ME-342

# Introduction to turbomachinery

Yim Eunok

| Cursus | Sem. | Type |
|---|---|---|
| Mechanical engineering minor | E | Opt. |
| Mechanical engineering | BA6 | Opt. |

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| Language of teaching | English |
| Credits | 2 |
| Session | Summer |
| Semester | Spring |
| Exam | Written |
| Workload | 60h |
| Weeks | 14 |
| **Hours** | **2 weekly** |
| Courses | 2 weekly |
| **Number of positions** | |


## Summary

This course covers fluid mechanics and turbomachinery. Students learn key equations, energy losses in pipe flow and thrust generation. You will explore turbomachine principles, including turbines, pumps, blade design, and scaling. This foundation prepares them for advanced engineering applications.


## Content

This course provides a comprehensive introduction to fluid mechanics and turbomachinery, beginning with fundamental principles before progressing to more specialized topics.
Students will first learn the essential equations governing fluid flow, including the conservation of mass, energy, and momentum. They will explore flow characteristics in pipes, the differences between laminar and turbulent flow, and how to calculate energy losses in both straight pipes and complex piping systems. The course also covers vortex phenomena and thrust generation in certain types of turbomachinery, laying the groundwork for understanding fluid motion and its effects.
Building on these foundations, students will then be introduced to the basic principles of turbomachines. They will learn how and why turbomachines work, the differences between turbines and pumps, and the importance of minimizing energy losses. The course will also cover blade design, the selection of appropriate turbomachines for specific applications, and the fundamentals of scaling machines from prototypes to various sizes.
By the end of the course, students will have the necessary knowledge to analyze fluid flow in engineering systems and advance to more specialized work in turbomachinery design, development, and research.

## Keywords

Energy equation, energy conversion, internal flow, turbomachine axial-, mixed-, and radial-flow velocity triangle, angular momentum, shaft torque, Euler turbomachine equation, shaft power, centrifugal pump, pump performance curve, overall efficiency, system equation, head-rise coefficient, power coefficient,  flow coefficient, pump scaling laws, specific speed, impulse turbine, reaction turbine, pelton wheel

## Learning Prerequisites

### Required courses

Fluid mechanics (for GM)

## Learning Outcomes

By the end of the course, the student must be able to:

- Explain how and why a turbomachine works
- Explain the basic differences between a turbine and a pump

- Recognize the importance of minimizing loss in a turbomachine
- Analyze turbomachine blades shape
- Solve basic energy equations for turbomachinery applications
- Design class of turbomachines for a particular application
- Derive thrust of a blade
- Apply energy equations to a complete system

## Transversal skills

- Demonstrate the capacity for critical thinking

## Teaching methods

Lectures with slides and exercises

## Assessment methods

Written exam at the end of the semester

## Resources

### Bibliography

Gerhart, Gerhart & Hochstein, Munson's Fluid Mechanics, Global Edition, 8th Edition
Elgar, LeBret, Crowe & Roberson, Engineering Fluids Mechanics, 12th Edition

### Moodle Link

- https://go.epfl.ch/ME-342