Fluvial Morphodynamics (250910)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA) Departament de Màquines i Motors Tèrmics (MMT)
Credits	5.0 ECTS
Programs	MÀSTER UNIVERSITARI ERASMUS MUNDUS EN GESTIÓ DEL RISC PER INUNDACIÓ (pla 2019) PARS: ENGINYER/A DE CAMINS, CANALS I PORTS (pla 2022)
Course	2023/24

Main teaching language at each group

- Group 10Q1 English (Q1)

Faculty

Responsible Faculty: Allen Bateman Pinzon
Faculty: Allen Bateman Pinzon, Vicente César De Medina Iglesias, Carles Ferrer Boix

Objectives of Education

The principal objective of the present course is to introduce the student to new phenomena as river dynamics. The students learn how to evaluate the principal sediment transport characteritics models. The students learn and apply concepts threshold of motion, dynamic stability, flow regimen, local and general scour.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	25.5 h	56.67 %
	Medium group	9.75 h	21.67 %
	Laboratory classes	9.75 h	21.67 %
	Guided Activities	0.0 h	0.00 %
Self Study		80.0 h	

Contents

Introduction

A general description of rivers. Discussion on the influence of rivers on man's activities and his relationship with nature. Statistical evaluation of the granulometry in a channel.
Particle size distribution exercise

Specific Objectives

Understand the nature of the channels.
Understand how to evaluate a real granulometry of a channel.

Equations of momentum energy and resistance to flow in riverbeds

Description of the equations of mass and energy in channels and the difference with channels.
Detailed description of the momentum equation in a stretch of channel. Consequences of the application of momentum. Description of the hydraulic jump.
Definition of resistance to flow, development of resistance equations. Law of distribution of speeds in channels. Study of the resistance to flow in vegetated channels, and channels with granulometry.
The first numerical model is developed in an Excel sheet. Energy equation.
Construction of the numerical model.
The construction of the model continues. momentum valuation
Backwater Curves Description
Introduction in the model of the solution of the backwater curves. Background tensions.
Introduction and first steps in the Hec Ras model.

Specific Objectives

Know the equations of conservation of mass and energy.
Know the implications of the momentum balance equation in rivers.
Understand the phenomenon of resistance to flow, in channels.
Begin to understand to develop a complete numerical model.
Introduction of resistance to flow.
Introduction of momentum.
Understanding backwater curves.
Follow the construction of the model. Understanding of background stresses and their implications.
Comprehension of the bases of fec ras.

Dynamic balance in rivers

Start of movement in bed and slopes.
Resistance to flow in channels. Rigid and flexible vegetation. consequences.
Distribution of stresses in channels
Assessment of the transport formulas, consequence of the distribution of stresses in the channel.
Stress balance, Lane balance, analysis of equilibrium in channels.
Program the transport formulas in channels in the one-dimensional model in Excel.
Development of the first morphodynamic equation in channels. Development of a quasi-stationary numerical method for the solution of the morphodynamic equation in riverbeds.
Implement the exner equation to the one-dimensional model elaborated by the students

Specific Objectives

Understand the start of movement in channels
Importance of vegetation in riverbeds. Evaluate the forces in rivers with vegetated channels.
Assessment of the morphology of the channel through the background stresses.
Importance of knowing the transport formulas, how they are evaluated.
Consequence of the long-term equilibrium of the channels, practical applications. Real examples, the channel of the dike, the channel of the Magdalena.
Carry out exercises with the model elaborated by the students.
Understand how the sediment mass conservation equation can be constructed, with the one-dimensional morphodynamic equation based on the Exner equation.
Construction of the first one-dimensional morphodynamic model with an Excel application.

QGIS and HECRAS modeling

Planning a model in Hec Ras

Specific Objectives

Exercises for building a Hec ras model based on Qgis. How to plan a complete flood model in Hec-RAs

local phenomena

Local erosion in bridge piers and abutments. Contractions, expansions, curves, dikes, submerged panels, shore control

How a fork works, what it is and how the fork can be evaluated. Consequences of bifurcations. Analysis of a practical case in the Patia river.

Specific Objectives

Development of the concepts of general and local erosion. Evaluation and understanding of local phenomena.
Understanding the dynamics of bifurcations. See a real application case.

fluvial morphodynamics

Carrying out experiments on dynamic equilibrium and local erosion in riverbeds. Assessment of the transport capacity of a channel.

Specific Objectives

Understand through the visit to the laboratory the phenomena of transport of solids in channels.

Teaching Methodology

The subject consists of 4 hours per week of face-to-face classes in the classroom.

Spend 2 hours in large group theory classes and 2 hours of practice.

The rest of the weekly hours are dedicated to laboratory practices.

Support material is used in the form of a detailed teaching plan through the ATENEA virtual campus: contents, schedule of assessment and directed learning activities and bibliography.

Although the majority of sessions will be held in the language indicated in the guide, sessions supported by other guest experts from time to time may be held in another language.

Grading Rules

(*) The evaluation calendar and grading rules will be approved before the start of the course.

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories .

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

Office Hours

2 hours a week available in the office. Agreed time on the day the course begins.

Bibliography

Basic

- Henderson. Open Channel Flow. London: Macmillan series, 1966.
- Julien, P.Y. Erosion and sedimentation. 2nd ed. Cambridge ; New York: Cambridge University Press, 2010. ISBN 9780521537377.
- Sergio Montes. Hydraulics of open channels. ASCE press, 1998. ISBN 0-7844-0357-0.
- Serge Leliavsky. River and Channel Hydraulics. oxford ibh publishing, 1965. ISBN 0-412-07350-1.

- Julien, P.Y. River mechanics. Cambridge ; New York: Cambridge University Press, 2002. ISBN 0-521-52970-0.
- A.J. Raudkivi. Loose Boundary Hydraulics. pergamon press, ISBN 0-08-034073-3.
- Chanson, H. Environmental hydraulics of open channel flows. Oxford: Elsevier Butterworth-Heinemann, 2004. ISBN 0750661658.