Master in Civil Engineering

Introduction to the Civil Engineering School

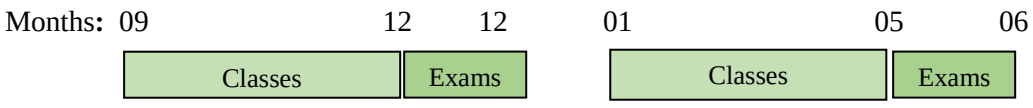
Since its foundation in 1998, the main concern of the Civil Engineering School of University of Castilla-La Mancha is the education of our students. One distinguishing hallmark of our teaching activity is based on the combination of a solid theoretical training together with a permanent approximation to the engineering practice by mean of the Project Based Learning (PBL) methodology. By this educational approach, students can choose a specialization track to develop real civil engineering in Hydraulics, Construction Engineering, or Transportation.

The teaching methodology of our school was awarded in 2016 with the **EUR-ACE** quality label.

Subjects in offered in English:

			Eligibility (Degree, D, and Master, M)				
	Semester	ECTS	D2	D3	D4	M1	M2
Mathematical Modelling in Civil Engineering	1	9	☐	☒	☒	☒	☒
Continuum Mechanics and Material Science	1	9	☐	☒	☒	☒	☒
Building design	1	4.5	☒	☒	☒	☒	☒
Design project of a structure	1	6	☐	☒	☒	☒	☒
Sanitary Engineering	1	4.5	☐	☒	☒	☒	☒
Dynamics of Materials and Structures	1	4.5	☐	☒	☒	☒	☒
Planning and Management of Coastal Areas	1	4.5	☐	☒	☒	☒	☒
Action Framework and Transport services optim.	1	4.5	☐	☒	☒	☒	☒
Transport Economics	2	4.5	☐	☒	☒	☒	☒
Hydraulic works and Hydroelectric Exploitation	2	4.5	☐	☒	☒	☒	☒
Management of Water Resource Systems	2	4.5	☐	☒	☒	☒	☒
Sustainable Urban Planning	2	4.5	☒	☒	☒	☒	☒
Internship in Civil Engineering Companies	1 & 2	12	☒	☒	☒	☒	☒
Final Master Project	1 & 2	18	☐	☐	☐	☒	☒

Academic calendar:



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Mathematical Modelling in Civil Engineering Semester 1 9 ECTS Code: 310800

Professor: Gabriel Fernandez Calvo, Gabriel.fernandez@uclm.es

Introduction:

Nowadays, nearly all engineering companies and firms worldwide utilize modelling software to deal with all kind of projects. Civil Engineering students should be able not only to acquire the ability to use those complex programs but also to understand their main underlying concepts. Moreover, developing the skills to construct mathematical models that can solve problems posed in a non-mathematical fashion, especially within the professional engineering scenario, can make a big difference. While in most routine situations it is not necessary to have a great deal of mathematical knowledge to solve civil engineering problems, having a sound background in mathematical modelling capabilities can make a huge impact when the time comes to really find both creative an innovative solutions to new and challenging problems.

The aim of this course is to provide the necessary tools for students to acquire and develop mathematical modelling abilities useful for the professional civil engineering. The course will start from elementary numerical methods and then move on to more advanced techniques to solve problems, which, quite often, will be proposed in a non-mathematical context and with minimal information. All these models will be developed in Matlab software, although other numerically oriented software can be used as well. The far-reaching goal is that every student should be able to become proficient to develop and solve advanced mathematical models.

Objectives:

- Formulating mathematically and solving quantitatively a problem involving differential equations using analytical techniques and/or numerical methods.
- Increasing students' abstraction capacity.
- Strengthening students' deductive reasoning capacity.
- Using estimation techniques of quantities and associated errors.
- Addressing efficiently computationally expensive problems.
- Employing software platforms to treat numerically problems emerging in civil engineering.
- Develop programs to implement the studied numerical methods for solving ordinary / partial differential equations in the field of Civil Engineering.
- Solving basic problems of optimization and optimal control that arise in planning and management of Civil Engineering.

Syllabus:

1. Introduction to Mathematical Modelling.
2. Introduction to the use of MATLAB.
3. Basic numerical methods: Error analysis, solution of linear and nonlinear equations, interpolation techniques and numerical differentiation and integration.
4. Numerical solution of ordinary differential equations.
5. Numerical solution of partial differential equations.
6. Optimization in Civil Engineering.

Prerequisites:

- Students from 3rd course of a Degree in Civil Engineering.
- Knowledge to solve linear systems and acquaintance with elementary linear algebra.
- Approximation of functions with Taylor expansions.
- Single variable and multiple variable calculus (both differential and integral).
- Analytical methods to solve differential equations (both ordinary and partial).
- Familiarity with numerical programming software.
- Analytical mechanics (particularly, the Euler-Lagrange equations).
- Familiarity with fundamental equations governing continuum media.

Continuum Mechanics and Material Science Semester 1 9 ECTS Code: 310801

Professor: Rena Yu, Rena@uclm.es

Introduction:

The aim of this course is introducing students into the theory of continuum mechanics and their connection to material science. The course is divided on the three following topics: (1) Elasticity: Elements of Cartesian Tensors, Continuum kinematics, Fundamental equations of continuum mechanics, Linear Elasticity, Hyper-elasticity and thermo-elasticity, (2) Plasticity: Theory of inelastic behaviour of materials with negligible time effects, Experimental background for metals and fundamental postulates for plastic stress-strain relations, Variational principles for incremental elastic-plastic problems, Tresca and von Mises yield criteria, Total and incremental strain theory and (3) Fracture Mechanics: Linear Elastic Fracture Mechanics in two dimensions following both the energy and the stress approaches, Fundamentals of fracture of quasi-brittle materials using cohesive models, Nucleation and growth of sub-critical cracks due to cyclic loading (Fatigue based on Fracture Mechanics).

Objectives:

- Understanding the behaviour of materials, structural elements and structures through constitutive models
- Applying numerical models and using them to predict mechanical phenomena
- Using computer programs that simulate the mechanical behaviour of materials and structures in static and dynamic rules

Syllabus:

1. Thermoelasticity, Elasticity and linear Viscoelasticity
2. Plasticity and Viscoplasticity
3. Fracture Mechanics

Prerequisites:

- Students from 3rd course of a Degree in Civil Engineering.
- Knowledge in solid mechanics of rigid and deformable bodies
- Knowledge in strength of materials

Building design Semester 1 4.5 ECTS Code: 310802

Professor: Jose Antonio Lozano Galant, joseantonio.lozano@uclm.es

Introduction:

In this holistic and skills focused course students will gain the skills to work in an architectural practice or building design company. Students will learn how to design and calculate the main structural typologies in buildings (such as beams, trusses, frames, cables or arches). To do so, firstly they will draw sketches and perform hand calculations to address the structural behavior of the main building elements (columns, slabs, beams, pads, piles…). This information will be used to check the calculations obtained by Building Information Modelling (BIM) simulation software.

Objectives:

- Using adequately the European codes to define the actions on buildings.
- Understanding the main building typologies for vertical and horizontal loads.
- Designing the main building elements (such as slabs, columns and beams).
- Designing the main foundation elements (such as walls, pads and piles).
- Understanding the building construction techniques.

Syllabus:

1. Actions in buildings
2. Structural systems for vertical loads
3. Structural systems for horizontal loads
4. Design of building elements
5. Foundation design
6. Construction of buildings

Prerequisites:

- Students from 2rd course of a Degree in Civil Engineering.
- Knowledge in strength of materials.
- Knowledge in concrete and steel design.

Design project of a structure Semester 1 6 ECTS Code: 310811

Professor: Jose Antonio Lozano Galant, joseantonio.lozano@uclm.es

Introduction:

The aim of this subject is introducing students into the design of a structure (bridge or building) by Project Based Learning (PBL) methodology. To do so, their structural knowledge in Building Information Modelling (BIM), computer simulation and composite structures is strengthen. The students are also introduced into the design of bridges. In fact, they are given the opportunity to participate in the International Workshop on Bridge Design of IABSE (International Association of Bridge and Structural Engineering) with one of their assignments.

Objectives:

- Introducing students into the design of bridges.
- Strengthen the knowledge of computer simulation.
- Strengthen the knowledge of steel, concrete and composite structures.
- Develop a project in groups.
- Introducing students into the BIM methodology.

Syllabus:

1- BIM in Civil Engineering projects
2- Workshop on Bridge Design
3- Advance computer simulation of structures
4- Advance simulation of composite structures
5- Design project of a structure

Prerequisites:

- Students from 3rd course of a Degree in Civil Engineering.
- Knowledge in strength of materials.
- Knowledge in bridge typologies.
- Knowledge in concrete, steel and composite design.

Sanitary Engineering Semester 1 4.5 ECTS Code: 310806

Professor: Luis Rodriguez Romero, luis.Rromero@uclm.es

Introduction:

Sanitary engineering has been one of the most important fields of interest for civil engineers. The ultimate goal of the sanitary engineering is the protection of public health in a manner commensurate with environmental, economic, social and political concerns. This subject is focused on the wastewater treatment technologies and the municipal solid waste management. After passing it, students should be capable to apply their knowledge to design and critically evaluate the conventional wastewater and municipal solid waste treatment facilities.

Objectives:

- Know the regulations applicable to the treatment and management of wastewater and urban waste.
- Knowing the physical, chemical and biological processes of the different treatment of wastewater and urban waste fundamentals.
- To propose an optimal solution for a construction project of industrial water treatment plant (WWTP).
- To propose an optimal alternative for the integrated management of Municipal Solid Waste (MSW) in a population or territory.
- Size the different elements and equipment of a WWTP.

Syllabus:

PART I: Wastewater treatment

1. Introduction to WWTPs design
2. Preliminary treatment
3. Primary treatment
4. Fundamentals of wastewater biological treatment
5. Suspended growth biological treatment processes
6. Attached growth and hybrid biological treatment processes
7. Processes for nitrogen and phosphorus removal
8. Wastewater plant residuals management

PART II: Municipal solid waste management

9. Current state of municipal solid waste management
10. Biological treatment of MSW
11. Thermal treatment of MSW
12. Landfill design

Prerequisites:

- Students from 3rd course of a Degree in Civil Engineering.
- Basic knowledge in environmental engineering and/or environmental chemistry is welcome.

Dynamics of Materials and structures Semester 1 4.5 ECTS Code: 310812

Professor: Rena Yu, rena@uclm.es

Introduction:

The aim of this course is introducing students into the concept of dynamics on linear systems and the extension on the dynamics material behavior. The course is divided on the two following sections: (1) Fundamentals of theory of elastic wave propagation. Measurement of mechanical properties. Constitutive material model and failure (fracture, fatigue) in dynamic regime for materials of interest in Civil Engineering, Inertia effect, loading rate effect on fracture toughness, fracture energy. (2) Digital signal processing techniques for linear systems (structures). Frequency components of dynamic loads. Modal, spectral, harmonic and transient analysis of structures.

Objectives:

- Know the actions that generate a dynamic response in the structure and conduct structural design effective actions against dynamic.
- Dimension and design technologically each of the elements comprising the structure according to the materials chosen and typology to resolve the structural problem.
- Understand the dynamic behavior of materials, structural elements and structures.
- Applying these models to specific cases and use them to predict mechanical phenomena. Identify and troubleshoot structures
- Numerically model the dynamic behavior of structures, determining the main characteristics that define its response dynamic.
- Use computer programs that simulate the mechanical behavior of materials and structures in static and dynamic regime.

Syllabus:

1- Dynamic behaviour of Civil Engineering materials
2- Theory of Digital signal processing
3- Digital Signal Processing Applied to Dynamic Structures
4- Fatigue of structures subjected to cyclic loading
5- Laboratory practice

Prerequisites:

- Students from 3rd course of a Degree in Civil Engineering.
- Knowledge in strength of materials.
- Knowledge in solid mechanics of rigid and deformable bodies.
- Knowledge in continuum mechanics.

Action Framework and Transport services optimization Semester 1 4.5 ECTS Code: 310818

Professor: José María Menéndez, josemaria.menendez@uclm.es

Introduction:

This subject is taught in the first semester of the second year and it is aimed at students enrolled in the specialty of Transport and Territory. Its objective is double: On one hand, familiarize the student with the framework of action in which the transport evolves today, in our country and in Europe, as a result of the Common Transport Policy led by the European Union. Secondly, teach them how to develop appropriate strategies for the provision of transport services in a competitive framework from the perspective of resource optimization.

Objectives:

- Applying specific optimization methods to ensure the provision of services from a commercial approach to company.
- Knowing what are the trends in both appearance and operation in selection of vehicles for the provision of services transport.
- Knowing the characteristics of the rolling stock and know fit the needs of exploitation
- Knowing the specifics of the infrastructure associated with the provision of services and particularly to high speed rail.

Syllabus:

1. Urban transport services for passengers and goods.
2. Railway services for passengers and goods.
3. Road transport services for passengers and goods.
4. Maritime transport services for passengers and goods.
5. Air transport services for passengers and goods.
6. Passenger modal integration.
7. Modal integration of goods.

Prerequisites:

- Students from 3rd course of a Degree in Civil Engineering.
- Knowledge in transport economics.
- Knowledge in modal centers exchange.
- Knowledge in tracing roads and railways.
- Knowledge in organization and management of projects.

Planning and Management of Coastal Areas Semester 1 4.5 ECTS Code: 310816

Professor: María del Carmen Castillo Sánchez, mariacarmen.castillo@uclm.es

Introduction:

With the basic knowledge on waves, coastal processes and coastal structures from the previous Coastal Engineering subject, we aim at learning how to manage infrastructures located on coastal areas, basically beaches and ports. After acquiring some knowledge on both, two cases are proposed: (1) Dealing with beaches: beach nourishment projects or armoring projects (soft engineering versus hard engineering). (2) Dealing with ports: operational thresholds, operational risks or decision making

Objectives:

- Identifying key points in Coastal Management
- Evaluating consequences of activities developed on a coastal area on coastal resources of the area
- Learning about alternatives for Beach Nourishment
- Understanding port operation
- Understanding constraints involved in Coastal Planning

Syllabus:

1. Introduction
2. Basic definitions on Coastal Management
3. Beaches:
   - Stability and evolution models for beaches
   - Beach nourishment (soft engineering)
   - Beach armoring (hard engineering)
4. Ports:
   - Types of Ports
   - Port facilities
   - Operational conditions
   - Planning resources

Prerequisites:

- Students from 3rd course of a Degree in Civil Engineering.
- Knowledge in Coastal Engineering.

Transport Economics Semester 2 4.5 ECTS Code: 310809

Professor: José María Menéndez , josemaria.menendez@uclm.es

Introduction:

The subject presents the first approach to transport world from an economic point of view. Firstly, students are introduced into the most important issues concerning design and construction of transport nodes and linear infrastructures. Then, they discover the relationship between transport and certain economical and operational matters. The course is a first step for those wishing to orientate their careers in the area of managing of transport companies or other institutions related with transportation system. Students interested in these aspects are also welcome to attend the course "Transport operation and optimization" given in the first semester of second year

Objectives:

- Knowing and interpreting the transport market.
- Knowing the transport organization.
- Knowing the economic costs and transport externalities.
- Knowing the management systems of a transport company.
- Identifying the involvement (share) of transport in the logistics sector.
- Solving the own problems of management and exploitation of transport services from the operating company field.
- Solving the own problems of the planning, management and exploitation of transportation from the Administration field.
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Syllabus:

1- The transport in the Economic System
2- Economic costs of transport
3- Costs and external benefits of transport infrastructures
4- Transport services financing
5- Taxation in transport
6- Utilities management
7- Structure and management of transport company
8- Marketing and Quality
9- Logistics and Transport
10- Demand modelling

Prerequisites:

- Students from 3rd course of a Degree in Civil Engineering.
- It is recommendable to have some basic knowledge in some optimization programs and management in mathematical tools (Mathematica, Matlab, GAMS)

Hydraulic works and Hydroelectric Exploitation Semester 2 4.5 ECTS Code: 310807

Professor: Javier González Pérez, Javier.gonzalez@uclm.es

Introduction:

This module aims to provide students with advanced competences and tools for hydraulic design. With this purpose, the course delves into the numerical modelling of several hydraulic works and hydroelectric developments that are common in Civil Engineering, including open channels, culverts, pipeline systems, dam structures, spillways and turbine systems. In this module, some theoretical background is firstly provided to ease the understanding of what these systems are and how they work. Then, the associated fluid mechanics and hydraulic engineering principles are revised and linked to numerically-based problem-solving techniques (Matlab programming). This enables students to expand their knowledge on hydraulic structures by numerically simulating how they work and how they should be modified or improved to achieve solutions within the common standards.

Objectives:

- Understanding the principles of operation; designing and maintaining the various typologies of common waterworks in Civil Engineering.
- Analyzing numerically the behavior of a design of a hydraulic work.
- Managing usual magnitude orders in hydraulic works in Civil Engineering

Syllabus:

1. Channels and Drainage works
   - Regulation of Channels and Transient Flows in Open Channel
   - Designing Drainage Works
2. Pipelines and Pumping systems
   - Water Hammer. Transient Flow in Pipes and Protection elements
3. Fluvial dynamics and flood defence works
   - Sediment traps. Erosion protection
   - Flood control and protection
4. Dams and reservoirs
   - Strength computation in concrete dams
   - Stability computation in earth dams
5. Hydraulic outlets in dams and reservoirs
   - Sizing of spillways and drainage elements
6. Turbines and hydroelectric uses
   - Sizing of hydroelectric turbines.

Prerequisites:

- Students from 3rd course of a Degree in Civil Engineering.
- Knowledge in numerical analysis.
- Knowledge in Hydraulic Engineering.
- Knowledge in Geotechnical Engineering.

Water Resources System Management Semester 2 4.5 ECTS Code: 310808

Professor: Javier González Pérez, Javier.gonzalez@uclm.es

Introduction:

This module aims to provide students with advanced competences and tools for water resources system management. First, a general overview of European and Spanish legislative framework is explained. Then, the course focus on providing the techniques used to quantify and characterize water resources from historical records, in particular using stochastic approaches. Complex water resources system modelling tools are exposed, going through the definition of system management rules, system performance indicators, and the application of optimization techniques to assist decision makers. The course content development is complemented with the practical work over a real case study, where the students must apply the new knowledges. Students must develop its own codes for implementing the numerical tools that the course provides.

Objectives:

- Modelling a system of water resources in their superficial and subsurface components with the purpose of its use for a set of demands and restrictions, searching for the satisfaction of themselves in a sustainable way with the maintenance of good environmental conditions.
- Analyzing numerically the behaviour of these systems and the implementation of optimization techniques as support tools to the decision.
- Knowing the normative setting and of techniques recommendations, both nationals and internationals.
- Knowing the environmental implications in the exploitation of water resources.

Syllabus:

1- Introduction, normative and legal setting of Water Resources Systems
2- Modelling of Water Resources Systems
3- Creation of Water Scenes in the Planning and Management
4- Systems Exploitation Rules and Functioning Indicators
5- Support Tools to the Decision in Water Resources Systems
6- Planning in Floods and Drought Events

Prerequisites:

- Students from 3rd course of a Degree in Civil Engineering.
- Knowledge in numerical analysis.
- Knowledge in Hydrologic Engineering.

Sustainable Urban Planning Semester 2 4.5 ECTS Code: 310810

Professor: José María Coronado Tordesillas, josemaria.coronado@uclm.es

Introduction:

Sustainability in cities and regions has become a key element when dealing with larger issues like mitigating global climate change, enabling regional adaptation, and preserving natural systems and ecological functions. Environmental and social processes emerge at different scales, they matter at the local or neighborhood scale when developing infrastructure projects but, at the same time, have causes and consequences at the regional or national levels, and even at the world sphere. Therefore, a sustainable urban and regional planning is achieved from the local to the meso, and to the global scales. The need for a comprehensive and systemic view of the city and the region justify, thus, the design and the multi-perspective approach of the course. More specifically, upon completion of the course students will: (1) Understand urban and regional plans, and the related environmental issues in Spain. (2) Become familiar with the specific shapes and forms of planning in other geographic settings: European Union, United States, Latin America, Asia… (3) Understand the keys to sustainable and ecological planning, and its management processes from the point of view of the infrastructure, water, energy, waste, transportation, economy, etc. (4) Examine the specific applications of different urban design paradigms on urban form, through domestic and international case studies of urban projects. (5) Learn about the current situation of different innovative planning issues: housing, public spaces, urban management, participatory planning, tactical urbanism, etc.

Objectives:

- Making studies of territorial planning, coastal environment, order and coastal defense and environmental aspects related to the infrastructures.
- Understanding the keys of the sustainable urban management, from the point of view of the infrastructures (networks), but also of water, energy, waste, transport, economics, etc.
- Incorporating sustainability criteria for urban and territorial plans.
- Knowing the figures and usual ways of planning in other geographic settings: UE, US, Latin America.

Syllabus:

1- Introduction to Regional Planning
2- Urban and Regional Planning in Spain, EU, and US
3- Environmental limitations to urban growth
4- Negotiation for Common Goods
5- Student presentations. Planning systems.
6- Urban Design Paradigms and the New Movements
7- Ecological Urbanism, Sustainable Urbanism, Green Urbanism
8- Housing and the social segregation and inequality in cities
9- Planning for Public Spaces
10- Participatory planning for equitable planning
11- Urban management: budget, water, energy, transport, waste
12- Student presentations. Case studies

Prerequisites:

- Students from 2rd course of a Degree in Civil Engineering.
- No previous requirements

Internship in Civil Engineering Companies Semester 1 & 2 12 ECTS Code: 310823

Professor: Rocío Porras Soriano, rocio.porras@uclm.es

Introduction:

The course is based on hands-on training by an internship in Civil Engineering companies. Those companies are diversified across different business areas, related with the Civil Engineering, such as, concessions, design, calculous, energy, construction, services or property.

Students will learn all the skills they need to liaise between the engineers, management and operatives in the field of civil engineering by collaborating with real projects, both in the project phase and in the construction phase. These projects are carefully selected by the Practice Commission of the School, trying to satisfy the students previous concerns. The most important thing is that these should be innovative, and will be solve by investigation to develop new methodologies.

This course is open to the three master specialization tracks, which are: Hydraulics, Construction Engineering, or Transportation. That means that almost all the civil engineering fields are represented.

This course was designed with the secure conviction that that participants' skills and employability will be increased through practical.

The course draws on a multi-disciplinary team of teaching staff to provide students the necessary support to reach the objectives of their projects. It is also important to emphasize that each student will be mentored by two Civil Engineers, one is a Professor form the School and the other one is a worker from the company.

Objectives:

- Provide students to understanding modern civil engineering projects.
- Practical skills acquisition in companies.
- Ability to apply the acquired knowledge and solve problems in new and multidisciplinary environments
- Ability to assume the responsibilities related to decision making.
- Ability to listen, negotiate, persuade and defend arguments orally or in writing.
- Development of human and professional relations in the business environment.
- Development of leadership and self-criticism.

Prerequisites:

- Students from 2rd course of a Degree in Civil Engineering.
- No previous requirements.

Master thesis Semester 1 & 2 18 ECTS Code: 310824

Professor: Ana María Rivas Álvarez, ana.rivas@uclm.es

Introduction:

The students will develop a master thesis on a research topic based on their main interests (hydraulics, structures, geotechnics, transportation, material engineering…). To do so, an academic tutor will be assigned to each student. This professor will instruct the student on data search and will help him/her with the research.

Syllabus:

- The research content will be defined together with the designed tutor.

Prerequisites:

- Students from the last course of a Master Degree in Civil Engineering.
- To present and defend the Master's Thesis is an indispensable condition that the student has passed the rest of the ECTS leading to the Master degree.