

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣١١١
Course Title	Environmental Chemistry
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

يزود هذه المادة الطالب بمعلوما متخصصة في البيئة وتشمل مبادئ التحليل في الكيمياء العضوية، المحاليل، مركبات التفاعل، الاتزان الكيميائي، مركبات التفاعل، القاعدية، العسرة، المواد العالقة، المواد الذائبة، الغروية، تفاعل رودكس، التبادل الايوني، التحلل الكيميائي.

Course Objectives:

By the end of this course students are expected to be able to:

1. Describe the major and minor chemical species that exist in natural waters .
2. ability to solve practical equilibrium problems in order
3. Describe the role that the carbonate system and other weak acid/base pairs have on determining important natural water properties such as pH and alkalinity.
4. Quantitatively determine the solubility of solids in natural waters
5. Quantitatively determine the speciation of metals in natural waters and understand how metals interact with organic ligands.
6. Understand the role of redox chemistry in the environment, including biologically mediated reactions.
7. Quantitatively determine the redox status of natural waters

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Basic concepts from general chemistry	<ul style="list-style-type: none"> • elements, symbols, and atomic weight, • compound formula • valency, oxidation state and bonding • chemical equations • oxidation reduction equation • metals and nonmetals • solutions • activity and activity coefficient • complexation • solubility product • ionization 	9
2	Basic concepts from equilibrium chemistry	<ul style="list-style-type: none"> • solution to equilibrium problems • solving acid base equilibrium problems • logarithmic concentration diagrams • acid base addition to solutions • buffers • solubility of salts 	9
3	Basic concepts from organic chemistry	<ul style="list-style-type: none"> • aliphatic compounds • hydrocarbons • nomenclature • alcohols • aldehydes and ketones • compounds containing nitrogen • aromatics 	6
4	Water and wastewater analysis	<ul style="list-style-type: none"> • turbidity • color • pH • acidity • alkalinity • hardness 	24

No.	Unit Title	Unit Content	Hours
		<ul style="list-style-type: none">• chlorine• dissolved oxygen• biochemical oxygen demand• chemical oxygen demand• solids• nitrogen• sulfates• iron and manganese	

Teaching Methods:

Lectures

Books and references:

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Course Book:

Chemistry for environmental engineering and science, Sawyer and McCarty, McGraw Hill, 2003

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣٢٦١
Course Title	Water desalination
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

تهدف هذه المادة الى تزويد الطالب بمعلومات متخصصة بتحلية المياه وتشمل: نوعية مياه البحر ، المياه المسوس، مواصفات مياه الشرب، قواعد تحلية مياه الشرب، انظمة التحلية بالاعشبية المعالجة التمهيدية اللازمة.

Course Objectives:

By the end of this course students are expected to be able to:

1. Understand the benefits of desalination.
2. Distinguish between the different types of desalination.
3. Knowledge the selection criteria for desalination technologies.
4. Understand the required preliminary treatment before desalination.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Introduction to water standards	<ul style="list-style-type: none"> Water quality criteria Applied standards. Sea water and brackish water. Impact of salinity on water quality. 	6
2	Thermal desalination.	<ul style="list-style-type: none"> Multistage Flash Distillation (MFS) Multiple Effect Distillation (MED). Vapor Compression (VC) 	6
3	Membrane Distillation	<ul style="list-style-type: none"> Historical information about membrane. Electrodialysis (ED) Technology illustration 	6
4	RO membrane	<ul style="list-style-type: none"> RO function. RO membranes modules. RO system – general description Membrane desalination plant components. RO membrane Separation 	8
5	Preliminary treatment	<ul style="list-style-type: none"> Removal of organic and inorganic suspended solids, Removal of oils and greases. Removal of organic nitrogen, Removal of heavy metals associated with solids. 	6

Teaching Methods:

Lectures

Books and references:

Desalination: Water from Water, Jane Kucera, 1st edition, 2014, Wiley.

Course Book:

Desalination Engineering: Planning and Design 1st Edition, by [Nikolay Voutchkov](#), McGraw-Hill Education; 1 edition (December 6, 2012).

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣١١٢
Course Title	Environmental Chemistry Lab
Credit Hours	1
Theoretical Hours	0
Practical Hours	3

Short Description:

خواص المياه الفيزيائية والكيميائية، العسرة، العكارة، المواد العالقة، المواد الذائبة، الموصلية الكهربائية، تفاعل رودكس، الحامضية، القلوية، الكلورايد، الكبريتات، الكلور الحر والمتبقي، مركبات النيتروجين.

Course Objectives:

By the end of this course students are expected to be able to:

1. distinguish glassware, and instruments.
2. prepare chemical solution
3. collect and preserve samples
4. conduct deferent test according to standard methods
5. analyze data, and test results
6. write technical report.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Introduction to analytical chemistry (3 labs)	Introduction for glassware, chemicals, and instruments used for tests. gravimetric, volumetric, and colorimetric tests. Mass solutions, molar, and normal solutions	9
2	Alkalinity and acidity	Determination of alkalinity and acidity of water, volumetrically	6
3	Hardness determination (1 lab)	Determination of total, calcium, and magnesium hardness of water, volumetrically	3
4	Solids determination (1 lab)	Determination of total, dissolved, volatile, and suspended solids. Gravimetrically	3
5	Ammonia and nitrate determination (1 lab)	Determination of ammonia, ammonium, and total nitrogen content. Volumetrically. Screening method for nitrate	6
6	Sulphate determination (1 lab)	Determination of sulphates in water and water. Gravimetrically	3
7	Chloride determination (1 lab)	Determination of chloride content in water and wastewater. volumetrically	3
8	Chlorine determination (1 lab)	Determination of total, residual, and demand chlorine. volumetrically	3
9	Dissolved oxygen, Turbidity, Electrical conductivity, pH	Determination of dissolved oxygen, Turbidity, electrical conductivity, and pH using Probes.	6

Teaching Methods:

Laboratory experiments and lectures

Books and references:

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Course Book:

Standard Methods for the Examination of Water and Wastewater, APHA, latest edition.

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣١٢١
Course Title	Hydrology
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

تقدم المادة معلومات اساسية في الهيدرولوجي وتشمل: الدورة المائية ، الامطار والفيضانات، التبخر، الجريان السطحي، الرشح، تداخل عناصر الدورة المائية، تخزين مياه الامطار، تأثير الجريان على نوعية المياه، تشكل المياه الجوفية، مبادئ حركة المياه الجوفية، البيانات الهيدرولوجية.

Course Objectives:

By the end of this course students are expected to be able to:

1. Knowledge of physical processes in the context of water cycle,
2. Determine the rainfall, evaporation, runoff, in a certain area.
3. Explain the impact of hydrological cycles on water quality.
4. Distinguish between surface and ground water occurrence and formation.
5. Describe the principal of ground water movement.
6. Understand the importance of the hydrological data.
7. Understand methods and importance of water storage.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Hydrological Cycle	<ul style="list-style-type: none"> • Definitions • Water formation • Elements of hydrological cycle. • Importance of each element. • Interaction between all elements. 	2
2	Precipitation and flood	<ul style="list-style-type: none"> • Rainfall formation • Types of precipitations. • Characterization of rainfall • Rainfall measurement • Computation for points, for area by Thiessen method 	8
3	Evapotranspiration	<ul style="list-style-type: none"> • Definition • Impacts on water budget. • Calculation using water budget. • Calculation using Penman method 	4
4	Runoff and flood	<ul style="list-style-type: none"> • Watershed and catchment area. • Factor affecting runoff. • Computation using the rational equation. • Flood control and storages 	6
5	Infiltration	<ul style="list-style-type: none"> • Importance. • Factors affecting it. • Computation using Horton's equation, and Φ-index method 	2
6	Ground water	<ul style="list-style-type: none"> • Definition of geological formations • Groundwater occurrence. • Groundwater movement • Computation of GW velocity using Darcy law. • Quality of groundwater. • Groundwater recharge. • Salt water intrusion. 	8
7	Hydrological data	<ul style="list-style-type: none"> • Importance of the hydrological data 	2

No.	Unit Title	Unit Content	Hours
		<ul style="list-style-type: none">• Climatological networks: types, uses,• Data error	

Teaching Methods:

Lectures

Books and references:

Lawrence K. Wang, Chih Ted Yang, Modern Water Resources Engineering, Humana Press, Totowa, NJ, 2013.

Course Book:

Warren Viessman Jr., Gary L. Lewis, introduction to Hydrology, 5th edition, Prentice Hall, 2002.

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣١٢٢
Course Title	Water quality and management
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

تشمل هذه المادة ادارة المياه والمياه العادمة وتتضمن : نوعية المياه، ملوثات المياه، مصادر المياه، الطلب على المياه، التحكم بالفيضانات، اهمية السدود، طرق معالجة المياه، اعادة استخدام المياه في الزراعة والصناعة، شحن المياه الجوفية، مصادر المياه غير التقليدية.

By the end of this course students are expected to be able to:

1. Understand the quality criteria,
2. Determine the sources of water contaminations.
3. Manage water resource with optimization manner.
4. Knowledge of dams functions.
5. Understand the opportunities of water reuse.
6. Knowledge of groundwater recharge: importance and methods.
7. Understand the available nonconventional water resources.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Water quality	<ul style="list-style-type: none"> • JS and WHO Water standards. • Physical, chemical and biological contamination. • Impact of water pollution on human health and the environment. • Pollution indicators. 	6
2	Water demand	<ul style="list-style-type: none"> • Water resources. • Population forecasting. • Water demand for domestic and firefighting • Supply-demand curve. 	4
3	Flood management	<ul style="list-style-type: none"> • Flood prediction. • Flood calculation by rational methods. • Method of control 	4
4	Dams	<ul style="list-style-type: none"> • Importance. • Site selection. • Types. • S- curve and storage. 	4
5	water reuse	<ul style="list-style-type: none"> • Importance in water budget. • Quality criteria. • Reuse for agriculture, industrial, and municipal purposes. • Adverse impacts of water reuse. • Groundwater recharge 	6
6	nonconventional water resources	<ul style="list-style-type: none"> • Fundamental of desalination. • Available techniques for desalination. • Brackish water. • Greywater • Water harvesting. 	6
7	Water economy	<ul style="list-style-type: none"> • Cost of water supply. • Revenue of water supply. • Data of Jordan 	2

Teaching Methods:

Lectures

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Books and references:

Books and references:

Warren Viessman Jr., Mark J. Hammer, Elizabeth M. Perez, Paul A. Chadik, Water Supply and Pollution Control, 8th Edition, Pearson, 2008.

Course Book:

Ruth E Weiner, Robin A. Matthews , ENVIRONMENTAL ENGINEERING, Fourth Edition, Butterworth-Heinemann, 2003.

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣١٣١
Course Title	Environmental Microbiology
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

وتشمل: النظام البيئي (التفاعل البيئي، التحمل، العلاقات)، التلوث البيولوجي، التطور، تصنيف الميكروبات، ميكروبات المياه، الامراض المنقولة عن طريق الماء، الاضرار على صحة الانسان، الطاقة، البناء والايض، نواتج التفاعلات البيولوجية، المعالجة الميكروبيولوجية، التخلص من الميكروبات في المياه.

Course Objectives:

By the end of this course students are expected to be able to:

1. Distinguish between different types of microorganisms
2. Understand water related diseases
3. Understand the role of microorganisms in wastewater treatment
4. Removal methods of microorganisms

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Introduction to microbes of sanitary importance	<ul style="list-style-type: none"> • Viruses • Bacteria • Protozoa • Algea • Fungi • Indicator Organisms. 	4
2	Water Related Diseases	<ul style="list-style-type: none"> • Microorganisms and disease • Water and wastewater related diseases • Drinking water standards • Wastewater reuse in agriculture health risks • Sludge reuse in agriculture health risks • Wastewater effluent standards 	12
3	Wastewater treatment microbiology	<ul style="list-style-type: none"> • Fixed film processes • Attached growth processes • Anaerobic treatment • Nitrification and denitrification • Phosphorous removal microbiology • Facultative and maturation ponds microbiology 	9
4	Water treatment microbiology	<ul style="list-style-type: none"> • Surface water microbiology • Stored water microbiology • Methods of treatment • Disinfection 	7

Teaching Methods:

Lectures

Books and references:

Microbiology, OpenStax College, 2015.

Course Book:

Handbook of water and wastewater microbiology, Duncan Mara and Nigel Horan, Academic Press,

2003

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣١٣٢
Course Title	Environmental Microbiology Lab
Credit Hours	2
Theoretical Hours	0
Practical Hours	6

Short Description:

تميز الميكروبات بواسطة الميكروسكوب، تحضير الوسط، طرق الصبغ، تقنيات العزل، النقل، العد، فحوصات المياه الميكروبيولوجية.

Course Objectives:

By the end of this course students are expected to be able to:

1. Use microscopes
2. Able to perform staining, culture preparation and sterilization
3. Perform different microbiological lab exams of environmental significance

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Microscopy in microbiology	<ul style="list-style-type: none"> Principles Use of microscope Microscopic examination of microbes 	12
2	Staining Methods	<ul style="list-style-type: none"> Staining using simple and advanced staining techniques 	18
3	Culture media preparation and sterilization	<ul style="list-style-type: none"> Preparation of different media and autoclaving techniques 	18
4	Environmental Microbiology	<ul style="list-style-type: none"> Microbiology of soil Quantitative enumeration of microorganisms Standard method of water analysis: multiple tube fermentation (Presumptive, confirmed, and completed tests) Standard method of water analysis: Membrane filter technique Standard Plate Count for tap water and surface waters E. Coli test Helminth Eggs in wastewater 	48

Teaching Methods:

Lectures

Books and references:

Laboratory Exercises in Microbiology, Harley and Prescott, Mc-Graw Hill company.

Course Book:

Laboratory Exercises in Microbiology, Chan, Pelczar, and Krieg, McGraw-Hill Inc.,

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣٢٤١
Course Title	Drinking Water Treatment
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

تشمل هذه المادة طرق المعالجة المختلفة للمياه وتشمل: نوعية المياه، المواصفات، وحدات المعالجة، المصافي، الترسيب الفيزيائي، التخثير والترقيق، الفلتر، إزالة العسرة، التبادل الأيوني، الادمصاص، التعقيم، مبادي الفصل بالاعشبية

Course Objectives:

By the end of this course students are expected to be able to:

1. Understand the different contaminants in drinking water sources.
2. Understand the different unit processes available to treat drinking water to acceptable levels.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Introduction	<ul style="list-style-type: none"> • Introduction • Objectives of water treatment • Water demand • Sources of water • Basic water treatment processes • Raw water systems 	3
2	Coagulation and Flocculation	<ul style="list-style-type: none"> • Rapid mixing units • Flocculation Units • Mixing intensity 	6
3	Sedimentation and solid contact systems	<ul style="list-style-type: none"> • Overflow rate • Types of sedimentation tanks • Inclined plate settlers • Solid contact units 	6
4	Filtration	<ul style="list-style-type: none"> • Filtration Media • Rapid sand filters • Dual and triple media • Backwashing • Slow sand filtration 	8
5	Softening	<ul style="list-style-type: none"> • Types and levels of hardness • Hardness removal using lime and soda ash • Basic and split treatment • Hardness removal using ion exchange 	4
6	Disinfection	<ul style="list-style-type: none"> • Chlorination • Factors affecting disinfection • Chlorine dosages • Other disinfectants 	3
7	Ion exchange, Adsorption, Membrane treatment	<ul style="list-style-type: none"> • Ion exchange • Adsorption • Membrane Treatment 	2

Teaching Methods:

Lectures

Books and references:

Course Book:

Water and Wastewater Engineering, Design Principles and Practice, Mackenzie L. Davis, McGraw-Hill, 2010.

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣٢٤٢
Course Title	Water Treatment Lab
Credit Hours	2
Theoretical Hours	0
Practical Hours	6

Short Description:

ويشمل تدريبات عملية على ازالة ملوثات المياه ويشمل: ازالة العكارة، ازالة المواد العالقة بالتخثير والترقيق، تقدير الزيوت والشحوم، ازالة العسرة، ازالة الفوسفات، ازالة الفينول، قياس الاكسجين المذاب، قياس متطلب الاكسجين البيوكيميائي بالطرق المختلفة، متطلب الاكسجين الكيميائي.

Course Objectives:

By the end of this course students are expected to be able to:

1. Perform different lab analysis tests of water and wastewater.
2. Perform treatability studies.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Jar test Procedure for coagulation and flocculation	<ul style="list-style-type: none"> • Turbidity Removal • Effect of pH • Effect of rapid and slow mixing intensities and duration 	12
2	Removal of Hardness	<ul style="list-style-type: none"> • Using lime • Using lime and soda ash • Using ion exchange resins 	9
3	Phosphate determination and removal	<ul style="list-style-type: none"> • Phosphate determination • Phosphate removal 	9
4	Phenol determination and removal	<ul style="list-style-type: none"> • Phenol determination • Phenol removal 	9
5	Heavy Metals removal	<ul style="list-style-type: none"> • Removal of heavy metals using hydroxide precipitation • Removal of hexavalent chromium 	9
6	BOD determination	<ul style="list-style-type: none"> • DO determination using Winkler method and probes • BOD determination using dilution method • BOD determination using dilution seeded test • BOD determination using oxitop method 	18
7	COD determination	<ul style="list-style-type: none"> • Using open reflux method • Using closed reflux method • Using photometric method 	15
8	Oil and Grease Determination	<ul style="list-style-type: none"> • Oil and Grease Determination 	3

Teaching Methods:

Lab Exercises and lectures

Books and references:

Standard Methods for the examination of water and wastewater, APHA + Instructor Handouts.

Course Book:

<h1>Engineering Program</h1>	
Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣٢٤٣
Course Title	wastewater treatment
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

وحدات المعالجة، المواصفات، المعالجة الفيزيائية، التهوية، الترسيب، المعالجة البيولوجية، التعقيم، ادارة الحمأة، تكنولوجيا المعالجة المتوفرة،

Course Objectives:

By the end of this course students are expected to be able to:

1. Comprehend the sequence of WW treatment.
2. Learn the parameters that determine the effluent quality.
3. Characterize WW strength.
4. Understand the common physical, chemical and biological unit operations encountered in treatment processes.
5. Choose the suitable treatment methods and units.
6. Knowledge the design criteria.
7. Formulate a preliminary design of WW treatment units.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Wastewater characterization	<ul style="list-style-type: none"> • Sources. • Separate and combined system. • Constituents. • Population Equivalent calculation. • Contamination loads. 	4
2	Physical treatment	<ul style="list-style-type: none"> • Screening, function, design criteria • Aeration, function, design criteria • Flotation, function, design criteria • Sedimentation, function, design criteria, calculation. 	6
3	biological treatment	<ul style="list-style-type: none"> • Activated sludge, function, design criteria, calculation. • Trickling filter, function, design criteria, calculation. • Lagoon, function, design criteria, calculation. • MBR, function, properties, • SBR, function, properties 	10
4	Disinfection	<ul style="list-style-type: none"> • Methods • Chlorination curve. • Basic design criteria. 	2
5	sludge management	<ul style="list-style-type: none"> • Sources. • Characteristics. • An aerobic treatment. • Dewatering methods. • Disposal alternatives. • Economical considerations. 	4
6	Advance treatment	<ul style="list-style-type: none"> • Nitrogen removal. • Phosphorus removal. • Softening. 	2
7	Wastewater treatment in Jordan	<ul style="list-style-type: none"> • Treatment technologies • The treatment plants. • Performance of the treatment plants 	4

No.	Unit Title	Unit Content	Hours
		<ul style="list-style-type: none">Site visit to a treatment plant.	

Teaching Methods:

Lectures.

Books and references:

Metcalf & Eddy, Wastewater Engineering: Treatment and Resource Recovery. McGraw-Hill Education; 5 edition, 2013,

Course Book:

Water and Wastewater Engineering, Design Principles and Practice, Mackenzie L. Davis, McGraw-Hill, 2010.

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣251
Course Title	Fundamentals of Instrumental Analysis
Credit Hours	2
Theoretical Hours	1
Practical Hours	3

Short Description:

تزود المادة الطالب بمبادئ اساسية حول التحليل الالي وتشمل مبادئ المطيافية الجزيئية، المطياف الذري، كروماتو الغاز والسائل عالي الاداء، تطبيقات التحليل الالي في المياه والبيئة.

Course Objectives:

By the end of this course students are expected to be able to:

1. ability to distinguish instrumental methods for the radiation, atomization, and separation
2. Ability to define light sources
3. ability to identify components of spectrophotometers, GC, and HPLC.
4. ability to analyze data from instrumental measures instrumentation employed in .
5. limitations of different instrumental based analysis methods.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Introduction to instrumental analysis	<ul style="list-style-type: none"> • methods of instrumental analysis • electromagnetic waves • interferences between electromagnetic waves and matter • sources for visible, ultraviolet, and infrared light • line and continuous sources • components of spectrophotometers • deflection, reflection, diffraction, transmission, absorption. 	2
2	Molecular spectroscopy	<ul style="list-style-type: none"> • Uv-Visible spectroscopy • infrared spectroscopy • sources for uv-visible-infrared waves • interferences 	4
3	Atomic Spectroscopy	<ul style="list-style-type: none"> • An Introduction to Optical Atomic Spectroscopy • components of atomic absorption • Atomic absorption spectroscopy • Atomic Emission Spectroscopy • atomization process • molecular and atomic excitation • cathode and anode lamps • detection limits 	4
4	Chromatography	<ul style="list-style-type: none"> • definition • gas chromatography • paper chromatography • liquid chromatography • stationary and mobile phases • separation columns efficiency 	4

No.	Unit Title	Unit Content	Hours
		<ul style="list-style-type: none">retention timeGC and HPLC components and comparisons	
5	Lab Experiments related to the above subjects	<ul style="list-style-type: none">UV-Visible application in water analysis (COD, Phosphate, Phenol, Nitrate, metals)Atomic absorption application in water analysis (metals, Ca, Mg)GC and HPLC application in water analysis (Organics, THM)	42

Teaching Methods:

Lectures

Books and references:

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Course Book:

: Principles of Instrumental Analysis (6th Edition) by Skoog, Holler and Crouch, published by Thomson Brooks/Cole

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣١٢١
Course Title	Computer Applications in Environmental Engineering
Credit Hours	2
Theoretical Hours	0
Practical Hours	6

Short Description:

ويشمل التدريب على برامج: نظام المعلومات الجغرافية، ادارة المشاريع، EPANET, SEWER CAD, WATER CAD

Course Objectives:

By the end of this course students are expected to be able to:

- 1- Can use EPANET for water distribution analysis and design
- 2- Can use WaterCAD for water distribution analysis and design
- 3- Can use SewerCAD for wastewater collection networks analysis and design
- 4- Importing maps from other softwares to EPANET, WaterCAD, and SewerCAD
- 5- Have a preliminary idea about GIS and engineering project management softwares.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	EPANET	<ul style="list-style-type: none"> • Introduction • Quick Tutorial • The Network Model • EPANET workspace • Analyzing networks • Viewing results • Project 	24
2	WaterCAD	<ul style="list-style-type: none"> • Introduction • Quick Tutorial • Analyzing networks • Viewing results • Project 	24
3	SewerCAD	<ul style="list-style-type: none"> • Introduction • Quick Tutorial • Analyzing sewer collection networks • Viewing results • Project 	30
4	GIS and Project management softwares	<ul style="list-style-type: none"> • GIS • Primavera 	6

Teaching Methods:

Computer practice

Books and references:

EPANET, WaterCAD, SewerCAD, GIS, Primavera User Manuals

Course Book:

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣٢٨١
Course Title	Air pollution
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

مصادر تلوث الهواء، تأثير تلوث الهواء على الانسان والبيئة، التغير المناخي، تاكل طبقة الازون، الامطار الحامضية، قياس التلوث، مراقبة التلوث، التحكم بالتلوث.

Course Objectives:

By the end of this course students are expected to be able to:

1. Identify the sources of air pollution
2. Recognize type of air pollutants.
3. Understand the global environmental challenge related to the air pollution.
4. Analyze (qualitatively) impacts of air pollution on human health, and the environment.
5. Select the suitable control method.
6. Select methods for measurement,
7. Design a monitoring program.

Detailed Description:

No.	Experiment Title	Experiment Content	Hours
1	Introduction to air pollution	<ul style="list-style-type: none"> • Definition • Concepts scales of air pollution. • Primary and secondary pollutants • The Earth's atmosphere: structure, composition and energy balance 	2
2	Sources of air pollution	<ul style="list-style-type: none"> • Natural sources. • Anthropogenic sources. • Major industries. • Transportation. • Type of sources: Fixe, mobile, point, line and area sources. 	3
3	Air pollutants	<ul style="list-style-type: none"> • Main pollutants. • Regulations. • Impact on human health and the environment. • Units of measurements 	3
4	Global air pollution	<ul style="list-style-type: none"> • Climate change, concept, causes, impact. • Depletion of ozone layer, concept, causes, impacts. • Acid rain, concept, causes, impact. • International agreements 	3
5	Transportation of pollutants	<ul style="list-style-type: none"> • Concept of dispersion.. • Parameter affecting transportation. • Gaussian model. • Simple calculation of the ground level concentration. 	3
6	Air pollution control	<ul style="list-style-type: none"> • Selection of control technologies. • Particulate matter control equipment: function, basic design criteria. • Gaseous pollutant control equipment: function, basic design criteria. 	8
7	Noise pollution	<ul style="list-style-type: none"> • Sources • Impacts. • Regulations, OSHA, 	2

No.	Experiment Title	Experiment Content	Hours
		<ul style="list-style-type: none"> • Measurement. • Mitigations measures. 	
8	Air pollution monitoring	<ul style="list-style-type: none"> • Benefits of monitoring • Data to be collected. • Instruments. • Design of the monitoring program. • Frequency of collection. • Continuous monitoring. • Data analyses (basically). 	5
9	Air pollution in Jordan	<ul style="list-style-type: none"> • Sources. • Major pollutants. • Control. • Site visit to MOE. 	3

Teaching Methods:

Laboratory

Books and references:

RICHARD W. BOUBEL, *others*, Fundamentals of Air Pollution, Academic Press, 2008

Course Book:

S.C. Bhatia, Textbook of Air Pollution and Its Control , Atlantic Publishers & Distributors, 2007.

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣٢٨٢
Course Title	Solid and Hazardous Waste
Credit Hours	2
Theoretical Hours	2
Practical Hours	0

Short Description:

مصادر النفايات، تصنيف النفايات، جمع ونقل النفايات، التخلص من النفايات، المردم الصحي، المحارق، التسميد، الفرز وإعادة التدوير

Course Objectives:

By the end of this course students are expected to be able to:

1. Do sampling and characterization of solid waste;
2. Understand the philosophy of hierarchy pyramid.
3. Distinguish between solid and hazardous waste.
4. Classify waste according different criteria.
5. Understand health and environmental issues related to solid waste management;
6. Apply steps in solid waste management-
7. Select the best disposal method.

Detailed Description:

No.	Unit Title	Unit Content	Hours
1	Introduction	<ul style="list-style-type: none"> • Definitions. • Sources of solid waste. • Impact of solid waste on human health and the environment. 	2
2	Waste Characterization	<ul style="list-style-type: none"> • Sampling • Classifications of solid waste • Constituents of solid waste • Generation rate. 	4
3	hazardous waste	<ul style="list-style-type: none"> • Criteria. • Classifications. • Codes. • Labeling. • MSDs • The Manifest. • Collection and transportation measures • Disposal techniques. 	5
4	Waste collection	<ul style="list-style-type: none"> • Methods of waste collection, • Collection techniques, • Waste container compatibility, • Waste storage requirements, • Transportation of solid wastes 	4
5	Waste Minimization	<ul style="list-style-type: none"> • Reduction at source. • Recycling. • Segregation • Energy production. 	4
6	landfilling	<ul style="list-style-type: none"> • Site selection of landfill. • Design criteria • Cells and compaction. • Gas production • Leachate collection. • Closure and post closure. 	7
7	Incineration	<ul style="list-style-type: none"> • Environmental consideration. • Function. • Design criteria. • Operation and monitoring. 	2

No.	Unit Title	Unit Content	Hours
		<ul style="list-style-type: none">• Closure and post closure.	
8	Composting	<ul style="list-style-type: none">• Objectives• Function.• Limitations.	2
9	Solid waste management in Jordan	<ul style="list-style-type: none">• Sources.• Quantity.• Collection• Disposal methods.• Site visit to Amman Municipality	2

Teaching Methods:

Lectures.

Books and references:

1. Pfeffer, J.T., "Solid Waste Management Engineering", Prentice Hall, 1992.
2. Wentz, C., "Hazardous Waste Management". McGraw-Hill, New York, 1995

Course Book:

3. Tchobanoglous, G., Theisen, H and Vigil, S., "Integrated Solid Waste Management", McGraw-Hill, New York, 1993.

Engineering Program

Specialization	Water and Environmental Engineering
Course Number	٠٢٠١٠٣٢٨٣
Course Title	Renewable Energy
Credit Hours	2
Theoretical Hours	1
Practical Hours	3

Short Description:

اهمية الطاقة البديله، خصائص الطاقة البديله، مصادر الطاقة البديله، طاقة الشمس، الرياح، المد والجزر، طاقة المياه، المياه الجوفية،الوقود الحيوي، تخزين الطاقة، تطبيقات الطاقة البديله في المياه والبيئة، الضوء والتهوية الطبيعية، المباني الخضراء، الجزء العملي يشمل تجارب في مختبر الطاقة الشمسية

Course Objectives:

By the end of this course students are expected to be able to:

1. Knowledge the possible sources of the renewable energy.
2. Understand the properties and benefits and limitations of the renewable energy.
3. Knowledge the application of the renewable energy.
4. Describe basic electrical concepts and system components.
5. Convert units of energy—to quantify energy demands and make comparisons among energy uses, resources, and technologies.
6. Describe the available renewable energy technologies.
7. Explain environmental impact and safety of each source of renewable energy.

8. Analyze different parameters related to the solar energy system.

Detailed Description:

No.	Experiment Title	Experiment Content	Hours
1	introduction to renewable energy	<ul style="list-style-type: none"> • Sources. • Properties. • Benefits. • Limitations. • Environmental considerations • Comparison and properties of different renewable energy sources. 	6
2	solar energy	<ul style="list-style-type: none"> • Solar radiation. • Solar utilization in buildings • System Elements. • Solar collectors. • Solar energy technologies. 	6
3	wind energy	<ul style="list-style-type: none"> • System Elements • Power control • Wind parks (farms) • Off-grid applications • Economic factors 	2
4	Renewable energy	<ul style="list-style-type: none"> • Water desalination. 	2

No.	Experiment Title	Experiment Content	Hours
	for water and environmental applications	<ul style="list-style-type: none">• Disinfection.• Sludge drying.• Conditioning	
5	lab experiments	Topics covered include but are not limited to, solar-thermal energy and photovoltaics, energy storage in batteries and ultra-capacitors, wind energy, ethanol production from corn and sugar and bio-diesel,, A field-trip is also included as a part of this course.	32

Teaching Methods:

Lecture/laboratory

Book:

محمد رافت اسماعيل، علي جمعة الشكيل، الطاقة المتجددة، دار الشروق،