**Course Description/Department of Water Resources and Environmental Management:**

**30202101 Calculus (1):**

3;3,0 Credit hour

*Pre-requisite: ----*

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.

**30206101 General Chemistry (1):**

3;3,0 Credit hour

*Pre-requisite: ----*

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

**30206102 General Chemistry Lab (1):**

1;0,3 Credit hour

*Pre- or Co-requisite: 30206101*

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.

**30206103 General Chemistry (2):**

3;3,0 Credit hour

*Pre-requisite: 30206102*

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.

**30206104 General Chemistry Lab (2):**

1;0,3 Credit hour

*Pre- or Co-requisite: 30206103*

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.

**30203101 General Biology (1):**

3;3,0 Credit hour

*Pre-requisite: ----*

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).

**30203111 General Biology Lab (1):**

1;0,3 Credit hour

*Pre- or Co-requisite: 30203101*

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).

**30201105 General Physics for Agriculture Students:**

3;3,0 Credit hour

*Pre-requisite: ----*

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.

**30201115 General Physics for Agriculture Students Lab:**

3;3,0 Credit hour

*Pre- or Co-requisite: 30201105*

Measurements, Kinematics, Vectors, Force and Motion, Simple Harmonic Motion I and II, Friction, Electric Field Mapping, Ohm’s Law, The Potentiometer, Parallel-Plate Capacitor, Specific Charge of copper Ions, The Electric Equivalent of Heat.

**30206241 Analytical Chemistry:**

3;3,0 Credit hour

*Pre-requisite: 30206103*

Methods of inorganic quantitative analysis including the methods of gravimetric and volumetric analysis with the use of simple instrumental methods included. Laboratory experiences involving the qualitative and quantitative analysis of chemical compounds including gravimetric, volumetric and spectrophotometric methods.

**30401221 Applied Geology:**

3;3,0 Credit hour

*Pre-requisite: ----*

Origin of the earth, minerals, rocks and structural geology (lineaments, faults, joints, maps, flexures and folds). Chemical and physical composition of the rocks containing water. Elementary knowledge of different geotectonic units, principles of structural geology (basic concepts, stress and strain), principle of historical geology, and hydrological cycle.

**30401211 Principles of Irrigation and Drainage:**

3;3,0 Credit hour

*Pre-requisite: ----*

Fundamentals of irrigation engineering. Crop water requirements. Irrigation scheduling. Irrigation system: sprinkler and drip irrigation. Soil drainage theory. Drainage, soil and crop relationship. Drainage sytems.

**30401212 Hydraulics:**

3;2,3 Credit hour

*Pre-requisite: 30202101 + 30201105*

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.

**30401222 Principles of Environmental Science:**

3;3,0 Credit hour

*Pre-requisite: ----*

Introduction to environmental science; Ecosystems, Nutrient cycle, and Pollution impact. Environmental pollution; water, soil, air, and noise. Concept of sustainable development.

**30401224 Meteorology and Air Pollution:**

3;3,0 Credit hour

*Pre-requisite: 30401222*

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.

**30401313 Hydrochemistry and Water Quality:**

3;2,3 Credit hour

*Pre-requisite: 30206241*

Origin of water, properties, influence of soil and aquifer materials on groundwater quality. Classification and assessment of groundwater quality. Changes in drinking water quality and quality criteria, water pollution and physiochemical treatment.

**30401314 Wastewater Treatment and Reuse:**

3;2,3 Credit hour

*Pre-requisite: 30206241 + 30401212*

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.

**30401315 Surface Water Hydrology:**

3;3,0 Credit hour

##### Pre-requisite: 30401221

Factors affecting runoff and runoff process. Drainage pattern and land forms developed under arid conditions. Unit hydrograph techniques (natural and synthetic). Frequency analyses of floods and droughts.

**30401316 Groundwater Hydrology:**

3;3,0 Credit hour

*Pre-requisite: 30401221 + 30401315*

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.

**30401325 Soil Physics:**

3;2,3 Credit hour

*Pre-requisite: 30201105*

Components of soil water potential: matric potential, osmotic potential, gravitational potential and hydraulic potential. Soil water movement under saturated and unsaturated conditions: Darcy’s law of continuity equation, soil water equilibrium with water table. Gaseous diffusion in soil. Heat flow equations in soil.

**30401326 Soil, Water, and Plant Relationships:**

3;3,0 Credit hour

*Pre-requisite: 30401211*

Basic relationships between soil, plant, and water that make it possible to better manage and conserve irrigation water. Review physical laws of solutions: vapor pressure, solution potential, and latent heat. Soil water terminology. Physical characteristics of soil, soil and water interactions, available soil water, and how plants use water to determine what crops to plant and when to irrigate. Review irrigation scheduling that determines when and how much water needs to be added to a crop’s root zone to promote optimum yields.

**30401327 Environmental Soil Chemistry:**

3;2,3 Credit hour

Pre-requisite: *30206241*

Introduction to soil and water chemistry. Chemical principles necessary to critically examine the soil environment. Identify and describe the chemical processes that occur in the soil environment and other water systems such as chemical reactions that take place at solid-liquid interface (e.g. adsorption reactions and characterization) to ultimately describe the fate and behavior of substances such as heavy metals in soil and other natural or waste water systems. Application of the knowledge of properties and soil processes to develop and evaluate strategies for protecting and/or improving soil and water quality.

**30401331 Environmental Impact Assessment:**

3;3,0 Credit hour

*Pre-requisite: 30401222 + 30401224*

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.

**30401341 Geographic Information System for Agricultural students:**

3;2,3 Credit hour

*Pre-requisite: 30401221*

Principles of Geographic Information System (GIS) to develop basic skills in using GIS techniques for water and environmental applications and studies on vegetation, soil, water, air, and land use. Basics of GIS, GIS data discovery, data structure and management, principles of cartographic visualization, and basic spatial analysis and modeling, and applications of GIS in water and environment.

**30401417 Irrigation System Design:**

3;3,0 Credit hour

*Pre-requisite: 30401211 + 30401212*

Importance of irrigation. Irrigation system elements. Irrigation system selection according to the soil type. Percentage area wetted associated with different irrigation systems. Design criteria for the different irrigation systems. Practical applications.

**30401428 Soil Fertility and Fertilizers:**

3;3,0 Credit hour

*Pre-requisite: 30401327*

Soil fertility and productivity. Soil properties in relation to soil fertility. Macronutrients; their reactions, importance, application, and uptake. Micronutrients; their availability and chemical forms. Fertilizers and their reaction in the soil, forms, methods of manufacturing, and application methods.

**30401429 Integrated Management of Ecosystems:**

3;3,0 Credit hour

*Pre-requisite: 30401222 + 30401326*

Principles of ecology and the definition of ecosystems; features of terrestrial and marine ecosystems. Essential elements of integrated management, the DPSIR model of integrated environmental indicators set and the concept of adaptive management. Physical, ecological, social and legal/institutional aspects of the major natural resource issue as well as management tools and techniques for prevention, control, and ecological restoration. Ecosystem services, protected areas planning, designation and management (case studies from protected areas in Jordan), land conservation/land use planning tools and legal and institutional context.

**30401432 Integrated Water Resources Management:**

3;3,0 Credit hour

*Pre-requisite: 30401315 + 30401316*

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.

**30401433 Water and Environmental Economics:**

3;3,0 CrH

*Pre-requisite: 30401432 + 30401429*

Water as an economic good, water pricing and demand, economics of water resources development, economics of water pollution control, economics of wastewater treatments and reuse. Concept of “Environmental Economics”. Environmental Analysis: benefits and costs, ecosystem services and products, values and valuation of ecosystem services. The cost of environmental degradation/conservation. Environmental externalities and the theory of market failure; Economics of pollution control; Economics of natural resource use (non-renewable resources such as oil, gas and metals as well as renewable resources such as fish and forests) and Economics of climate change.

**30401434 Integrated Solid Waste Management:**

3;3,0 Credit hour

*Pre-requisite: 30401222*

Solid waste management with particular reference to a multidisciplinary perspective. Identify and describe wastes and their key sources; different types of waste, classification of waste, waste flows in society, amounts, properties and composition. Concepts and options of recycling and reuse (composting, source separation, and re-use). Description of the waste treatment, handling and landfills (planning, siting, and landfill processes). The status of solid waste management in Jordan including practices and the relevant national regulations.

**30401442 Environmental Monitoring and Early Warning Systems:**

3;3,0 Credit hour

*Pre-requisite: 30401331*

Fundamental principles of monitoring and Early warning systems. Key concepts of relevance such as: environmental monitoring, hazards vs risks, environmental/geological hazards, environmental risks, risk assessment, disaster risk reduction… etc. Concept and objectives of “Early warning” and other associated concepts and definitions e.g. risk analysis; monitoring and predicting location and intensity of the disaster; communicating alerts and responding to the disaster. Different technologies and operational aspects of early warning systems. Issues of emergency planning/management and response.

**30401402 Seminar in Water Resources and Environmental Management:**

1;1,0 Credit hour

*Pre-requisite: After successfully passing 100 credit hours*

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.

**30401403 Graduation Project in Water Resources and Environmental Management:**

3 Credit hour

*Pre-requisite: After successfully passing 100 credit hours*

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.

**30401401 Field Training in Water Resources and Environmental Management:**

6 Credit hour

*Pre-requisite: After successfully passing 100 credit hours*

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.

**30401223 Principles of Soils and Irrigation:**

3;3,0 Credit hour

*Pre-requisite: ----*

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.

**30401443 Environmental Modeling:**

 3;2,3 Credit hour

 *Pre-requisite: 30401331*

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.

**30401318 Design of Small Dams:**

3;3,0 Credit hour

*Pre-requisite: 30401315*

Types of dams, Foundation construction materials. Design of earthfill, rockfill and concrete gravity dams. Spillways and outlet regulations. Dam design, monitoring, operation and maintenance.

**30403371** **Principles of Agricultural Extension:**

3;3,0 Credit hour

*Pre-requisite: 30403211*

The concepts about agricultural extension, importance, philosophy, principle, objectives and the role integrated rural development, in addition to rural leadership and its important in agricultural extension, communication process and its role in adoption the agricultural innovation, planning, implementation and evaluation extensional programs by using extension methods and means and giving an idea about actual extensional work in Jordan.

**30403211 Principles of Plant Production:**

3;3,0 Credit hour

*Pre-requisite: 30203101*

Principles of growth and development of cultivated species. Methods of propagation. Environmental factors affecting crop production. Culture and use of fruit, vegetable, flower, ornamental, forest and agronomic crops.

**30403473 Statistics and Agricultural Experimental Design:**

3;3,0 Credit hour

*Pre-requisite: 30202101*

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.

**30145352 Remote Sensing (1):**

3;3,0 Credit hour

*Pre-or Co-requisite: ----*

Fundamental theory and application of remotely sensed imagery, including aerial photography, Landsat imagery, Spot imagery, radar imagery and thermal imagery; the basic characteristics of electromagnetic radiation; radiometry; characteristics of sensor systems and their measurements; interactions between radiation and terrestrial materials (vegetation, soil, water, and rocks) and atmospheric constituents, with incorporation of ancillary data and ground truth, image enhancement, image processing techniques, image interpretation, classification, indexes (vegetation and mineral indexes).

**30145354 Remote Sensing (1) Lab:**

1;0,3 Credit hour

*Pre-or Co-requisite: 30145352*

Exercises and projects covering topics discussed in the Principles of Remote Sensing course as following: the language of color; color models; Color film as a remote sensing tool; Black and white film; Film and filter combinations; Training on selected remote sensing software such as PCI, ENVI or ERDAS; Earth resources signatures on CIR films and satellite imagery; Classifications.