Annexe A: New/Revised Course Content in OBTL+ Format

Course Overview

The sections shown on this interface are based on the templates UG OBTL+ or PG OBTL+
If you are revising/duplicating an existing course and do not see the pre-filled contents you expect in the subsequent sections e.g. Course Aims, Intended Learning Outcomes etc. please refer to Data Transformation Status for more information.

Expected Implementation in Academic Year	
Semester/Trimester/Others (specify approx. Start/End date)	
Course Author * Faculty proposing/revising the course	Lee-Chua Lee Hong
Course Author Email	clhlee@ntu.edu.sg
Course Title	Fluid Mechanics
Course Code	CV1012
Academic Units	3
Contact Hours	39
Research Experience Components	Not Applicable

Course Requisites (if applicable)

Pre-requisites	
Co-requisites	
Pre-requisite to	
Mutually exclusive to	
Replacement course to	
Remarks (if any)	

Course Aims

To introduce the basic principles of fluid mechanics and the concepts of dimensional analysis and similitude; applications of the principles to internal pipe flows and fluid machines.

Course's Intended Learning Outcomes (ILOs)

Upon the successful completion of this course, you (student) would be able to:

ILO 1	Describe the fundamental knowledge of fluid properties, fluid statics and manometers, hydrostatic forces on plane and curved surfaces for the design of engineering structures against hydrostatic forces
ILO 2	Apply Archimedes Principles to solve buoyancy and stability of floating bodies
ILO 3	Describe the fundamental knowledge of fluid motion and classification of flow
ILO 4	Apply the Continuity, Bernoulli's and Momentum equations to solve fluid flow problems
ILO 5	Describe the fundamental knowledge of Buckingham Pi Theorem, significance of dimensionless groups in fluid flow problems
ILO 6	Apply dimensional analysis to hydraulic modelling, similitude and scale models
ILO 7	Describe the fundamental knowledge of laminar and turbulent flows, and apply the energy concepts in pipe flow
ILO 8	Apply the Darcy-Weisbach equation and Moody Diagram to calculate energy losses in pipe flows
ILO 9	Describe the fundamental knowledge of fluid machines, pump characteristics, similarity laws and machine selection, cavitation and NPSH
ILO 10	Apply pump and system characteristics with pumps in parallel and/or series in the operation of engineering works that regulate the conveyance of water in closed conduits

Course Content

S/N	Topic	Lecture Hrs	Tutorial Hrs
1.	Fluid statics and manometers.	2	1
2.	Hydrostatic forces on plane and curved surfaces.	2	1
3.	Buoyancy and stability of floating bodies	2	1
4.	Description of fluid motion. Classification of flow. System and control volume	1	1
5.	Continuity equation. Bernoulli's equation and its application	2	1
6.	Momentum equation for steady flow. Forces on objects	3	1
7.	Buckingham Pi theorem. Significance of dimensionless groups	2	1
8.	Similitude and scale models	2	1
9.	Laminar and turbulent flows in pipes. Energy concepts in pipe flows	2	1
10.	Darcy-Weisbach equation and Moody diagram. Frictional and minor losses. Basic pipe network analysis	4	2
11.	Principles of fluid machines. Performance characteristics of pumps. Similarity laws. Specific speed and machine selection. System characteristics and matching. Cavitation and NPSH. Pumps in parallel and series	4	2
	Total:	26	13

Reading and References (if applicable)

Textbooks:

1. Munson, B.R., young, D.F. and Okiishi, T.H., “Fundamentals of Fluid Mechanics”, 6th Edition, John Wiley & Sons, 2010.

References:

1. Franzini, J.B. and Finnemore, E.J., “Fluid Mechanics with Engineering Applications”, 10th Edition, McGraw-Hill, 2002.

Planned Schedule

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
1	Fluid Properties: Definitions of fluid properties, Newton's Law of Absolute Viscosity for Newtonian fluids in laminar motion; compressibility of liquid.	1, 2		In-person	2 lectures and 1 tutorial on fluid properties
2	Fluid Statics: Fluid statics, manometer, hydrostatic pressure within body of static fluid; hydrostatic thrust on plane and curved surfaces; buoyancy force on body; Archimedes principle, stability of floating bodies.	1, 2		In-person	3 lectures and 1 tutorials on fluid statics, hydrostatic thrust and buoyancy

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
3	Fluid Statics: Fluid statics, manometer, hydrostatic pressure within body of static fluid; hydrostatic thrust on plane and curved surfaces; buoyancy force on body; Archimedes principle, stability of floating bodies.	1, 2		In-person	Fluid Statics: Fluid statics, manometer, hydrostatic pressure within body of static fluid; hydrostatic thrust on plane and curved surfaces; buoyancy force on body; Archimedes principle, stability of floating bodies.
4	Fluid in motion: Describe fluid motion, classification of flow, system and concept of control volume; Continuity, Bernoulli and Equations and applications.	3, 4		In-person	5 lectures and 2 tutorials on Continuity and Bernoulli Equations
5	Fluid in motion: Describe fluid motion, classification of flow, system and concept of control volume; Continuity, Bernoulli and Equations and applications.	3, 4		In-person	5 lectures and 2 tutorials on Continuity and Bernoulli Equations

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
6	Momentum Equation and forces on surfaces, Quiz – CA 1	3, 4		In-person	2 lectures and 1 tutorial on momentum equation
7	Momentum Equation and forces on surfaces, Quiz – CA 1; Dimensional Analysis and its applications, Apply Buckingham Pi theorem to derive dimensional groupings, and to use similitude in hydraulic modelling of scale models in fluid flow problems.	3, 4; 5, 6		In-person	2 lectures and 1 tutorial on momentum equation; 4 lectures and 2 tutorials on dimensional analysis and hydraulic modelling
8	Dimensional Analysis and its applications, Apply Buckingham Pi theorem to derive dimensional groupings, and to use similitude in hydraulic modelling of scale models in fluid flow problems.	5, 6		In-person	4 lectures and 2 tutorials on dimensional analysis and hydraulic modelling

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
9	Flow in Pipes: Distinguish between laminar and turbulent flow; derive the head loss equations for laminar and turbulent flow; apply the Darcy-Weisbach equation and Moody Diagram to calculate friction and minor energy losses for pipelines in series, parallel and branching networks.	7, 8		In-person	5 lectures 2 tutorials on pipe flow
10	Flow in Pipes: Distinguish between laminar and turbulent flow; derive the head loss equations for laminar and turbulent flow; apply the Darcy-Weisbach equation and Moody Diagram to calculate friction and minor energy losses for pipelines in series, parallel and branching networks.	7, 8		In-person	5 lectures 2 tutorials on pipe flow

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
11	Flow in Pipes: Distinguish between laminar and turbulent flow; derive the head loss equations for laminar and turbulent flow; apply the Darcy-Weisbach equation and Moody Diagram to calculate friction and minor energy losses for pipelines in series, parallel and branching networks.	7, 8		In-person	5 lectures 2 tutorials on pipe flow
12	Quiz – CA 2; Fluid Machines and similitude for fluid machines: Apply similitude laws for pump characteristics, and perform numerical analysis to compute system flow characteristics with pump installation in series and parallel.			In-person	3 lectures 1 tutorial on fluid machines, and pumps

Week or Session	Topics or Themes	ILO	Readings	Delivery Mode	Activities
13	Fluid Machines and similitude for fluid machines: Apply similitude laws for pump characteristics, and perform numerical analysis to compute system flow characteristics with pump installation in series and parallel.	9, 10		In-person	3 lectures 1 tutorial on fluid machines, and pumps

Learning and Teaching Approach

Approach	How does this approach support you in achieving the learning outcomes?
Lecture	Formal lectures on the topics with in-class discussion
Tutorial	This helps you to achieve one or more of the outcomes as you would need to work on tutorial questions using the concepts and principles taught in lectures. (The class is split into groups for tutorials so that the instructor-student interaction can be more effective.)

Assessment Structure

Assessment Components (includes both continuous and summative assessment)

No.	Component	ILO	Related PLO or Accreditation	Weightage	Team/Individual	Rubrics	Level of Understanding
1	Summative Assessment (EXAM): Final exam(Final Examination)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	CVE SLOs (2018) a, c, e, g, j	60	Individual	Holistic	Relational
2	Continuous Assessment (CA): Test/Quiz(Continuous Assessment 1 (CA1) : Quiz 1)	1,2,3,4,5	CVE SLOs (2018) a, c, e, g, j	20	Individual	Analytic	Multistructural
3	Continuous Assessment (CA): Test/Quiz(Continuous Assessment 2 (CA2): Quiz 2)	4,5,6,7,8	CVE SLOs (2018) a, c, e, g, j	20	Individual	Analytic	Multistructural

Description of Assessment Components (if applicable)

CVE SLOs (2018)

a) Engineering Knowledge: Apply the knowledge of mathematics, natural science, engineering fundamentals, and civil engineering specialisation to the solution of complex civil engineering problems.

b) Problem Analysis: Identify, formulate, research literature, and analyse complex civil engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c) Design/development of Solutions: Design solutions for complex civil engineering problems and design system components or processes with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

d) Investigation: Conduct investigations of complex problems using research-based knowledge and methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex civil engineering activities with an understanding of the limitations.

f) The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and the need for the sustainable development.

h) Ethics: Apply ethical principles and commit to professional and moral responsibilities in the civil engineering practice.

i) Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

j) Communication: Communicate effectively on complex civil engineering activities with the engineering community and with society at large, be able to comprehend and write effective reports and design documentation, and make effective presentations.

k) Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to work, as a member and leader in a multidisciplinary team.

l) Life-long Learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological evolution.

Formative Feedback

The instructor(s) will provide feedback on your performance on the CA. Guidance will also be provided through active interactions during tutorial sessions and consultation meetings.

NTU Graduate Attributes/Competency Mapping

This course intends to develop the following graduate attributes and competencies (maximum 5 most relevant)

Attributes/Competency	Level
Care for Environment	Basic

Course Policy

Policy (Academic Integrity)

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values. As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. On the use of technological tools (such as Generative AI tools), different courses / assignments have different intended learning outcomes. Students should refer to the specific assignment instructions on their use and requirements and/or consult your instructors on how you can use these tools to help your learning. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Policy (General)

You are advised to go through the class material and related texts before the lecture. You are also encouraged to share and deliberate on the challenges and difficulties of the tutorial exercises during the tutorials.

Policy (Absenteeism)

Policy (Others, if applicable)

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