School of Professional Education and Executive Development

Subject Description Form

Subject Code	SEHS3304
Subject Title	Fluid Mechanics
Credit Value	3
Level	3
Medium of Instruction	English
Pre-requisite/ Co-requisite/ Exclusion	Nil
Prior Knowledge	Fundamental knowledge of engineering mathematics. *(The above is not a pre-requisite for taking the subject but is for students' reference of the scope of basic knowledge required. It is the responsibility of students to ensure their fulfilment of the prior-knowledge required for the subject.)*
Objectives	The subject aims to equip students with the fundamental knowledges and concepts of fluid mechanics and fluid flow related applications in mechanical engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) solve fluid flow problems by applying knowledge of fluid mechanics and mathematics; (b) search for updated relevant technology of fluid mechanics in related to fluid systems; (c) apply fluid mechanics knowledge to analyse the performance of fluid machinery (d) analyze data obtained from experiments in fluid mechanics.
Subject Synopsis/ Indicative Syllabus	**Basic Concepts** Define fluid and its important properties; Viscosity and shear stress; Newton's Law of viscosity; Newtonian and non-Newtonian fluids; Compressibility; Incompressible and compressible fluids. **Fluid Statics** Fluid pressure; Pascal's law and pressure-height relation; Forces on submerged surfaces and buoyancy; Manometers; Stability of unconstrained body in fluid. **General Description & Equations of Motion of Fluid Flow**

	Flow: steady and unsteady, uniform and non-uniform, laminar and turbulent; Streamline; Continuity, Euler's, Bernoulli's and Momentum Equations; Force on stationary/moving object caused by a fluid jet; Navier-Stokes equations and energy equation. **Dimensional Analysis** Principle of dimensional analysis; Fundamental dimensions; Buckingham's π theorem; Dimensionless groups and their physical significance; Similarity and model testing. **Internal Flow** Fully developed flow and entrance length in a pipe; Darcy's law; Moody chart; Primary (frictional) and minor losses in pipe system; Design for pipes in parallel and in series. **External Flow** Viscosity and viscous stress; Laminar and turbulent boundary layers over a flat plate; Effects of adverse pressure gradient and flow separation; Velocity profiles and characteristics of flow over bluff body and streamline body; Lift, friction and profile drag; Boundary layer theory; Boundary layer thicknesses; Laminar boundary layer profiles; Skin friction coefficient; Turbulent boundary layer profiles, power law and laws of walls. **Flow Measurement** Introduction to Flow measurement techniques; Orifice, Venturi meter, and Pitot Tube; Rotameters and turbine flow meters; Calibration and accuracy in flow measurement. **Fluid Machinery** Construction and working principles of pumps, turbines, fans and blowers; Selection of centrifugal pumps for pipe flow systems; Characteristics of pumps in series/parallel; Velocity triangles through impeller and Euler head gained.
Teaching/Learning Methodology	Lectures aim to deliver the fundamental knowledge and theories in fluid mechanics, covering topics such as the definitions of fluid properties, fluid statics, equations of fluid flow, and dimensional analysis. Tutorials are deployed to engage students in problem-solving activities related to fluid mechanics, reinforcing concepts learned in lectures and to illustrate the application of the fundamental knowledge to practical engineering situations in fluid mechanics. Laboratory sessions are arranged to relate the theoretical knowledge to practical scenarios in laboratory settings. By conducting experiments related to flow measurement, drag and lift forces, and pump performance, students gain hands-on experience, develop

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<tr><td></td><td>critical thinking skills, and deepen their understanding of fluid mechanics principles through observation and analysis.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>A variety of assessment tools will be used to develop and assess students' achievement of the subject intended learning outcomes.

<table>
<tr><td rowspan="2">Specific assessment methods/ tasks</td><td rowspan="2">% weighting</td><td colspan="4">Intended subject learning outcomes to be assessed</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td></tr>
<tr><td>Continuous Assessment</td><td>50</td><td colspan="4"></td></tr>
<tr><td>▪ Individual Assignment 1</td><td>10</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>▪ Individual Assignment 2</td><td>10</td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>▪ Group Project</td><td>10</td><td></td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>▪ Test</td><td>20</td><td>✓</td><td></td><td>✓</td><td></td></tr>
<tr><td>Examination</td><td>50</td><td>✓</td><td></td><td>✓</td><td></td></tr>
<tr><td>Total</td><td>100</td><td colspan="4"></td></tr>
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To pass this subject, students are required to obtain Grade D or above in <u>both</u> the Continuous Assessment and Examination.

Individual assignment 1 requires students to delve into topics such as internal and external flow, centrifugal pumps, flow measurement, and drag and lift forces. By completing assignment, students showcase their capacity to apply theoretical knowledge to practical problems, analyze complex fluid dynamics scenarios, and demonstrate proficiency in key subject areas related to fluid mechanics.

Individual assignment 2 requires students to apply the fluid mechanics knowledge to evaluate and explain the performance of fluid machinery used in fluid systems.

Group project with laboratory work is aimed at assessing students' abilities to carry out experiments systematically, collect, interpret and analyze data to make meaningful conclusions. It engages students in collaborative discussions focused on topics including flow measurement, drag and lift forces, and pump characteristics.

Test is aimed at assessing students' comprehension of fundamental concepts such as fluid properties, fluid statics, equations of fluid flow, and dimensional analysis.

Examination is adopted to assess students on their overall ability to formulate and solve fluid flow problems by applying related fluid dynamics concepts and mathematics.</td></tr>
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<tr><td rowspan="6">Student Study Effort Expected</td><td>Class contact</td><td>Hours</td></tr>
<tr><td>▪ Lecture</td><td>26</td></tr>
<tr><td>▪ Tutorial</td><td>13</td></tr>
<tr><td>▪ Laboratory</td><td>6</td></tr>
<tr><td>Other student study effort</td><td></td></tr>
<tr><td>• Self-study</td><td>85</td></tr>
<tr><td>Total student study effort</td><td>130</td></tr>
<tr><td>Reading List and References</td><td colspan="2">Recommended Textbook

White, F. M. (2021). Fluid mechanics (9th ed.). McGraw-Hill Education.

Zierep, J., & Bühler, K. (2022). Principles of fluid mechanics: Fundamentals, statics and dynamics of fluids. Springer.

References

Durst, F. (2022). Fluid mechanics: An introduction to the theory of fluid flows (2nd ed.). Springer.

Uddin, N. (2023). Fluid mechanics: A problem-solving approach (1st ed.). CRC Press.

Journals

Journal of Mathematical Fluid Mechanics

Journal of Fluid Mechanics

Journal of Fluids and Structures

Physics of Fluids

The Reading List and References are indicative. Relevant reading materials will be suggested and assigned from time-to-time when they are deemed appropriate.</td></tr>
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