COURSE CONTENT

Academic Year	AY2018/19	**Semester**	1
Course Coordinator			
Course Code	CV1012		
Course Title	Fluid Mechanics		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	Lecture: 26 hrs; Tutorial: 13 hr; Lab: 0 hr.		
Proposal Date	24 May 2019		

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.

Intended Learning Outcomes (ILO)

After the successful completion of the course, you should be able to:

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;
2. Apply Archimedes Principles to solve buoyancy and stability of floating bodies;
3. Describe the fundamental knowledge of fluid motion and classification of flow;
4. Apply the Continuity, Bernoulli's and Momentum equations to solve fluid flow problems;
5. Describe the fundamental knowledge of Buckingham Pi Theorem, significance of dimensionless groups in fluid flow problems;
6. Apply dimensional analysis to hydraulic modelling, similitude and scale models;
7. Describe the fundamental knowledge of laminar and turbulent flows, and apply the energy concepts in pipe flow.
8. Apply the Darcy-Weisbach equation and Moody Diagram to calculate energy losses in pipe flows;
9. Describe the fundamental knowledge of fluid machines, pump characteristics, similarity laws and machine selection, cavitation and NPSH;
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

Assessment (includes both continuous and summative assessment)

Component	Course ILO Tested	Related Programme SLO or Graduate Attributes	Weighting	Team /Individual	Assessment rubrics
1. Final Examination	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	CVE SLOs (2018) a, c, e, g, j	60%	Individual	
2. Continuous Assessment 1 (CA1) : Quiz 1	1, 2, 3, 4,5	CVE SLOs (2018) a, c, e, g, j	20%	Individual	
2. Continuous Assessment 2 (CA2): Quiz 2	4, 5, 6, 7,8	CVE SLOs (2018) a, c, e, g, j	20%	Individual	
Total			100%		

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.

Learning and Teaching approach

Class meets three times per week in lecture (2 hours) and tutorial (1 hour) format.

Approach	How does this approach support students 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.)

Reading and References

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.

Course Policies and Student Responsibilities

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.

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. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
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Planned Weekly Schedule

Week	Topics	Course	Activities

		ILO	
1	Fluid Properties Definitions of fluid properties, Newton's Law of Absolute Viscosity for Newtonian fluids in laminar motion; compressibility of liquid.	1,2	2 lectures and 1 tutorial on fluid properties
2-3	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	3 lectures and 1 tutorials on fluid statics, hydrostatic thrust and buoyancy
4-5	Fluid in motion Describe fluid motion, classification of flow, system and concept of control volume; Continuity, Bernoulli and Equations and applications.	3,4	5 lectures and 2 tutorials on Continuity and Bernoulli Equations
6-7	Momentum Equation and forces on surfaces Quiz – CA 1	3,4	2 lectures and 1 tutorial on momentum equation
7 - 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	4 lectures and 2 tutorials on dimensional analysis and hydraulic modelling
9 – 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	5 lectures 2 tutorials on pipe flow
12	Quiz – CA 2		
12 and 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	3 lectures 1 tutorial on fluid machines, and pumps.