Subject Description Form

Subject Code	ME44007
Subject Title	Fluids Engineering
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: ME34004 Fluid Mechanics
Objectives	This subject provides students with knowledge to: 1. Apply principle of rotodynamic machinery to centrifugal pump design. 2. Select centrifugal pump system to aid operation of pipe flow system. 3. Understand major parameters of axial-flow fan design and their effects on fan characteristics. 4. Understand the phenomena of crossflow around cylinder(s) and their applications to flow-induced vibration.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Apply fluid mechanics/dynamics and mathematics to centrifugal/axial-flow pump/fan selection and design. b. Acquire skills and hands-on experience to assess the performance of centrifugal/axial-flow pump/fan at different operation conditions. c. Apply fluid mechanics/dynamics and mathematics to analyze the vibration caused by crossflow around cylinder. d. Conduct a pump/fan design project and produce a design report. e. Search for suitable information related to pump/fan design, and methods to control flow-induced vibration.
Subject Synopsis/ Indicative Syllabus	***Rotodynamic Machinery*** – Construction and characteristics of rotodynamic machinery: pump/fan and turbine, centrifugal pump/fan, axial-flow fan/turbine; application of Euler’s equation and Bernoulli’s equation. ***Centrifugal Pump*** – Velocity triangles through impeller and volute; losses and efficiency; Net Positive Suction Head (NPSH); impeller design: blade angle and number of blades; problem of cavitation; revision of pipe-flow system; selection of centrifugal pump for pipe flow system; characteristics of pumps in series/parallel; effects of pump speed; Similarity Laws and specific speed. ***Axial-flow Fan*** – Velocity triangles through impeller blade and stationary vane; static pressure and efficiency vs volume discharged; aero-foil lift/drag coefficients and angle of attack; hub/tip ratio; number and solidity of blades (pitch/chord ratio); relation of lift coefficient with blade solidity and flow deflection angle; effects of blade speed; aero-foil blades with losses. ***Crossflow around Cylinder(s)*** – Velocity distribution; effect of Reynolds numbers; flow separations; laminar and turbulent vortex street; vortex shedding; lift and drag; pressure distribution and coefficients; mean and fluctuating forces; effects of freestream turbulence, surface roughness and compressibility of the fluid on flow

	field; Prandtl's mixing length model; flow-induced vibration; multi-cylinders system. control of vortex induced vibration. **Laboratory Work:** There are 2 two-hour laboratory sessions: Typical experiments are: 1. Selection of centrifugal pump for a pipe-flow system. 2. Performance of axial-flow fan at different blade designs. 3. Vortex generation for a crossflow at different Reynolds numbers around a cylinder.
Teaching/Learning Methodology	Lectures are used to deliver the fundamental knowledge in relation to centrifugal/ axial-flow pump/fan, and crossflow around cylinder(s) (outcomes a and c). Tutorials are used to illustrate the application of fundamental knowledge to practical situations (outcomes a, b and c). Design project/case study are used to allow students to develop and enhance their knowledge and skills in design/analysis of centrifugal/axial-flow pump/fan and floe-induced vibration problem (outcomes a, b, c, d and e). Experimental works are used to relate the concepts to practical applications and students are guided to obtain hand-on experience, proper use of equipment and application of analytical skills on interpreting experimental results (outcomes b and e).

Teaching/Learning Methodology	**Learning Outcomes**				
	a	**b**	**c**	**d**	**e**
Lectures	√		√		
Tutorials	√	√	√		
Design Project / Case Study	√	√	√	√	√
Experimental Work		√			√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	**% weighting**	**Intended subject learning outcomes to be assessed**				
		a	**b**	**c**	**d**	**e**
1. Examination	50 %	√		√		
2. Test	20 %	√	√	√		
3. Design Project and Report	14 %	√	√		√	√
4. Case Study	8 %			√		√
5. Laboratory Work and Reports	8 %		√	√		√
Total	100 %					

	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: Overall Assessment: 0.5 × End of Subject Examination + 0.5 × Continuous Assessment Examination is adopted to assess students on the overall understanding and the ability of applying the concepts. It is supplemented by the test, design project, case study and laboratory work which provide timely feedbacks to both lecturers and students on various topics of the syllabus. Written reports on design project, case study and laboratory work are used to assess the students' knowledge on these topics and ability on report writing.	
On Student Study Effort Expected	**Class contact:**	
	• Lectures	33 Hrs.
	• Laboratory Work/Tutorials	6 Hrs.
	Other student study effort:	
	• Assignments: Design Project and Report, Case-study and Report, Laboratory Work and Reports	48 Hrs.
	• Self-study and Literature Search	30 Hrs.
	Total student study effort	**117 Hrs.**
Reading List and References	1. Darby, R., Chemical Engineering Fluid Mechanics, Marcel Dekker Inc., latest edition. 2. Zdravkovich, M.M., Flow around Circular Cylinders, Oxford University Press, latest edition. 3. Shaw, C.T., Using Computational Fluid Dynamics, Prentice Hall, latest edition. 4. Wallis, R.A., Axial Flow Fans and Ducts, John-Wiley, latest edition. 5. Osborne, W.C., Fans, Pergamon, latest edition.	

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