University of Macau

Department of Civil and Environmental Engineering

CEEB220 – Fluid Mechanics

Syllabus

Coordinating Unit:	Department of Civil and Environmental Engineering, Faculty of Science and Technology		
Supporting Unit(s):	Nil		
Course Code:	CEEB220	Year of Study:	2
Course Title:	Fluid Mechanics		
Compulsory/Elective:	Compulsory		
Course Prerequisites:	MATB110, PHYS120		
Prerequisite Knowledge:	Basic integral and differential calculus, vectors, engineering mechanics		
Duration:	One semester	Credit Units:	3
Class/Laboratory Schedule:	Three hours of lecture, and one hour of practice 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; Application in civil engineering: pipe flow, pipe networks, and open channel analysis.		
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. 5. Apply fundamental principles of fluid mechanics for the solution of practical civil engineering problems of water conveyance in pipes, pipe networks, and open channels.		
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];		

Texts & References: * *recommended textbook*	1. "Fluid Mechanics" by F. M. White, 7th 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: 10% • Laboratory reports: 10% • One mid-term examination: 40% • One final examination: 40%
Learning Outcome Assessment:	• Assignments, laboratory reports and examinations • Course evaluation
Pedagogical Methods:	☑ Lecture ☐ Guest speakers ☐ Case study ☐ Role playing ☐ Student presentation ☐ Project ☐ Simulation game ☑ Exercises and problems ☐ Service learning ☐ Internship ☐ Field study ☐ Company visits ☐ e-learning ☑ Independent study ☑ Others: Hydraulics Laboratory

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														
Assignment(s)							✓							
Mid-term Examination												✓		
Final Examination												✓		
Others *(please specify)* _Lab Reports__					✓									
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** Hydrostatic Pressure Center on Partially Submerged Surfaces	2,3	1,2,3
5	**Kinematics of Fluid Flow** Properties of the Fluid Velocity Field; Flow Classification and Flow Patterns; Reynold's Transport Theorem	4	1,2
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
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	1,2
9,10	**Dimensional Analysis and Similarity** The Buckingham Pi Theorem; Common Dimensionless numbers; Geometric and Dynamic Similitude; Model Study	9	1,2,3
11-14	**Application of Fluid Mechanics in Civil Engineering** 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; Steady Flow in Pressure Conduits; Open Channel Flow Analysis **Laboratory Experiments** Pipe Friction	9,10	1,2,3
15	**Final Examination**	--	--

Percentage Content of:

Mathematics and Basic Sciences	Engineering Subjects	Complementary Studies	Total
25	70	5	100

Timetabled work in hours per week:

Lecture	Tutorial	Practice	Total
3	---	1	4

Contribution to Programme Outcomes:	

Programme Outcomes	Contribution to POs	
	Primary	Secondary
(a) an ability to apply knowledge of mathematics, science, and engineering appropriate to the degree discipline	✓	
(b) an ability to design and conduct experiments, as well as to analyse and interpret data	✓	
(c) an ability to design a system, component or process to meet desired needs within realistic constraints, such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability		
(d) an ability to function on multi-disciplinary teams		✓
(e) an ability to identify, formulate and solve engineering problems	✓	
(f) an ability to understand professional and ethical responsibility		
(g) an ability to communicate effectively		✓
(h) an ability to understand the impact of engineering solutions in a global and societal context, especially the importance of health, safety and environmental considerations to both workers and the general public		
(i) an ability to stay abreast of contemporary issues		
(j) an ability to recognise the need for, and to engage in life-long learning		
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice appropriate to the degree discipline		✓
(l) an ability to use the computer/IT tools relevant to the discipline along with an understanding of their processes and limitations		

Course Instructor(s):	Prof. K. M. Mok (Please refer to the following link for the consultation hours of the course instructor: http://www.fst.umac.mo/cee/contacthour.html)