Universidad Politécnica de Madrid

Escuela Técnica Superior de Ingenieros de Caminos, Canales y Puertos

Subdirección de Relaciones Internacionales

BASIC GUIDE

GRADO EN INGENIERÍA CIVIL Y TERRITORIAL

(Bachelor Civil Engineering)

Last update: July 2013

IMPORTANT

Please note that this is not an official document. Spanish is the official language to publish syllabus and programs. The documents in English are provided for information purposes only and have no legal force. This document has been elaborated by the International Relations Office at ETSICCP-UPM in collaboration with the departments and it is intended as a helpful tool for international students coming to our school.

CONTENT

1. INTRODUCTION

This guide is intended to inform international students about the content of the subjects of the degree “Grado en Ingeniería Civil y Territorial” (Bachelor in civil engineering). Since we are progressively introducing more information, try to have always the last version from our web page (http://www.caminos.upm.es/internacional/index.htm).

2. OVERVIEW OF COURSES

This degree consists of 8 semesters (4 years). Each semester includes 30 ECTS. Most of the subjects are common for all students. Some optional subjects in 6th, 7th and 8th semesters allow reaching a different specialization: 1) Civil constructions; 2) Hydrology; 3) Transports and Urban Planning.

BACHELOR IN CIVIL ENGINEERING
SPECIALIZATION CIVIL CONSTRUCTIONS

Sem.																			
8º	Structural Engineering		Organization of Constructio Works		Foundation Procedures		Railways for Civil Constructions			History, Art and Aestethics in Civil Engineering		Final Degree Proyect							
7º	Construction and Prefabrication					Pavements and road surfaces for CC / Geographical Information Systems for CC (see Note 3)			Construction of Concrete and Steel Structures (see Note 3)			Tunnels and Underground Excavations		Transports			Roads for Civil Constructions		
6º	Civil Engineering and Environment		Maritime Works			Hydraulic Infraestructures			Sanitary Engineering for Civil Constructions			Geotechnics		Concrete and Steel Structures					
5º	General Process of Construction					Hydraulics and Hydrology			Urban Planning			Soil and Rock Mechanics		Structural Analysis			Computational Mechanics		
4º	Differential Equations		Construction and Building Materials II			Electrical Engineering				Geology for Engineers II		Strength of Materials					Mechanics		
3º	Field Theory		Construction and Building Materials I			English Language				Geology for Engineers I		Physics of Solids and Fluids					Topography and Cartography		
2º	Statistics and Optimization				Calculus II				Chemistry of Materials			Physics					Graphic Design		
1º	Linear Algebra and Geometry				Calculus I				Business Administration			Computer Science				Graphic Expression			
ECTS	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15	16.5	18	19.5	21	22.5	24	25.5	27	28.5	30

BACHELOR IN CIVIL ENGINEERING
SPECIALIZATION HYDROLOGY

Sem.																			
8º	Design of Hydraulic Infraestructures aided by Computer		Thermal Power Plants		Geographical Information Systems for Hydrology		Energetic Technology			History, Art and Aestethics in Civil Engineering		Final Degree Proyect							
7º	Electrical Technology		Services, Urban Protection and Waste Management for Hydrology		Hydrogeology		Hydrology and Hydraulic Resources			Design, Landscape and Environmental Restoration for Hydrology		Water Chemistry		Water Engineering in Urban Zones		Coastal Engineering		Roads for Transports & Urban Services	
6º	Civil Engineering and Environment		Maritime Works			Hydraulic Infraestructures			Sanitary Engineering for Hydrology			Geotechnics		Concrete and Steel Structures					
5º	General Process of Construction					Hydraulics and Hydrology			Urban Planning			Soil and Rock Mechanics		Structural Analysis			Computational Mechanics		
4º	Differential Equations		Construction and Building Materials II			Electrical Engineering				Geology for Engineers II		Strength of Materials					Mechanics		
3º	Field Theory		Construction and Building Materials I			English Language				Geology for Engineers I		Physics of Solids and Fluids					Topography and Cartography		
2º	Statistics and Optimization				Calculus II				Chemistry of Materials			Physics					Graphic Design		
1º	Linear Algebra and Geometry				Calculus I				Business Administration			Computer Science				Graphic Expression			
ECTS	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15	16.5	18	19.5	21	22.5	24	25.5	27	28.5	30

BACHELOR IN CIVIL ENGINEERING

SPECIALIZATION TRANSPORTS AND URBAN PLANNING

Sem.									
8º	Pavements and road surfaces for Transports and UP	Traffic Engineering and Traffic Safety	Geographical Information System for Transports and UP	Railways for Transports and UP	History, Art and Aestethics in Civil Engineering	Final Degree Proyect			
7º	Territorial Systems	Services, Urban Protection and Waste Management for Transports and UP	Urban Transports	Port Operation	Port Engineering	Design, Landscape and Environmental Restoration for Transports and UP	Urban Project	Transports	Roads for Transports & UP
6º	Civil Engineering and Environment	Maritime Works	Hydraulic Infraestructures	Sanitary Engineering for T. and UP	Geotechnics	Concrete and Steel Structures			
5º	General Process of Construction	Hydraulics and Hydrology	Urban Planning	Soil and Rock Mechanics	Structural Analysis	Computational Mechanics			
4º	Differential Equations	Construction and Building Materials II	Electrical Engineering	Geology for Engineers II	Strength of Materials	Mechanics			
3º	Field Theory	Construction and Building Materials I	English Language	Geology for Engineers I	Physics of Solids and Fluids	Topography and Cartography			
2º	Statistics and Optimization	Calculus II	Chemistry of Materials	Physics	Graphic Design				
1º	Linear Algebra and Geometry	Calculus I	Business Administration	Computer Science	Graphic Expression				
ECTS	1.5 3 4.5 6	7.5 9 10.5 12	13.5 15 16.5 18	19.5 21 22.5 24	25.5 27 28.5 30				

Legend

- BT: Basic Training
- CTCI: Common Training in Civil Engineering
- STT: Scientific and Technical Training
- STT: Specific Technological Training
- CTT: Complementary Technological Training
- Subjects of 7th and 8th semesters that are "similar" between specialties

Notes

1. Subjects from 1st to 6th semester are the same for all specialties, even though they are represented by different name and colour.
2. Mobility for outgoing is thought during the 7th semester.
3. It would be possible to modify the curriculum by reducing the optional courses of the CC specialization (Pavement / GIS) from 4.5 to 3 ECTS. Accordingly, the remaining 1.5 ECTS would increase "Construction of Concrete Structures and Steel" (this is however subjected to approval by ANECA)

3. COMPETENCES

The degree “Grado en Ingeniería Civil y Territorial” results in the habilitation to those who successfully finish it for the profession “Ingeniero Técnico de Obras Públicas” in Spain. In agreement with the national regulation (CIN/307/2009), the professional competences achieved are as follows:

3.1. Competences linked to subjects (CM)

These competences are achieved by successfully passing the subjects that are specifically related to them.

CM11.1. Capacity to apply resources of linear algebra, geometry, differential geometry, differential and integral calculus, differential equations, numerical methods, numerical algorithms, statistics and optimization to solve engineering problems.
CM11.2. Optimal capacity to select resources from linear algebra, geometry, differential geometry, differential and integral calculus, differential equations, numerical methods, numerical algorithms, statistics and optimization to solve civil engineering problems.
CM11.3. Capacity to apply physical-mathematical modelling for engineering problems in disciplines where elements of linear algebra, geometry, differential geometry, differential and integral calculus, differential equations, numerical methods, numerical algorithms, statistics and optimization are integrated.
CM12.1. Spatial vision capacity and knowledge of graphical representation techniques from metric geometry, descriptive geometry, and computer-aided design software.
CM12.2. Capacity to select and apply optimally graphic representation techniques based on metric geometry, descriptive geometry, and computer-aided design software to solve civil engineering problems.
CM13.1. User-level knowledge of computers and operating systems, and ability to use spreadsheets, databases and mathematical software.
CM13.2. Capacity to apply programming languages to computational solutions of civil engineering problems.
CM14.1. Understanding and assumption of basic concepts and general laws of mechanics, thermodynamics, fields, waves and electromagnetism, and capacity to apply them to solve Physics-related problems.
CM14.2. Capacity to apply the general laws of mechanics, thermodynamics, fields, waves and electromagnetism to solve Physics-related problems, with the most appropriate methodologies for civil engineering.
CM14.3. Capacity to predict solutions in civil engineering problems by applying the general laws of mechanics, thermodynamics, fields, waves and electromagnetism together with specific material laws.
CM14.4. Capacity to model and predict analytically the mechanical behaviour of rigid solid systems and linear elastic solids.
CM14.5. Capacity to model and predict computationally the mechanical behaviour of rigid solid systems and linear elastic solids.
CM15.1. Basic knowledge of geology and soil morphology (external and internal Geodynamics, Petrology, Mineralogy, Palaeontology and Historical Geology) and capacity to apply them to engineering problems. Basic knowledge of climatology and its relations with engineering.
CM15.2. Understanding of interaction between the geological environment and public works and capacity to predict the geological conditions for feasibility, design, construction and operation of public works.
CM16.1. Knowledge of how companies perform business administration, institutional and legal framework, organization and management.
CM16.2. Understanding of the interaction between the functions of companies, the interaction between companies and markets, strategies and reaction mechanisms.
CM16.3. Basic knowledge of laws, legal systems, administrative organization, labour legislation, sector legislation and legal regulations for professional practice of civil engineering at the national and community levels.
CM17.1. Knowledge and capacity to apply concepts and techniques of surveying and mapping needed to obtain measurements, derive drawings, establish paths, put into field defined geometries, and control structural movements or land works.

CM17.2. Knowledge and capacity to apply concepts and techniques of Astronomy, Geodesy, digital models and geographic Information systems to support, complement and enhance surveying and mapping techniques.
CM18.1. Theoretical and practical knowledge of chemical, physical, mechanical and technological properties of construction materials.
CM18.2. Capacity to identify and select the properties of construction materials. Capacity to derive and implement quality control rules for construction materials.
CM18.3. Understanding and capacity to predict the chemical processes that take place in solid media, liquid and gaseous which forms the basis of the use and recycling of soil, pavements and construction materials, preservation of works and structures, durability, water treatment, and environmental protection in civil engineering.
CM19.1. Capacity to apply the knowledge on construction materials in structural systems, the relations between structures and mechanical properties of materials.
CM19.2. Understanding of physicochemical mechanisms that determine the life-cycle stages of construction materials (manufacture, use, disposal and recycling), their durability and impact on the environment.
CM20.1. Capacity to analyze and understand how the mechanical characteristics influence the structural behaviour. Capacity to apply the knowledge on how resistant structures work to design them according to existing regulations. Use of analytical and numerical methods.
CM20.2. Capacity to analyze and design structural elements with analytical models with nonlinear mechanical behaviour.
CM20.3. Capacity to analyze and design structures with interactive resistant mechanisms by using analytical and computational models in agreement to codes.
CM21.1. Knowledge of geotechnics, soil and rock mechanics and capacity to apply them in civil engineering studies, projects, construction works and operations. Application to land movements, foundations and retaining walls.
CM21.2. Understanding and capacity to apply predictive models on water flows in soils, mechanical behaviour and structural failure of soils and rocks.
CM22.1. Knowledge of the fundamentals of the behaviour of concrete, steel and composite structures, and capacity to conceive, design, build and maintain these structures.
CM22.2. Capacity to apply the rules and codes to design and analyze constructive details in reinforced concrete structures and steel structures.
CM23.1. Knowledge of concepts and technical aspects of pipeline and water transport systems.
CM24.1. Knowledge of basic concepts of surface and groundwater hydrology.
CM25.1. Capacity to analyze the importance of health and safety in construction works.
CM26.1. Fundamental knowledge about power electric system: power generation, transport, delivery and distribution, and about types of lines and drivers. Knowledge of regulations on low and high voltage.
CM26.2. Capacity to apply the theory of electric circuits (DC, AC, and polyphase AC) and magnetic circuits. Understanding of the operation of electric machines and their applications. Knowledge of the basics of lighting.
CM27.1. Capacity to apply methodologies for environmental impact assessments.
CM28.1. Knowledge of construction procedures and construction machines. Organizational skills, measurement and valuation of construction works.
CM28.2. Capacity to plan, organize and manage the execution of public works.
CM29.1. Knowledge of types and basis of calculation of prefabricated elements and to apply them in manufacturing processes.
CM30.1. Knowledge of the design, calculation, construction and maintenance of public works in terms of structure, finishing, installations and equipment.
CM30.2. Capacity to apply quality control systems in construction.
CM31.1. Capacity to control and organize construction and conservation of marine works.
CM31.2. Understanding of the interaction weather-wind-waves-coast and the conditions imposed to marine works.
CM32.1. Capacity to construct and maintain roads, dimensioning and design road layers.
CM32.2. Understanding and capacity to quantify road and traffic variables that determine safety, quality and sustainability of road transport infrastructure.
CM33.1. Capacity to construct and maintain railway lines and to implement specific technical regulations, by recognising the different mobile material characteristics.
CM33.2. Understanding of the theoretical models that explain the mechanical behaviour of railway lines, the train-track interaction, and their influence on the design specifications.

CM34.1. Capacity to implement construction procedures, and organize construction machines and construction techniques.
CM35.1. Capacity to construct geotechnical works.
CM36.1. Knowledge and understanding of water supply and sanitary systems and their dimensioning, construction and maintenance.
CM37.1. Knowledge and capacity to design and dimensioning hydraulic works and installations, hydroelectric energy systems, organization and management of water resources.
CM37.2. Understanding and applicability of structural models for hydraulic infrastructures.
CM37.3. Understanding and applicability of hydrological models for surface and groundwater.
CM37.4. Understanding the fundamentals of renewable energy systems.
CM38.1. Knowledge and understanding of ecosystem functioning and environmental factors.
CM38.2. Understanding and capacity to apply methodologies for environmental restoration.
CM39.1. Knowledge of urban service projects related to the distribution of water and sanitation.
CM39.2. Quantitative understanding of water demand.
CM40.1 Knowledge of the regulatory framework of urban management.
CM40.2. Understanding of urban phenomena and their conditions (history, economics, mobility, human activity).
CM40.3. Understanding and capacity to derive urban projects.
CM41.1. Knowledge of the influence of infrastructure in regional planning and participate in the development of urban public space, and in projects of urban services, such as water supply, sanitary infrastructures, waste management, transportation systems, traffic, lighting, etc...
CM42.1. Knowledge of the design and operation of modal infrastructures, such as ports, airports, railway stations and transport logistics centres.
CM43.1. Synthesis, integration and understanding of the skills acquired in an original professional project of civil engineering, to be done individually, capacity to present and defend it to a university jury.
CM43.2. Understanding and capacity to derive civil engineering projects.
CM43.3. Assumption of the principles of universal accessibility and design in civil engineering.
CM44. Assessment of the historical, social, economic, environmental, cultural, political and global effects of civil engineering works.
CM45. Understanding and assumption of the principles of uncertainty, risk and opportunity in the application of methods and models of civil engineering.

3.2. Transverse Competences (CT)

These competences are general skills and they affect the degree as a whole.

CT1. Commitment and capacity to apply the principles of sustainability in professional activities.
CT2. Capacity to organize and put in order the efforts of small, homogeneous groups of people.
CT3. Capacity to perform effectively as a member of interdisciplinary teams.
CT4. Capacity to prepare oral, written and graphic communications.
CT5. Versatility and capacity for independent learning.
CT6. Commitment and capacity to implement the standards of professional conduct.
CT7. Understanding and capacity to use information systems and TIC, including the platforms provided by the UPM to support teaching and learning.
CT8. Technical communication skills in spoken and written English, with previous accreditation of Level B2 according to the Common European Framework of Reference for Languages.
CT9. Capacity to design, analyze and interpret experiments relevant to civil engineering.

4. DESCRIPTION OF COURSES

4.1. 1st and 2nd semesters

SUBJECT		Calculus I					
Name in Spanish		Cálculo I					
ECTS	6	Type	Obligatory	Semester	1st	Code	45001101
Responsible person		Prof. Mª Dolores López González		E-mail	marilo.lopez@upm.es		
Department		Applied Mathematics to Civil Engineering		Language	Spanish		
Requirements		Mathematics					
Competences		CM11.1, CM11.2, CT5					
Keywords		Mathematics, Calculus, Real Functions					
Content		1. Real and complex numbers. 2. Limits. 3. The derivative. Applications of the derivative 4. The integral. Applications of the integral 5. Calculation of displacements. 6. Function of two or more variables.					

SUBJECT		Mathematics I (Linear Algebra and Geometry))					
Name in Spanish		Matemáticas I (Álgebra y Geometría)					
ECTS	6	Type	Obligatory	Semester	1st	Code	45001102
Responsible person		Prof. Manuel Pastor		E-mail	manuel.pastor@upm.es		
Department		Applied Mathematics and Computer Science		Language	Spanish		
Requirements		Mathematics					
Competences		CM11.1, CM11.2, CT5					
Keywords		Algebra, Calculus					
Content		1. Functions, limits, derivatives. 2. Integration techniques. 3. Functions in 2D. 4. Gradients, directional derivatives. 5. Area, volume and line integrals. 6. Integral theorems. 7. Matrices, determinants and systems of linear equations. 8. Vector spaces. 9. Linear applications. Eigenvalues and eigenvectors					

SUBJECT		Business Administration					
Name in Spanish		Empresa					
ECTS	6	Type	Obligatory	Semester	1st	Code	45001103
Responsible person		Prof. Antonio Sánchez Soliño		E-mail	antonio.sanchezso@upm.es		
Department		Civil Engineering-Construction		Language	Spanish		
Requirements							
Competences		CM16.1, CM16.2, CM16.2, CT5					
Keywords		Management; industrial organization; construction sector; finance; firm; economics					
Content		1. Firm theory and industrial organization. Production function. 2. Construction sector. Public services. 3. Investment analysis. 4. Accounts and balance sheet of the firm. 5. Financial markets. 6. Project finance. 7. Economic environment. 8. Institutional and legal environment.					

SUBJECT		Graphic expression					
Name in Spanish		Expresión gráfica					
ECTS	6	Type	Obligatory	Semester	1st	Code	45001104
Responsible person		Prof. Antonio Arcos Álvarez		E-mail	antonio.arcos@upm.es		
Department		Soil Morphology and Engineering		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Computer science					
Name in Spanish		Informática					
ECTS	6	Type	Obligatory	Semester	1st	Code	45001105
Responsible person		Prof. Israel Herráiz Tabernero		E-mail	israel.herraiz@upm.es		
Department		Mathematics and Computing Applied to Civil Engineering		Language	Spanish		
Requirements							
Competences		CM13.1, CM13.2, CT4, CT5, CT7					
Keywords		Programming languages, algorithms, graphs, computational mathematics					
Content		1. Language Fundamentals: Syntax, operators, matrices and arrays, data types. 2. Programming Scripts and Functions: Control flow, scripts, functions, data and file management. 3. Graphics: Two- and three-dimensional plots. 4. Computational mathematics: Algorithms applied to problems of linear algebra, numerical integration, optimization and interpolation					

SUBJECT		Calculus II					
Name in Spanish		Cálculo II					
ECTS	6	Type	Obligatory	Semester	2nd	Code	45001106
Responsible person		Prof. Mariano Soler		E-mail	mariano.soler@upm.es		
Department		Applied Mathematics to Civil Engineering		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Statistics and Optimization					
Name in Spanish		Estadística y Optimización					
ECTS	6	Type	Obligatory	Semester	2nd	Code	45001107
Responsible person		Prof. Israel Herraiz Tabernero		E-mail	Israel.herraiz@upm.es		
Department		Mathematics and Computing Applied to Civil Eng.		Language	Spanish		
Requirements		None					
Competences		CM11.1, CM11.2, CT5					
Keywords		Statistics; Probability; Probability models; Sampling; Estimation; Inference; Quality Control; Optimization					
Content		1. Probability 2. Random variables 3. Probabilty models 4. Central Limite Theorem and its applications 5. Sampling theory 6. Estimation theory 7. Hypothesis testing 8. Standard statistical tests 9. Statistical modelling of extreme values 10. Quality Control 11. Linear programming 12. Graph theory					

SUBJECT		Physics					
Name in Spanish		Física					
ECTS	9	Type	Obligatory	Semester	2nd	Code	45001108
Responsible person		Prof. Andrés Valiente		E-mail	andres.valiente@upm.es		
Department		Materials Science		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Materials chemistry					
Name in Spanish		Química de Materiales					
ECTS	4.5	Type	Obligatory	Semester	2nd	Code	45001109
Responsible person		Prof. Amparo Moragues		E-mail		Amparo.moragues@upm.es	
Department		Civil engineering: Construction		Language		Spanish	
For further information regarding this subject, please refer to the responsible professor							

4.2. 3rd and 4th semesters

SUBJECT		Field Theory					
Name in Spanish		Teoría de Campos					
ECTS	4,5	Type	Obligatory	Semester	3rd	Code	45001201
Responsible person		Prof. Jorge R.-Pinero Fernandez		E-mail	jorge.rodriguezpinero@upm.es		
Department		Applied Mathematics to Civil Eng.		Language	Spanish		
Requirements		Linear Algebra and Geometry, Calculus I, Calculus II, Statistics and Optimization					
Competences		CM11.3, CM45, CT5					
Keywords		Tensors, Vector Field, differential operators, field integration theorems, differential geometry					
Content		1. Tensor Algebra. Cartesian components. General components. Eigenvector representations. 2. Coordinate systems and variable bases. Classic systems of coordinates. 3. Basic calculus of vector and tensor fields. Differentiation of fields. Classic differential operators: Cartesian and curvilinear expressions. 4. Differential Geometry of a space curve. Frenet trihedron, curvature and torsion. Frenet formulas. 5. Differential geometry of a surface. Parameterization, coordinate lines and natural base. Fundamental Forms and curvature tensor of surface. 6. Fields integration theorems. Line, surface and volume integrals. Grteen, Stokes and Gauss theorems..					

SUBJECT		Construction and Building Materials I					
Name in Spanish		Materiales de Construcción I					
ECTS	4.5	Type	Obligatory	Semester	3rd	Code	45001202
Responsible person		Prof. Jaime Gálvez		E-mail	jaime.galvez@upm.es		
Department		Civil Engineering: Construction		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		English					
Name in Spanish		Inglés					
ECTS	6	Type	Compulsory	Semester	3rd	Code	45001203
Responsible person		Prof. Rafael Rigol Verdejo		E-mail	rafael.rigol@upm.es		
Department		Linguistics Applied to Science and Technology		Language	English		
Requirements		Level B2 from the “Common European Framework of Reference for Languages”					
Competences		CT4, CT5, CT7, CT8					
Keywords		Reading. Writing. Listening. Speaking. Translating. Academic and professional English for Civil Engineering.					
Content		1. Reading techniques: scanning and skimming. Coherence and cohesion in civil engineering texts. 2. Analysing internet websites: critical evaluation. 3. Predicting meaning from technical contexts. 4. Interpreting graphs, diagrams and tables 5. Summarizing information from a civil engineering text. 6. Revising different types of essays practising sequence signalling markers and connectors. 7. Developing written accuracy: punctuation, spelling, cohesive and coherent devises. Precise selection of terms. 8. The report layout. 9. Listening to lecturers and note-taking. 10. Pronunciation: learning the phonemic symbols (phonetic transcription practice). 11. Oral presentations on civil engineering issues. 12. Participating in seminars. 13. Interpreting and translating civil engineering texts from English into Spanish and from Spanish into English.					

SUBJECT		Geology for Engineers I					
Name in Spanish		Geología					
ECTS	4.5	Type	Obligatory	Semester	3rd	Code	45001204
Responsible person		Prof. Eugenio Sanz		E-mail	eugenio.sanz@upm.es		
Department		Soil Morphology and Engineering		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Physics of Solids and Fluids					
Name in Spanish		Física de Sólidos y Fluidos					
ECTS	6	Type	Obligatory	Semester	3rd	Code	45001205
Responsible person		Prof. Andrés Valiente		E-mail	andres.valiente@upm.es		
Department		Materials Science		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Topography and Cartography					
Name in Spanish		Topografía y Cartografía					
ECTS	4.5	Type	Obligatory	Semester	3rd	Code	45001206
Responsible person		Prof. Rubén Martínez Marín		E-mail	Ruben.martinez@upm.es		
Department		Soil Morphology and Engineering		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Differential Equations					
Name in Spanish		Ecuaciones Diferenciales					
ECTS	6	Type	Obligatory	Semester	4th	Code	45001207
Responsible person		Prof. Carlos Castro Barbero		E-mail	carlos.castro@upm.es		
Department		Mathematics and Computing Applied to Civil Engineering		Language	Spanish		
Requirements							
Competences		CM11.3, CM45, CT5,					
Keywords		Ordinary Differential Equations, Partial Differential Equations, Numerical approximation of Differential equations					
Content		1. Initial Value problems 2. Numerical approximation of initial value problems 3. Boundary value problems 4. Numerical approximation of boundary value problems: finite differences 5. Introduction to partial differential equations 6. Parabolic problems: heat equation. Finite differences for parabolic problems 7. Hyperbolic problems: wave equation. Finite differences for hyperbolic problems 8. Elliptic problems: Poisson equation. Numerical approximation of elliptic problems.					

SUBJECT		Construction and Building Materials II					
Name in Spanish		Materiales de Construcción II					
ECTS	4.5	Type	Obligatory	Semester	4th	Code	45001208
Responsible person		Prof. Jaime Gálvez		E-mail	jaime.galvez@upm.es		
Department		Civil Engineering: Construction		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Introduction to Electrical Engineering					
Name in Spanish		Electrotecnia					
ECTS	6	Type	Obligatory	Semester	4th	Code	45001209
Responsible person		Prof. Jesús Fraile Mora		E-mail		frailemora@caminos.upm.es	
Department		Hydraulic and Energy Engineering		Language		Spanish	
Requirements		Mathematics, Physics and Physics of Solids and Fluids					
Competences		CM26.1, CM26.2, CT5, CT9					
Keywords		Electric circuits; electric machines; electrical installations.					
Content		1. Introduction to electrical circuit analysis. 2. Alternating Current circuit analysis. 3. Three-phase circuit analysis. 4. Magnetic materials and circuits. 5. Electric machines. General aspects. 6. Transformers. 7. Induction machines. 8. Power stations. 9. Distribution lines. 10. Electric lighting.					

SUBJECT		Geology for Engineers II					
Name in Spanish		Geología aplicada a las Obras Públicas					
ECTS	4.5	Type	Obligatory	Semester	4th	Code	45001210
Responsible person		Prof. Eugenio Sanz		E-mail		eugenio.sanz@upm.es	
Department		Soil Morphology and Engineering		Language		Spanish	
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Strength of Materials					
Name in Spanish		Resistencia de Materiales					
ECTS	6	Type	Obligatory	Semester	4th	Code	45001211
Responsible person		Prof. Rafael Fernández Díaz-Munío		E-mail		rafael.fernandez@upm.es	
Department		Continuum Mechanics and Structures		Language		Spanish	
Requirements		Mathematics, Physics and Physics of Solids and Fluids					
Competences		CM20.1, CM20.2, CT5					
Keywords		Beams; section analysis; stresses; strains; deflections; frames; arches.					
Content		1. Hypotheses and definitions. 2. Equilibrium. Internal forces. Statically determined structures. 3. Linear elastic behaviour of materials. Fundamentals of Elasticity. 4. Stresses and strains. 5. Beam deflections. 6. Statically undetermined beams. The force method. 7. Frames and arches. 8. Differential equations for beams and trusses. Elastic buckling. 9. Fundamentals of Plasticity. Section analysis. Statically determined structures.					

SUBJECT		Mechanics					
Name in Spanish		Mecánica					
ECTS	4.5	Type	Obligatory	Semester	4th	Code	45001212
Responsible person		Prof. José María Goicolea		E-mail		jose.goicolea@upm.es	
Department		Continuum Mechanics and Structures		Language		Spanish	
For further information regarding this subject, please refer to the responsible professor							

4.3. 5th and 6th semesters

SUBJECT		General Process of Construction					
Name in Spanish		Procedimientos Generales de Construcción					
ECTS	7,5	Type	Obligatory	Semester	5th	Code	45001301
Responsible person		Prof. Manuel Rivas Cervera		E-mail	manuel.rivas@upm.es		
Department		Civil Construction		Language	Spanish		
Requirements		Mathematics; Physics; Design; Computing; Geology; Construction Materials					
Competences		CM25.1, CM28.1, CM28.2, CT1, CT3, CT4					
Keywords		Machine; Motors; Lubrication; Explosives; Cables; Pumps; Planning					
Content		1. Machinery monitoring and maintenance 2. Electric installations and motors 3. Internal combustion engines 4. Ventilation 5. Earth moving machine 6. Specific road and airports building machines 7. Rail track machinery 8. Specific port machinery 9. Production concepts.					

SUBJECT		Hydraulics and Hydrology					
Name in Spanish		Hidráulica e Hidrología					
ECTS	6	Type	Obligatory	Semester	5th	Code	45001302
Responsible person		Prof. Jaime García Palacios		E-mail	jaime.garcia.palacios@upm.es		
Department		Hydraulics and Energy		Language	Spanish		
Requirements		Mathematics, Physics and Physics of Solids and Fluids					
Competences		CM23.1, CM24.2, CT9					
Keywords		Hydraulics, Hydrology, Pipelines, channels, Water resources, Fluid mechanics.					
Content		1. Fluid properties 2. Hydrostatics 3. Steady flow Hydrodynamics. 4. Pressure conductions. 5. Open Channel Hydraulics. 6. Dimensional analysis. 7. Superficial Hydrology. 8. Subterranean Hydrology.					

SUBJECT		Urban Planning					
Name in Spanish		Urbanismo					
ECTS	4.5	Type	Obligatory	Semester	5th	Code	45001303
Responsible person		Prof. Juan A. Santamera Sánchez		E-mail	juanantonio.santamera@upm.es		
Department		Urban planning and environment		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Soil and Rock Mechanics					
Name in Spanish		Mecánica de Suelos y Rocas					
ECTS	4.5	Type	Obligatory	Semester	5th	Code	45001304
Responsible person		Prof. Rafael Jiménez Rodríguez		E-mail	rafael.jimenez@upm.es		
Department		Soil Morphology and Engineering		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Structural Analysis					
Name in Spanish		Cálculo de Estructuras					
ECTS	4.5	Type	Obligatory	Semester	5th	Code	45001305
Responsible person		Prof. Florencio del Pozo Vindel		E-mail		florencio.delpozo@upm.es	
Department		Continuum Mechanics and Structures		Language		Spanish	
Requirements		Strength of Materials, Mechanics					
Competences		CM20.3, CM45, CT5					
Keywords		Structures, trusses, frames, plates, shells.					
Content		1. Elastic analysis of plane trusses 2. Elastic analysis of plane grids 3. Elastic and plastic analysis of plates 4. Basics of Shell analysis 5. Basics of matrix method for analysis of prismatic element structures					

SUBJECT		Computational Mechanics					
Name in Spanish		Mecánica Computacional					
ECTS	3	Type	Obligatory	Semester	5th	Code	45001306
Responsible person		Prof. Felipe Gabaldón		E-mail		felipe.gabaldon@upm.es	
Department		Continuum Mechanics and Structures		Language		Spanish	
Requirements		Mechanics, Mathematics, Physics of Solids and Fluids, Computing					
Competences		CM13.2, CM14.4, CM14.5, CM45, CT9					
Keywords		Rigid bodies, Non-linear dynamics, Linear vibrations, n-dof systems, Linear elasticity, Finite element methods.					
Content		1.1 Rigid body kinematics with finite rotations. 1.2 Lagrange equations for rigid body dynamics and their numerical integration. 1.3 Rigid body dynamics with constraint equations. 2.1 Linear oscillations of 1-dof systems. 2.2 Linear oscillations of n-dof systems. 2.3 Computational techniques for eigenvalue problems. 2.4 Numerical integration of the dynamic equations in the time domain. 2.5 Numerical integration of the dynamic equations in the frequency domain 5.1 Review of basic concepts in linear elasticity 5.2 Strain energy. Principle of virtual work. 5.3 Introduction to the finite element method.					

SUBJECT		Civil engineering and environment					
Name in Spanish		Ingeniería Civil y Medio Ambiente					
ECTS	3	Type	Obligatory	Semester	6th	Code	45001307
Responsible person		Prof. Rosa María Arce Ruiz		E-mail		rosa.arce.ruiz@upm.es	
Department		Urban planning and environment		Language		Spanish	
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Maritime Works					
Name in Spanish		Obras Marítimas					
ECTS	4.5	Type	Obligatory	Semester	6th	Code	45001308
Responsible person		Prof. J. Javier Diez González		E-mail		josejavier.diez@upm.es	
Department		Civil Engineering: Territory, Urban Planning and Environment		Language		Spanish	
Requirements		Statistic, Geology, Materials, Hydraulic Engineering, Geotechnics					
Competences		CM31.1, CM31.2, CM45, CT1					
Keywords		Wave Climate, Sediment transport, Coastline evolution, Harbour, Breakwaters, Docks					
Content		1. Introduction and basic concepts. 2. The vessel and the goods. 3. Climate. Atmosphere and hydrosphere. Applied marine climatology. 4. Wave climate. Description of the average and extreme wave events. 5. Sea levels and their changes. Sea level and wave interactions. 6. Maritime works vulnerability. 7. The port. The harbour. Layout. 8. Breakwaters: Roubble mound, vertical and composite. 9. Mooring and berthing maritime works 10. Coastal dynamics. Impacts. 11. Littoral landscape. Coastal engineering and coastal planning. 12. Ocean energy. Types of energy converters, mooring and berthing, coastal impacts.					

SUBJECT		Sanitary engineering					
Name in Spanish		Ingeniería Sanitaria					
ECTS	4.5	Type	Obligatory, different for each speciality	Semester	6th	Code	45001309 / 45001313
Responsible person		Prof. José Rubió Bosch		E-mail		jose.rubio@upm.es	
Department		Urban planning and Environment		Language		Spanish	
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Hydraulic Infrastructures					
Name in Spanish		Infraestructuras Hidráulicas					
ECTS	4.5	Type	Obligatory	Semester	6th	Code	45001310
Responsible person		Prof. Miguel Ángel Toledo Municio		E-mail		matoledo@caminos.upm.es	
Department		Hydraulic and Energy Engineering		Language		Spanish	
Requirements		Hydraulics, Soil and rock mechanics, Structural computation.					
Competences		CM37.1, CM45 y CT1					
Keywords		Dams, canals, pipelines, hydroelectric scheme, irrigation, pump.					
Content		1. Dams 2. Spillways and outlet works 3. Pipelines 4. Pump schemes 5. Canals 6. Hydroelectric schemes 7. Irrigation 8. Defence works against flooding 9. Hydraulic planning.					

SUBJECT		Geotechnics					
Name in Spanish		Geotecnia					
ECTS	4.5	Type	Obligatory	Semester	6th	Code	45001311
Responsible person		Prof. Jesús González Galindo		E-mail		jesus.gonzalezg@upm.es	
Department		Soil Morphology and Engineering		Language		Spanish	
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Concrete and Steel Structures					
Name in Spanish		Hormigón y Estructuras Metálicas					
ECTS	9	Type	Obligatory	Semester	6th	Code	45001312
Responsible person		Prof. Hugo Corres Peiretti		E-mail	hugoeduardo.corres@upm.es		
Department		Continuum Mechanics and Structures		Language	Spanish		
Requirements		Descriptive Geometry, Physics, Chemistry, Infinitesimal and Integral Calculus, Mechanics and Computers					
Competences		CM22.1, CM22.2, CM45					
Keywords		Steel, concrete and composite structures. Design basis. Ultimate and serviceability limit states.					
Content		1. Introduction to the Steel and Concrete Structures. 2. Mechanical material properties. 3. Basic behaviour of structural elements. 4. Design basis 5. Elastic calculation of sections and elements under bending. 6. Serviceability limits states. 7. Ultimate Limit States due to axial stresses. 8. Ultimate Limit State due to shear forces. 9. Ultimate Limit State of buckling. 10. Connections concrete to concrete, steel to steel and concrete to steel. 11. Bond Stress Limit state. Anchoring and overlapping of reinforcement					

4.4. 7th and 8th semesters

SUBJECT		Roads					
Name in Spanish		Caminos					
ECTS	4.5	Type	Obligatory	Semester	7th	Code	45001401 (for CC) 45001408 (for H and TUP)
Responsible		Prof. Manuel G. Romana (for CC) Prof. Rafael Jurado (for H and TUP)		E-mail	manuel.romana@upm.es rafael.jurado@upm.es		
Department		Transports		Language	Spanish		
Requirements		Mathematics, Materials, Geometry, Geotechnics, Statistics					
Competences		CM32.1, CM32.2, CM 45, CT1, CT9					
Keywords		Traffic Engineering, Geometric Design, Cross section, Earthworks, Construction, Subgrades, Drainage, Pavements, Maintenance.					
Content		1. ROAD PLANNING AND TRAFFIC ENGINEERING. Road transport, vehicles characteristics and performance, traffic counts, speed, flow, and density, level of service, capacity, traffic signing and road marking. 2. GEOMETRIC DESIGN. Speed and sight distances, road alignments and grades, cross-section elements, coordination between alignments and profile, intersections, interchanges and roundabouts, use of computers in road design. 3. EARTHWORKS, SUBGRADES AND DRAINAGE. Geotechnical surveys, soil classifications, earthworks, capping layers, compaction, bearing capacity, construction, erosion, drainage. 4. PAVEMENTS. Principles of design, basic materials, structural design, surface characteristics, maintenance and rehabilitation.					

SUBJECT		Transports					
Name in Spanish		Transportes					
ECTS	4.5	Type	Obligatory for CC and TUP	Semester	7th	Code	45001417
Responsible person				E-mail	@upm.es		
Department		Transports		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Tunnels and underground excavations					
Name in Spanish		Túneles y excavaciones subterráneas					
ECTS	4.5	Type	Obligatory for CC and TUP	Semester	7th	Code	45001429
Responsible person				E-mail	@upm.es		
Department		Soil Morphology and Engineering		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Building Construction and Prefabrication					
Name in Spanish		Edificación y Prefabricación					
ECTS	7.5	Type	Obligatory for CC	Semester	7th	Code	45001402
Responsible person		Prof. Jaime Fernández-Gómez		E-mail	jfernandez@caminos.upm.es		
Department		Civil Engineering: construction		Language	Spanish		
Requirements		Concrete and steel structures					
Competences		CM29.1, CM30.1, CM30.2, CT2, CT3, CT4 and CT5					
Keywords		Prefabrication; building					
Content		1. Building construction. Introduction. 2. Buildings with concrete structures. 3. Buildings with steel structures. 4. Buildings with masonry and wood structures. 5. Quality assurance. 6. Façades, partitions and windows. 7. Building systems. 8. Prefabrication.					

SUBJECT		Water Chemistry					
Name in Spanish		Química del agua					
ECTS	3	Type	Obligatory for H	Semester	7th	Code	45001415
Responsible person		Prof. Amparo Moragues Terrades		E-mail	amparo.moragues@upm.es		
Department		Civil Engineering: Construction		Language	Spanish		
Requirements		Basic concepts of chemistry. Fundamentals of chemical equilibrium					
Competences		CT1,CT5,CT9, CM18,1(part) CM18.3(part)					
Keywords		Water properties, Pollutants, Quality indicators. Wastewater treatments, Indicators					
Content		1. Introductions: Water and living things 2. Chemical proprieties of water. 3. Physical properties of water. 4. Water pollution I: Pollution definition, Types of contaminant. 5. Water pollution II: Biological Contamination 6. Water pollution III. Organic Pollutants 7. Water quality criteria. 8. Introduction to the Framework Directive. 9. Establishment of environmental quality standards 10. Wastewater treatments.					

SUBJECT		Introduction to Electrical Technology					
Name in Spanish		Tecnología Eléctrica					
ECTS	3	Type	Obligatory for H	Semester	7th	Code	
Responsible person		Prof. Nieves Herrero Martínez		E-mail	nieves.herrero@.upm.es		
Department		Hydraulic and Energy Engineering		Language	Spanish		
Requirements		Introduction to electrical engineering					
Competences		CM37.1, CM37.4, CT2, CT3, CT6					
Keywords		Power lines; distribution systems; protections					
Content		1. Power lines. Steady state analysis. Electrical design. 2. Mechanical design of overhead power lines. 3. Calculation of fault currents. 4. Overcurrent and overvoltage protections. 5. Grounding systems in distribution networks. 6. Electrical contact protection. 7. Transformers.					

SUBJECT		Services, urban planning and waste management					
Name in Spanish		Servicios, protección del medio urbano y gestión de residuos					
ECTS	3	Type	Obligatory for H and TUP	Semester	7th	Code	45001410 (for H) 45001422 (for TUP)
Responsible person				E-mail	@upm.es		
Department		Urban planning and Environment		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Hydrogeology					
Name in Spanish		Hidrogeología					
ECTS	3	Type	Obligatory for H	Semester	7th	Code	45001411
Responsible person		Prof. Eugenio Sanz Díez		E-mail	eugenio.sanz@upm.es		
Department		Soil Morphology and Engineering		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Hydrology and hydraulic resources					
Name in Spanish		Hidrología y Recursos Hidráulicos					
ECTS	4.5	Type	Obligatory for H	Semester	7th	Code	45001412
Responsible person				E-mail	@upm.es		
Department		Hydraulics and Energy		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Water engineering in urban zones					
Name in Spanish		Ingeniería del agua en núcleos urbanos					
ECTS	3	Type	Obligatory for H	Semester	7th	Code	45001431
Responsible person				E-mail	@upm.es		
Department		Urban planning and environment		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Coastal Engineering					
Name in Spanish		Ingeniería del Litoral					
ECTS	3	Type	Obligatory for H	Semester	7th	Code	45001434
Responsible person		Prof. J. Javier Diez González		E-mail	josejavier.diez@upm.es		
Department		Civil Engineering: Territory, Urban Planning and Environment		Language	Spanish		
Requirements		Statistic, Geology, Materials, Hydraulic Engineering, Geotechnics. Maritime					

	Works
Competences	CM38.1, CM39.2, CM44, CM45, CT2, CT3, CT6
Keywords	Currents, Wave Climate, Sediment transport, Coastline evolution, Coastal protection.
Content	1. The coast and littoral landscape 2. Coastal hydrodynamic. Basic concepts. 3. Littoral sediment transport. 4. Beach profiles. 5. Coastline evolution. 6. Estuarines and deltas. 7. Artificial beach nourishment. 8. Coastal protection. Structural design. 9. Coastal protection. Functional design. 10. Integrated coastal zone management.

SUBJECT		**Design of landscape and environmental restoration**					
Name in Spanish		**Diseño, paisaje y restauración ambiental**					
ECTS	3	**Type**	Obligatory for H and TUP	**Semester**	7th	**Code**	45001414 (for H) 45001424 (for TUP)
Responsible person				**E-mail**	@upm.es		
Department		Urban planning and environment		**Language**	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		**Ports exploitation**					
Name in Spanish		**Explotación de puertos**					
ECTS	3	**Type**	Obligatory for TUP	**Semester**	7th	**Code**	45001420
Responsible person				**E-mail**	@upm.es		
Department		Urban planning and environment		**Language**	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		**Port engineering**					
Name in Spanish		**Ingeniería Portuaria**					
ECTS	3	**Type**	Obligatory for TUP	**Semester**	7th	**Code**	45001423
Responsible person				**E-mail**	@upm.es		
Department		Urban planning and environment		**Language**	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		**Urban project**					
Name in Spanish		**Proyecto urbano**					
ECTS	3	**Type**	Obligatory for TUP	**Semester**	7th	**Code**	45001436
Responsible person				**E-mail**	@upm.es		
Department		Urban planning and environment		**Language**	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		**Territorial systems**					
Name in Spanish		**Sistemas territoriales**					
ECTS	3	**Type**	Obligatory for TUP	**Semester**	7th	**Code**	45001437
Responsible person				**E-mail**	@upm.es		
Department		Urban planning and environment		**Language**	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Urban transports					
Name in Spanish		Transportes urbanos					
ECTS	3	Type	Obligatory for TUP	Semester	7th	Code	45001438
Responsible person				E-mail	@upm.es		
Department		Transports		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		History, arts and aesthetics in civil engineering					
Name in Spanish		Historia, arte y estética en la ingeniería civil					
ECTS	4.5	Type	Obligatory	Semester	8th	Code	45001427
Responsible person		Prof. Miguel Aguiló Alonso		E-mail	miguel.aguilo@upm.es		
Department		Urban planning and Environment		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Construction of Concrete and Steel Structures					
Name in Spanish		Construcciones de estructuras de hormigón y metálicas					
ECTS	6	Type	Obligatory for CC	Semester	8th	Code	45001405
Responsible person		Prof. Hugo Corres Peiretti		E-mail	hugoeduardo.corres@upm.es		
Department		Continuum Mechanics and Structures		Language	Spanish		
Requirements		Descriptive Geometry, Physics, Chemistry, Infinitesimal and Integral Calculus, Mechanics and Computers					
Competences		CM22.1, CM22.2, CM45					
Keywords		Concrete, steel, composite structures. Ultimate and serviceability limit states. Detailing. Durability. Execution of steel and concrete structures. Quality control.					
Content		1. Presentation. 2. Material connection between steel and concrete. 3. Design of slender steel/composite sections. 4. Buckling structures. Imperfections methods. 5. Elastic redistribution in composite and concrete structures. 6. Limit State of punching. 7. Limit state of torsion. 8. Structural Details. 9. Durability. 10. Execution and control quality of steel/composite and concrete structures.					

SUBJECT		Organization of construction works					
Name in Spanish		Organización de obras					
ECTS	3	Type	Speciality	Semester	8th	Code	45001403
Responsible person		Prof. Ildefonso Lucea Martínez		E-mail	Ildefonso.lucea@upm.es		
Department		Civil construction		Language	Spanish		
Requirements		Basics studies and General procedures of construction					
Competences		CM 25.1,28.1,28.2,30.2,31.1,32.1,33.1,34.1,35.1					
Keywords		Management, projects, public works, legislation, quality control.					
Content		1. General Aspects of the Project. 2. Construction Works General Aspects. 3. Legislation. 4. Constructing Procedures. 5. Construction Work Organization 6. The Influence of labor, materials and equipment in the planning and organizing of construction works. 7. Construction work programming. 8. Execution management of the project. 9. Contracting management. Buying Strategy. 10. Financial Management. 11. Quality Management. 12. Environmental Management. 13. Health & Safety Management. Preventing Occupational Hazards. 14. Conservation and Exploitation. 15. Innovation and the incorporation of new technologies. 16. Leadership and People management.					

SUBJECT		Railways					
Name in Spanish		Ferrocarriles					
ECTS	4.5	Type	Obligatory for CC and TUP	Semester	8th	Code	45001404 (for CC) 45001419 (for TUP)
Responsible person		Prof. Manuel Melis Maynar		E-mail		m.melis@upm.es	
Department		Transports		Language		Spanish	
For further information regarding this subject, please refer to the responsible professor							

SUBJECT		Structural engineering					
Name in Spanish		Ingeniería Estructural					
ECTS	3	Type	Obligatory for CC	Semester	8th	Code	45001428
Responsible person		Pro. Florencio del Pozo Vindel		E-mail		florencio.delpozo@upm.es	
Department		Continuum Mechanics and Structures		Language		Spanish	
Requirements		Structural Analysis					
Competences		CM20.3, CM45, CT5					
Keywords		Structures, Dynamics, FEM method, Shells					
Content		1. Matrix method for analysis of prismatic element structures 2. Finite element method for structural analysis 3. Introduction to Dynamics of structures 4. Basics of Shell analysis					

SUBJECT		Foundation procedures					
Name in Spanish		Procedimientos de Cimientación					
ECTS	3	Type	Obligatory for CC	Semester	8th	Code	45001430
Responsible person				E-mail		@upm.es	
Department		Soil Morphology and Engineering		Language		Spanish	
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Pavements and Road Surfaces					
Name in Spanish		Firmes y pavimentos					
ECTS	4.5	Type	Optional for CC, obligatory for TUP	Semester	8th	Code	45001406 (for CC) 45001421 (for TUP)
Responsible person				E-mail		@upm.es	
Department		Transports		Language		Spanish	
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Geographical information systems					
Name in Spanish		Sistemas de información geográfica					
ECTS	4.5	Type	Optional for CC, obligatory for H and TUP	Semester	8th	Code	45001407 (for CC) 45001416 (for H) 45001425 (for TUP)
Responsible person				E-mail		@upm.es	
Department		Soil Morphology and Engineering		Language		Spanish	
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Energy technology					
Name in Spanish		Tecnología Energética					
ECTS	4.5	Type	Obligatory for H	Semester	8th	Code	45001433
Responsible person		Prof. María José Suárez Navarro		E-mail	mariajose.suarez@upm.es		
Department		Hydraulic and Energy Engineering		Language	Spanish		
Requirements		Physics and Physics of Solids and Fluids					
Competences		CM37.1, CM37.4, CM45, CT2, CT3					
Keywords		Thermodynamics, Thermodynamics cycles, energy efficiency					
Content		1. Introduction to energy technology. 2. General Thermodynamics. Laws and principles 3. Thermal power plants. Rankine Cycles 4. Thermal Machines and Engines. 5. Renewable Energy. 6. Introduction to hydroelectric developing plans. 7. Energy Efficiency.					

SUBJECT		Thermal Power Plant Engineering					
Name in Spanish		Ingeniería civil de centrales térmicas					
ECTS	3	Type	Optative for H	Semester	8th	Code	45001413
Responsible person		Prof. Luis Alberto Sánchez Díez		E-mail	Luisalberto.sanchez@upm.es		
Department		Hydraulic and Energy Engineering		Language	Spanish		
Requirements		Chemistry, Physic, Thermodynamic					
Competences		CM26.1, CM26.2, CT5, CT9					
Keywords		Power Plant Engineering					
Content		1. Introduction: Economics of Power Generation 2. Analysis of Steam Cycles 3. Combined Cycle Power Generation 4. Fuels and Combustion 5. Combustion Mechanism, Combustion Equipment and Firing Methods 6. Steam Generators 7. Steam Turbines 8. Condenser, Feedwater and Circulating Water Systems 9. Nuclear Power Plants 10. Diesel Engine and Gas Turbines Power Plants					

SUBJECT		Computer aided design of hydraulic infrastructures					
Name in Spanish		Diseño asistido por ordenador de infraestructuras hidráulicas					
ECTS	3	Type	Obligatory for H	Semester	8th	Code	45001432
Responsible person				E-mail	@upm.es		
Department		Hydraulics and Energy		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Traffic and road safety					
Name in Spanish		Tráfico y seguridad viaria					
ECTS	3	Type	Obligatory for TUP	Semester	8th	Code	45001418
Responsible person				E-mail	@upm.es		
Department		Transports		Language	Spanish		
For further information regarding this subject, please refer to the responsible professor or department							

SUBJECT		Final Project					
Name in Spanish		Trabajo Fin de Grado					
ECTS	12	Type	Obligatory	Semester	8th	Code	45001400
Responsible person		Prof. Fernando Rodriguez López		E-mail		Fernando.Rodriguezl@upm.es	
Department		Civil Engineering: Construction		Language		Spanish, English, Portuguese	
Requirements		To have passed basic training modules, common civil engineering, scientific and technical, and be registered in the common part of technology-specific module.					
Competences		CM43.1;CM43.2; CM 43.3; CM45; CT1; CT2; CT3; CT4; CT6; CT7					
Keywords		Engineering Project; Construction & Draw Project; Engineering Design; Professional Engineering works.					
Content		1. Project sustainability justification. 2. Project scope justification 3. Legal and administrative requirements compliance. 4. Design requirements identification 5. Break down structure (systems & elements) 6. Designer technical competence justification. 7. Location & environmental studies 8. Description, both graphically and in writing; Location & environment integration. 9. Accessibility in the project 10. Functional & technical justification. 11. Quality requirements in the project 12. The time and cost in the project 13. Safety and health in the project 14. Sustainability and maintenance of the project. 15. The protection against extraordinary risks.					

5. DEPARTAMENTAL INFORMATION

The School of Civil Engineering includes the following departments:

Department	Director	Contact	Web
Civil Engineering: Construction	Prof. Manuel Rivas Cervera	manuel.rivas@upm.es	http://www2.caminos.upm.es/Departamentos/Construcción2005/index.html
Hydraulics and Energy	Prof. José Ángel Sánchez Fernández	joseangel.sanchez@upm.es	http://www1.caminos.upm.es/diche/
Urban Planning and Environment	Prof. José Rubió Bosch	jose.rubio@upm.es	http://www2.caminos.upm.es/Departamentos/puertos/index.html
Transports	Prof. Alberto Camarero Orive	alberto.camarero@upm.es	http://www2.caminos.upm.es/Departamentos/ict/index.html
Soil Morphology and Engineering	Prof. Antonio Soriano Peña	antonio.soriano@upm.es	http://www2.caminos.upm.es/Departamentos/imt/imt.html
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