Conservation laws and collisions. Expanded presentation of rocket motion, Rotation of body about a fixed axis. Expanded discussion of laminar motion, Moments of inertia, Rotation of a body in three dimensions, Numerical solutions of the rotation of bodies with differing principal moments of inertia, Lagrangian and Hamiltonian mechanics, Conservation laws.</p>			

Module 22

Code	Level /Module Title	ECTS	Semester
PHY 2422	Two/Digital Electronics	5	4
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	31
Description			
<p>A- Theory (3ECTS):- Digital electronics is field of electronics involving the study of digital signals. It is the study of electronic circuits that are used to process and control digital signals. In contrast to analog electronics, where information is represented by a continuously varying voltage, digital signals are represented by two discrete voltages or logic levels.</p> <p>B- Experiments (3ECTS):- The Electronics Labs are used by the students of electronics to design and experiment with electronic circuit programs. The objective of Digital Electronics Laboratory is to link the theoretical concepts of different Digital Electronics circuits with practical feasibility. This laboratory will enable the undergraduate students to learn the basic concepts and techniques in digital electronic circuits and systems.</p>			

Module 23

Code	Level /Module Title	ECTS	Semester
COS 2317	Two/Mathematics (3)	4	3
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	37
Description			
<p>Theory (3ECTS):- The mathematics Level typically covers a range of fundamental mathematical topics, including calculus, Infinite sequences and series, Vectors and geometry space and Partial derivatives. . The Level aims to develop students' mathematical skills, including problem-solving, critical thinking, and analytical reasoning, and to prepare them for advanced study in mathematics and related fields.</p>			

Module 24

Code	Level /Module Title	ECTS	Semester
UOB 207	Two/ Computer (2)	3	3
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
1	2/-/3	48	27
Description			
<p>Theory (3ECTS):- The main strategy that will be adopted in delivering this module is to encourage students' participation in the exercises, while at the same time refining and expanding their critical thinking skills. Different forms of teaching will be used to reach the objective of this module, including power point presentation for the subjects which contains titles, definitions, summary and conclusions, whiteboard will be used and classroom discussion with assignments, the students will be asked to prepare papers on selective topics.</p>			

Module 25

Code	Level /Module Title	ECTS	Semester
COS 2423	Two/Mathematics (4)	4	4
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	37
Description			
<p>Theory (3ECTS):- The mathematics Level typically covers a range of fundamental mathematical topics, including calculus, Infinite sequences and series, Vectors and geometry space and Partial derivatives. . The Level aims to develop students' mathematical skills, including problem-solving, critical thinking, and analytical reasoning, and to prepare them for advanced study in mathematics and related fields.</p>			

Module 26

Code	Level /Module Title	ECTS	Semester
PHY 3636	Three/ Molecular Physics	2	6
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/1/3	48	2
Description			
<p>Theory (2ECTS):- The molecular physics Level covers the fundamentals of chemical bonding, including types of bonding, electronegativity, and electron affinity. It also explores molecular bonding theories, molecular orbitals, and their properties such as magnetism and color. Additionally, the Level introduces molecular spectroscopy, discussing rotational, vibrational, and electronic energy levels, as well as selection rules for transitions.</p>			

Module 27

Code	Level /Module Title	ECTS	Semester
PHY 3526	Three/ Physical Optics	6	5
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- The science of optics is very old, but in recent years have been a number of new developments. In this semester the student deals with physical optics, that is , the propagation of light, its vectorial nature, coherence and interference, diffraction, and the optics of solids.</p> <p>B- Experiments (3ECTS):- The student must cover the experimental parts of optics, these experiments include, Refractive Index via Different Methods, Focal length of the convex Lens, Focal length of the concave Lens, Aberrations in lenses, The prism and its dispersion and resolving powers, : Young’s Experiment, Lloyd's mirror, Michelson Interferometer, Fabry – Perot Interferometer, Diffraction at a slit and Heisenberg uncertainty principle, Refractive index of a slide via Michelson interferometer, Newton's rings, Zone plate, Optical activity via the Penumbra polarimeter, Wedge interference and thickness measurements, Diffraction grating, and Photo voltaic cell.</p>			

Module 28

Code	Level /Module Title	ECTS	Semester
PHY 3528	Three/Quantum Mechanics (1)	5	5
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
3	-/2/3	63	62
Description			
<p>Theory (6ECTS):- This Level is enable the student to understand the basics of quantum mechanics and explain the observations that could not be describe with classical mechanics using the physical phenomena from a mathematical point of view. Interpretation of the wave function and explain the properties and the normalization condition of the wave function. Also, enable students to derivation Schrodinger Equation.</p>			

Module 29

Code	Level /Module Title	ECTS	Semester
PHY 3529	Three/Material Physics (1)	6	5
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (2ECTS):- Introduces to three fundamental topics in materials science: structure, bonding, and thermodynamics. These subjects are usually taught separately, but their conceptual ties are important for understanding materials. Bonding affects structure, and structure influences thermodynamic properties. Appreciating diverse perspectives in materials science enhances understanding.</p>			

B- Experiments (2ECTS):- Study and apply practical physics experiments using electronic simulation programs to enable students to understand, comprehensive and visualize concepts and laws through a three-dimensional application that facilitates viewing the experiment, controlling its variables, obtaining results, applying and drawing it.

Module 30

Code	Level /Module Title	ECTS	Semester
PHY 3527	Three /Laser Physics (1)	6	5
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (2ECTS):- This Level description provides a brief summary of the most important characteristics of what laser is and how to produce it or reach it and get it. through of understand the meaning of population inversion with mathematical relations, Studying the types of resonator in details, Studying the types of pumping in details; Introducing students to the types of lasers according to the type of active medium and the quality of pumping. And studying some lasers such as the Ruby, Nd-YAG, He-Ne, CO₂ & Dye laser, study its applications in the field of medicine.</p> <p>B- Experiments (2ECTS):- Introduce students to how to use lasers in measurement diameter of pin hole, diameter of single slit- introduce students to how to study IV characteristics curve of semiconductor laser- introduce the students the safety rules in laser lab.</p>			

Module 31

Code	Level /Module Title	ECTS	Semester
PHY 3531	Three/Optional (1)	6	5
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	87
Description			
<p>A- Theory (6ECTS):- Physics Sciences cover a wide range of applications in various fields. Physicists possess the capacity to work with radiation sources, lasers, and material structures. They can analyses spectra, utilize plasma, and apply physics in quality control. In the renewable energy sector, physicists can utilize nuclear energy, lasers, and solar cells. In medical physics, they apply nuclear physics, lasers, and materials for cancer treatment and water purification. Industrial physicists work with nuclear facilities, lasers, and electrical circuits. Agricultural physicists improve agriculture using nuclear radiation, lasers, and plasma. In optical communications, physicists enhance communication through nuclear energy, lasers, fibre manufacturing, and spectrum analysis. In forensic physics, physicists use nuclear detection, lasers, and plasma for crime evidence analysis. They can also employ physics sciences for quality control and assurance.</p>			

Module 32

Code	Level /Module Title	ECTS	Semester
PHY 3632	Three /Mathematical Physics	5	6
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	62
Description			
<p>Theory (7ECTS):- In this semester, the student shall familiar with the Green's theorem in the plane, Gauss's theorem and Stoke's theorem. Such theorems involve line, surface and volume integrals with solved problems, assignments and applications in physics (especially in electromagnetism and electrodynamics) and engineering (especially in fluid mechanics).</p>			

Module 33

Code	Level /Module Title	ECTS	Semester
PHY 3634	Three /Quantum Mechanics (2)	5	6
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	62
Description			
<p>Theory (6ECTS):-In this semester the student learns about commute operator and Ehrenfest theorem Also, enable the student to find the solutions of someone- dimensional systems and derivation Schrodinger equation in three dimensions with some application. Thus, preparing qualified competencies in the field of theoretical physics to work in all ministries and scientific research centers.</p>			

Module 34

Code	Level /Module Title	ECTS	Semester
PHY 3635	Three / Material Physics (2)	6	6
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- This Level provides basic knowledge of metals, polymers, ceramics, plasma and nanomaterials. It covers fundamental properties of materials, phase diagrams, and concepts of degradation and failure. Upon completion, students will have the necessary foundation to pursue advanced Level s in the MSE curriculum.</p> <p>B- Experiments (3ECTS):- Study and apply practical physics experiments using electronic simulation programs to enable students to understand, fundamental properties of materials, phase diagrams, and concepts of degradation and failure. Upon completion concepts and laws through a three-dimensional application that facilitates viewing the experiment, controlling its variables, obtaining results, applying and drawing it.</p>			

Module 35

Code	Level /Module Title	ECTS	Semester
UOB 309	Three / Research Methodology	1	5
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
1	-/-/3	18	7
Description			
<p>Theory (1ECTS):- This Level will present an overview of research methodology including basic concepts employed in quantitative and qualitative research methods. Research techniques and methods will be examined for the formulation of hypotheses, development of testable objectives, experimental design, subject selection, data collection, data analysis and interpretation, and report preparation. This Level will focus also on laboratory-based methods and simple statistical procedures for the analysis of data. Students will apply the concepts and methods in laboratory exercises.</p>			

Module 36

Code	Level /Module Title	ECTS	Semester
PHY 3633	Three /Laser Physics (2)	4	6
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (2ECTS):- This Level description provides a brief summary of the most important characteristics of what laser is and how to produce it or reach it and get it. through of understand the meaning of population inversion with mathematical relations, Studying the types of resonator in details, Studying the types of pumping in details; Introducing students to the types of lasers according to the type of active medium and the quality of pumping. And studying some lasers such as the Ruby, Nd-YAG, He-Ne, CO₂ & Dye laser, study its applications in the field of medicine.</p> <p>B- Experiments (2ECTS):- Introduce students to how to use lasers in measurement diameter of pin hole, diameter of single slit- introduce students to how to study IV characteristics curve of semiconductor laser- introduce the students the safety rules in laser lab.</p>			

Module 37

Code	Level /Module Title	ECTS	Semester
PHY 3637	Three /Optional (2)	6	6
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	87
Description			
<p>Theory (6ECTS):- Physics Sciences cover a wide range of applications in various fields. Physicists possess</p>			

the capacity to work with radiation sources, lasers, and material structures. They can analyse spectra, utilize plasma, and apply physics in quality control. In the renewable energy sector, physicists can utilize nuclear energy, lasers, and solar cells. In medical physics, they apply nuclear physics, lasers, and materials for cancer treatment and water purification. Industrial physicists work with nuclear facilities, lasers, and electrical circuits. Agricultural physicists improve agriculture using nuclear radiation, lasers, and plasma. In optical communications, physicists enhance communication through nuclear energy, lasers, fibre manufacturing, and spectrum analysis. In forensic physics, physicists use nuclear detection, lasers, and plasma for crime evidence analysis. They can also employ physics sciences for quality control and assurance.

Module 38

Code	Level /Module Title	ECTS	Semester
PHY 4738	Four /Nuclear Physics (1)	6	7
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- Nuclear Physics aims to provide students with effective concepts and basic knowledge of nuclear physics, including properties of the nucleus such as mass, volume, nuclear binding energy, and nuclear separation energy. The Level also aims to study and describe the nucleus using the concepts of quantum mechanics by adopting the Schrodinger equation.</p> <p>B- Experiments (3ECTS):-The study in the Nuclear Physics Laboratory aims to prepare specialists in general and nuclear physics and its practical applications, where the student can learn ,identification of radioactive nuclear isotopes and the type of radiation they emit, learn safety rules in dealing with radiation, knowing the laboratory equipment prepared for the purpose of radiation detection and how to use it, conducting practical experiments related to various nuclear radiations and linking the practical results with the theoretical study.</p>			

Module 39

Code	Level /Module Title	ECTS	Semester
PHY 4739	Four /Solid State Physics (1)	6	7
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- This Level aims to provide students with a comprehensive understanding of the fundamental principles and applications of solid state physics. Solid state physics is concerned with studying the physical properties of solid materials, including crystals, amorphous solids, and nanostructures. The Level delves into the behavior of electrons, atoms, and molecules within these materials, exploring topics such as crystal structure, lattice vibrations, electronic band theory, magnetism, and semiconductor physics.</p> <p>B- Experiments (3ECTS):- This Level serves as a practical complement to the theoretical concepts</p>			

covered in solid-state physics lectures, allowing students to deepen their understanding of the fundamental principles and phenomena of condensed matter. Through this laboratory-based Level, students will gain practical skills in handling and characterizing materials, analyzing their structural, electrical, and optical properties, and exploring various phenomena exhibited by solids. The Level emphasizes the use of advanced experimental techniques and instruments commonly employed in solid-state physics research.

Module 40

Code	Level /Module Title	ECTS	Semester
PHY 4740	Four /Electromagnetic Theory (1)	4	7
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	/2/3	63	37
Description			
<p>Theory (6ECTS):- Definition of static and time-dependent electromagnetic fields, their sources, and how to calculate them in space and material media. Also, electromagnetic radiation and its transmission in waveguides, as well as the inertia of radiation and its importance in energy conservation.</p>			

Module 41

Code	Level /Module Title	ECTS	Semester
PHY 4743	Four /Research Project (1)	4	7
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/-/3	63	37
Description			
<p>A-Theory (2ECTS):- The purpose of academic research is to provide a sufficient description of phenomena and explain the relationship between them and the subjects. This description facilitates the generalization and study of phenomena, and it helps scientists and researchers to make more accurate scientific observations related to their studies. This is because science relies on systematic and precise description and uses scientific definitions for these phenomena. It organizes the writing of topics.</p> <p>B- Experiments (1ECTS):- This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.</p>			

Module 42

Code	Level /Module Title	ECTS	Semester
PHY 4742	Four /Optional (3)	5	7
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	/2/3	63	62
Description			

Theory (6ECTS):- Physics Sciences cover a wide range of applications in various fields. Physicists possess the capacity to work with radiation sources, lasers, and material structures. They can analyse spectra, utilize plasma, and apply physics in quality control. In the renewable energy sector, physicists can utilize nuclear energy, lasers, and solar cells. In medical physics, they apply nuclear physics, lasers, and materials for cancer treatment and water purification. Industrial physicists work with nuclear facilities, lasers, and electrical circuits. Agricultural physicists improve agriculture using nuclear radiation, lasers, and plasma. In optical communications, physicists enhance communication through nuclear energy, lasers, Fibre manufacturing, and spectrum analysis. In forensic physics, physicists use nuclear detection, lasers, and plasma for crime evidence analysis. They can also employ physics sciences for quality control and assurance.

Module 43

Code	Level /Module Title	ECTS	Semester
PHY 4741	Three/Nano science	5	7
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	62
Description			
<p>Theory (3ECTS):- Classification of nanomaterials: Nanosized metals , semiconductors, ceramics—a comparison with respective bulk materials, Organic semiconductors, carbon materials, quantum dots, quantum wells, quantum rods, quantum wires, quantum rings; bulk nanostructured, nanocomposites, nanomachines and Devices.</p>			

Module 44

Code	Level /Module Title	ECTS	Semester
PHY 4844	Four /Nuclear Physics (2)	6	8
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- Nuclear Physics aims to provide students nuclear models such as (shell model, semi empirical mass formula, liquid drop model, ...) the Level also includes the study of nuclear decay processes (α-decay, β-decay and γ-decay) as well as the study of nuclear reactions (compound nucleus, direct reaction, fission reaction and fusion reaction).</p> <p>B- Experiments (3ECTS):- In this semester the student learns nuclear spectra of different types of nuclear radiation, knowing the ways of radiation interacts with matter. And how to benefit from these principles in different aspects of life and identify the methods of protection against radiation and the useful materials for protection. Thus, preparing qualified competencies in the field of nuclear physics, to work in the Ministry of Environment, the Radiation Protection Center, and the Iraqi Radioactive Sources Regulatory Authority. In addition, can work in the Ministry of Health.</p>			

Module 45

Code	Level /Module Title	ECTS	Semester
PHY 4845	Four /Solid State Physics (2)	6	8
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/2/4	94	56
Description			
<p>A- Theory (3ECTS):- Solid state physics is concerned with the study of the physical properties of solid materials, including crystals, amorphous solids, and nanostructures. The Level delves into the behavior of electrons, atoms, and molecules within these materials, exploring topics such as crystal structure, lattice vibrations, electronic band theory, magnetism, and semiconductor physics. Through a combination of theoretical lectures, laboratory experiments, and problem-solving sessions, students will develop a strong foundation in the principles that govern the behavior of solids.</p> <p>B- Experiments (3ECTS):- The Solid State Laboratory Physics Level aims to develop students' practical laboratory skills, critical thinking, data analysis, and scientific communication abilities. Students will work individually or in groups to conduct experiments, analyze data, and present their findings in the form of laboratory reports and presentations. By successfully completing the Solid State Laboratory Physics Level, students will enhance their understanding of the principles and applications of solid-state physics, strengthen their experimental skills, and be better prepared for further studies or careers in fields such as materials science, condensed matter physics, semiconductor technology, and nanotechnology.</p>			

Module 46

Code	Level /Module Title	ECTS	Semester
PHY 4846	Four /Electromagnetic Theory (2)	4	8
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	37
Description			
<p>Theory (6ECTS):- As a continuation of what was mentioned in the first part. Definition of static and time-dependent electromagnetic fields, their sources, and how to calculate them in space and material media. Also, electromagnetic radiation and its transmission in waveguides, as well as the inertia of radiation and its importance in energy conservation.</p>			

Module 47

Code	Level /Module Title	ECTS	Semester
PHY 4847	Four /Plasma Physics	5	8
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	62
Description			
<p>Theory (3ECTS):- Complementing what was studied in the first part, the student will study the equilibrium and stability of plasma, as well as the study of plasma through kinetic theory, as well as the study of nonlinear effects and special plasmas, ending with the most important applications of plasma.</p>			

Module 48

Code	Level /Module Title	ECTS	Semester
PHY 4849	Four /Research Project (2)	4	8
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	2/-/3	63	37
Description			
<p>A-Theory (2ECTS):- The purpose of academic research is to provide a sufficient description of phenomena and explain the relationship between them and the subjects. This description facilitates the generalization and study of phenomena, and it helps scientists and researchers to make more accurate scientific observations related to their studies. This is because science relies on systematic and precise description and uses scientific definitions for these phenomena. It organizes the writing of topics.</p> <p>B- Experiments (1ECTS):- This will be achieved through classes, interactive tutorials and by considering types of simple experiments involving some sampling activities that are interesting to the students.</p>			

Module 49

Code	Level /Module Title	ECTS	Semester
PHY 4849	Four / Optional (4)	4	8
Class (hr/w)	Lab./Tutor/Exam	SSWL (hr/sem)	USSWL (hr/w)
2	-/2/3	63	37
Description			
<p>Theory (6ECTS):- Physics Sciences cover a wide range of applications in various fields. Physicists possess the capacity to work with radiation sources, lasers, and material structures. They can analyses spectra, utilize plasma, and apply physics in quality control. In the renewable energy sector, physicists can utilize nuclear energy, lasers, and solar cells. In medical physics, they apply nuclear physics, lasers, and materials for cancer treatment and water purification. Industrial physicists work with nuclear facilities, lasers, and electrical circuits. Agricultural physicists improve agriculture using nuclear radiation, lasers, and plasma. In optical communications, physicists enhance communication through nuclear energy, lasers, fibre manufacturing, and spectrum analysis. In forensic physics, physicists use nuclear detection, lasers, and plasma for crime evidence analysis. They can also employ physics sciences for quality control and assurance.</p>			

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