University of Macau

Undergraduate Civil Engineering Programme

Coordinating Unit:	Department of Civil and Environmental Engineering, Faculty of Science and Technology		
Supporting Unit(s):	Nil		
Course Code:	CIVL301	Year of Study:	3
Course Title:	Environmental Engineering II		
Compulsory/Elective	Compulsory		
Course Prerequisites:	Environmental Engineering I		
Prerequisite Knowledge:	Water quality, water resources, water chemistry as well as natural water quality processes		
Duration:	One semester	Credit Units:	4
Class/Laboratory Schedule:	Three hours of lecture and two hours of laboratory/tutorial classes per week.		
Laboratory/Software Usage:	Environmental Engineering Laboratory*		
Course Description:	This course is organized with the following chapters: introduction to water and wastewater treatment including physical, chemical and biological treatment processes; designs for water and wastewater treatment facilities; operation units involving coagulation and flocculation, sedimentation and flotation, filtration and clarification, disinfection, activated sludge biochemical treatment for wastewater; water recycle and reuse treatment; water pollution control in natural waters.		
Course Objectives:	1. To introduce to students the theory and application of water and wastewater treatment engineering systems; 2. To develop students with an understanding of the self-purification process of natural waters; 3. To prepare students for the effective applications of the conventional water and wastewater treatment techniques for design and operation of the treatment engineering systems.		
Learning Outcomes (LO):	Upon completion of this course, students should be able to: 1. understand fundamental aspects of water and wastewater treatment engineering systems; 2. apply conventional techniques for water and wastewater treatment processes to make design for the engineering systems; 3. identify and determine the self-purification capacities for the specific natural waters;		
Texts & References: ** recommended textbook*	1. * Mackenzie L. Davis, Susan J. Masten (2004), Principles of Environmental Engineering and Sciences, McGraw Hill Higher Education 2. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous (1985), Environmental Engineering, McGraw-Hill 3. Clair N. Sawyer, Perry L. McCarty, Gene F. Parkin (fourth edition) (1991), Chemistry for Environmental Engineering, McGraw-Hill 4. Steel and McGhee (1990) Water Supply and Sewerage, McGraw-Hill		
Student Assessment:	• Assignments: 20% • One mid-term examination: 30% • One final examination: 50%		
Learning Outcome Assessment:	• Assignments, mid-term test and final examination • Course evaluation		

Pedagogical Methods:	☑ Lecture	☐ Service learning
	☐ Guest speakers	☐ Internship
	☐ Case study	☐ Field study
	☐ Role playing	☐ Company visits
	☐ Student presentation	☐ e-learning
	☐ Project	☑ Independent study
	☐ Simulation game	☐ Others:
	☑ Exercises and problems	

* In CIVL301, usually we offered the laboratory classes to our students each semester but this semester we did not because the previous laboratory technician resigned and we did not yet recruit a new one.

Major Assessment Methods:	Case Study	Role Playing	Student Presentation	Individual project/paper	Group project/paper	Simulation Game	Exercises & problems	Service learning	Internship	Field Study	Company visits	Written examination	Oral examination	Others (please specify)
Class Participation/ Discussion (10%)							✓							
Assignment(s) (10%)												✓		
Mid-term Examination (30%)												✓		
Final Examination (50%)												✓		
Others *(please specify)*														
Course Web: (if any)	Course materials are available in UMMoodle (http://webcourse.umac.mo/).													

Course Content: (topic outline)

Week no.	Topics	Assignment no.	LO no.
1	**Introduction of engineering systems for water and wastewater treatments** Water resources vs. hydrological cycling of natural water; raw water quality, wastewater quality; Water quality standards		1
2	**Natural self-purification capacities for receiving waters** Oxygen demanding materials; DO sag curve analsys; Balance between deoxygenation and reoxygenation	1	3
3	**Process rates and unit operations** Water treatment principle options; Process rates; cost-benefit analysis; unit operations in water treatment principles	1	1,2
4, 5	**Carbonate buffering system and softening treatment** Introduction to chemical equilibrium of carbonate species in water; hardness; Lime-soda ash treatment for water softening.	1	1,2,3
6,7,8	**Coagulation and flocculation** Colloidal stability; colloidal destabilization of a suspension; Surface chemical equilibrium vs mass transfer, jar tests for optimal coagulant dosage; Gt value vs optimal hydraulic conditions	1	1, 2
9,10	**Sedimentation and flotation** Rectangular settling tank: design and operation; Type 1 and type 2 suspensions; sedimentation efficiency	1	1, 2
11, 12	**Filtration and clarification** Deep bed filtration; optimal operation conditions; backwash hydraulics; filtration efficiency	1	1, 2
13	**Disinfection and chemical reaction kinetics** Chlorination: kinetics and chemical equilibrium; organic micro-pollution vs. THMs		1, 2
14	**Activated sludge treatment for municipal wastewater** Biochemical reactions; metabolism; completed mixing reactor; Monod equations; aerobic bacteria	1	2, 3

Percentage Content of:

Math	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies
30	35	30	5	---

Timetabled work in hours per week:

Lecture	Tutorial	Laboratory	Other	Total
3	2		---	5

Contribution to Program Outcomes:

Program Outcomes	Contribution to POs[#] 5 Significant ----------> 1 Least				
	1	2	3	4	5
(a) Apply knowledge of mathematics, science, and engineering		✓			
(b) Design and conduct experiments, and analyze data	✓				
(c) Design components, systems or processes in presence of constraints	✓				
(d) Function in a multi-disciplinary team		✓			
(e) Engineering problem solving	✓				
(f) Understand professional and ethical responsibility		✓			
(g) Communicate effectively			✓		
(h) Understand the impact of engineering solutions to the society					
(i) Recognize the need and have the ability for lifelong learning		✓			
(j) Have knowledge of contemporary issues	✓				
(k) Apply the skills, techniques, modern engineering tools					
(l) Use the computer/IT tools relevant to the discipline					

 # Note 5: Significant contribution; 4: Supporting contribution; 3: Moderate contribution; 2: Marginal support; 1: Least support

Course Instructor(s): Prof. Z. S. Wang