**COURSE OUTLINE**

## (1) GENERAL

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|---|---|---|---|
| **SCHOOL** | School of Engineering | | |
| **DEPARTMENT** | Financial and Management Engineering | | |
| **ACADEMIC UNIT** | Chios | | |
| **LEVEL OF STUDIES** | Undergraduate | | |
| **COURSE CODE** | **ΓΕ 0148** | **SEMESTER** | 4 |
| **COURSE TITLE** | **Transport Phenomena** | | |

| **INDEPENDENT TEACHING ACTIVITIES** *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits* | **WEEKLY TEACHING HOURS** | **CREDITS** |
|---|---|---|
| | 3 | 4.5 |
| | | |
| | | |
| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).* | | |

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|---|---|
| **COURSE TYPE** *general background, special background, specialised general knowledge, skills development* | *Special Background* |
| **PREREQUISITE COURSES:** | -------- |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | Greek |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | ---------- |
| **COURSE WEBSITE (URL)** | http://www.fme.aegean.gr/en/c/transport-phenomena-fluids-heat |

## (2) LEARNING OUTCOMES

**Learning outcomes**

*The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.*

*Consult Appendix A*

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*

- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of the course students should be capable to:

- Know what various quantities mean and be able to determine the properties of a fluid (density, viscosity, compressivity, etc)
- Understand the meaning of pressure and more specifically the pressure of a gas and hydrostatic pressure.
- Be able to use the ideal gas law.
- Be able to solve problems of fluids in equilibrium, eg. Calculate pressure and forces acting on the walls of the container.
- Apply Bernoulli equation in the motion of ideal fluids.
- Know Reynolds' theorem for the study of mass, momentum and energy transport and be able to apply it in open systems.
- Be able to identify laminar and turbulent flow.
- Be able to calculate flows in closed pipes and flow differences because of major (primary) and minor (secondary) losses.

**General Competences**

*Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

| | |
|---|---|
| *Adapting to new situations* | *Respect for difference and multiculturalism* |
| *Decision-making* | *Respect for the natural environment* |
| *Working independently* | *Showing social, professional and ethical* |
| *Team work* | *responsibility and sensitivity to gender* |
| *Working in an international* | *issues* |
| *environment* | *Criticism and self-criticism* |
| *Working in an interdisciplinary* | *Production of free, creative and inductive* |
| *environment* | *thinking* |
| *Production of new research ideas* | |

- *Working independently*

**(3) SYLLABUS**

Some Characteristics of Fluids, Analysis of Fluid Behavior, Measures of Fluid Mass and Weight, Density, Specific Weight, Specific Gravity, Ideal Gas Law, Viscosity, Compressibility of Fluids, Compression and Expansion of Gases, Vapor Pressure, Surface Tension, Viscosity. - Pressure at a Point, Pressure Variation in a Fluid at Rest, Incompressible Fluid, Standard Atmosphere, Measurement of Pressure. - Flotation, Archimedes' Principle, Basic equations of Fluid Statics, Rigid body motion of a fluid,

Forces exerted by fluids on a surface.-Newton's Second Law along and normal to a Streamline; Static, Stagnation, Dynamic, and Total Pressurε; Examples of Use of the Bernoulli Equation, Confined Flows, Flowrate Measurement, Restrictions on Use of the Bernoulli Equation.-The Velocity Field, Eulerian and Lagrangian Flow Descriptions, The Acceleration Field, The Material Derivative, Convective Effects, Control Volume and System, The Reynolds Transport Theorem.-Conservation of Mass—The Continuity Equation, Derivation of the Continuity Equation, Fixed Nondeforming Control Volume, Newton's Second Law—The Linear Momentum Equation, Derivation of the Linear Momentum Equation, Application of the Linear Momentum Equation, First Law of Thermodynamics—The Energy Equation, Derivation of the Energy Equation, Comparison of the Energy Equation with the Bernoulli Equation.- **(Additional optional material – two additional lectures)** Irrotational Flow, Some Basic, Plane Potential Flows, Uniform Flow, Source and Sink, Vortex, Flow around a Circular Cylinder, Viscous Flow, Stress-Deformation Relationships, The Navier–Stokes Equations, Some Simple Solutions for Viscous Incompressible Fluids, Steady, Laminar Flow between Fixed Parallel Plates, Couette Flow, Steady, Laminar Flow in Circular Tubes

**TEACHING and LEARNING METHODS - EVALUATION**

<table>
<tr><td>DELIVERY<br>Face-to-face, Distance learning, etc.</td><td>Face-to-face or via distant learning because of covid-19</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY<br>Use of ICT in teaching, laboratory education, communication with students</td><td>Classweb, zoom</td></tr>
<tr><td>TEACHING METHODS<br>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.<br><br>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>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>3.5</td></tr>
<tr><td>mid and final Exams</td><td>1.0</td></tr>
<tr><td>Course total</td><td>4.5</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION<br>Description of the evaluation procedure<br><br>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>One final written exam (or via internet) or 2 midterm exams</td></tr>
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| *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.* | |

**(4) ATTACHED BIBLIOGRAPHY**

*- Suggested bibliography:*

**A) Principal Reference:**

- Fluid Mechanics, Munson - Okooshi - Huensch – Rothmayer, 8η Έκδοση /2016**,** ISBN: 978-960-418-525-2 (in Greek Translation)
- Applied Fluid Engineering, Horst Herr, 2010, 1η εκδοση, 2010. (in Greek translation)

**B) Additional Reference:**

- Fluid Mechanics, Antonios Liakopoulos, 1st edition, 2010 (in Greek)
- Fluid Mechanics, Streeter/Wylie/Bedford Edition 576/2009, (in Greek translation)
- Engineering Fluid Mechanics, C.T. Crowe, D.F. Elger, B.C. Williams, J.A. Roberson, 9th edition, 2009 John Wiley and Sons