TO: The Engineering Faculty

FROM: The Faculty of the School of Mechanical Engineering

RE: New Course - ME 30801 Fluid Mechanics Laboratory

The Faculty of the School of Mechanical Engineering has approved the following new course. The format of the ME 30900 Fluid Mechanics lecture and lab course was altered from a total of 4 credits, including 3 credits of lecture and 1 credit of laboratory, to 3 credits of lecture only, with the 1 credit of laboratory assigned to this new dedicated laboratory course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ME 30801 Fluid Mechanics Laboratory, Sem. 1, 2, Lab 1, cr. 1. Prerequisites: Prerequisites: ME 30800 or equivalents.

Physical experiments in fluid mechanics. Application of fluid mechanics theory and fundamental concepts to measuring and analyzing fluid systems and flows. A laboratory design project on a flow system reinforces the design process.

Reason: This course is the lab component of an already established ME 30900 Fluid Mechanics (4 cr) course, which is now being split into an ME 30800 (3 cr) Fluid Mechanics lecture course, and the material covered in this new ME 30801 (1 cr) Fluid Mechanical Laboratory. The content of both of these courses remains unchanged. The splitting of the lab from the lecture will enable better enrollment load balancing in the existing ME undergraduate laboratory facilities. Details of this new laboratory are outlined in the appended material below.

James D. Jones

James D. Jones, Associate Professor and Associate Head
School of Mechanical Engineering

ME 30801
FLUID MECHANICS LABORATORY

Course Outcomes [Related ME Program Outcomes in brackets]

1. Conduct *simple experiments* and analyze data. [1,3,5,6]
2. Enhance *systematic problem-solving skills* and sharpen *written-communication* skills through short technical laboratory reports. [1,3,5]
3. Complete a design project on a flow system. [2, 3, 7]

Flow Visualization

1. Streaklines, pathlines.
2. Laminar, transitional, turbulent flow.
3. Particle-image velocimetry.

External Flow

1. Lift and drag on objects in flow.
2. Bernoulli's principle and pressure variation.
3. Boundary layers on solid surfaces.
4. Compressible flow and shock waves.

Internal Flow

1. Viscous and frictional effects.
2. Hydraulic systems: pipes, head losses, pumps.

Representative Laboratory Experiments

Core laboratory experiments:
1. Flow visualization: flow past cylinder and airfoil
2. Bernoulli's principle: dynamic pressure along streamline
3. Momentum study: drag force on a sphere
4. Dynamic similarity: drag coefficient of a sphere
5. Boundary layer study: velocity profile over a flat plate
6. Pipe friction study
7. Compressible flow: pressure along a CD nozzle

Additional experiments variations and capabilities:
8. PIV measurement of wake behind a cylinder
9. Airfoil lift coefficient study
10. Pump efficiency study
11. Velocity profile in a pipe: laminar vs turbulent
12. Reynolds experiment: flow transitioning in a pipe
13. Visualization of normal and oblique shocks using Schlieren

COURSE NUMBER: ME 30801

COURSE TITLE: Fluid Mechanics Laboratory (1 credit)

REQUIRED COURSE OR ELECTIVE COURSE: Required

TERMS OFFERED: Fall and Spring

TEXTBOOK/REQUIRED MATERIAL:
None. Handouts provided by the instructors.

PRE-REQUISITIES:
ME 30800 – Fluid Mechanics

COORDINATING FACULTY: P. Vlachos & C. Wassgren

COURSE DESCRIPTION: Physical experiments in fluid mechanics. Application of fluid mechanics theory and fundamental concepts to measuring and analyzing fluid systems and flows. A laboratory design project on a flow system reinforces the design process.

COURSE OUTCOMES [Related ME Program Outcomes in brackets]:

1. Conduct *simple experiments* and analyze data. [1,3,5,6]
2. Enhance *systematic problem-solving skills* and sharpen *written-communication* skills through short technical laboratory reports. [1,3,5]
3. Complete a design projects on a flow system. [2, 3, 7]

ASSESSMENTS TOOLS:

- Laboratory reports.
- Project reports.
- Pre-lab quizzes.

NATURE OF DESIGN CONTENT: The students participate in a design project lab, in which a fluid flow system is designed to achieve a performance goal.

RELATED ME PROGRAM OUTCOMES:
1. Engineering fundamentals
2. Engineering design
3. Communication skills
5. Teamwork skills
6. Experimental skills
7. Knowledge acquisition

PROFESSIONAL COMPONENT:

1. Engineering Topics: Engineering Science – 90%
   Engineering Design – 10%

COMPUTER USAGE: Knowledge of word processing, spreadsheet software, and basic programming (for example, MATLAB) are necessary for laboratory report preparation and homework assignments.

COURSE STRUCTURE/SCHEDULE:

a. Laboratory Prep – 1 day per week at 50 minutes

b. Laboratory – 1 day per week at 100 minutes

PREPARED BY: I. Christov, P. Vlachos & C. Wassgren

REVISION DATE: January 28, 2020