Subject Description Form

Subject Code	CSE29202
Subject Title	Fluid Mechanics
Credit Value	3
Level	2
Exclusion	CSE29207 Introduction to Fluid Mechanics for EESD
Objectives	This subject aims to: (1) familiarize students with the basic principles of fluid mechanics; (2) enable students to acquire basic laboratory techniques of fluid mechanics; and (3) To train students to apply the basic principles to explain fluid mechanics related phenomena and solve practical engineering problems.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Understand the fundamentals of fluid mechanics, i.e., the fluid mechanics background, basic fluid properties, hydrostatics, conservations of mass, momentum and energy, dimensional analysis, and operations of pipe networks and pumps; b. Apply the laws of similitude and identify the important dimensionless parameters in designing fluid flow models to predict the performance of the prototype; c. Apply the basic knowledge of vector algebra and calculus to solve both integral and differential forms of conservation of mass, momentum and energy equations in steady or quasi-steady flow situations; d. Evaluate the correct applications of basic fluid statics and dynamics to different situations critically and independently; e. Apply basic laboratory techniques to study fluid mechanics problems; f. Actively engage in group discussion and group work.
Subject Synopsis/ Indicative Syllabus	1. <u>Fundamental Concepts Relating to Fluids</u> (2 weeks) The nature of the problem, including a brief outline of the history of the subject and some typical engineering problems. Definitions and properties, including density, specific volume, relative density, pressure, compressibility, bulk modulus, surface tension, capillarity, and state, units and dimensions, ideal fluid, viscosity, Newton's equations for viscous shear, real fluid. 2. <u>Fluids at Rest</u> (2 weeks) Hydrostatic pressure distribution. Thrust on surface. Pressure measurement. Elementary treatment of the equilibrium of

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<td>submerged and floating objects, and of liquid in containers subject to acceleration.

3. Flow Visualization and Kinematics (1 week)
Velocity fields. Streamlines, path lines, streak lines. Steady and unsteady flows, laminar and turbulent flows, uniform and non-uniform flows, compressible and incompressible flows, flow motions and kinematics. Basic introduction to CFD and hydraulic modelling.

4. Conservation Principles and Derived Equations (4 weeks)
Control volumes and surfaces. Conservation of mass and equation of continuity. The momentum principle and analysis. Steady flow energy equation. Bernoulli's equation. Jet impact and propulsion, nozzles. Velocity and flow measurement: Pitot tube, current meter, anemometer, venturi meter, orifice meter, notches and weirs.

5. Pipe Flows and Applications (2 weeks)
Pipe friction formulas, head loss and pressure drop. Hydraulic grade line and energy grade line. Pipe flows in branched and looped networks; Sprinkler flows and application area.

6. Dimensional Analysis and Pump Performance (2 weeks)
Geometric, kinematic and dynamic similarity. Dimensional analysis, Buckingham method. Performance of impeller machines. Dimensionless labelling of pumps, matching of pump and pipe systems.

7. Laboratory Work
Hydrostatic force; V-notch; Venturi meter; and Jet impact.</td>
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<td>Teaching/Learning Methodology</td>
<td>(1) Basic principles of fluid mechanics and application procedures will be introduced in lectures;
(2) Tutorials will be conducted mainly in the form of example class and problem-solving session to supplement understanding from lectures;
(3) Laboratory work will help student appreciate the limitations of physical principles and will provide the opportunities for familiarity with basic instruments.</td>
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<td>Assessment Methods in Alignment with Intended Learning Outcomes</td>
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<tr><th rowspan="2">Specific assessment methods/tasks</th><th rowspan="2">% weighting</th><th colspan="6">Intended subject learning outcomes to be assessed (Please tick as appropriate)</th></tr>
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1. Laboratory report	10	✓	✓	✓	✓	✓	✓
2. Mid-term test	20	✓	✓	✓	✓		
3. Final Examination	70	✓	✓	✓	✓		
Total	100 %						

Students must attain at least grade D in both coursework and final examination (whenever applicable) in order to attain a passing grade in the overall result.

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Students are required to submit individual reports for the laboratory experiments, which will test the understanding of basic principles as well as the applications of different laboratory techniques. The mid-term test and examination will assess the competence of students in applying the basic principles to solve practical fluid mechanics problems, examples of which will be discussed in the tutorials.

Students will also be provided with problems to be solved during private study to gauge their level of understanding and problem-solving skills.

Student Study Effort Expected

Class contact:	Average hours per week
▪ Lectures / Tutorials / Laboratories	4 Hrs.
Other student study effort:	
▪ Reading and study	3 Hrs.
▪ Assignments and laboratory reports	3 Hrs.
Total student study effort	10 Hrs.

Reading List and References

(1) "Fluid Mechanic: Fundamentals and Applications", 4th Edition in SI Unit System, 2017 – Cengel, Y.A. and Cimbala, J.M., McGraw Hill.
(2) "Fire Service Hydraulics and Pump Operations", 2012 – Spurgeon, P.: PennWell Corporation.
(3) "Mechanics of Fluids", 5th Edition, 2016 – Potter M.C., Wiggert D.C., and Ramadan B.H., Cengage Learning.
(4) "Fluid boundaries", Video Materials, 2014 – Mun, J.H., Haryanto, D.R., and Todorovic, V. South Korea: CinemaDAL
(5) "Advanced Engineering Mathematics", 10th Edition, 2010 – Kreyszig E., John Wylie & Sons, Inc., NJ