بسم الله الرحمن الرحيم

Al-Balqa Applied University

Faculty of Agricultural Technology
Curriculum for the Bachelor's Degree
in Water Resources and Environmental Management
الخطة المعدلة المعتمدة بقرار مجلس العمداء رقم 2023/2022/1108 بتاريخ 2023/7/4
لمرحلة البكالوريوس وعلى بداية العام الجامعي 2024/2023

The curriculum for the B.Sc. degree in Water Resources and Environmental Management consists of (132) credit hours distributed as follows:

Course No.	Requirements	Credit Hours
1	University Requirements ▪ Compulsory ▪ Elective	**24** 18 6
2	Faculty Requirements	**21**
3	Specialization Requirements ▪ Compulsory ▪ Elective	**80** 71 9
4	Supportive Specialization Requirements	**7**
Total		**132**

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Al-Balqa Applied University **جامعـة البلقــاء التطبيقيـة**

تأسست سنة 1997

Curriculum for the Bachelor's Degree in Water Resources and Environmental Management

First: University Requirements (24 credit hours):

A. Compulsory University Requirements **(18 credit hours)**:

Course No.	Course Title	Credit hours	Weekly Hours		Prerequisite
			Lecture	Lab.	
35001101	Military sciences	3	3	0	Passing 90 credit hours
AEL101	Applied English Language (1)	3	3	0	English 99 or passing English Level Exam
AAL101	Applied Arabic Language	3	3	0	Arabic 99 or passing Arabic Level Exam
CS101	Computer Skills and E-Learning	1	1	0	Computer Skills 99 or passing Computer Skills Level Exam
AEL102	Applied English Language (2)	3	3	0	Applied English Language (1) (AEL101)
NE101	National Education and University Behavior	3	3	0	-
IEC101	Innovation, Entrepreneurship, and Creativity	2	2	0	-
Total		**18**	**18**	**0**	**-**

B: Elective University Requirements: (6 credit hours):

The student can select **(6 credit hours**) from the University elective courses offered by Faculties other than the Faculty of Agricultural Technology.

Course No.	Course Title	Credit hours
36001101	Communication skills	3
36002102	Introduction to psychology	3
36003103	Jordanian Society	3
36004104	Sports and health for all	3
36005105	Islamic culture	3
36009111	Economic concepts	3
36006106	Contemporary Administrative Concepts and Skills	3
36012109	The Orthodox Caliphs	3
36009114	Jerusalem (Palestinian issue)	3
36009112	Law, Media and Society	3
36009109	Islam and Life	3
36009115	Numerical Society	3
Total		**36**

Second: Faculty Requirements: (21 credit hours).

Course No.	Course Title	Credit hours	Weekly Hours		Prerequisite
			Lecture	Lab.	
30202101	Calculus 1	3	3	0	-
30206101	General Chemistry 1	3	3	0	-
30206102	General Chemistry Lab 1	1	0	3	30206101*
30206103	General Chemistry 2	3	3	0	30206102
30206104	General Chemistry Lab 2	1	0	3	30206103*
30203101	General Biology 1	3	3	0	-
30203111	General Biology Lab	1	0	3	30203101*
30201105	General Physics for Agricultural Students	3	3	0	-
30403211	Principles of Plant Production	3	3	0	30203101
Total		**21**	**18**	**9**	

*The prerequisite can be registered concurrently

Third: Specialization Requirements: (80 credit hours):

A: Compulsory Specialization Requirements: (71 credit hours)

Course No.	Course Title	Credit hours	Weekly Hours		Prerequisite
			Lecture	Lab.	

WRE221	Applied Environmental Geology	3	3	0	-
WRE211	Hydraulics	3	2	3	30202101 30201105
WRE222	Meteorology and Air Pollution	3	3	0	WRE221
WRE212	Principles of Irrigation and Drainage	3	3	0	WRE211
WRE213	Drinking water quality	3	2	3	30206103 WRE221
WRE223	Environmental Soil Physics	3	2	3	WRE221
WRE314	Surface Water Hydrology	3	3	0	WRE221 WRE213
WRE316	Design of smart irrigation system	3	3	0	WRE211 WRE212
WRE326	Wastewater Treatment and Reuse	3	2	3	30206104 WRE213
WRE331	Environmental Impact Assessment	3	3	0	WRE222 WRE314
WRE315	Groundwater Hydrology	3	3	0	WRE314
WRE325	Environmental Soil Chemistry	3	3	0	WRE221 WRE331
WRE324	Climate change and sustainable development	3	3	0	WRE314 WRE331
WRE327	Soil Fertility and Fertilizers	3	2	3	WRE325
WRE341	Environmental remote sensing and GIS	3	3	0	WRE221
WRE342	Environmental remote sensing and GIS Lab	1	0	3	WRE341
WRE433	Water harvesting systems	3	3	0	WRE314 WRE341
WRE443	Environmental Monitoring and Early Warning Systems	3	3	0	WRE324
WRE417	Integrated Water Resources Management	3	3	0	WRE315 WRE324
WRE432	Integrated Solid Waste Management	3	3	0	WRE324
WRE434	Water and Environmental Economics	3	3	0	WRE324 WRE433
WRE401	Field Training in Water Resources and Environmental Management	6	0	0	After successfully passing 100 credit hours
WRE402	Seminar in Water Resources and Environmental Management	1	1	0	After successfully passing 100 credit hours

WRE403	Graduation Project in Water Resources and Environmental Management	3	0	0	After successfully passing 100 credit hours
Total		**71**	**56**	**18**	

B: Elective Specialization Requirements: **9 credit hours** to be selected from the following list:

Course No.	Course Title	Credit hours	Weekly Hours		Prerequisite
			Lecture	Lab.	
WRE228	Principles of Soils and Irrigation	3	3	0	-
WRE335	Integrated Management of Ecosystems	3	3	0	WRE331
WRE344	Environmental Modeling	3	2	3	WRE222 WRE223
OAT459	Hydroponics	3	2	3	30203101 211 م م ب
ABT426	Environmental biotechnology	3	3	0	331 م م ب
Total		**15**	**13**	**6**	

Fourth: Supportive Specialization Requirements: (7 credit hours)

Course No.	Course Title	Credit hours	Weekly Hours		Prerequisite
			Lecture	Lab.	
30403473	Statistics and Design of Agricultural Experiments	3	3	0	30202101
a30601222	Project Management (College of Business)	3	3	0	-
CIE0215	Surveying Lab	1	0	3	-
Total		**7**	**6**	**3**	

*The prerequisite can be registered concurrently

Guidelines for the Bachelor's Degree in Water Resources and Environmental Management

First Academic Year					
First Semester			**Second Semester**		
Course No.	Course Title	Credit hour	Course No.	Course Title	Credit hour
AAL101	Applied Arabic Language	3	IEC101	Innovation, Entrepreneurship, and Creativity	2
AEL101	Applied English Language (1)	3	AEL102	Applied English Language (2)	3
CS101	Computer Skills and E-Learning	1	30202101	Calculus 1	3
30203101	General Biology 1	3	-	University Elective Course (UEC)	3
30203111	General Biology Lab	1	30206103	General Chemistry 2	3
30206101	General Chemistry 1	3	30201105	General Physics for Agricultural Students	3
30206102	General Chemistry Lab 1	1	-	-	-
Total		**15**	**Total**		**17**

Second Academic Year					
First Semester			**Second Semester**		
Course No.	Course Title	Credit hour	Course No.	Course Title	Credit hour
NE101	National Education and University Behavior	3	WRE222	Meteorology and Air Pollution	3
WRE221	Applied Environmental Geology	3	WRE212	Principles of Irrigation and Drainage	3
WRE211	Hydraulics	3	WRE213	Drinking water quality	3
30206104	General Chemistry Lab 2	1	WRE223	Environmental Soil Physics	3
30403211	Principles of Plant Production	3	-	Specialization Elective Course (SEC)	3

-	University Elective Course (UEC)	3	a30601222	Project Management (College of Business)	3
Total		**16**	**Total**		**18**

Third Academic Year					
First Semester			**Second Semester**		
Course No.	Course Title	Credit hour	Course No.	Course Title	Credit hour
WRE314	Surface Water Hydrology	3	WRE315	Groundwater Hydrology	3
WRE316	Design of smart irrigation system	3	WRE327	Soil Fertility and Fertilizers	3
WRE325	Environmental Soil Chemistry	3	WRE324	Climate change and sustainable development	3
WRE326	Wastewater Treatment and Reuse	3	WRE342	Environmental remote sensing and GIS Lab	1
WRE341	Environmental remote sensing and GIS	3	WRE331	Environmental Impact Assessment	3
-	Specialization Elective Course (SEC)	3	-	Specialization Elective Course (SEC)	3
			CIE0215	Surveying Lab	1
Total		**18**	**Total**		**17**

Fourth Academic Year					
First Semester			**Second Semester**		
Course No.	Course Title	Credit hour	Course No.	Course Title	Credit hour
WRE433	Water harvesting systems	3	WRE417	Integrated Water Resources Management	3
WRE443	Environmental Monitoring and Early Warning Systems	3	WRE432	Integrated Solid Waste Management	3
30403473	Statistics and Design of Agricultural Experiments	3	WRE434	Water and Environmental Economics	3
WRE401	Field Training	6	WRE402	Seminar	1
-	UCC	3	WRE403	Graduation Project	3
Total		**18**	**Total**		**13**

Note: Seminar, Field Training and Graduation Project can be proposed for the first &/or second semesters of the fourth academic year. Seminar &/or Field Training can also be proposed for the summer semester.

Course Description/Department of Water Resources and Environmental Management:

Course No.	Course Title	Credit hours	Pre-requisite
30202101	**Calculus 1** Functions: domain, operations on functions, graphs of functions, trigonometric functions; limits and continuity; the derivative: techniques of differentiation, the chain rule, implicit differentiation; differentials; Roll's theorem; the main value theorem; L'Hôpital's rule; increasing and decreasing functions; concavity; maximum and minimum values of a function, graphs of including rational functions; the indefinite integral; the fundamental theorem of calculus; the area between two curves; inverse functions; logarithmic and exponential functions; hyperbolic functions.	3;3,0	-
30206101	**General Chemistry 1** Fundamentals of chemical changes, The periodic table and some properties of the elements, Stoichiometry, quantitative chemical relationships, Reactions between ions in aqueous solutions, Oxidation-reduction reactions, Atomic and electronic structure, Chemical Bonding, Chemical bonding and molecular structure	3;3,0	-
30206102	**General Chemistry Lab 1** Laboratory techniques, Chemical observations, Measurements of volume and mass, Limiting reactant in a salt mixture, Empirical formula for magnesium oxide, Standardization of sodium hydroxide solution, Vinegar analysis, metathesis reactions, Separation and identification of common ions. Determination of Na and K by flame photometer.	1;0,3	30206101*
30206103	**General Chemistry 2** States of matter and intermolecular forces, Properties of solutions, Chemical thermodynamics, Chemical kinetics, Chemical equilibrium in gaseous systems, Electrochemistry, Acid-Base equilibrium, Solubility and complex ion equilibrium.	3;3,0	30206102

30206104	**General Chemistry Lab 2** Molar mass of a volatile liquid and a solid from freezing point depression, Calorimetry, Thermo chemistry and Hess's law, Studies on some factors affecting chemical reaction, Le Chatelier's principle, Equilibrium constant of a chemical reaction using visible spectrophotometer. Oxidation-reduction reactions, Galvanic cells, Electrolytic cells, Faradays laws, Molar solubility and common ion effect.	1;0,3	30206103*
30203101	**General Biology 1** Water (importance for environment and living organism), Macromolecules (structure and function). Structure and function of prokaryote and eukaryotes, cell division (mitosis meiosis). Molecular genetics and DNA technology, Genetics of virus and bacteria. respiration, photosynthesis, fungi, plants (structure, growth, reproduction and development).	3;3,0	-
30203111	**General Biology Lab** Microscope, cell of plants and animals, (structure and division), chemical and physical properties of cell, enzymes, photosynthesis, cell division (mitosis meiosis). plant tissues, plant organs (Stems, roots, leaves, flowers and fruits).	1;0,3	30203101*
30201105	**General Physics for Agricultural Students** Newton's laws of motion, work energy & power, momentum, temperature & the behavior of gases, thermodynamics, thermal properties of matter, fluids, electrostatics, direct current and geometrical optics.	3;3,0	-
30403211	**Principles of Plant Production** This course is aimed to enter the wonderful world of plant science, discover why we depend on plants and the people who understand them for our survival. Find out how plants keep us alive and allow us to enjoy our lives. Learn about growing, maintaining, and utilizing plants for the benefit of ourselves and the environment in which we live.	3;3,0	30203101

WRE221	**Applied Environmental Geology** The fundamentals of geology (rock and deposit types, geomorphological processes, groundwater etc.); Natural processes and anthropogenic effects on those processes in the context of natural hazards, natural resources and sustainability; Basic Concepts in Environmental Geology (Internal Structure of the Earth, Minerals, Rocks, Soils); Introduction to Natural Hazards (Earthquakes and Related Phenomena, Volcanic Activity, Rivers and Flooding, Slope Processes and Subsidence, Coastal Processes); Mineral resources and the impact of their mining on the environment; soil resources; water resources; human impacts on the environment: waste disposal, contaminants in the geologic environment; atmospheric change and global warming; Discussion of case studies and one field trip.	3;3,0	-
WRE211	**Hydraulics** Fluid properties. Hydrostatic pressure forces. Fluid in motion. Forces of fluid in motion. Continuity, energy, and momentum equations. Resistance to fluid flow in pipes and open channels.	3;3,0	30202101 30201105
WRE222	**Meteorology and Air Pollution** Structure of the atmosphere and its thermodynamics; water and its transformations; cloud formation; precipitation… etc. Current climate issues such as global warming. Fundamentals of air pollution, major pollutants, their sources and their effects (environmental, economic and health), air pollution from mobile/stationary sources and indoor air quality. Pollutant sampling and measurement devices, pollutant distributions and dispersal modes as well as available methods to control the pollutants. Relevant Jordanian air quality policies and standards and presents relevant case studies.	3;3,0	WRE221

WRE212	**Principles of Irrigation and Drainage** Water resources of Jordan. Measurement of irrigation water. Irrigation water conveyance systems. Soil – Water – Atmosphere – Plants Interaction: soil water, infiltration, soil water movement, soil water constants, evapotranspiration, crop water requirement, irrigation scheduling, irrigation efficiency. Pressurized irrigation: sprinkler irrigation, types and components of sprinkler system, evaluation of sprinkler irrigation system, drip irrigation, components of drip irrigation system, description of drip system components, evaluation of drip emitters, application of fertilizers and chemicals through irrigation systems. Economic evaluation of irrigation project. Quality of water supply. Environmental concerns. Drainage.	3;3,0	WRE211
WRE213	**Drinking water quality** This course is designed to introduce students to the main aspects of drinking water supply and quality as different water standards are explained theoretically in class. The laboratory analysis related to each parameter is then carried out. The course begins with an extensive review related to aqueous chemistry. Elements, radicals, and compounds present in or interacting with water and gas solubility in water. The course also discusses types and sources of pollution, changes in water quality, and water quality standards. Students also learn about water treatment such as mixing, flocculating, sedimentation, turbidity removal, filtration, softening, taste and odor control, and iron and manganese removal. All the common chemical indicators and analyzes of water such as conductivity, chloride, alkalinity and turbidity, sulfate, phosphorous, nitrate, iron and manganese removal and determination of dissolved material content and removal are presented in class and then students carry out experiments in the water laboratory under the supervision of the course instructor and safety procedures in the laboratory are well applied. Students are distributed into groups to carry out water experiments. After each lecture in the laboratory, the students must submit a report of the implemented experiment to the instructor for evaluation. Two classroom hours and one three-hour lab class per week.	3;2,3	30206103 WRE221

WRE223	**Environmental Soil Physics** Soil physics is a branch of soil science. This course will discuss the different phases of soil physics, which includes the main physical properties of soil, for example, soil texture, soil composition, porous media, particle size, aggregate shapes, and quantitative characterization of soil physical properties. Describe and measure the physical properties of soil that determine water retention and movement in the ground, soil strength, and resistance to erosion and compaction. The course will discuss soil layers, their characteristics, and the calculations required to determine soil density, porosity, and others and apply them through laboratory and field experiments.	3;2,3	WRE221
WRE314	**Surface Water Hydrology** Factors affecting runoff and runoff process. Drainage pattern and landforms developed under arid conditions. Unit hydrograph techniques (natural and synthetic). Frequency analyses of floods and droughts.	3;3,0	WRE221 WRE213
WRE316	**Design of smart irrigation system** Introduction to micro-irrigation (MI). Types of MI systems. Components of MI system. Drip irrigation system design and installation: Design considerations, Emitter selection, Hydraulics of drip irrigation system, Pump selection, Installation, and maintenance guidelines, Evaluation of irrigation systems. IoT based Smart Irrigation. Communication over Internet. Automated irrigation system using Arduino. soil moisture and ET sensors. Economic evaluation of smart irrigation system. Software applications in irrigation system design.	3;3,0	WRE211 WRE212
WRE326	**Wastewater Treatment and Reuse** Composition and characterization of wastewater and sludge, Wastewater microbiology, Municipal wastewater treatment systems including physical unit operations (physical treatment) and biological unit processes (biochemical treatment), treatment and disposal of sludge, and wastewater reuse.	3;2,3.	30206104 WRE213
WRE331	**Environmental Impact Assessment** Definition of environmental impact assessment. Jordan law of environment protection. Jordan environment regulations and legislations. Objectives of environmental assessment. Elements of environment assessment projects. Approaches to environmental analysis and framework development.	3;3,0	WRE222 WRE314

WRE315	**Groundwater Hydrology** Basics of groundwater hydrology, groundwater occurrence, movement and quality, hydraulic parameters and Darcy Law, local and regional flow, climate-surface water-groundwater inter-relationships, groundwater balance, groundwater investigation and exploration, groundwater quality and monitoring, groundwater data management and representation, groundwater flow modeling, managed aquifer recharge (MAR), and groundwater management and optimization.	3;3,0	WRE314
WRE325	**Environmental Soil Chemistry** Introduction to soil chemistry. Chemical principles as applied to soils. Soil weathering. The soild phase. Soil organic matter. Cation and anion exchange. Carbonate system. Soil pH. Soil phosphates. Stability diagrams. Solid-solution interface. Salt-affected soils. Redox reactions. Heavy metals and pesticides. Software applications in soil chemistry.	3;3,0	WRE221 WRE331
WRE324	**Climate Change and Sustainable Development** This course covers several aspects of defining climate change, its causes and effects on environmental and economic resources, and its connection to sustainable development and food security. This course covers the concepts of ecological sensitivity, climate models, and the prevailing pattern in Jordan. Methods of benefiting from cerebral information and how to obtain and process it are among the most important axes of this course. The role of geographic information systems and the mechanism of harnessing this technology to study this phenomenon and benefit from the environmental and climatic simulation will be addressed to solve problems related to drought, desertification, water scarcity, and pollution in Jordan	3;3,0	WRE314 WRE331

WRE327	**Soil Fertility and Fertilizers** Principles and relevance of soil fertility, nutrients required by plants, concentration of elements in plant tissue, forms of nutrient absorbed, nutrient deficiency symptoms. Soil factors affecting nutrient availability: ion adsorption and exchange, ion movement, rhizosphere dynamics, mineralization-immobilization turnover, texture, pH, conductivity, aeration. Nitrogen: forms and amounts, soil N flows and transformations, crop residues and soil N, fertilizer N forms, fate and management of N fertilizers, interpretation of soil tests. Phosphorus: forms and amounts, transformations of P in the soil, P fertilizers, fate and management of P fertilizers. Potassium: nature and equilibria of soil K, K fertilizers: forms and fate. Sulfur, Calcium, Magnesium and micronutrients. Fertilizer calculations and recommendations. Organic farming: basic concepts and definitions. Preparation and use of compost. Foliar application of fertilizers. Economics of fertilizer use. Environmental considerations in plant nutrient use.	3;3,0	WRE325
WRE341	**Environmental remote sensing and GIS** This course provides the theoretical knowledge necessary to use the data and technologies of geographic information systems and remote sensing and then activate them in issues related to the environment and society so that it exposes students to a set of biophysical and social applications of the two systems, through which each student investigates and writes a research paper independently where lectures are based on references books, ESRI guides, and case studies implemented in Jordan and around the world. This course aims to enrich the knowledge of postgraduate students in the fields of remote sensing and geographic systems, with a focus on theory and digital image processing, and to enable the student to know and understand the two systems and methods of using them in obtaining data from the environment, natural resources and society, and how these data can be analyzed and understood. In its two parts, this course gives special attention to spatial analysis and its implementation in the real world because of its influential applied role in solving issues and challenges related to water resources and the environment.	3;3,0	WRE221

WRE342	**Environmental remote sensing and GIS Lab** This course provides practical skills necessary to use the data and technologies of geographic information systems and remote sensing and then activate them in issues related to the environment and society so that it exposes students to a set of biophysical and social applications of the two systems, through which each student investigates and writes a research paper independently and prepares Laboratory reports where lectures and practical sessions are organized to complement each other and which are based on references from foreign curricula, books, ESRI guides, and case studies implemented in Jordan and around the world. The hands-on exercises are based on ArcGIS (version 10.1 and above) and ESRI and include all data entry, editing, and analysis aspects. This course aims to enrich the knowledge of postgraduate students in the fields of remote sensing and geographic systems, with a focus on theory and digital image processing, and to enable the student to know and understand the two systems and methods of using them in obtaining data from the environment, natural resources and society, and how these data can be analyzed and understood. This course, in its two parts, gives special attention to spatial analysis and its implementation in the real world because of its influential applied role in solving issues and challenges related to water resources and the environment.	1;0,3	WRE341
WRE433	**Water harvesting Systems** This course describes different water harvesting systems and their design and structure depending on precipitation (amounts, distribution and intensity), cultivation and catchment areas, and vegetation types. Students should be able to distinguish between different systems and decide which option is best in the field. The types of water harvesting, methods of activating and establishing them, what are the specifications of each system and its effectiveness will be studied and analyzed.	3;3,0	WRE314 WRE341

WRE443	**Environmental Monitoring and Early Warning Systems** The essential processes involved in developing a monitoring program are discussed in detail. These include defining the objectives of a monitoring exercise and addressing the why, what, where, when, and how questions. Development of the sampling program involves consideration of system heterogeneity and hence variability and the minimum spatial and temporal resolution needed. This will determine the number of sampling sites and replicates required to address the study objectives satisfactorily. The number of samples and statistical considerations are covered. Discussion of case studies. Moreover, early warning systems for natural hazards. These include hydro meteorological hazards, such as floods, mudflows, tropical cyclones, storms, extreme temperatures, and droughts; geological hazards, such as earthquakes, tsunamis, volcanic activity and emissions and mass movements including landslides; as well as biological hazards, such as epidemics, plant and animal contagion and infestations. Environmental degradation processes that contribute to an increase in vulnerability and frequency and intensity of natural hazards, such as desertification and wildland fires, are considered near-earth space objects. Discussion of case studies and one field trip.	3;3,0	WRE324
WRE417	**Integrated Water Resources Management** IWRM is a comprehensive, participatory planning and implementation tool for managing and developing water resources in a way that ensures efficient, equitable and sustainable development and management of water resources. Principles of IWRM, conventional and non-conventional water resources, trans-boundary and water transfer, water supply and demand at sector level including domestic, industry, agriculture and tourism using simplified calculations on water balance level, and sophisticated modeling techniques such as WEAP and decision support system (DSS) techniques. Water governance and community-based approaches, organizational infrastructure and management, water resources policies, and applications of integrated water resource management.	3;3,0	WRE315 WRE324

WRE432	**Integrated Solid Waste Management** Defining ISWM, Life-cycle Perspective, Generation-Source Perspective, Stakeholders/Management Perspective, Benefits of ISWM, ISWM Coverage, ISWM Plan, Process to Develop ISWM Plan, Development of Sub-management Systems, Outline of ISWM Plan, Activities on ISWM, Collection, Transport and Treatment also Hygiene and Environmental Health Module, Identification of Generation and characteristics of waste, Waste collection, storage and transport, Waste processing techniques, Types of Solid Waste, Solid Waste Treatment, Composting, Thermal treatment, landfill, reuse treated solid waste in agriculture; upstream operating downstream activities framework and developing a model that estimates the greenhouse gas emissions, Discussion and case studies, one field trip to the landfill and environment department at Greater Amman Municipality.	3;3,0	**WRE324**

WRE434	**Water and Environmental Economics** Basic economic concepts specifically relevant to environmental economics; the economics of natural resource scarcity; ecology, economics and the biophysical constraints to economic growth; ecological economics; the economics of sustainable development; the economics of pollution; valuing the environment; Valuation of environmental benefits and services, the methodological issue the economics of natural resources; population; development and the environment, The economic theory and measurement of Environmental damage; Environmental microeconomics, market equilibrium. Practical part included discussion and Case studies using excel software : Value of the pollination service in coffee plantations, Erosion control by forest systems in Western China, Evaluation of the tourism service Natural Important of problems, Accounting for Natural Resource Assets & Depletion Contributing Factors, Market signals of natural resource, Prediction of consumers' reaction to products from irrigation with low quality water (Jordan, 2000), Calculation of the Environmental damage and the environmental damage cost; Household consumption of agricultural products and the readiness for higher prices if high quality water is used in Nablus/Palestine, 2000; Good Weather effect on Draw a demand and supply model to illustrate the market equilibrium change for salmon in the year 2019 and 2020, Market equilibrium point of in the case of increase the steel price and in the case of decrease the steel price.	3;3,0	WRE324 WRE433
WRE401	**Field Training in Water Resources and Environmental Management** Students have to conduct at least eight fulltime-weeks (equivalent to 280 training hours per semester) training in public or private institutions related to the specialization of water and environment. The students will acquire practical skills in the field of water and environment.	6	After successfully passing 100 credit hours
WRE402	**Seminar in Water Resources and Environmental Management** Training of students to collect information on a certain topic related to water resources and environmental management from different sources; presentation and discussion of special topics and research data.	1;1,0	After successfully passing 100 credit hours

WRE403	**Graduation Project in Water Resources and Environmental Management** Theoretical and/or experimental investigations of a problem in the field of water resources and environmental management. The student(s) undertake(s) an investigation of theoretical or practical problem in the field of water and environment under the supervision of faculty advisor(s). The student(s) has to submit a report (minimum of 10 pages) of his/her/their work and make(s) presentation in the presence of some faculty members for discussion and evaluation purposes.	3;0,3	After successfully passing 100 credit hours
WRE228	**Principles of Soils and Irrigation** Identify soil texture, soil layers and effective root zone. Describe how water is held by soil. Define the terms field capacity, permanent wilting point and readily available water (RAW). Calculate the soil RAW to determine water available to the plant. Sample soil and water to check their suitability for irrigation. List water-quality problems that may affect irrigation. Introduce sprinkler and drip irrigation systems. Calculate crop water requirements and time of irrigation. Reclamation of salt-affected soils.	3;3,0	-
WRE335	**Integrated Management of Ecosystems** The conservation, sustainable use and ecosystem services aspects; Description of the "integrated environmental management" and the relevant concepts e.g. prevention, ecological restoration, protected areas planning/ designation /management and adaptive management. Furthermore, the course will tackle the physical, ecological, socioeconomic and legal/institutional aspects of the integrated management approaches. Discussion and case studies on protected areas, land conservation/ land use planning tools and legal and institutional context (focus shall be made on the Jordanian context); Two field trips to protected areas.	3;3,0	WRE331
WRE344	**Environmental Modeling** Environmental modeling: a tool consists of multiple skills to represent and predict environmental systems including water, soil, and air. Introduction to environmental modeling, types of environmental models, physical models, conceptual models, mathematical models, and model components including equations, input data, and parameters values, model development, calibration, validation, and uncertainty analysis. Modeling applications including hydrologic models; surface water and groundwater, climate models; climate variability and change.	3;3,0	WRE222 WRE223

OAT459	**Hydroponics** This course provides the principles and technologies of hydroponic systems, nutrition solution preparation, the types of hydroponic systems, establishment, preparing protected agriculture systems for hydroponics, seedling production and preparation, plantation, agricultural practices conducted for hydroponic plants, controlling the environment, pest protection, maintenance and harvesting methods.	3;2,3	-
ABT426	**Environmental biotechnology** This course discusses the applied and practical basics of biotechnology to solve environmental problems. It deals with issues of biological treatment of polluted environment and the recovery of important elements. It also discusses sustainable development in protecting the environment through the production of biofuels, bioplastics, bio-pesticides, bio-fertilizers and improving soil quality. This course also deals with the vital methods for treating wastewater and solid waste. It also discusses vital ways to control pollutants in the environment and gives ideas for making agriculture more sustainable and environment-friendly.	3;3,0	-
30403473	**Statistics and Design of Agricultural Experiments** Statistical measurements. Statistical tests (t and f tests). Principles of experimental design. Tests of hypothesis. Completely randomized design Randomized complete block design, factorial experiments, Latin square design. Mean separation. Regression analysis. Use of computer programs (such as SAS and SPSS) in analysis of agricultural experiments.	3;3,0	-
a30601222	**Project Management** Advanced concepts and their applications in project management, the role of the project manager in administrative and technical terms, how to coordinate between the conflicting goals of the project, the mechanisms of project selection, the preparation of the project structure, methods of planning, management, follow-up and control of projects, planning and control tools and mechanisms for scheduling, the structure of business division and networks, how to manage conflicts, manage resource allocation and re-allocation, end projects and behavioral aspects in project management	3;3,0	30202101
CIE0215	**Surveying Lab**	1;0,3	-

* co-requisite