COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Naval Architecture		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	NAOME1222	**SEMESTER**	4th
COURSE TITLE	**VISCOUS FLOWS - FLUID MACHINERY**		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS (ECTS)**
Lectures		4	5
COURSE TYPE *general background, specialbackground, specialized general knowledge, skills development*	Special background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/NA212/		

(2) COURSE GOALS / LEARNING OUTCOMES

The aim of the course is to educate the student in order to be able to understand and solve problems of fluid mechanics in incompressible and compressible viscous flows. Apart from the basic principles, topics of applied fluid mechanics are included, focusing on duct flows, hydraulic networks and fluid dynamic machines. After the completion of the course, the student will be able to:

- Be aware of basic viscous flow phenomena.
- Calculate flow rates and losses and design / size hydraulic networks.
- Be aware of the various fluid machines and their principle of operation.
- Select the appropriate pump for a hydraulic network.

(3) COURSE CONTENT / SYLLABUS

Lectures:

- Fluid viscosity. Navier-Stokes equations. Analytical flow solutions in simple geometries. Effect of viscous terms. Measurement of fluid mechanical quantities pressure, velocity, flow rate, viscosity coefficient). Dimensional analysis. Rayleigh and Buckingham method. Similitude theory (geometrical, kinematic and dynamic similarity). Reynolds, Froude, Weber and Euler numbers. Prototype testing.
- Boundary layer, calculation of boundary layer thickness, flow separation, flow around bodies, drag. Laminar and turbulent flow. Turbulent boundary layer. Incompressible flow in a duct, laminar and turbulent, flow losses, Moody diagram, secondary losses, hydraulic networks and their calculation.

- Fluid dynamic machines, classification, (hydrodynamic machines, thermal turbomachines). Euler theorem operation, velocity triangles. Centrifugal pumps, specific speed, pumps in serial and in parallel configurations, diagrams. Characteristic curve of a hydraulic network, location of operation point. Reference to hydraulic turbines. Cavitation phenomenon.
- Elements of compressible flow, sound velocity, Mach number, isentropic flow, stagnation state, compressibility phenomena. Compressors, turbines, classification, isentropic and polytropic efficiency, aerothermodynamic one-dimensional analysis of thermal turbomachines.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Support learning through the electronic e-class platform.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non- directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Workload (hours)</th></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Homework assignments</td><td>26</td></tr>
<tr><td>Individual study</td><td>52</td></tr>
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<tr><td>Course total</td><td>130</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</td><td>Evaluation:
Written examination (100%).
Alternatively, percentage of the final mark could be obtained by means of an assignment or a project presentation.</td></tr>
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(5) ATTACHED BIBLIOGRAPHY

1. Munson, Okooshi, Huensch, Rothmayer, Fundamentals of Fluid Mechanics, 7th edition, Wiley, 2012.
2. White, F.M., “Fluid Mechanics”, 5th edition, McGraw – Hill, 2003.
3. Pritchard P.J., Fox and McDonald’s Introduction to Fluid Mechanics, 8th edition, Wiley, 2011.
4. Karassik, I., Messina, J., Cooper P., Heald C., 2008, “Pump Handbook”, 4th edition.