COURSE ID SHEET

Course No.	5098	NTUA

Semester:	4	Core	X	Elective		Specialization	

Title: **TRANSPORT PHENOMENA I: FLUID MECHANICS**

Aim:

Physical and mathematical investigation of the flow phenomena leading to theoretical prediction and experimental verification. The basic objective is the documented, safe and direct technical implementation.
The purpose of an optional computational laboratory is to familiarize students with 1) the approximate solution of flow problems that cannot be solved by analytical mathematics and 2) the graphical representation of the flow.

Content:

- **Introduction**. The concept of fluid from a technical point of view. Continuum hypothesis. Physical properties of fluids. Type of flows. System and control volume concepts. Fundamental laws of fluid mechanics. Basic methods of fluid flow analysis.
- **Fluid Kinematics**. Material and spatial coordinates. Methods for describing flow fields. Flow rates. Flow field representation – path lines, streamlines.
- **Forces and Deformation of Fluids**. Origin and form of fluid forces. Body forces. Surface forces. Stress dyadic. Origin of viscous stress. Forces in fluids at rest. Hydrostatics. Pressure measuring instruments. Deformation of fluids. Rate of strain dyadic.
- **Newtonian Fluids**. The concept of material (constitutive) equation. Newton's law of viscosity.
- **Macroscopic Flow Analysis**. Transport Theorem. Macroscopic continuity equation. Macroscopic momentum equation. Macroscopic energy equation. Equation of mechanical energy.
- **Differential Flow Analysis**. Differences between macroscopic and differential flow equations. Differential equation of continuity. Differential momentum equation. Differential equation of mechanical energy.
- **Boundary Layer Flow**. The concept of the boundary layer. Macroscopic analysis of boundary layer. Laminar boundary layer. Turbulent boundary layer. Drag force.
- **Dimensional Analysis and Similarity**. Basics of dimensional analysis. The Π-theorem. Determination of dimensionless groups. Basic principles of similitude.

Hours per semester

LECTURE	52	EXERCISES	-	LABORA-TORY	8	HOME-WORK	35	**TOTAL HOURS: 95**

Student performance /evaluation:

The grade is that of the final (written) examination. The participation of the students in the optional Computational Laboratory includes their brief training in a computational code, problem solving, delivery of corresponding technical reports and individual examination in the School's PC-lab. The grade of the laboratory contributes (positively) to the final grade by 30%; in that case the final exam grade contributes by 70% to the course grade.