Universitat de Lleida

DEGREE CURRICULUM

FLUIDS ENGINEERING

Coordination: ILLA ALIBES, JOSEP

Academic year 2017-18

FLUIDS ENGINEERING 2017-18

Subject's general information

Subject name	FLUIDS ENGINEERING
Code	102302
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	Degree / Course / Typology / Modality: Bachelor's Degree in Mechanical Engineering / 3 / COMPULSORY / Attendance-based
ECTS credits	6
Groups	1GG,2GM
Theoretical credits	3
Practical credits	3
Coordination	ILLA ALIBES, JOSEP
Department	INFORMATICA I ENGINYERIA INDUSTRIAL
Teaching load distribution between lectures and independent student work	Attendance time: 60 h. Home work: 90 h.
Important information on data processing	Consult this link for more information.
Language	Catalan
Distribution of credits	Theory: 3 cr. Problems: 2 cr Case study: 1 cr
Office and hour of attention	Desk 2.08 EPS

Typology detail:

Degree	Course	Typology	Modality
Bachelor's Degree in Mechanical Engineering	3	COMPULSORY	Attendance-based

FLUIDS ENGINEERING 2017-18

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ILLA ALIBES, JOSEP	jilla@macs.udl.cat	9	Office 2.08, EPS, at agreed time.

Subject's extra information

Suggestions

The present course is based on the concepts already exposed in Mechanics of Fluids and is intended to achieve the level of analysis commonly used in the practice of engineering design. The difficulty in the analysis of complex fluid systems forces the use of numerical computational techniques where the major handicap is the accurate design of the algorithms adapted to each problem type. It is recommended for the student to refresh the concepts of Fluid Mechanics, Numerical Methods and Programming given in previous courses.

The course as part of the academic plan

The fluids system engineering is a part of mechanics, considered as a whole discipline. With that background the present course provides a practical perspective integrating concepts both from Mechanics and Fluid Mechanics. The course will take place during the second semester and is structured in 3cr theory, 2cr problems and 1cr practicum. In the individualized practicum specific problems will be proposed and the student will have to develop a strategy to solve each of them and implement it in Matlab. Some basic references for the course are in english.

Learning objectives

-Establish the equations that define the steady state in elemental pumping facilities.

-Apply basic numerical algorisms to solve problems of facilities with pumps.

-To set out and run algorisms to optimize the design and operation of basic facilities.

-To set out and solve numerically the equations defining the steady state in hydraulic networks using different approaches.

-Develop numerical algorisms for the analysis of hydraulic networks.

-To set out the equations governing hydraulic transients and development of the algorisms to find out approximate numerical solutions.

Competences

Degree-specific competences

- GEM21. Applied knowledge of thermal engineering.
- GEM24. Applied knowledge of the basics of fluid mechanic machinery.

Degree-transversal competences

- EPS1. Capacity to solve problems and prepare and defence arguments inside the area of studies.
- EPS6. Capacity of analysis and synthesis.

Subject contents

Chapter 1. INTRODUCTION TO MATLAB

1. Types of variables in Matlab
2. Logical and arithmetic operators
3. Mathematical functions
4. Loops and conditionals
5. Main programs and user defined functions
6. Basic numerical algorithms:

   -Bisection and secant methods

   -The Newton-Raphson method for non linear equation systems

   -Ordinary differential equations: The Euler method

   -Fitting curves with the least squares criterion

Chapter 2. BASIC PIPE CONFIGURATIONS

1. Series pipe configuration
2. Parallel pipe configuration
3. Characteristics of pumps in series and parallel
4. Working point
5. Similitude laws in centrifugal pumps
6. The three reservoir problem
7. Optimal diameter
8. Use of the elemental numerical algorisms in Matlab

Chapter 3. INTRODUCTION TO PIPE NETWORK ANALYSIS

1. General concepts. Basic types of networks
2. Power law and the Darcy-Weisbah equation
3. Branched networks. Trickling irrigation
4. Method of the continuity equations (Q- eqs method)
5. Method of the energy equations (H-eqs method)
6. Method of Hardy-Cross (?Q eqs method)
7. Introduction of singular elements in the network
8. Introduction of a pump in the network

9. Problems of pipe network analysis

Chapter 4. TRANSIENT FLOW

1. Analysis of systems with pseudo transient flow

2. Incompressible transient flow in rigid pipes

3. Basic description of the water hammer. Practical calculations

4. Equations governing the water hammer

5. Numerical solutions. The characteristics method

6. Transients in networks

7. Problems of transients

Methodology

Master class, where the basic concepts are exposed in a deductive sequence.

Problem solving. The methodology to solve the typical problems is exposed, starting from the basic concepts.

Case study. The different approaches to analyze a complex problem, the adopted solution strategies and the form to present the achieved results are discussed. The students should present their own work within an established death line.

Written exam. At day and time established by the study board. Each student has to solve by its own the proposed questions in a limited time. The students know the punctuation criteria.

Development plan

Week	Methodology	Contents	Attendance hours	Autonomous working hours
1-2	Master class Problems	Chapter 1	8	12
3-8	Master class Problems Case study	Chapter 2 Chapter 3 (up to 3.6)	24	36
9	Written exam (E1)	Chapter 1 up to Chapter 3.6	3	
10-15	Master class Problems Case study	Finishing Chapter 3 Chapter 4	24	36
16	Written exam (E2)	Chapters 1 to 4	3	

Evaluation

There will be a written exam by mid semester (E1) and by the end of the semester (E2) and a final recuperation exam (EJ) on the dates fixed by the Direction of the EPS. During the course there will be at least 5 cases proposed (P) due to be solved and discussed at a established date. Solving those cases is optional, but it contents is subject of the exams. The final mark for a person who has not presented all the problems (NJa) will be calculated as:

NJa=max{(E1+E2)/2, E2}

while for a person who has presented all problems (NJb) and has NJa >3 will be calculated as:

NJb= 0.5*NJa + 0.45*P + 0.05*A

where A is a mark reflecting the professor global appraisal. Those who did not pass at the first attempt will have a second opportunity where the final recuperation exam (EJ) will replace the mark NJa.

Bibliography

Basic references:

-J.Agüera Soriano, "Mecánica de fluidos incompresibles y turbomáquinas hidráulicas", 5ª ed., Editorial Ciencia3 S.A., 2002 (ISBN: 84-95391-01-05)

- Claudio Mataix, "Mecánica de fluidos y máquinas hidraulicas" , 2ª ed.,Ediciones del Castillo S.A., Madrid 1986 (ISBN: 84-219-0175-3).

-V.L. Streeter, E.Benjamin, K.W. Bedford, "Mecánica de los fluidos", Ed. McGraw-Hill, 9ª ed., 2000 (ISBN: 968-600-987-4).

-Irving H. Shames, "Mecánica de fluidos", Ed. McGraw-Hill, 1995

Advanced references:

-Bruce E. Larock, Roland W. Jeppson, "Hydraulics of pipelines systems". Ed. CRC Press. 2000 (ISBN: 0-8493-1806-8).

-Frank M.White, "Fluid Mechanics", Ed. McGraw-Hill, 1986