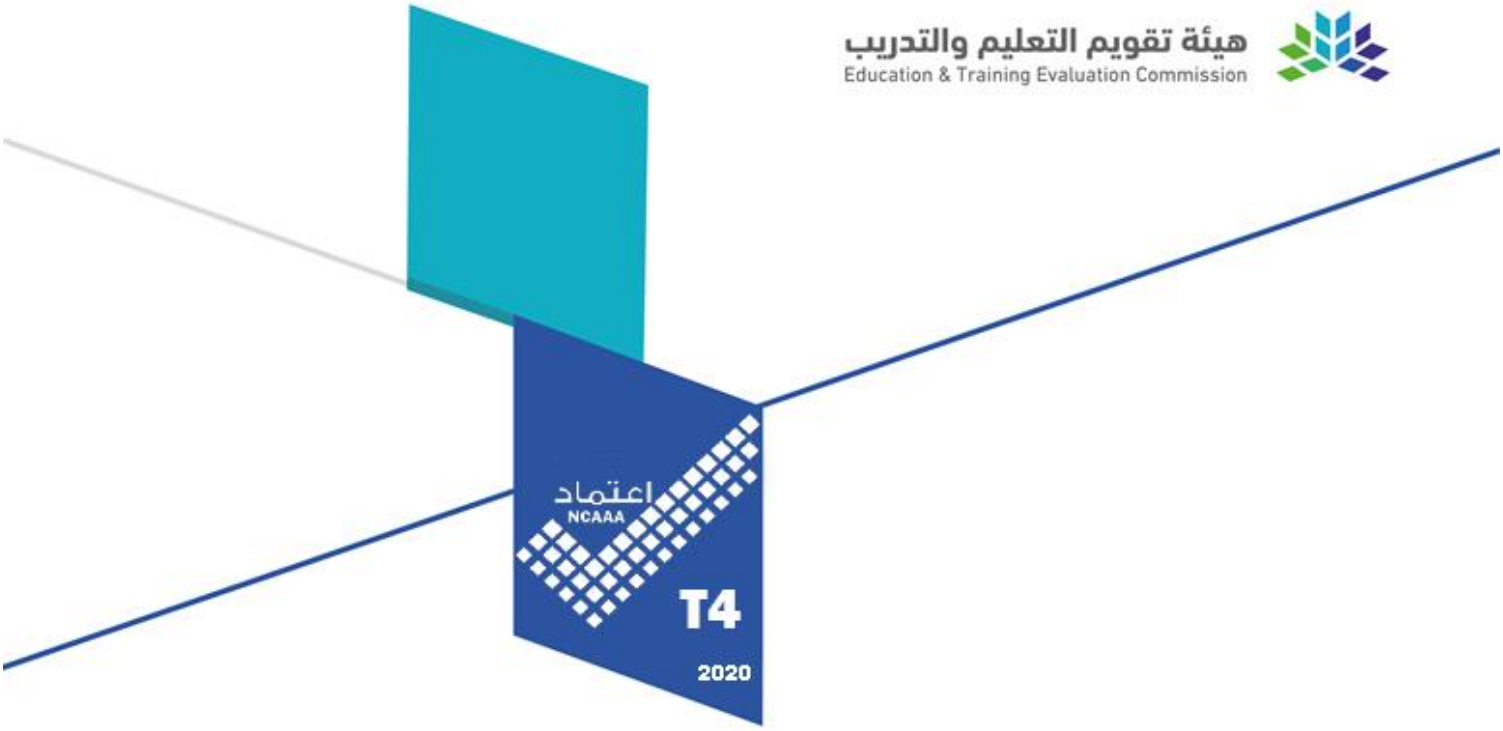
هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission



Course Specifications

Course Title:	Water & Wastewater Engineering
Course Code:	CE 445
Program:	B.Sc. in Civil Engineering
Department:	Civil Engineering
College:	Jubail University College
Institution:	Jubail University College

Table of Contents

A. Course Identification

1. Credit hours: 3
2. Course type **a.** University ☐ College ☐ Department ☑ Others ☐ **b.** Required ☐ Elective ☑
3. Level/year at which this course is offered: Level 6, Third Year Level 7, Fourth Year
4. Pre-requisites for this course (if any)**:** CE 205 Engineering Fluid Mechanics & CE317 Environmental Engineering Principles
5. Co-requisites for this course (if any)**:** None

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	✓	100
2	**Blended**		
3	**E-learning**		
4	**Correspondence**		
5	**Other**		

7. Contact Hours (based on academic semester)

No	Activity	Contact Hours
Contact Hours		
1	**Lecture**	30
2	**Laboratory/Studio**	45
3	**Tutorial**	
4	**Others** (specify)	
	Total	**75**

B. Course Objectives and Learning Outcomes

1. Course Description

CE 445 Water & Wastewater Engineering (2-3-3) ***Prerequisite: CE 205, CE 317***

Analysis of water distribution and wastewater collection systems, computer modeling of network systems; water treatment including coagulation, flocculation, softening, sedimentation, filtration, desalination and disinfection; wastewater treatment, primary and secondary treatment systems

2. Course Main Objective

The main purpose of this course is to prepare students to understand and analyze water distribution and wastewater collection systems. Course also prepares students to understand water and wastewater quality and perform various quality analyses..

3. Course Learning Outcomes

	CLOs	Aligned PLOs
1	**Knowledge and Understanding**	
	N/A	
2	**Skills :**	
2.1	Analyze water & wastewater quality based on standards and need of primary, secondary and tertiary treatment of wastewater	1
2.2	Translate the information related to water & wastewater transport & treatment systems to achieve desired quality for disposal and reuse.	1
2.3	Discover the water requirement and design various water & wastewater treatment unit	2
2.4	Develop skills for handling basic instruments used in water & wastewater quality determination, analyze, and interpret data obtained.	6
3	**Values**	
	N/A	

C. Course Content

No	List of Topics	Contact Hours
1	**Unit 1 : Review: Fundamentals of water and wastewater engineering** 1.1. Definition of terms, History of water supply, World population and available water 1.2. Water Quality & safe drinking water, Treatment requirements & types of examination, Water quality parameters, Organic & inorganic pollutants, 1.3. Drinking water standards 1.4. Introduction of Water & Wastewater testing lab.	5
2	**Unit 2 : Water Demand & Supply** 2.1. Part 1:Components of a water supply system, Design parameters (design period, population, Water usage and its variations, Factors influencing water usage 2.2. Part 2: Water Distribution Network, Water transportation system, Hydraulic consideration, Design of transportation system, Design by Hardy Cross method, Modelling with WaterCAD 2.3. Experiment # 1: Determination of Temperature for Water Samples 2.4. Experiment # 2: Determination of pH of Water and Wastewater Samples	10
3	**Unit 3 : Chemical Concept in Water and Wastewater Engineering** 3.1. Part 1: Inorganic Chemistry, Definitions: Atomic & molecular weight, Valency, Equivalent weight, Concentration units, Hydrogen ion concentration and pH, Acid or base, Chemical equliberia, Carbonic acid-bicarbonate-carbonate system, Alkalinity & buffers 3.2. Part 2: Physical Chemistry, Chemical kinetics, application in water & wastewater treatment, Effect of temperature on reaction rates, Gas laws, application in water & wastewater treatment, Colloidal dispersions, application in water & wastewater treatment 3.3. Experiment # 3: Determination of Color of Water and Wastewater Samples	5

4	**Unit 4 : Introduction to Water & Wastewater Treatment** 4.1. Water Treatment: Purpose of water treatment, Water treatment philosophy, Water treatment plants, Degree of treatment, 4.2. Design parameters, 4.3. Rapid sand filtration plant, lime-soda softening plant & groundwater treatment plant, 4.4. Typical functions of various unit operations, 4.5. Wastewater Treatment: Purpose of wastewater treatment, Municipal wastewater treatment plants, Primary and secondary (activated sludge) plant, Tertiary treatment plant, Physical-chemical treatment plant, Industrial wastewater treatment plants, 4.6. Completely-mixed AS process, Aerated lagoon system 4.7. Experiment # 4: Determination of Turbidity for Water and Wastewater Samples	10
5	**Unit 5 : Chemical Treatment: Coagulation Flocculation** 5.1. Turbidity and purpose of water treatment, Overview of the process, process steps, 5.2. Concept of floc formation & electrical charge, Common chemical coagulants , The Jar Test 5.3. Objectives of Sedimentation ,Uses, Design & design criteria for Sedimentation basins, Types of settling, Sedimentation in water treatment, Sedimentation in wastewater treatment 5.4. Experiment # 5: Determination of dissolved oxygen in water and wastewater samples	5
6	**Unit 6 : Filtration& Disinfection** 6.1. Filtration: Definition and objective, Overview of process, Uses in water & wastewater treatment, Classification of filters, Single& duel media filter, Filtration cycle, Mechanisms of particle removal, Head loss, backwash, Operational problems 6.2. Disinfection: Objective and overview of process, Disinfection methods, Chlorination, Chlorine dioxide, Ozonation, High pH, UV radiation & other halogens, Disinfection kinetics, Chlorination: Reactions, dosage, demand and residual, dechlorination, advantages & disadvantages, Ozonation: Ozone production, characteristics, advantages & disadvantages, Chlorine-Dioxide: characteristics, advantages & disadvantages, Ultraviolet radiation: characteristics, advantages & disadvantages, High pH treatment: overview, advantages & disadvantages 6.3. Experiment # 6. Jar Test (Coagulation and Flocculation) 6.4. Review of Lab experiments and practice.	10
7	**Unit 7 : Water Treatment: Water Softening, Iron & Manganese Removal** 7.1. Hardness and types of water hardness, 7.2. Lime –soda softening, Chemistry involved in lime-soda softening, Calculation of dosage, 7.3. Overview: Iron & Manganese removal, Problems associate with iron & manganese, Chemistry of iron & manganese in water system, 7.4. Quality standards, Treatment processes, oxidation, filtration & ion exchange 7.5. Experiment # 7. Adsorption Using Granular Activated Carbon	5

8	**Unit 8 :Taste & Oder Problems** 8.1. Overview: Problems associate with taste & odor in water, Testing for taste & odor problems, Eutrophication, 8.2. Treatment methods, Oxidation by chlorine, Ozone and potassium permanganate, Activated carbon adsorption, Aeration 8.3. Experiment # 8: Determination of Solids in Water and Wastewater Samples	5
9	**Unit 9 : Membrane Processes** 9.1. Overview: **Membrane Processes,** Dialysis, electro-dialysis & reverse osmosis (desalination), Reverse osmosis & osmotic pressure, 9.2. flux in membranes, Types of RO membranes, Application of RO process, Calculation of flux, Osmotic pressure & membrane area 9.3. Experiment # 9. Demonstration of Biochemical Oxygen Demand in Wastewater Sample	5
10	10.1. Unit 10 : Wastewater Quantity & Quality 10.2. Introduction, Sanitary sewer system, types of sewer systems, Sources of wastewater flow, calculations, 10.3. Wastewater quality parameters, Physical, chemical & biological quality characteristics, Priority pollutants, 10.4. Measurement of waste organic material: BOD, COD and TOC, Kinetics of process & calculations, Wastewater microbial life: bacteria, viruses, protozoa, rotifers, fungi & nematodes, coliform, Water sample preservation and analysis in laboratory 10.5. Experiment # 10. Demonstration of Chemical Oxygen Demand in Water and Wastewater Samples	5
11	**Unit 11 :Wastewater Treatment** 11.1. Overview of primary, secondary & tertiary treatment, 11.2. Screens, design parameters & equations, Grit chamber, need for grit removal, 11.3. Objectives of biological treatment, Suspended growth processes & attached growth processes, Activated sludge process: Basic design calculations, R/Q ratio, Sludge volume index, F/M ratio, Mean cell residence time, relation between F/M ratio & Mean cell residence time, Types of Reactors: Plug-flow, Dispersed plug-flow & completely-mixed reactors , Conventional Activated Sludge system design parameters, Performance of AS system, Rotating Biological Contactor (RBC's): Process overview, characteristics, 11.4. Trickling Filters: Process overview, classifications of trickling filters, mechanism, operational problems, 11.5. Aerated Lagoons: Overview, Stabilization Ponds: Introduction, requirements for process, general characteristics, classification, Design of facultative pond 11.6. Experiment # 11. Analysis of Water and Wastewater Samples 11.7. Review of Lab experiments and practice	10

Total	75

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge and Understanding**		
	N/A		
2.0	**Skills**		
2.1	Analyze water & wastewater quality based on standards and need of primary, secondary and tertiary treatment of wastewater	Interactive learning Self-directed, Promote critical thinking and independent learning	Quiz 1, assignment 1, midterm, final & project
2.2	Translate the information related to water & wastewater transport & treatment systems to achieve desired quality for disposal and reuse.		Quiz 2, assignment 2, midterm & final
2.3	Discover the water requirement and design various water & wastewater treatment unit		Quiz 2, assignment 2, midterm & final
2.4	Develop skills for handling basic instruments used in water & wastewater quality determination, analyze, and interpret data obtained.	Promote critical thinking Independent learning Experiential Learning	Written exams (Quizzes, midterm & final), lab performance & Lab record
3.0	**Values**		
	N/A		

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Quiz 1	4	5%
2	Assignment 1	6	5%
3	Mid-Term LT	8	20%
4	Mid-Term LB	9	5%
5	Quiz 2	12	5%
6	Assignment 2	14	5%
7	Final Exam -LB	16	10%
8	Performance LB	16	10%
9	Lab Record	16	5%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

- Office hours 6hr/week; students can go in times of office hours for teacher to explain what could not be understood from the lesson.
- Students can communicate with a staff member outside the official working hours by email.
- Students are also encouraged to visit their academic advisors.

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Hammer, M. Jr. *and* Hammer, M. J. Sr. (2012). *Water and wastewater technology*, USA: Prentice Hall Publisher
Essential References Materials	Mackenzie L. D (2010). *Water and wastewater engineering: design principles and practice*, USA: McGraw-Hill Education Baruth, E. E. (2005**).** *Water treatment plant design*. New York, USA: McGraw-Hill.
Electronic Materials	www.epa.gov › Laws & Regulations
Other Learning Materials	N/A

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	Lecture rooms with a capacity of at least 25 students and fitted with multimedia projector and a computer.
Technology Resources (AV, data show, Smart Board, software, etc.)	None
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	Environmental Engineering laboratory to carryout water and wastewater sample analysis

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of teaching and assessment as per QMS-Policy-006 Feedback Survey, QMS-QAP-116 Monitoring Students' Satisfaction	Students	Indirect: Analyzing the results of the following surveys Course Evaluation Survey(CES), Program Evaluation Survey (PES), Student Experience Survey (SES)
Quality of Exam papers and Verifying Standards of Student Achievement as per QMS-Policy-004 Policy for Examinations and Marking, QMS-ACP-102 Procedure for Marking Examinations	Examination Committee	Direct: Peer review of examination papers and review or double check a minimum of three or 10% of answer papers. Verifying the

Evaluation Areas/Issues	Evaluators	Evaluation Methods
		entries in the Activity Mark Sheet.
Achievement of learning outcomes as per QMS-Policy-001 Course Review, QMS-CDP-106, QMS-CDP-112 Curriculum Review	Faculty	Direct: Course Report (Section B-3)
Implementation of the action plans based on previous semester as per QMS-Policy-001 Course Review, QMS-CDP-106 Procedure for Course Review, QMS-CDP-112 Procedure for Curriculum Review	Faculty	Direct and Indirect: Course report (Section G-1, G-2)
Monitoring Teaching and Learning as per QMS-Policy-005 Monitoring of Teaching and Learning	Chairperson/Program Director/Course Director	Indirect: Feedback by Chairperson/Program director/Course director. Program Delivery Record.
Effectiveness of planned Teaching Strategies QMS-Policy-001 Course Review	Faculty	Indirect: Course Report (Section B-4)
Course effectiveness and planning for improvement as per QMS-Policy-001 Course Review, QMS-CDP-106 Procedure for Course Review, QMS- CDP-112 Procedure for Curriculum Review	Faculty	Direct and Indirect: Course report (Section G-3)
Verifying Standards of Student Achievement and Quality of Exam papers as per QMS-ACP-119 External Assessment Review	Assessment External Reviewer	Direct: Report of assessment external reviewer. Review of sample of ten or 10% of student's assessments and coursework scripts.

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Civil Engineering Department Council
Reference No.	REG MIN-CED-10
Date	27-04-2020

Appendix A
Revision Details

Revision no.	DESCRIPTION	Reference MoMs			
		DC		CDC	
		Sem	#	Sem	#
1	Revision of Course Teaching Strategies and action verbs based on the comments of NCAAA reviewer	392	4	392	4
2	Course Specification Template 2018	402			