Spring –International Civil & Environmental Engineering Semester–

July 2, 2018

Available Courses 2018-19

1 Hydropower Engineering (4.5 ECTS)

1.1 Course Data

- Name: Hydropower Engineering
- Course area: Hydraulic Engineering
- Code: 213101017
- Degree programme (and number of semester): MSc Civil Engineering (4th semester)
- Center: School of Civil & Mining Engineering
- Type: Elective course
- Semester: Spring

- Language: English
- ECTS: 4.5

1.2 Course description

1.2.1 Summary

The course shows the students the different types of hydropower plants. The course provides an introduction to wind power technology. And, it highlights the relevance of reversible hydropower plants regarding wind power integration. In the practical classes, the students acquire and/or reinforce their skill to program and solve problems through GNU Octave (or Matlab).

1.2.2 Theory syllabus

I. Hydro Turbines.

Dimensional analysis and similarity laws. Types of turbines (Kaplan, Francis, Pelton and others). Energy analysis. Euler equation. Cavitation. Turbine selection.

II. Introduction to Wind Power.

The nature of wind power. Atmospheric boundary layer. Wind turbines technology. Wind energy assessment. Offshore wind power. Wind power integration.

III. Hydro Power Plants.

Water intakes and passages. Regulation. Reversible Hydropower plants. Micro/Minihydro systems. Wind Power Integration through Pumped-storage Hydropower.

1.2.3 Practice syllabus

Turbine characterisation (Lab)

Hydropower plant regulation (LAB/PC)

Turbine sizing and selection (PC)

Wind energy assesment (PC)

Management of reversible hydropower plant. Wind power integration (PC).

Energy recovery in water sypply systems (PC)

Visiting a hydropower plant (*)

1.2.4 Assesment method

Exam of first unit 25%
Exercise / Project report unit 2 20%
Exercise / Project report unit 3 20%
Exercises and practice report 35%

1.3 Bibliography and resources

1.3.1 Basic bibliography

- Norm ISO IEC 61400. IEC. Switzerland.
- Dixon, SL (1998). Fluid Mechanics, Thermodynamics of Turbomachinery. Butterworth-Heinemann (Reed elsevier plc group). United Kingdom.
- Warnick CC et al (1984). Hydropower Engineering. Prentice-Hall, Inc. Englewood Cliffs. ISBN 0-13-448498-3. New Jersey (USA).
- Leif Vinogg & Ivar Elstad (2003). Hydropower Development 12 Mechanical Equipment. NTNU, Norway.
- Burton T, et al (2011). Wind Energy Handbook. Wiley. United Kingdom.
- Castillo Elsitdié, Luís G. (2009). Apuntes de Obras y Aprovechamientos Hidráulicos: Aprovechamientos Hidroeléctricos. Reprografía de la UPCT. Spain
- Cuesta, L. & Vallarino, E. (2000). Aprovechamientos hidroeléctricos (tomos I y II). Colección Seinor nº 19. Colegio de Ingenieros de Caminos, Canales y Puertos. Spain.

1.3.2 Supplementary bibliography and/or on-line resources

- Hansen, Martin OL (2008). Aerodynamics of Wind Turbines. Earthscan/Routledge. United Kingdom.
- Leif Vinogg & Ivar Elstad (2003). Hydropower Development 8 Hydraulic Design. NTNU, Norway.
- Mataix Claudio (1986). Mecánica de Fluidos y Máquinas Hidráulicas 2ª Ed. Ediciones del Castillo. Spain.

- Viedma Robles, A. y Zamora Parra, B. (2002). Teoría y problemas de máquinas hidráulicas. Ed. Horacio Escarbajal. Spain.

1.4 Lecturer data

Lecturer in charge: Antonio Vigueras Rodríguez
Department: Department of Civil Engineering
Knowledge area: Hydraulic Engineering
Office location: "Anexo de la Escuela Técnica Superior de Caminos, Canales y Puertos y de Ingeniería de Minas. Primera planta - Despacho A.1.09"
Telephone: +34 968 32 7071
Email: avigueras.rodriguez@upct.es
URL/Web:

2 River Engineering (4.5 ECTS)

2.1 Course Data

- Name: River Engineering
- Course area: Hydraulic Engineering
- Code: 213101020
- Degree programme (and number of semester): MSc Civil Engineering (4th semester)
- Center: School of Civil & Mining Engineering
- Type: Elective course
- Semester: Spring
- Language: English
- ECTS: 4.5

2.2 Lecturer data

- Lecturer in charge: Juan Tomás García Bermejo
- Department: Civil Engineering

- Knowledge area: Hydraulic Engineering
- Office location: (sin traducir)
- Telephone: 968 32 70 26
- Email: juan.gbermejo@upct.es
- URL/Web: www.upct.es/~ingcivil/

2.3 Course description

2.3.1 Descripción general

The course analyzes the following aspects of river engineering:

1. Morphology and fluvial Ecosystem distinguishing roughness, bed forms and properties of sediments;
2. Equations of Fluvial Hydraulics;
3. Mechanics of sediment transport: equations of resistance of the channel

to erosion, beginning of erosion and erosion process itself, defining equations of bed load transport of sediment and suspended load.

1. The design criteria, the calculation and definition of

the necessary actions will be developed for the correction and stabilization of the river channels, as well as the protection of works of passage, as the case of piers of bridges on the channel.

2.3.2 Theory syllabus

Module I

Unit 1. Introduction. Rivers. Fluvial morphology. Preponderant flows in rivers. River ecosystems

Module II

Unit 2. River Hydraulics. Principles of movement. Hydraulic characterization of river channels

Module III

Unit 3. Introduction to the Sediment Transport Mechanics.

Unit 4. Sediment characteristics in a river

Unit 5. Application of Sediment Transport equations

Tea 6. Erosion and sedimentation phenomenons

Module IV

Unit 7. River Channel stabilization

Unit 8. Desing and calcule of channeling, stabilzations and hydrological corrections

Unit 9. Bridge hydraulics

2.3.3 Assesment method

Individual Exercises proposed in class: 30%

Grupal Works proposed in class acccording to the units: 30%

Final individual work: 40%

2.4 Bibliography and resources

2.4.1 Basic bibliography

- Castillo Elsitdié, Luis G. (2002). Apuntes de obras y aprovechamientos hidráulicos. (2 Volúmenes). Reprografía de la UPCT. España.
- Martín Vide, J.P. (2002). Ingeniería de ríos. Ediciones de la Universidad Politécnica de Cataluña, España
- Martín Vide, J.P. (2003). Ingeniería Fluvial. Ediciones de la Universidad Politécnica de Cataluña, España.

2.4.2 Supplementary bibliography and/or on-line resouces and others

- Chang, H.H. (1988). Fluvial Processes in River Engineering. John Wiley, Nueva York
- Simons, Daryl B. y Sentürk, Fuat. (1992). Sediment Transport Technology. Water Resources Publications, Colorado- USA.
- Erosion and Sedimentation Manual. (2006) U.S. Department of the Interior Bureau of Reclamation Technical Service Center Sedimentation and River Hydraulics Group, Denver-Colorado-USA
- Vanoni, V. (1975). Sedimentation Engineering. ASCE, Nueva York
- Henderson, F.M. (1966). Open Channel Flow. Macmillan, Nueva York.

- Garcia, M.H. (2004) Hydraulic Desing Handbook, Chapter 6 Sedimentation and Erosion Hydraulics. McGraw-Hill
- Jansen, P. et al. (1979). Principles of River Engineering. Pitman, London
- Petersen, M. (1986). River Engineering. Pretince-Hall, Englewoods Clifford-

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3 Bridges (4.5 ECTS)

3.1 Course description

3.1.1 Theory syllabus

Unit I.- History and regulations.

- Brief history of bridges.
- Loads and regulations.

Unit II.- Deck analysis.

- Longitudinal typology.
  - Grider decks.
  - Slab decks.
  - Rigid frame bridges.
  - Arch bridges.
  - Cable stayed bridges.
  - Suspension bridges.
- Cross-section typology.
  - Beam and slab decks.
  - Slab decks.
  - Box-girder decks.
- Skew and curved decks.
- Railway bridges.

Unit III.- Substructure.

- Substructure.
  - Piers
  - Abutments
  - Bearings.

Unit IV.- Bridge detailing and construction

- Bridge detailing.
- Bridge construction.

3.2 Bibliography and resources

3.2.1 Basic bibliography

3.2.2 Supplementary bibliography and/or on-line resouces and others

4 Landscape Engineering (4.5 ECTS)

4.1 Course Data

- Name: Landscape Engineering
- Course area: Transportation, Urbanism and Land Planning
- Code:213101028
- Degree programme (and number of semester): MSc Civil Engineering (4th semester)
- Center: School of Civil & Mining Engineering
- Type: Elective course
- Semester: Spring
- Language: Partially in English
- ECTS: 4.5

4.2 Lecturer data

- Lecturer in charge: Salvador García-Ayllón Veintimilla
- Department: Civil Engineering
- Knowledge area: Land Planning, Transportation and coastal engineering
- Office location: School of Civil & Mining Engineering
- Telephone: +34639778537
- Email: salvador.ayllon@upct.es
- URL/Web:

4.3 Course description

4.3.1 Summary

The course is focused on analyzing how engineering infraestructures affect the landscape and how to integrate the landscape as an item from the beginning of the design process.

1. Relationship with other courses and/or prior recommendations (sólo si necesario, borrar si no) It is recommended but not strictly necessary to have coursed the subject Urbanism in the 2nd semester of the Master.

4.3.2 Theory syllabus

I – GENERAL ASPECTS
1 Landscape in the civil engineering
2 Good practices
3 The road infraestructure in the territory
II – LANDSCAPE LAWS AND NORMATIVES
4 Environmental law
5 Guidelines management and territorial impact studies
6 Environmental planning instruments
7 Introduction to landscape restoration
III – PLANNING WORKSHOP
8 Introduction to SIG
9 Landscape, planning and design
10 Project development: Practical cases

4.3.3 Practice syllabus

- Development of a report on the influence of a real infraestructure on the landscape during the course (PC)

4.3.4 Assesment method

Test at the end of the semester (25%)
Report of the practices conducted during the course (60%)
Oral presentation of the practices conducted during the course (15%)

4.4 Bibliography and resources

4.4.1 Basic bibliography

- Inés Sánchez de Madariaga, "Introducción al Urbanismo: conceptos y métodos de la planificación urbana", Madrid, Alianza Editorial, 1999.
- V.V.A.A., La práctica del planeamiento urbanístico, Luis Moya (editor), Madrid: Síntesis, 1994
- Riera, Pere Evaluación de impacto ambiental Rubes, Barcelona, 2000.
- José Fariña Tojo "La ciudad y el medio natural" 2ª ed. Rev, Tres Cantos (Madrid): Akal, 2001
- Jaume Font Romà Pujadas, Ordenación y planificación territorial, Madrid: Síntesis, 1998.

4.4.2 Supplementary bibliography and/or on-line resouces and others

- P. Dericke. "Economía urbana" I.E.A.L., 1971.
- AA.VV. Art et Paysage Critique nº 577-578 (nº especial), París, Junio 1995.
- AA.VV. Paisaje y ordenación del territorio Junta de Andalucía/Fundación Duques de Soria, Sevilla, 2002.
- Español Echaniz, Ignacio Miguel Las obras públicas en el paisaje. Guía para el análisis y evaluación del impacto ambiental en el paisaje Centro de Estudios y Experimentación de Obras Públicas, Madrid, 1998.

- M. Herce i F. Magrinya "La ingeniería en la evolución de la urbanística", UPC, 2001.
- M. Herce y J. Miró "El soporte infrestructural de la ciudad", UPC, 2001.
- Juli Esteban i Noguera. "Elementos de Ordenación Urbana", Colegio de Arquitectos de Cataluña. Barcelona, 1981.
- Comunidad de Madrid "Madrid. Región Metropolitana. Estrategia Territorial y Actuaciones". Madrid, 1991.
- Rubio Requena, P.M. "Instalaciones Urbanas, Control Ambiental". Madrid, 1979.
- Martínez Sarandeses, José et alt. Espacios públicos urbanos: trazado, urbanización y mantenimiento Instituto del Territorio y Urbanismo - M.O.P.U., Madrid, 1990.

5 Structural and constructive typology (4.5 ECTS)

5.1 Course description

5.1.1 Theory syllabus

UNIT 1. PREVIOUS CONCEPTS.
1.1- General approach.
1.2- The concept of structural type.
1.3 -The structural behaviour
UNIT 2. BUILDING MATERIALS.
2.1-The classic materials.
2.2.- Materials tractional resistant.
2.3- Other metallic materials and composites.
UNIT 3. ELEMENTARY LINEAR ELEMENTS.
3.1-The stay and the cable: tension.
3.2-The support: compression.
3.3- The beam: bending and shear.
3.4- Triangulations and trusses.
3.5- Arches and antifunicularity.
3.6- Torsion.
UNIT 4. ELEMENTARY SURFACE ELEMENTS.
4.1- Beams grid.

4.2-Slabs and plates.
4.3-Vaults.
4.4-Domes.
4.5- Vaults.
4.5- Barrel vaults.
4.6- Folded shells
UNIT 5. UNCONVENTIONAL LINEAR AND SURFACE ELEMENTS.
5.1 – Free-Form Shells .
5.2.- Spatial Grid Structures.
5.3.- Air Structures.
5.4.- Cable structures.
5.5.- Membrane Structures.

6 Water desalination (4 ECTS)

6.1 Course Data

- Name: Water desalination
- Course area: Water technology and hydraulic resources
- Code:228101016
- Degree programme (and number of semester): MSc in Water and Ground Science & Technology, first semester (2nd semester)
- Center:Escuela Técnica Superior de Ingeniería de Caminos, Canales y Puertos y de Ingeniería de Minas
- Type: Compulsory
- Semester: Spring
- Language: English
- ECTS: 4

6.2 Lecturer data

- Lecturer in charge: Francisco Javier Pérez de la Cruz
- Department: Civil Engineering
- Knowledge area: Hydraulic Engineering

- Office location: Paseo Alfonso XIII, 52. Cartagena (A.1.05)
- Telephone: 0034868071235
- Email: javier.cruz@upct.es
- URL/Web: www.upct.es/~ingcivil/

6.3 Course description

6.3.1 Summary

The course develops the basic fundaments of the processes used in water desalination (with special emphasis on reverse osmosis), as well as its application to the design and construction of desalination plants

6.3.2 Theory syllabus

Unit 1. Introduction to water desalination
Topic 1. Basic principles and desalination technologies
Topic 2. Historical background and current figures
Unit 2. Reverse osmosis
Topic 3. General concepts of reverse osmosis
Topic 4. Water intakes
Topic 5. Reagents dosage
Topic 6. Pretreatment
Topic 7. Membranes and reverse osmosis racks
Topic 8. High pressure pumps
Topic 9. Energy recovery systems
Topic 10. Remineralization of desalinated water
Unit 3. Economical and enviromental aspects
Topic 11. Costs of a desalination plant

6.3.3 Assesment method

Written test to assess theoretical knowledge (50%)
Exercises similar to those solved and proposed in class (50%)
Class attendance may increase the final qualification by up to 5%

6.4 Bibliography and resources

6.4.1 Basic bibliography

- Voutchkov, N. Desalination engineering: planning and design. Mc Graw Hill, 2012
- Voutchkov, N. Desalination engineering: operation and maintenance. Mc Graw Hill, 2014

6.4.2 Supplementary bibliography and/or on-line resouces and others

- Mulder, M. Basic principle of membrane technology. Springer, 1996

7 Urban Wastewater Treatment (4 ECTS)

7.1 Course Data

- Name: Urban Wastewater Treatment
- Course area: Hydraulic Engineering
- Code: 228101014
- Degree programme (and number of semester): MSc OF SCIENCE AND TECHNOLOGY IN WATER AND SOIL
- Center: School of Civil & Mining Engineering
- Type: Elective course
- Semester: Autumn
- Language: English
- ECTS: 4.0

7.2 Lecturer data

- Lecturer in charge: Juan Tomás García Bermejo
- Department: Civil Engineering
- Knowledge area: Hydraulic Engineering

- Office location: (sin traducir)
- Telephone: 968 32 70 26
- Email: juan.gbermejo@upct.es
- URL/Web: www.upct.es/~ingcivil/

7.3 Course description:

In this subject students will intensify knowledge of physical, chemical and biological processes, systems and equipment involved in the purification of urban wastewater, the fundamentals for the design and simulation of wastewater treatment plants (WWTP) and familiarize with the tools for monitoring, control and optimization of active sludge including elimination of nutrients.

7.3.1 Theory syllabus

Module I Introduction to wastewater treatment.

Unit 1. Presentation

Unit 2. Pretreatments

Unit 3. Primary treatment

Unit 4. Secondary Treatment I: Foundations and settings

Unit 5. Secondary Treatment II: Removal of nutrients and various technologies

Unit 6. Treatment 2: Microbiology of biological treatment. Dysfunctions of the active biomass

Unit 7. Tertiary treatment for removal of solids and organic matter

Unit 8. Modeling of activated sludge systems (WWTP)

Module II The sludge line

Unit 1. The thickening of sludge. (gravity, flotation, dynamic)

Unit 2. The stabilization of sludge. Anaerobic digestion and other technologies (Conditioning with lime, DAT, etc.)

Unit 3. Sludge Dewatering: Centrifuges. Band filters. Filter presses

Unit 4. The minimization of sludge production: Technologies available

Unit 5. Composting.

Unit 6. The thermal drying

Unit 7. Calculation of sludge production, Sludge 1 and biological sludge. Material balance,

Module III Facilities and ancillary activities

Unit 1. Odors. Origen. Disposal

Unit 2. Cogeneration

Unit 3. The management of pumping stations of wastewater

Unit 4. The control of discharges to the sewer

Module IV Advanced Treatment and Water Treatment Techniques

Unit 1. R&D in treatment and depuration

Unit 2. Control of processes and spills, Regeneration of treated wastewater, Soft or extensive treatments, Treatments applied to sewage treatment plant's sludge of small municipalities,

7.4 Bibliography and resources

7.4.1 Basic bibliography:

APHA, 1992. Métodos normalizados para el análisis de aguas potables y residuales, 17 ed., American Public Health Assotiation, Washington DC. Diaz de Santos, Madrid

Eckenfelder, W.W. y J.L. Musterman. 1995. "Activated sludge treatment of industrial wastewater". Technomic publishing.

Lancaster, PA, Eikelboom, D. 1975. "Filamentous organisms observed in activated sludge". Water res. 9:365-388,

EGEVASA. "Microbiología de la Depuración Mediante Fangos Activos". Empresa General Velenciana de Agua, S.A. Diputación dde Valencia, 1998,

Degremont. "Momento Technique de L'Eau" (1989),

Ferreo, F.H. «Depuración Biológica de las Aguas». Editorial Alhambra. Madrid, 1974,

Jenkins, D., M.G. Richard y G.T. Daigger. 1993. "Manual on the causes and control of activated sludge bulking and foaming". 2nd Ed.. Lewis publishers. Chelsea. MI Metcalf-Eddy, Ingeniería Sanitaria: Tratamiento, evacuación y reutilización de aguas residuales. Labor. Barcelona, 1985

Ramalho, R.S. 1993. Tratamiento de aguas residuales.. De. Reverté. Barcelona, SEARSA. "Microscopia de la depuración biológica". Sociedad de Explotación de Aguas Residuales, 1991,

WPCF Manual de prácticas Nº 8 "Diseño de Estaciones de Tratamiento de Aguas Residuales".

8 Water purification methods and technology (4.0 ECTS)

8.1 Course Data

- Name: Water purification methods and technology
- Course area: Hydraulic Engineering
- Code: 228101015
- Degree programme (and number of semester): MSc OF SCIENCE AND TECHNOLOGY IN WATER AND SOIL
- Center: School of Civil & Mining Engineering
- Type: Elective course
- Semester: Autumn
- Language: English
- ECTS: 4.0

8.2 Lecturer data

- Lecturer in charge: Juan Tomás García Bermejo
- Department: Civil Engineering
- Knowledge area: Hydraulic Engineering
- Office location:
- Telephone: 968 32 70 26
- Email: juan.gbermejo@upct.es
- URL/Web: www.upct.es/~ingcivil/

8.3 Course description:

Water purification encompasses all physical, chemical and biological processes necessary for the treatment of water for human consumption. The subject includes both the theoretical review of these processes and their application for the design of drinking water treatment plants.

8.3.1 Theory syllabus

Module I

Unit 1. Introduction to water purification

Module II

Unit 2. Processes: Flocculation

Unit 3. Processes: Sedimentation

Unit 4. Processes: Filtration

Unit 5: Processes: Disinfection

Module III

Unit 6. Sizing and Calculation of Water Purification Plants

Unit 7. Drinking water legislation

8.4 Bibliography and resources

- Tchobanoglous, G., & Burton, F. L. (1991). Wastewater engineering. Management, 7, 1-4,
- Qasim, S. R., Motley, E. M., & Zhu, G. (2000). Water works engineering: Planning, design, and operation. Prentice Hall
- HERNÁNDEZ MUÑOZ, A. Abastecimiento y distribución de agua. 5ª ed. Madrid: Colegio de ICCP, 2008. 936 p. ISBN: 8438003907. Colección Seinor nº 6,
- CEH - CEDEX. Guía técnica sobre depósitos para abastecimiento de agua potable. Ministerio de Medio Ambiente, 2010. 187 p. ISBN: 978-84-7790-513-4,
- CEH - CEDEX. Guía técnica sobre tuberías para el transporte de agua a presión. 5ª ed. Madrid: Ministerio de Medio Ambiente, 2007. 438 p. ISBN: 978-84-7790-437-3,
- LIRIA MONTAÑÉS, J. Proyecto de redes de distribución de agua en poblaciones. 5ª ed. Madrid: Colegio de Ingenieros de Caminos, Canales y Puertos, 1995. 278 p. SBN: 978-84-380-0081-6. Colección Seinor nº 1.

9 Planning of natural and urban water resources (4 ECTS)

9.1 Course Data

- Name: Planning of natural and urban water resources
- Course area: Water
- Code: 228101004
- Degree programme (and number of semester): Master in Water and Geotechnical Science & Technology
- Center: Civil Engineering & Mining Engineering School
- Type:
- Semester: Spring
- Language: English
- ECTS: 4

9.2 Lecturer data

- Lecturer in charge: Luis Altarejos García, Ph.D.
- Department: Civil Engineering
- Knowledge area: Hydraulic Engineering
- Office location: (sin traducir) Universidad Politécnica de Cartagena

Ud. Predepartamental de Ingeniería Civil Paseo Alfonso XIII, 52

- Telephone: +34 868071294
- Email: luis.altarejos@upct.es
- URL/Web:

9.3 Course description

9.3.1 Summary

This course develops concepts, methodologies and tools needed for water management at river basin scales, comprising the full water cycle. Includes water planning concepts, water resources evaluation, forecasting water demand, infrastructure asset management, together with planning methodologies and tools.

1. Relationship with other courses and/or prior recommendations (sólo si necesario, borrar si no) The course is strongly linked with the course on Hydrology. Prior knowledge on hydrology and statistics is highly recommended.

9.3.2 Theory syllabus

UNIT 1. Planning and water resources assessment
Topic 1. Water planning
Topic 2. Water resources
Topic 3. Water resources assessment
Topic 4. Models of assessment and prediction
UNIT 2. Resource management
Topic 5. Uses and demands
Topic 6. Supply management
Topic 7. Advanced analysis and urban infrastructure planning
UNIT 3. Economic and legal aspects of water planning
Topic 8. Economy of water
Topic 9. Legislation

9.3.3 Assesment method

Written Exam: 50%
Practical Tasks: 50%

9.4 Bibliography and resources

9.4.1 Basic bibliography

- BALAIRÓN PÉREZ, L. Gestión de recursos hídricos. Edicions UPC, 2000. 487 p. ISBN: 978-84-8301-626-8

- ESTRELA, T. Metodologías y recomendaciones para la evaluación de recursos hídricos. Madrid: Centro de Estudios y Experimentación de Obras Públicas, 1993. 52 p. ISBN: 84-7790-138-4
- GRIGG, N.S. Water resources management: principles, regulations and cases. McGraw-Hill, 1996. 540 p. ISBN: 9780070247826
- MAYS, L. W. Water Resources Handbook. McGraw-Hill, 1996. 1568 p. ISBN: 978-0070411500
- MIMAM. Libro Blanco del Agua. Madrid: Centro de publicaciones. Ministerio de Medio Ambiente, 2000. 637 p. ISBN: 84-8320-128-3

9.4.2 Supplementary bibliography and/or on-line resouces and others

- UNESCO. El agua, una responsabilidad compartida. Edelvives, 2006. 567 p. ISBN: 92-3-104006-5
- ANDREU, J. Conceptos y métodos para la planificación hidrológica. Barcelona: Centro Internacional de Métodos Numéricos en Ingeniería, 1993. 391 p. ISBN: 9788487867194
- Adamowski J, Zyla C, Cuenca E, Medema W, Clamen M, Reig P. 2013. Integrated and adaptive water resources planning, management, and governance. Water Resources Publications LLC. Littleton, Colorado, USA. ISBN Number: 9781887201810
- `https://www.oecd.org/tad/sustainable-agriculture/49040929.pdf`
- `https://www.iwapublishing.com/books/9781780401140/sustainable-water-ecosystems-ma`
- `http://www.eurelectric.org/media/26690/hydro_report_final-2011-160-0011-01-e.pdf`

10 Quality Control Structure (3 ECTS)

10.1 Course Data

- Name: Quality Control Structure
- Course area: 4º
- Code: 516109002

- Degree programme (and number of semester): BSc in Civil engineering, 2nd semester
- Center: Escuela Técnica Superior de Ingeniería de Caminos, Canales y Puertos y de Ingeniería de Minas
- Type: Optative
- Semester: Spring
- Language: English
- ECTS: 3

10.2 Lecturer data

- Lecturer in charge: Juan Manuel García Guerrero
- Department: Civil engineering
- Knowledge area: Construction engineering
- Office location: I+D de construcción, 1ª planta anexo edificio de Navales/Minas (sin traducir)
- Telephone: 968 17 7715
- Email: jm.guerrrero@upct.es
- URL/Web:

10.3 Course description

10.3.1 Summary

The aim of this course is to provide the skills and the capabilities required to plan and to understand and apply the quality control of concrete structures, in order to assure the quality of their construction.

1. Relationship with other courses and/or prior recommendations (sólo si necesario, borrar si no) It is recommended that the students have attended to courses related to reinforced concrete structures and steel structures prior to attending this one.

10.3.2 Theory syllabus

1. General basis for quality control
2. Proyect quality control
3. Quality control of products
4. Building control

10.3.3 Assesment method

Homework 30%
Online tests 40%
Attendance 30%

10.4 Bibliography and resources

10.4.1 Basic bibliography

-Aseguramiento de la calidad en la construcción. Antonio Garrido Hernández.

-Control estadístico del hormigón estructural. ACHE, Asociación Científico-Técnica del Hormigón Estructural.

-Manual práctico de control de calidad en la EHE-08. Pérez Navarro, Julián. Colegio Oficial de Aparejadores, Arquitectos Técnicos e Ingenieros de Edificación de la Región de Murcia, 2011.

10.4.2 Supplementary bibliography and/or on-line resouces and others

- EHE-08: instrucción de hormigón estructural (Comisión Permanente del Hormigón (España); Ministerio de Fomento.
- EC-2/Eurocódigo 2. "Proyecto de estructuras de hormigón. Part 1-1 (EN 1992-1-1:2004 - EN 1992-1-1:2004/AC:2008): General rules

and rules for buildings.

11 Pathology Analysis and Structure Reinforcement (3.0 ECTS)

11.1 Course Data

- Name: Pathology Analysis and Structure Reinforcement
- Course area: Construction Engineering
- Code: 516109003
- Degree programme (and number of semester): Bachelor in Civil Engineering (4th semester)
- Center: School of Civil & Mining Engineering
- Type: Elective course
- Semester: Spring
- Language: English
- ECTS: 3.0

11.2 Lecturer data

- Lecturer in charge: Gregorio Sánchez Olivares
- Department: Department of Civil Engineering
- Knowledge area: Construction Engineering
- Office location: "Anexo de la Escuela Técnica Superior de Caminos, Canales y Puertos y de Ingeniería de Minas. Primera planta - Despacho A.1.13"
- Telephone: +34 968 32 5927
- Email: gregorio.sanchez@upct.es
- URL/Web:

11.3 Course description

11.3.1 Summary

The purpose of this course is to present pathology problems in structures and repair & reinforcement solutions for them.

11.3.2 Theory syllabus

UNIT I. PATHOLOGY OF STRUCTURES.
LESSON 1. FUNDAMENTALS. BASIC TERMINOLOGY.
LESSON 2. DAMAGE MECHANISMS.
LESSON 3. DETECTION OF DEFECTS. TESTS.
LESSON 4. ANALYSIS AND DIAGNOSIS.
UNIT II. STRUCTURAL REHABILITATION.
LESSON 5. MATERIALS AND PROCEDURES.
UNIT III. STRUCTURAL REINFORCEMENT.
LESSON 6. COLUMN REINFORCEMENT.
LESSON 7. BEAM REINFORCEMENT.
LESSON 8. SLAB REINFORCEMENT.
LESSON 9. FOUNDATION REINFORCEMENT.

11.3.3 Assesment method

Short questions on theory(about 20) 50%
Exercises and practice report 50%

11.4 Bibliography and resources

11.4.1 Basic bibliography

- CALAVERA J. Patología de estructuras de hormigón armado y pretensado (2 vol.) 2ª ed., INTEMAC, Madrid, 2005.
- CALAVERA J. Cálculo, construcción, patología y rehabilitación de forjados de edificación, INTEMAC, Madrid, 2002.
- CARBONELL DE MASY M. Protección y reparación de estructuras de hormigón. OMEGA, Madrid, 1995.
- FERNÁNDEZ CÁNOVAS M. Patología y terapéutica del hormigón armado. ETSICCP, Madrid, 1994.
- BRUFAU I NIUBÓ R. Rehabilitar con acero. APTA, 2010.

11.4.2 Supplementary bibliography and/or on-line resouces and others

- DEPARTAMENTO DE CONSTRUCCIÓN Y TECNOLOGÍA ARQUITECTÓNICA (DCTA-UPM). Tratado de Rehabilitación (6 tomos). Ed. Munilla-Leiría, Madrid, 1999.

- LOZANO MARTÍNEZ-LUENGAS A. y LOZANO APOLO G. Curso: informes, dictámenes y periciales. Lozano y asociados, Gijón, 2006.
- LOZANO MARTÍNEZ-LUENGAS A. y LOZANO APOLO G. Curso: diseño, construcción y patología de los forjados. Lozano y asociados, Gijón, 1999.
- LOZANO MARTÍNEZ-LUENGAS A., LOZANO APOLO G. y DEL COZ DIAZ JJ. Curso: síndrome, patología y terapéutica de las humedades. Lozano y asociados, Gijón, 2006.
- MONJÓ CARRIÓ J. Patología y técnicas de intervención. Elementos estructurales. Ed. Munilla-Leiría, Madrid, 2008.
- UNE-EN 1504, Partes 1 a 6. Productos y sistemas para la protección y reparación de estructuras de hormigón. AENOR, 2007.

12 Solar Energy (3 ECTS)

12.1 Course Data

- Name: Solar Energy
- Course area: Engines and Thermal Engineering
- Code: 517109003
- Degree programme (and number of semester): BSc in Mining & Energy Engineering (7th semester)
- Center: School of Civil and Mining Engineering
- Type: Elective course
- Semester: Spring
- Language: English
- ECTS: 3

12.2 Lecturer data

- Lecturer in charge: Dr. Francisco Javier Sánchez Velasco
- Department: Thermal and Fluids Engineering
- Knowledge area: Engines and Thermal Engineerning
- Office location: Hospital de Marina 3ª planta (fachada norte)
- Telephone: N/A
- Email: fjavier.sanchez@upct.es
- URL/Web: `http://www.upct.es/~fluiterm/index.php`

12.3 Course description

12.3.1 Summary

The objective of the course is to obtain basic background of solar renewable energy from an engineering point of view. The course revise both, solar thermal and solar photovoltaic technologies. During the practice sessions the alumnii will face the design of a low temperature solar thermal facility including the planning, the evaluation of the heat demand, the selection of equipments, and the definition of the piping / hydraulics aspects of the facility.

1. Relationship with other courses and/or prior recommendations (sólo si necesario, borrar si no)

12.3.2 Theory syllabus

Didactic Units (DU)

DU 1. INTRODUCTION

T1. Solar geometry and solar radiation.

DU 2. INSTALLATIONS OF USE OF THERMAL SOLAR ENERGY

T2. Thermal solar energy of low temperature. The flat plate collector.

T3. Thermal Solar installations of low temperature.

T4. Calculation and design of thermal solar systems for low temperature.

T5. Regulations applicable to thermal solar installations for low temperature.

T6. Thermal solar energy of medium and high temperature.

DU 3. INSTALLATIONS OF USE OF PHOTOVOLTAIC SOLAR ENERGY

T7. Calculation and design of photovoltaic solar installations.

T8. Regulations applicable to photovoltaic solar installations.

12.3.3 Practice syllabus

During the practice sessions the alumnii will face the design of a low temperature solar thermal facility including the planning, the evaluation of the heat demand, the selection of equipments, and the definition of the piping / hydraulics aspects of the facility.

12.3.4 Assesment method

Practice sessions reports 10% of the final mark (student rate)

Grooup project: Design of a solar facility. To be done in groups 90% of the final mark (student rate)

12.4 Bibliography and resources

12.4.1 Basic bibliography

- Duffie JA, Beckman WA, "Solar Engineering of Thermal Processes", 3rd Edition,2006.
- IDAE, Instalaciones de Energía Solar Térmica, Pliego de Condiciones Técnicas de Instalaciones de Baja Temperatura, 2009.
- Gas Natural, Manual de cálculo y diseño de instalaciones de producción de ACS en edificaciones de viviendas mediante energía solar y apoyo individual a gas natural, Casos Prácticos, 2004

12.4.2 Supplementary bibliography and/or on-line resouces and others

- Henning HM, "Solar-Assisted Air-Conditioning in Buildings, A handbook for planners", SpringuerWien New York, 2004
- Gas Natural, Manual de cálculo y diseño de instalaciones de producción de ACS en edificaciones de viviendas mediante energía solar y apoyo individual a gas natural, 2004.

13 Spanish Courses (1.5 ECTS each)

- ECTS: 1,5
- Code:
- Number of hours: 3 hours per week (two sessions of 1,5h) .
- Start date: October and February.
- Levels: A1.1, A1.2, A2.2, B1.1, B2.1

14 Master's Thesis (9 ECTS)

- Name: Master's Thesis
- Course area: Electable
- Code: 210701053
- Center: School of Civil & Mining Engineering
- Semester: Autumn / Spring
- Language: English
- ECTS: 9