Fluid mechanics and partial differential equations

Academic Year: (2019 / 2020) **Review date: 22-04-2018**

Department assigned to the subject: Department of Physics

Coordinating teacher:

Type: Electives ECTS Credits : 3.0

Year : 2 Semester :

STUDENTS ARE EXPECTED TO HAVE COMPLETED

Basic knowledge of mechanics (graduate level) and differential equations.

COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

The course intends to provide with the basics for an understanding of the fluid mechanics theory making emphasis on mathematical aspects such as modelling, mathematical analysis of the models, stability and so on. Different techniques of partial differential equations will be introduced. The magnetically confined plasma will be considered in the framework of the ideal MHD.

The course will provide the student with an appropiate training in simple fluid mechanics problems and its mathematical treatment.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Basic Modelling: conservation laws and constitutive equations.
2. Elliptic problems. Movements to low Reynolds numbers. Stokes flows
3. Parabolic problems. Existence and uniqueness of solutions. Movements to low Reynolds numbers. Porous media and lubrication
4. Hyperbolic problems. Movements to high Reynolds numbers. Euler equations. Acoustics
5. Asymptotic techniques. Boundary layers
6. Stability and chaos. Applications in hydrodynamics
7. The ideal MHD and Grad-Safranov

LEARNING ACTIVITIES AND METHODOLOGY

* Teaching Methods:

Classroom lectures and classroom problem solving sessions.

* Course Material:

Copies of the presentations.

ASSESSMENT SYSTEM

Evaluation shall take into account attendance and class participation, including practical classes (30% of the final mark). The work of the student on a selected topic among a list and a final written examination will be also taken into account (20% and 50% of the final mark, respectively).

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- Acheson, D.J. Elementary Fluid Dynamics, Clarendon Press, Oxford, 1990
- Temam, R. Navier-Stokes Equations, North-Holland, Amsterdam, 1984
- Temam, R. and Miranville, A. Mathematical Modeling in Continuum Mechanics, Cambridge Univ. Press, 2001

ADDITIONAL BIBLIOGRAPHY

- Evans, L.C., Partial Differential Equations, AMS, Providence, 1998
- Sherman, F. S. Viscousflows, McGraw-Hill, New York, 1990
- Whitham, G. Linear and Nonlinear Waves, Wiley, New York, 1974