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:	CIVL230	Year of Study:	2
Course Title:	Hydraulics I		
Compulsory/Elective:	Compulsory		
Course Prerequisites:	None		
Prerequisite Knowledge:	Basic integral and differential calculus, vectors, engineering mechanics		
Duration:	One semester	Credit Units:	4
Class/Laboratory Schedule:	Three hours of lecture and one hour of tutorial and one hour of laboratory per week.		
Laboratory/Software Usage:	Hydraulics Laboratory		
Course Description:	Properties of fluids. Fluid statics. Fluid in motion and the conservation of mass. Pressure variation in flows. Momentum and energy principles. Dimensional analysis and similitude. Surface resistance: laminar and turbulent boundary layers. Flow in simple conduits. Drag and lift. Flow measurement.		
Course Objectives:	1. Identify and obtain values of fluid properties and relationship between them. 2. Understand the principles of continuity, momentum, and energy as applied to fluid motions. 3. Recognize these principles written in form of mathematical equations. 4. Apply these equations to analyze problems by making good assumptions and learn systematic engineering method to solve practical fluid mechanics problems.		
Learning Outcomes (LO):	Upon completion of this course, students should be able to: 1. apply fundamental knowledge of mathematics to modeling and analysis of fluid flow problems in civil and environmental engineering. [POs: a, b, e]; 2. conduct experiments (in teams) in pipe flows and open-channel flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports. [POs: a, b, d, g, k]; 3. understand or become aware of disasters caused by an incorrect analysis in hydraulic engineering system. [POs: a, e]; 4. take higher level hydraulics courses. [POs: a, b, e].		
Texts & References: *(* recommended textbook(s))*	1. "Fluid Mechanics" by F. M. White, 6th ed., McGraw-Hill.* 2. "Fundamentals of Fluid Mechanics" by Munson, Young & Okiishi, 2nd ed., Wiley 3. "Fluid Mechanics" by Streeter and Wylie, McGraw-Hill 4. "Fluid Mechanics with Engineering Application" by Daugherty, Franzini and Finnemore, McGraw Hill 5. "An Introduction to Fluid Mechanics" by Bachelor, Cambridge University Press		
Student Assessment:	• Assignments and laboratory reports: 20% • One mid-term examination: 40% • One final examination: 40%		
Learning Outcome Assessment:	• Assignments, laboratory reports and examinations • Course evaluation		
Pedagogical	☑ Lecture ☐ Service learning		

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

Major Assessment Methods: For each Major Assessment Method below, please indicate the specific pedagogical methods involved (by putting a ✓ in the relevant box(es) on the right-hand side).	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 (0%)														
Assignment(s) (10%)							✓							
Mid-term Examination (40%)												✓		
Final Examination (40%)												✓		
Others *(please specify)* _Lab Reports_ (10 %)					✓									
Course Web: (if any)														

Course Content: (topic outline)

Week no.	Topics	Assignment no.	LO no.
1,2	**Introduction** Fluid Concept and the Continuum Hypothesis; Properties of fluids	1	1
2,3,4	**Fluid Statics** Pressure and Its Variation in a Static Fluid; Measurement of Static Fluid Pressure: Manometers; Hydrostatic Forces on Plane and Curved Surfaces; Buoyancy and Stability **Laboratory Experiments** Visualization of Flow Patterns around Immersed Objects; Hydrostatic Pressure Center on Partially Submerged Surfaces	2,3	1,2,4
5	**Kinematics of Fluid Flow** Properties of the Fluid Velocity Field; Flow Classification and Flow Patterns; Reynold's Transport Theorem	4	1,4
5,6,7	**Finite Control Volume Analysis** Conservation of Mass; The Linear Momentum Equation and the Moment-of-Momentum Equation; The Energy Equation; Bernoulli Equation (Derived from Newton's Second Law); Energy and Hydraulic Grade Lines **Laboratory Experiments** Impact of Jet; Verification of The Bernoulli Theorem	4,5,6	1,2,3,4
8,9	**Differential Analysis of Fluid Flow** Fluid Element Kinematics; Conservation of Mass and Introduction of Stream Function; Conservation of Linear Momentum and Equation of Motion; Inviscid and Potential Flow; Viscous Flow	7,8	1,4
9,10	**Dimensional Analysis and Similarity** The Buckingham Pi Theorem; Common Dimensionless numbers; Geometric and Dynamic Similitude; Model Study	9	1,2,4
11,12, 13	**Flow in Pipes** Criterion for Laminar and Turbulent Flow in a Pipe: The Reynolds Number; Energy Losses in Laminar and Turbulent Pipe Flow: The Darcy-Weisbach Equation; Pipe Friction: Moody Diagram and its Alternate Form; Minor Losses in Pipe Flow, Pipe Flow Problems **Laboratory Experiments** Osborne Reynolds Apparatus; Pipe Friction	10,11	1,2,3,4
13,14	**Flow over Immersed Body** Laminar and Turbulent Boundary Layers; Drag and Lift	12	1,3,4
To be scheduled	**Final Examine**	--	--

Percentage Content of:

Math	Basic Science	Engineering Science	Engineering Design and Synthesis	Complementary Studies	Computer Studies	Total
50	0	25	20	5	0	100

Timetabled work in hours per week:

Lecture	Tutorial	Laboratory	Other	Total
3	1	1	---	5

Contribution to Program Outcomes:	

Program Outcomes	Contribution to POs[#] 5 ----------> 1 Significant Least				
	5	4	3	2	1
(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. K. M. Mok