Subject Description Form

Subject Code	ME34004
Subject Title	Fluid Mechanics
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: AMA2112 Mathematics II
Objectives	1. To teach fundamental concepts and knowledge of fluid mechanics. 2. To provide fundamental concepts and knowledge of inviscid and viscous flows, low-Reynolds number and high-Reynolds number flows, incompressible and compressible flows, and their applications in mechanical engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Formulate and solve flow problems by applying knowledge of fluid mechanics and mathematics. b. Analyze and interpret data obtained from experiments in fluid mechanics. c. Search for updated technology in fluid mechanics in completing assignments related to fluid systems. d. Communicate effectively in completing written reports of laboratory work and assigned tasks.
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; introduction to shock waves. ***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, incompressible and compressible, laminar and turbulent; subsonic and supersonic; shock waves; streamline; Continuity, Euler's, Bernoulli's and Momentum Equations; Pitot and Pitot-static tubes, venture-meter and orifice; force on stationary/moving object caused by a fluid jet. ***Dimensional Analysis -*** Principle of dimensional analysis; fundamental dimensions; Buckingham's π theorem; dimensionless groups and their physical significance; similarity and model testing. ***Conservation Equations -*** Navier-Stokes equations and Energy equation; exact solutions on solving N-S equations applied to fluid systems: Couette flow and Poiseuille flow; introduction on solving N-S equations by CFD software and numerical simulation models. ***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. **Laboratory Experiment** There are two 2-hour laboratory sessions and the typical Experiments are: 1. Compressible flow nozzle 2. Potential Flow Visualization (Hele-Shaw Experiment) 3. Wind Tunnel Testing of Cylinder and aerofoil 4. Universal velocity Profile 5. Boundary Layer Experiment
Teaching/Learning Methodology	Lectures aim to deliver the fundamental knowledge in relation to fluid mechanics (Outcome a). Tutorials are deployed to illustrate the application of fundamental knowledge to practical situations (Outcomes a and c). Experiments are arranged to relate the concepts to practical applications and students are exposed to hand-on experience, proper use of equipment and application of analytical skills on interpreting experimental results (Outcomes b, c and d). Assignments are arranged to provide opportunity for students to search information, to analyze fluid systems with knowledge obtained, and to present the completed tasks (Outcomes a, c and d).

Teaching/Learning Methodology	**Learning Outcomes**			
	a	**b**	**c**	**d**
Lectures	√			
Tutorials	√		√	
Laboratory Work		√	√	√
Assignments	√		√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/ tasks	% weighting	Intended subject learning outcomes to be assessed			
		a	b	c	d
1. Examination	50%	√	√		
2. Assignments/ Laboratory Reports	30%	√	√	√	√
3. Test	20%	√	√		
Total	100%				

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

Overall Assessment:
$0.50 \times$ End of Subject Examination + $0.50 \times$ Continuous Assessment

Examination is adopted to assess students on the overall understanding and the ability of applying the concepts. It is supplemented by the tests, assignments (including analyses of fluid systems and problem-solving) and laboratory reports which provide timely feedbacks to both lecturers and students on various topics of the syllabus.

Student Study Effort Expected

Class contact:	
• Lecture	33 Hrs.
• Tutorial / Laboratory	6 Hrs.
Other student study effort:	
• Assignments	38 Hrs.
• Laboratory Reports	10 Hrs.
• Self-study and information search	30 Hrs.
Total student study effort	**117 Hrs.**

Reading List and References

1. Y.A. Cengel J.M. Cimbala, Fluid Mechanics (Fundamentals and Applications), McGraw-Hill, latest edition.
2. F.M. White, Fluid Mechanics, McGraw-Hill, latest edition.
3. J.F. Douglas, J.M. Gasiorek and J.A. Swaffield, Fluid Mechanics, Pearson, latest edition
4. M.C. Potter, and D.C. Wiggert, Mechanics of Fluids, Prentice-Hall, latest edition.

September 2017