**Department of Mathematics**

# Course Profile

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| **Course Number:** **MATH 451** | **Course Title: Mathematical Theory of Fluids** |
| **Required / Elective:** Required | **Prerequisites:** None |
| Catalog Description: Definitions, Kinematics of fluids, velocity and acceleration vectors, material derivative, path and stream lines, vorticity. Equations of motion, stress, constitutive relations. Hydrostatics, ideal fluids, Bernoulli theorems, incompressible ideal fluids, potential flows, vortex flows, surface waves, viscous fluids, Stokes approach, boundary layer theory. | **Textbook / Required Material:** Fluid Mechanics, Third Edition, Pijush K. Kunda and Ira M. Cohen**,** Elsevier Academic Press, 2004 USA. |
| **Course Structure / Schedule: (3+0+0) 3 / 7 ECTS** | |
| **Extended Description:** Definitions and classification of fluids, mathematical preliminaries, vectors and tensors, gradient of scalers and vectors Curvilinear coordinates, cylindrical and spherical coordinates, integral theorems, Green- Gauss theorems, Stokes theorems Kinematics of fluids:motion, material derivative, velocity and acceleration vectors, path and flow lines, velocity field around a point: deformation rate and vorticity tensors Transport theorems,jump conditions,Balance laws: conservation of mass, balance of linear and angular momenta, balance of energy,stress at a point, stress tensor Moving coordinate systems, circulation, Constitutive equations, Helmholtz resolution theorem, Ideal fluids,Viscous fluids, Equations of ideal fluids in various coordinate systems Bernoulli's theorems, Incompressible ieal fluids,Flows in two dimension, Axially symmetric flows Potential flows Sphere in rectilinear motion, Plane potential lows Uniform plane flows, source and sink problems The use of complex functions in solving plane flow problems Blausius theorems, Blausius theorems for a cylinder in motion, Theorem for a circular disc Conform mapping and its applications to plane flow | |
| **Design content:** None | **Computer usage:** No particular computer usage required |

**Course Outcomes:** By the end of the course the students should be able to:

1. characterize the behaviour of a fluid body by a mathematical expression(mathematical modelling) **[2,3,6],**
2. understand the physical characterization of various differential equations **[3,4],**
3. characterize some phenomenon existing in the nature by some mathematical formulas and interpret the resulting solution **[2,3,6],**
4. understand the origin of some phenomenon like sound and its propagation as a wave **[2,3,4,6].**

**[2] demonstrate knowledge of mathematics and mechanics to construct, analyze and interpret real world problems,**

**[3] demonstrate the ability to apply mathematics to the solutions of problems,**

**[4] have a basic knowledge of mechanics, information sciences and social sciences,**

**[6] have a basic knowledge of the main fields of mathematics and mechanics, including differential equations, elasticity theory, fluid mechanics,**

**Recommended reading:** Any fluid mechanics textbook.

**Teaching methods:** Lectures, homework and office hours discussions.

**Assessment methods:** Midterm and final exams.

**Student workload:**

Pre-reading .................................................35 hrs

Lectures ……………………………………45 hrs

Preparatory reading ………………….. 40 hrs

Literature review for presentation………… 35 hrs

Team work for presentation ………………20 hrs

**TOTAL ……………………………… 175 hrs …… to match 25x7 ECTS**

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