

School of Industrial Engineering of Ciudad Real
5-year Degree in Industrial Engineering

ECTS Co-ordinator	Name	Francisco J. Montans Leal
	Address	E.T.S. Ingenieros Industriales Avda. Camilo José Cela, s/n 13071 Ciudad Real
	Telephone nº	+34 926 295300
	Extension	3841
	Fax	+34 926 295301
Dean or Director	e-mail	Fco.Montans@uclm.es
	Name	Vicente Feliu Batlle
	Address	E.T.S. Ingenieros Industriales Avda. Camilo José Cela, s/n 13071 Ciudad Real
	Telephone nº	+34 926 295300
	Extension	3802
Centre Details	Fax	+34 926 295301
	e-mail	Vicente.Feliu@uclm.es
	Address	E.T.S. Ingenieros Industriales Avda. Camilo José Cela, s/n 13071 Ciudad Real
	Telephone nº	+34 926 295300
Description of the Syllabus	e-mail	
	Professional Qualification	Industrial Engineering
	Duration	5 years
	Division in Cycles	2 cycles

Name of the Faculty/Centre	School of Industrial Engineering of Ciudad Real
Professional Qualification	Industrial Engineering
Date of the Syllabus	1999
Overall number of classes in UCLM credits	375 credits
Overall number of classes in ECTS credits	300 credits

First Year

Code	Subject	ECTS Credits
56100	Calculus	12
56101	Linear Algebra	9
56102	Foundations of Computer Science	12
56103	Physics Foundations of Engineering	12
56104	Foundations of Chemistry in Engineering	12
56105	Engineering Graphics	12

Second Year

Code	Subject	ECTS Credits
	Annual	
56106	Differential Equations	12
56107	Applied Physics	9
	1st Semester	
56108	Applied Mechanics	7,5
56109	Foundations of Material Science	7,5
56110	Introduction to Industrial Production	4,5
56111	Thermodynamics	4,5
	2nd Semester	
56112	Strength of Materials	7,5
56113	Circuitry Theory	6

56114	Statistic Methods in Engineering	6
56115	Heat Transfer	4'5

Third Year

Code	Subject	ECTS Credits
1st Semester		
56116	Systems and Signals	6
56117	Introduction to Electronics	7'5
56118	Theory of Machines	6
56119	Mechanics of Fluids	6
56120	Industrial Economics	6
2nd Semester		
56121	Electric Machines	6
56122	Continuum Mechanics	6

Fourth Year

Code	Subject	ECTS Credits
Annual		
56123	Mathematic Methods	12
1st Semester		
56123	Mathematic Methods	12
56124	Materials Technology	4'5
56125	Automatic Regulation	4'5
56126	Thermal Engineering	4'5
56127	Electric Technology	4'5
2nd Semester		
56129	Manufacturing Technology and Machines Technology	6
56130	Electronic Systems	4'5
56131	Engineering of Fluids	4'5

Fifth Year

Code	Subject	ECTS Credits
1st Semester		
56132	Structural Analysis and Industrial Constructions	6
56133	Energy Technology	6
56134	Business Administration	6
56135	Environmental Science and Technology	6
2nd Semester		
56136	Transportation Engineering	4'5
56137	Project Management	6
9015	End of Degree Project	4'5

Elective (Subject not required for the Industrial Engineer degree)

(All subjects are included in the Industrial Engineering degree program). A total of 66 Elective credits are required to obtain the Industrial Engineer degree; 30 credits during the first cycle (1st, 2nd and 3rd years) and 36 credits during the second cycle (4th and 5th years).

Code	Subject	ECTS Credits
56140	Electric and Magnetic Materials	6
56141	Digital electronics	6
56142	Electronic Instrumentation	6
56143	Automation Technology	6
56144	Industrial Informatics	6
56145	Computer Aided Design	6
56146	Mechanical vibrations	6
56147	Structural analysis of steel and concrete structures	6
56148	Machine Elements.	6
56149	Kinematics and Dynamics of Machines.	6
56150	Chemical Technology	6
56151	Hidraulic Machines	6
56152	Industrial Statistics	6
56153	Design of Production Systems and Logistics	6
56154	Business Management	6
56155	Centrals, Substations and Lines	6
56156	Control Engineering	6
56157	Engineering materials	6
56158	Nuclear Engineering	6
56159	Alternative Energies	6
56160	Business Strategy and Politics	6
56161	Total Quality Techniques	6
56162	Quantitative Methods of Industrial Organisation	6
56163	Organisation of Production	6
56164	Computer Integrated Manufacturing	6
56165	Facilities Planning	6
56166	Power Electronics	6
56167	Electronic Analysis of Electric Energy Systems	6
56168	Industrial Robotics	6
56169	Ampliation of Electric Machines	6
56170	Economic Analysis of Electric Energy Systems	6
56171	Radiology Protection	6
56172	Computer Aided Manufacturing	6
56173	Pneumatic and Hydraulic Systems	6
56174	Advanced theory of structures	6
56175	Manufacturing Engineering	6
56176	Thermal Engines	6
56177	Energy industrial plant analysis	6
56178	Combustion Technology	6
56179	Industrial Cold	6

Elective (Subject not required)

Code	Subject	ECTS Credits
56180	Environmental Engineering Process Design	6
56181	Signal Processing	6
56182	Computer Vision	6
56183	Industrial Artificial Intelligence Applications	6
86125	Projects I	6
86126	Projects II	6
86127	Informatic Tools of Mathematics for Engineering	6

Primer Curso

Subject Code	56100
Subject Name	Calculus
Subject term	First and second terms of the first year
Hours per week	4
Subject type	
Credits	6 (5 ECTS)
Descripción	
Objectives	To establish the basic Calculus skills for engineers as concerns functions of one and several variables.
Contents	Functions of one variable: differentiation and integration, functions of several variables: differentiation and integration, Vector calculus.
Bibliography	``Calculus'', Marsden-Weinstein, Springer-Verlag. ``Cálculo con Geometría Analítica'', Zill, Grupo Editorial Iberoamérica. ``Cálculo Vectorial'', Marsden-Tromba, Fondo Educativo Interamericano.
Professor	Pablo Pedregal Tercero Julio Muñoz Martín
Teaching Method	Classroom teaching.
Evaluation Method	Mid-term, final exams and regular exercise assignments.

Subject Code	56103
Subject Name	Physics Foundations of Engineering
Subject term	Two semesters of the first year
Hours per week	4
Subject type	Mandatory for obtaining the Engineer degree in the UCLM
Credits	12 (10 ECTS credits)
Descripción	
Objectives	Learning the foundation of physics for the development of the engineering.
Contents	Mechanics, Thermodynamics, Electromagnetism & Optics.
Bibliography	Principles of Physics, Third Edition. Vol. 1,2 . Serway & Jewett. Ed. Thomson Physics: Calculus. Sec. Edition. Eugene Hetch. Ed. Brooks/Cole
Professor	Osvaldo Daniel Cortázar
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams

Subject Code	56105
Subject Name	Engineering Graphics
Subject term	1 year (1st academic year)
Hours per week	4
Subject type	“Troncal” (required for Degree in Engineering)
Credits	12 (10 ECTS)
Description	
Objectives	Mastering the graphical language, including CAD techniques, for: 1- Studying shapes and representing geometric entities. 2- Exchanging technical information.
Contents	Introduction to Computer Graphics and CAD. Solid modeling. Graphical representation systems. Sections and conventional breaks. Dimensioning. Dimensional and geometric tolerances. Surface texture. Screwed, welded and riveted attachments. Machine elements. Assemblies.
Bibliography	Félez, J., Martínez, M.L. (1999). Dibujo Industrial (3ª ed.). Ed. Síntesis. Hidalgo, A., Saldaña, M. (1994). Técnicas de representación y dibujo. UNED. Earle, J. H. (1999). Engineering Design Graphics. Addison Wesley. Anderson, A. (2002). MicroStationV8: An introduction. Schroff Dev. Corp. Sánchez-Reyes, J. (2003). Formatos Gráficos 2D y modelos de color.

	RedC@mpus, UCLM..
Instructors	Jesús M. Chacón Rubén Dorado Javier Sánchez-Reyes
Teaching Method	Multimedia classroom teaching. Drawing board and CAD laboratory.
Evaluation Method	Midterm and final examinations. CAD assignments.

Subject Code	56108
Subject Name	Applied Mechanics
Subject term	First term of 2nd year
Hours per week	5
Subject type	Required
Credits	7.5 (6 ECTS credits)
Description	
Objectives	Understanding the mechanics of rigid bodies. Statics, Kinematics and Dynamics of rigid bodies in the three-dimensional space. Basic engineering applications.
Contents	Fundamentals of vector mechanics. Rigid body equilibrium, kinetics and dynamics of systems of particles, kinetics and dynamics of rigid bodies and analytical methods in mechanics.
Bibliography	B. Beer, E. R. Johnston. "Mecánica Vectorial para Ingenieros". (Estática y Dinámica). Editorial: Mc. Graw Hill. H. Shames. "Mecánica para Ingenieros ". 2 tomos (Estática y Dinámica). Editorial: Prentice Hall.
Professor	José Flores Gómez José Manuel Chicharro Higuera
Teaching Method	Theory and problem-solving classes, as well as laboratory work and assignments
Evaluation Method	Mid-term and final exams

Subject Code	56109
Subject Name	Foundations of Materials Science
Subject term	First quarter of 2nd year
Hours per week	5
Subject type	TRONCAL
Credits	7,5 (6 ECTS)
Description	
Objectives	Provides a foundation for understanding the structure and properties of engineering materials such as metals, ceramics, polymers and composites.
Contents	Introduction to Materials Science and Engineering. The structure of crystalline solids and diffusion. Phase diagrams. Microstructure and mechanical properties. Engineering materials: metals, ceramics, polymers and composites materials.
Bibliography	Introduction to materials science for engineers, James F. Shackelford, Prentice Hall, 2000. Materials science and engineering: an introduction, W. D. Callister, John Wiley and Sons, 1999. The science and engineering of materials D. R. Askeland Stanley Thornes (Publishers) Ltd, 1998.
Professor	Gloria Patricia Rodríguez Donoso
Teaching Method	Lectures on theory supplemented by exercises and experimental classes in laboratory
Evaluation Method	The practical classes in the lab are mandatory. It is strictly necessary to assist in order to pass the course Mid-term and final exams.

Subject Code	56112
Subject Name	Strength of Materials
Subject term	Second quarter of 2nd year

Hours per week	5
Subject type	Troncal (required for the Industrial Engineer degree in Spain)
Credits	7.5 ECTS credits (6 ECTS credits)
Description	
Objectives	Learning of the mechanical behaviour of materials and their simpler structural elements: beams and truss structures. Computation of stress distributions in the section and displacements in the structures.
Contents	Review of the computation of center of mass and inertia moments of sections. Normal and shear stress distributions in sections of beams. Thin-wall beams: open and closed sections. Center of shear. Displacements computed by Mohr theorems and by the principle of virtual forces. Hyperstatic structures. Torsion. Buckling of columns.
Bibliography	J.A.Garrido, A.Foces. "Resistencia de Materiales". Univ. Valladolid, 1994 J.M.Gere, S.P. Timoshenko "Resistencia de Materiales". Thomson 2002. J.M.Gere, S.P. Timoshenko "Mechanics of Materials". PWS, 1984.
Professor	Francisco Javier Montáns Leal
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams

Subject Code	56115
Subject Name	Heat Transfer
Subject term	Second quarter of 2nd year
Hours per week	3
Subject type	Obligatory (mandatory for obtaining the Engineer degree in the UCLM)
Credits	4.5 (4 ECTS credits)
Descripción	
Objectives	Learning of the different modes related to heat transfer (conduction, convection and radiation), governing equations and practical applications
Contents	One and multidimensional steady-state conduction, transient conduction, forced and free convection, boiling and condensation, radiation heat transfer
Bibliography	F.P. Incropera, D.P. De Witt "Introduction to heat transfer", John Wiley & Sons, 1996 J.P. Holman, "Transferencia de calor", McGraw Hill, 1998 F. Kreith, M.S. Bohn, "Principios de transferencia de calor", Ed. Thomson, 2002
Professor	Juan José Hernández Adrover
Teaching Method	Classroom and laboratory teaching
Evaluation Method	Mid-term and final exams

Subject Code	56117
Subject Name	Introduction to electronics
Subject term	First quarter of 3 rd year
Hours per week	5
Subject type	Troncal (Mandatory)
Credits	7.5 (6 ECTS credits)
Description	
Objectives	Introduction to the most important semiconductor devices and electronic circuits.
Contents	Operational Amplifiers. Diodes fundamentals and basic circuits. Bipolar and FET transistors: operation modes and basic applications as amplifiers and switches. Power stages with discrete components and OA. Introduction to commercial integrated circuits. Several laboratory sessions are included in the course.
Bibliography	Microelectronic Circuits. Sedra and Smith. Oxford Univ. Press. Electronic Circuits. Malik. Prentice-Hall
Professor	Jose Luis Sanchez de Rojas
Teaching Method	Classroom teaching (theory and exercises) and laboratory assignments
Evaluation Method	Single exam

Subject Code	56118
Subject Name	Theory of Machines
Subject term	First term of third year
Hours per week	4
Subject type	Required
Credits	6
Description	
Objectives	Study of the geometry, kinematics, dynamics, synthesis and balancing of mechanisms using graphic and analytical methods. Study of gear trains and cams.
Contents	Mechanisms. Kinematics. Dynamics. Gears and Cams. Synthesis.
Bibliography	Erdman A.G., Sandor G.N.; Mechanism design: Analysis and Synthesis,I, third edition. Prentice-Hall, 1997 Mabie H.H, Reinholtz C.F.; Mecanismos y Dinámica de Maquinaria. Limusa 1998..
Professor	Publio Pintado Sanjuán.
Méching Method	Theory and problem-solving classes, as well as laboratory work and assignments
Evaluation Method	Assignment and final exam.

Subject Code	56122
Subject Name	Continuum Mechanics
Subject term	Second term of 3 rd year
Hours per week	4
Subject type	Obligatoria (required for the Industrial Engineer degree in the UCLM)
Credits	6 UCLM credits (5 ECTS credits)
Description	
Objectives	Learning of the algebra and calculus of tensors and its application to the continuum mechanics equations. Tridimensional linear elasticity theory is emphasized
Contents	Tensor algebra; tensor calculus; stress; infinitesimal strains; finite strains; continuum mechanics equations; linear elasticity; plasticity
Bibliography	W.S.Slaughter. "The Linearized Theory of Elasticity". Birkhäuser, Boston 2002 J.J. López-Cela. "Mecánica de los Medios Continuos". Publ. UCLM. 1999
Professor	Francisco Javier Montáns Leal
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams

Subject Code	56124
Subject Name	Materials Technology
Subject term	First quarter of 4th year
Hours per week	3
Subject type	TRONCAL
Credits	4,5 (4 ECTS credits)
Description	
Objectives	Study the effect of processing on the structure and properties of engineering materials. Processes considered include Casting and Molding, Metal Forming Particulate processing of materials and welding. Study the failure mechanisms of fracture, creep, fatigue, wear and corrosion.
Contents	Introduction to Materials Technology. Processing methods: Casting and Molding, Metal Forming, Particulate processing of materials. Welding and joining processes. Service performance of engineering materials: fracture, fatigue, creep, corrosion and wear. Measurement and Inspection: non destructive evaluation
Bibliography	Materials science and engineering: an introduction, W. D. Callister, John Wiley and Sons, 1999 Fundamentos de Manufactura Moderna, M.K. Groover, Prentice-Hall, 1997 Corrosión y degradación de materiales, E. Otero, Editorial Síntesis, 1997

	Tribology, Friction and Wear of Engineering Materials, I.M. Hutchings, Edward Arnold 1992
Professor	Gloria Patricia Rodríguez Donoso
Teaching Method	Classroom teaching and laboratory assignments Industrial visits.
Evaluation Method	Final exam.

Código Asignatura	56129
Nombre Asignatura	Manufacturing Technology and Machines Technology
Duración	Second quarter of 4 th year
Nº de horas semanales	4
Tipo Asignatura	Troncal (mandatory for obtaining the Engineer degree in the UCLM)
Créditos	6 (5 ECTS credits)
Descripción	
Objetivos	Learning of technology aspects of manufacturing processes and machines technology, manufacturing systems, automation in manufacturing and quality control.
Contenido	Technology aspects of machining processes, plastic deformation of metals, metal casting and joining processes. Machines technology in Manufacturing. Manufacturing Systems. Automation in manufacturing. Quality control in manufacturing.
Bibliografía	L. Altिंग. "Manufacturing Engineering Processes. Marcel Dekker Inc., 1994. S. Kalpakjian, "Manufacturing Engineering and Technology". Addison-Wesley, 2000.
Profesor	Pedro J. Núñez López
Mét. Enseñanza	Classroom teaching and laboratory assignments
Mét. Evaluación	Mid-term and final exams

Subject Code	56130
Subject Name	Electronic Systems
Subject term	Second quarter of 4 th year
Hours per week	3
Subject type	Troncal (Mandatory)
Credits	4.5 (4 ECTS credits)
Description	
Objectives	Introduction to the electronic circuits, systems and instruments concepts.
Contents	Frequency response of basic configuration. Introduction to the time constants methods. Feedback, stability and compensation. OA based systems: active filters, signal generation and processing, timing. Basic communications systems. Several laboratory sessions are included in the course.
Bibliography	Microelectronic Circuits. Sedra and Smith. Oxford Univ. Press. Operational Amplifiers and linear integrated circuits. Coughlin, Driscoll. Prentice-Hall.
Professor	Jose Luis Sanchez de Rojas
Teaching Method	Classroom teaching (theory and exercises) and laboratory assignments
Evaluation Method	Single exam

Subject Code	56132
Subject Name	Structural Analysis and Industrial Constructions
Subject term	First quarter of 5 th year
Hours per week	4
Subject type	Troncal (mandatory for obtaining the Engineer degree in Spain)
Credits	6 (5 ECTS credits)
Descripción	
Objectives	Learning of the structural behaviour of two-dimensional structural members. Introduction to numerical methods of structural analysis.

Contents	Structural behaviour of membranes, plates and shells. Matrix structural analysis. Introduction to dynamic structural analysis.
Bibliography	Stresses in plates and shells, A.C. Ugural, Mc Graw-Hill, 1999 Matrix structural analysis, W. Mc Guire et al, John Willey, 2000
Professor	Juan José López Cela
Méching Method	Classroom teaching
Evaluation Method	Mid-term and final exams

Subject Code	56133
Subject Name	Energy Technology
Subject term	First quarter of 2nd year
Hours per week	4
Subject type	Troncal (mandatory for obtaining the Engineer degree in Spain)
Credits	5 (5 ECTS credits)

Descripción	
Objectives	Conocer datos sobre consumos energéticos a escala mundial, europeo y nacional. Aplicar conceptos como el rendimiento a transformaciones globales. Conocer las principales fuentes de energía y sus interconexiones. Conocer las principales instalaciones industriales térmicas para la producción de energía mecánica y energía eléctrica. Conocer conceptos relacionados con instalaciones y acciones encaminadas al ahorro y planificación energética. Conocer los problemas fundamentales derivados de la relación entre la energía y el medio ambiente.
Contents	Introducción. Instalaciones energéticas para la producción de energía mecánica: Motores de combustión interna y externa. Instalaciones energéticas para la producción de energía eléctrica: Centrales térmicas y nucleares. Otros tipos de centrales. Ahorro y planificación energética: sistemas de cogeneración, almacenamiento energético, fundamentos de análisis exergético. Energía y medio ambiente: emisiones, legislación, tecnologías para reducir emisiones.
Bibliography	Bermúdez, V. Et al. "Tecnología Energética". SPUPV, 2000 Dorf, R. "Energy, Resources, & Policy". Addison-Wesley Pub. Co. 1979 Babcock & Wilcox "Steam. Its generation and use". Sala Lizarraga, J. "Cogeneración". SEUPV. 1999 Rizhkin, V. "Centrales Termo-eléctricas 1ª y 2ª parte". MIR, 1979.
Professor	Octavio Armas Vergel
Méching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams

Subject Code	56135
Subject Name	Environmental Science and Technology
Subject term	First term of 5 nd year
Hours per week	4
Subject type	required for the Industrial Engineer degree in Spain
Credits	6 UCLM credits (5 ECTS credits)

Description	
Objectives	Learning of different treatment methods of solid waste and liquid or gas effluents. Analyze the environmental management.
Contents	Introduction of waste waters treatments. Aerobic biological treatments. Design and operation of active sludge. Atmospheric contamination. Solid waste. Environmental management.
Bibliography	<ul style="list-style-type: none"> - Metcalf & Eddy. <i>Waste Waters Engineering</i>. Ed. McGraw-Hill, (1995) - Sanz, L.M. <i>La contaminación atmosférica</i>. MOPT, (1991) - Otero, L.R. <i>Residuos sólidos urbanos</i>. MOPT (1992)

Professor	José María Monteagudo Martínez
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Final exam

Subject Code	56136
Subject Name	Transportation Engineering.
Subject term	Second term of fifth year
Hours per week	3
Subject type	Required
Credits	4.5 (3.75 ECTS credits)

Description	
Objectives	Overview of the different fields into which transportation engineering can be divided, with special emphasis on automotive engineering.
Contents	Traffic flow. Highways. Automotive engineering: transmission, suspension, steering and lateral dynamics, brakes, aerodynamics.
Bibliography	Khisty C.J., Lall B.K.; <i>Transportation Engineering</i> . Prentice-Hall, 1990. Pintado, P.; <i>Un curso de automoción</i> . Universidad de Sevilla, 1994. Gillespie T.D.; <i>Fundamentals of Vehicle Dynamics</i> . SAE, 1992.

Professor	Publio Pintado Sanjuán
Teaching Method	Theory and problem-solving classes, assignments.
Evaluation Method	Assignment and final exam.

Subject Code	56137
Subject Name	Project Management
Subject term	First quarter of the 5th year
Hours per week	4
Subject type	Troncal (mandatory for obtaining the Engineering degree in UCLM)
Credits	6 (5 ECTS credits)

Description	
Objectives	The objective is to show the methodology, organization and management of projects.
Contents	Introduction to the Theory of Projects. Feasibility studies. Project engineering. Project management
Bibliography	-Apuntes de la asignatura "Proyectos de Ingeniería", Juan Luis Cano, E.T.S.I.I.Z., Centro Politécnico Superior, Universidad de Zaragoza, 1989. -Teoría General del Proyecto: volume 1: dirección de proyectos/project management, volume 2: dirección de proyectos/project engineering . Manuel de Cos Castillo, E.T.S.I.I.M., Universidad Politécnica de Madrid, Editorial Síntesis, 1997. -Project Management Book of Knowledge, 2 nd edition, PMI.

Professor	Javier Contreras Sanz
Teaching Method	Classroom teaching, home assignments and projects
Evaluation Method	Project evaluation and final exam

Subject Code	56141
Subject Name	Digital electronics
Subject term	Second quarter of 3 rd year
Hours per week	4
Subject type	Opcional (Optional, it belongs to the line "Electricity and Electronics")
Credits	6 (5 ECTS credits)

Description	
Objectives	Basic education in digital analysis and design.
Contents	CMOS gates. Boolean algebra. Combinational circuit analysis and synthesis. MSI integrated circuits (decoders, multiplexors, adders,...). Programmable logic devices. Sequential circuits: latches and flip flops. Sequential MSI integrated circuits (shift registers, counters). Asynchronous and synchronous sequential circuit synthesis.

Bibliography	V.P. Nelson, H.T. Nagle, B.D. Carroll, J.D. Irwin. Digital logic circuit analysis and design. Prentice Hall, 1996 J.F. Wakerly. Digital Design. Third edition. Prentice Hall, 2000
Professor	Javier Vázquez del Real
Teaching Method	Classroom teaching (theory and exercises) and laboratory assignments
Evaluation Method	Single exam

Subject Code	56142
Subject Name	Electronic Instrumentation
Subject term	Second quarter of 4 th year
Hours per week	4
Subject type	Optional: belongs to the line "Electricity and Electronics"
Credits	6 (5 ECTS credits)

Description	
Objectives	Fundamentals and applications of sensors, transducers, signal conditioning and virtual instrumentation
Contents	Virtual instrumentation and data acquisition systems. Characteristics of instruments and sensors. Sensors technologies. Measurements of Temperature, force, strain, radiation, chemical magnitudes, etc. with passive and active sensors. Several laboratory sessions are included in the course.
Bibliography	Introduction to Instrumentation and Measurements. Robert B. Northrop. CRC press. 'INSTRUMENTACIÓN ELECTRÓNICA'. M.A. Pérez / J.C. Álvarez / J.C. Campo / F.J. Ferrero / G.J. Grillo. Editorial Paraninfo
Professor	Jose Luis Sanchez de Rojas
Teaching Method	Classroom teaching (theory and exercises) and laboratory assignments
Evaluation Method	Single exam

Subject Code	56143
Subject Name	Automation Technology
Subject term	Second term of 3 th year
Hours per week	4
Subject type	Optativa de Intensificación (Electricidad y Electrónica) (elective, subject not required for the Industrial Engineer degree, but necessary for obtaining the specific degree in Electricity)
Credits	6 UCLM credits (5 ECTS credits)

Description	
Objectives	The main objective of this subject is to give an overall vision of the most commonly used technologies in the area of process automation and control. This will allow the student to identify and chose the most adequate technologies for a specific case; while the practical sessions will prepare him for their implementation.
Contents	1. Introduction. The Automation in the Industrial Processes. Part I: Microcomputer and computer in process automation. 2. Introduction; 3. Microprocessor 68000; 4. Microcontrollers. Part II: PLC's 5. Introduction to the control with PLC's; 6. PLC programming; 7. Advanced PLC programming. Design of ladder logic diagrams with Petri nets. Part III: Communication networks 8. Communications in industrial environments; 9. Field area Communications
Bibliography	
Professor	Andrés García Higuera
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams plus lab controls

Subject Code	56144
Subject Name	Industrial Informatics

Subject term	Second term of 3 rd year
Hours per week	4
Subject type	elective, subject not required for the Industrial Engineer degree (Plant Engineering)
Credits	6 UCLM credits (5 ECTS credits)
Description	
Objectives	Learning the characteristics of Industrial Hardware and Software. Programming of Industrial Informatics systems. Introduction to Data Base and SQL.
Contents	Introduction to computer architecture. Industrial Hardware. Industrial Buses. Industrial Communications. Introduction to Operative Systems. ANSI C Programming. Introduction to Relational Data Bases and SQL.
Bibliography	The VME handbook IEEE 1014 PCI Local Bus Specification Rev. 2.1. Industrial Ethernet IEEE 802.3 / 802.3u Real-Time Systems and Programming Languages. A. Burns and A. Wellings. Addison Wesley. 2001. 3 rd edition. Introducción a los sistemas de bases de datos. C.J. DATE.. 5 ^a edición. Volumen 1. Editorial Addison-Wesley.
Professor	José A. Somolinos
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams

Subject Code	56145
Subject Name	Computer Aided Design
Subject term	1st quarter of 3rd academic year
Hours per week	4
Subject type	Elective (required for Degree in Mechanical Engineering)
Credits	6 (5 ECTS)
Description	
Objectives	<ul style="list-style-type: none"> Understanding the basis of geometric modeling. Applying this knowledge for product design. Effective use of commercial CAD software.
Contents	Introduction to CAD. 2D and 3D CAD software. Curves, surfaces and solids. Techniques for surface generation. Assessing the quality of surfaces. Bézier and B-spline curves and surfaces. Emerging 3D applications: generation of virtual objects.
Bibliography	<ul style="list-style-type: none"> Sánchez-Reyes, J. (2004). Lecture notes (.pdf format). RedC@mpus, UCLM. Farin, G. (2001). Curves and Surfaces for CAGD,3rd ed.. Academic Press. Rockwood, A., Chambers, P. (1996). Interactive Curves and Surfaces. Morgan Kaufmann.
Professor	Javier Sánchez-Reyes
Teaching Method	Multimedia classroom Teaching. CAD laboratory.
Evaluation Method	Midterm and final examinations. CAD assignments.

Subject Code	56146
Subject Name	Mechanical vibrations
Subject term	Second term of 3 rd year
Hours per week	4
Subject type	Elective
Credits	6 (5 ECTS credits)
Descripción	
Objectives	To be able to interpret the vibration of mechanical systems, to model said systems, and to analyze their vibratory response. The vibration of mechanical systems, both free and forced, is studied. Emphasis is made on multi-degree of freedom systems and on engineering applications.
Contents	Free vibration of single degree of freedom systems, harmonically excited vibration, vibration of multi-degree of freedom systems, continuous systems,

	vibration measurement and applications.
Bibliography	Rao S.S.; <i>Mechanical Vibrations</i> . Addison-Wesley, 1995. Shabana A.A.; <i>Vibration of Discrete and Continuous Systems</i> . Springer, 1997.
Professor	José Manuel Chicharro Higuera
Teaching Method	Theory and problem-solving classes, as well as laboratory work and assignments
Evaluation Method	Mid-term and final exams

Subject Code	56147
Subject Name	Structural analysis of steel and concrete structures
Subject term	Second quarter of 2 th cycle
Hours per week	4
Subject type	Optative
Credits	6 (5 ECTS credits)
Descripción	
Objectives	Structural analysis of steel and concrete structures according to Spanish and European normative.
Contents	Steel and concrete structures. Tipology. Calculus basis. Spanish and European normative.
Bibliography	NBE-EA-95, EHE, Eurocodes 2, 3. La estructura metálica hoy. Teoría y práctica. Argüelles Álvarez, Librería Técnica Bellisco Proyecto y cálculo de estructuras de hormigón, J. Calavera, Intemac.
Professor	Jesús María Rodríguez Romero
Teaching Method	Classroom teaching
Evaluation Method	Mid-term and final exams

Subject Code	56148
Subject Name	Machine Elements.
Subject term	Second term of third year
Hours per week	4
Subject type	Elective
Credits	6 (5 ECTS credits)
Description	
Objectives	Understanding the theories and foundations on which machine element design and dimensioning is based. Study of the different machine elements used in machine construction.
Contents	Fatigue, contact mechanics, tribology. Shafts, screws, springs, ball bearings, belts, chains, brakes.
Bibliography	Shigley, J.E., Mischke, C.R.; <i>Diseño en Ingeniería Mecánica</i> . 5 ^a ed., McGraw-Hill, 1990. Hamrock, B.J., Jacobson, B.O., Schmid, S.R.; <i>Elementos de Máquinas</i> . McGraw-Hill, 2000.
Professor	Publio Pintado Sanjuán
Teaching Method	Theory and problem-solving classes, as well as laboratory work and assignments
Evaluation Method	Assignment and final exam.

Subject Code	56149
Subject Name	Kinematics and Dynamics of Machines.
Subject term	Second term of third year
Hours per week	4
Subject type	Elective
Credits	6
Description	
Objectives	Advanced modelling and analysis of mechanisms and machines.
Contents	Advanced dynamics. Computational Kinematics and Dynamics. Synthesis using CAD-CAE software. Modelling and analysis of mechanisms using CAD-CAE

	software.
Bibliography	Erdman A.G., Sandor G.N.; Mechanism design: Analysis and Synthesis,I, third edition. Prentice-Hall, 1997 A A. Shabana; Computacional Dynamics. John Wiley and Sons 1994.
Professor	Antonio González Rodríguez
Teaching Method	Theory and problem-solving classes, as well as laboratory work and assignments
Evaluation Method	Assignment and final exam.

Subject Code	56150
Subject Name	Chemical Technology
Subject term	Second quarter of 3 rd year
Hours per week	4
Subject type	Optative
Credits	6 (5 ECTS credits)
Description	
Objectives	Design of homogeneous and heterogeneous reactors. Introduction to Unit Operations. Study of some industrial chemical process (cement, petroleum, coal, air)
Contents	Chemical Reactor Engineering. Unit Operations. Industrial Chemistry
Bibliography	<ul style="list-style-type: none"> - Levenspiel, O. Chemical Reactor Engineering, J. Wiley. New York (1972). Traducción al castellano: Ingeniería de las reacciones químicas, Ed. Reverté S.A. Barcelona (1975). - Mc Cabe,W.L. y Smith, J.C. Unit operations of Chemical Engineering. Mc Graw Hill. Traducción al castellano: Operaciones Básicas de Ingeniería Química, Vol II, Ed. Reverté S.A. (1981). - Vian, A. Introducción a la Química Industrial. Ed. Reverté S.A.(1994).
Professor	Antonio Durán Segovia
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Final exam + voluntary work

Subject Code	56157
Subject Name	Engineering materials
Subject term	Second quarter of 4th year
Hours per week	4
Subject type	OPTATIVE
Credits	6 (5 ECTS)
Description	
Objectives	Engineering materials: Effect of thermal treatments and strengthening methods. Surface modification of materials (coatings and surface treatments). Materials selection in engineering applications.
Contents	<i>Engineering materials: Ferrous and non-ferrous alloys, ceramics, polymers and composite materials. .</i> Superficial treatments and coatings processing Materials selection.
Bibliography	Materials selection in mechanical design, Michael F. Ashby, Butterworth-Heinemann, 2000 Engineering materials, Michael F. Asbhy and David R. H. Jones, Butterworth-Heinemann, 1999 Ciencia e Ingeniería de la superficie de los materiales metálicos, A.J. Vázquez, J.J. de Damborenea, CSIC, 2001
Professor	Gloria Patricia Rodríguez Donoso

Teaching Method	Classroom teaching and laboratory assignments Industrial visits and Conferences.
Evaluation Method	Final exam. The practical classes in the lab are mandatory. It is strictly necessary to assist in order to pass the course.

Subject Code	56164
Subject Name	Computer Integrated Manufacturing
Subject term	First term of 5 th year
Hours per week	4
Subject type	Optativa de Intensificación (Organización Industrial) (elective, subject not required for the Industrial Engineer degree, but necessary for obtaining the specific degree in Industrial Management)
Credits	6 UCLM credits (5 ECTS credits)
Description	
Objectives	To give the student an overall vision of Computer Integrated Manufacturing so that he/she could: Identify those problems in need of CIM solutions To define problems in terms that are adequate to CIM To integrate CIM systems
Contents	1. Introduction to CIM; 2. Models of companies; 3. Modelling of a CIM system and its implementation; 4. Manufacturing Engineering I; 5. Manufacturing Engineering II; 6. Manufacturing Planning and Control (MPC model); 7. Production supervision and control; 8. CIM components: CAD/CAM/CAE systems; 9. Simulation; 10. Communications in Production.
Bibliography	
Professor	Andrés García Higuera
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams

Subject Code	56165
Subject Name	Facilities Planning
Subject term	First quarter of the 5 th year
Hours per week	4
Subject type	Optativa (elective, not required for obtaining the Engineer degree)
Credits	6 (5 créditos ECTS)
Descripción	
Objectives	Design of facilities of industrial complexes
Contents	Introduction to facilities planning. Plant size. Process engineering. Layout planning. Plant settlement. Industrial architecture. Facilities. Urban development. Industrial organization. Economic studies. Case study
Bibliography	-Casals Casanova, M., editor, Calvet Puig, M. D. y Roca Ramon, X., "Complejos Industriales", Servicio de Publicaciones de la UPC, Barcelona, 2001. -Gómez-Senent Martínez, E., Gómez-Senent Martínez, D., Aragonés Beltrán, P., Sánchez Romero, M. A. Y López Gómez-Senent, D., "Cuadernos de Ingeniería de Proyectos I: Diseño Básico (anteproyecto) de Plantas Industriales", Servicio de Publicaciones de la Universidad Politécnica de Valencia, Colección: Libro Docente, SPUPV-97.440, 1997. -De Heredia, Rafael, "Arquitectura y Urbanismo Industrial. Diseño y Construcción de Plantas, Edificios y Polígonos Industriales", segunda edición, Servicio de Publicaciones de la E.T.S.I.I.M., Publicaciones de la Cátedra de Construcciones Industriales, 1981. -Mata Landete, J., "Curso de Introducción al Urbanismo Industrial", Centro Politécnico Superior, Universidad de Zaragoza. Tompkins, J.A. y otros, "Facilities Planning", 3 ^a ed., Wiley Text Books, 2002.
Professor	Javier Contreras Sanz
Méching Method	Classroom teaching, home assignments and projects

Evaluation Method	Project evaluation and final exam
Subject Code	56168
Subject Name	Industrial Robotics
Subject term	First term of 5 th year
Hours per week	4
Subject type	elective, subject not required for the Industrial Engineer degree (Electric and Electronic)
Credits	6 UCLM credits (5 ECTS credits)
Description	
Objectives	Learning the mathematical description of Industrial Robots. The main robot applications in industry. Introducing to Service Robots.
Contents	Definitions/Clasifications of Industrial Robots. Kinematics, Dynamics, Trajectory Planning, Control, Programming, Simulation. Applications and Robots Market. Service Robots are introduced.
Bibliography	Barrientos A. And others. "Fundamentos de Robótica". Editorial Mc Graw Hill. 1997. "ROBOTIC TOOLBOX Release 7" It can be obtained freely from: http://www.cat.csiro.au/cmst/staff/pic/robot/ Sciavicco, Siciliano. "Modelling and Control of Robot Manipulators" Springer Verlag 2000. Somolinos, J.A. Editor "Avances en Robótica y Visión por Computador". Ed. UCLM. 2001. Ollero, A. "Robótica de Manipulación y Móvil". Editorial Marcombo. 2001
Professor	José A. Somolinos
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams
Código Asignatura	56172
Nombre Asignatura	Computer Aided Manufacturing
Duración	Second quarter of 5 rd year
Nº de horas semanales	4
Tipo Asignatura	Optional subject (no mandatory for obtaining the Engineer degree in the UCLM)
Créditos	6 (5 ECTS credits)
Descripción	
Objetivos	Learning of automation in Manufacturing, specially flexible manufacturing technology and CAD/CAM-CNC-CIM systems.
Contenido	Manufacturing automation systems. CAD/CAM systems. CNC programming. Flexible Manufacturing Systems. Automation in manufacturing.
Bibliografía	M. P. Groover, "Automation, production systems, and computer integrated manufacturing", Prentice Hall, 1987. M. P. Groover; E. W. Zimmers, "CAD/CAM: computer-aided design and manufacturing", Prentice Hall, 1984.
Profesor	Pedro J. Núñez López
Mét. Enseñanza	Classroom teaching and laboratory assignments
Mét. Evaluación	Mid-term and final exams
Subject Code	56173
Subject Name	Pneumatic and Hydraulic Systems
Subject term	Second term of 3 rd year
Hours per week	4
Subject type	Elective
Credits	6 (5 ECTS credits)
Description	
Objectives	Understanding the working principles of the standard components of pneumatic and hydraulic systems, as well as circuit and automatic system design

Contents	Basic concepts, symbols, production, distribution and treatment of pneumatic and hydraulic fluids, valves, Linear and rotating actuators, structure and development of pneumatic and hydraulic systems.
Bibliography	M.J.Pinches, B.J.Callear. "Power Pneumatics". Prentice Hall Europe. 1996 A. Serrano Nicolás. "Neumática". Paraninfo.1999 J. Roldán Vitoria. "Neumática, Hidráulica y Electricidad Aplicada". Paraninfo.2003
Professor	Publio Pintado Sanjuán Antonio Javier Nieto Quijorna
Teaching Method	Theory and problem-solving classes, as well as laboratory work and assignments
Evaluation Method	Mid-term and final exams

Subject Code	56174
Subject Name	Advanced theory of structures
Subject term	Second quarter of 2 nd cycle
Hours per week	4
Subject type	Optative
Credits	6 (5 ECTS credits)
Descripción	
Objectives	Learning of the Finite Element Method applied to structural analysis
Contents	The Finite Element Method. Bars. Beams. 2D elasticity. 3D elasticity. Bending of plates
Bibliography	The Finite Element Method, T.J.R. Hughes, Prentice-Hall, 1987
Professor	Juan José López Cela
Teaching Method	Classroom teaching and laboratory assignments with a FE code
Evaluation Method	Mid-term and final exams

Código Asignatura	56175
Nombre Asignatura	Manufacturing Engineering
Duración	First quarter of 5 th year
Nº de horas semanales	4
Tipo Asignatura	Optional subject (no mandatory for obtaining the Engineer degree in the UCLM)
Créditos	6 (5 ECTS credits)
Descripción	
Objetivos	Learning of analytical methods and fundamentals of manufacturing processes, technology aspects of non-traditional manufacturing processes, dimensional metrology and quality control in production.
Contenido	Analytical methods to study of machining processes, plastic deformation of metals, metal casting and joining processes. Dimensional metrology: length, from and surface texture. Techniques for quality control in production.
Bibliografía	M. P. Groover, "Fundamentals of modern manufacturing, Materials, Processes and Systems", Prentice Hall, 1997. S. Kalpakjian, "Manufacturing Engineering and Technology". Addison-Wesley, 2000.
Profesor	Pedro J. Núñez López
Mét. Enseñanza	Classroom teaching and laboratory assignments
Mét. Evaluación	Mid-term and final exams

Subject Code	56176
Subject Name	Thermal Engines
Subject term	Second quarter of 5 th year
Hours per week	4
Subject type	Optional
Credits	6 (5 ECTS credits)
Descripción	

Objectives	Conocer características constructivas y de funcionamiento de motores térmicos alternativos y de flujo continuo. Conocer las fundamentales relaciones causa efecto entre distintos procesos termofluidodinámicos y las prestaciones y la emisión de contaminantes. Saber determinar parámetros característicos de estos motores.
Contents	Motores alternativos: Características constructivas. Parámetros característicos. Renovación de carga. Pérdidas energéticas. Formación de mezcla y combustión. Curvas características y ensayos. Turbomáquinas: Motores de reacción. Determinación de empuje y rendimientos. Clasificación de Turbomáquinas. Ciclos de vapor y gas. Ecuación general. Aplicación de la ecuación general. Escalonamientos. Pérdidas en Turbomáquinas. Rendimientos. Métodos de regulación en Turbomáquinas.
Bibliography	Heywood, J. "Internal Combustion Engine Fundamentals" Mc Graw-Hill. 1988. Mattingly, J. "Elements of Gas Turbine Propulsion" Mc Graw-Hill. 1999. Muñoz, M., Payri, F. "Motores de Combustión Interna Alternativos" UPM. 1989 Mataix, C. "Turbomáquinas Térmicas" CIE S.L. DOSSAT 2000.
Professor	Octavio Armas Vergel
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams

Subject Code	56177
Subject Name	Energy industrial plant analysis
Subject term	First quarter of 5 th year
Hours per week	4
Subject type	optional
Credits	6 (5 ECTS credits)
Descripción	
Objectives	Learning of methods to do energy analysis of industrial plants, techniques to increase the energy efficiency
Contents	National and european energy policy. Energy systems evaluation (energy and exergy balances). Energy cost and economic analysis. The exergy method and thermoeconomy. Development of a practical study in a real company.
Bibliography	T.J. Kotas, "The exergy method of thermal plant analysis", Krieger Pub., 1995 L.A. Molina, G. Molina, "Manual de eficiencia energética térmica en la industria", Cadem, 1993.
Professor	Juan José Hernández Adrover
Teaching Method	Classroom teaching and external practical study
Evaluation Method	Final exam and evaluation of the practical study

Libre configuración

Subject Code	56180
Subject Name	Environmental Engineering Process Design
Subject term	Second term of 5 th year
Hours per week	4
Subject type	elective, subject not required for the Industrial Engineer degree
Credits	6 UCLM credits (5 ECTS credits)
Description	
Objectives	Learning of chemical, physical and biological operations, identifying the different types of operation and calculation methods for the equipment design on environmental engineering. Knowing of main characteristics of the equipments used in each operation and the influence of variables.
Contents	Fundamental concepts of unit operations. Conventional oxidation processes. Advanced oxidation processes. Catalytic converter. NO _x reduction. Industrial applications. Equipments. Aerobic and anaerobic digestion. Composting.

	Sedimentation. Ion exchange. Extraction. Membrane technology. Absorption-desorption.
Bibliography	- Ramalho, RS. <i>Tratamiento de aguas residuales</i> . Editorial Reverté, (1991) - Sanz, L.M. <i>La contaminación atmosférica</i> . MOPT, (1991) - Metcalf & Eddy. <i>Waste Waters Engineering</i> . Ed. McGraw-Hill, (1995)
Professor	José María Monteagudo Martínez
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Final exam and presentation of monographic work

Subject Code	56181
Subject Name	Signal Processing
Subject term	1 term
Hours per week	4
Subject type	Optional
Credits	6 UCLM credits (5 ECTS credits)
Description	
Objectives	Study and analysis of discrete signals, filter design and lineal system analysis both in spatial and frequency domain. Development of some practical work based on the learned concepts – application to image and speech analysis.
Contents	Signal and Systems, Fourier Transform, Z Transform, Digital Filters, FIR and IIR design. Practical Work, real applications: sound and image processing.
Bibliography	Proakis, J. G., Manolakis, D. G. <i>Digital Signal Processing</i> . (3a ed.), Prentice Hall, 1998. Oppenheim, A. V., Schaffer, R. W., Buck, J. R. <i>Discrete Signal Processing</i> (2a ed.), Prentice Hall, 2000.
Professor	Pedro Roncero y Gloria Bueno
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Practical Work + Final exam

Subject Code	56182
Subject Name	Computer Vision
Subject term	Second term of 5 th year
Hours per week	4
Subject type	Elective, subject not required for the Industrial Engineer degree Elective, subject not required
Credits	6 UCLM credits (5 ECTS credits)
Description	
Objectives	
Contents	Chapter 1. Introduction to computer vision Chapter 2. Concepts and system vision requirements. Chapter 3. Visual processing Chapter 4. Image math opera Chapter 5. Low-level image pre-processing Chapter 6. Medium level image processing Chapter 7. High level image processing
Bibliography	- <i>Tratamiento Digital de Imágenes</i> . González R., Woods C., Richard E.. Addison-Wesley/Díaz de Santos, 1996 - <i>Visión por Computador</i> . Gonzalez J. Paraninfo 2000 - <i>Visión por Computador</i> . De La Escalera, A.. Prentice-Hall 2001 - <i>Visión por Computador</i> . C. Pajares, J. M. De la Cruz ,.Rama 2001
Professor	Antonio Adán Oliver
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams

Subject Code	56183
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Subject Name	Industrial Artificial Intelligence Applications
Subject term	Second term of 5 th year
Hours per week	4
Subject type	Elective, subject not required for the Industrial Engineer degree Elective, subject not required
Credits	6 UCLM credits (5 ECTS credits)
Description	
Objectives	
Contents	<p>Chapter A: Recognition techniques</p> <ul style="list-style-type: none"> - Concepts. - Image Applications <p>Chapter B: Neural Network techniques</p> <ul style="list-style-type: none"> - Concepts. - Speech and Image Applications <p>Chapter C: Fuzzy-Logic techniques.</p> <ul style="list-style-type: none"> - Concepts. - Control Applications
Bibliography	<ol style="list-style-type: none"> 1. <i>Tratamiento Digital de Imágenes</i>. González R., Woods C., Richard E.. Addison-Wesley/Díaz de Santos, 1996. 2. <i>Reconocimiento de Formas y Visión Artificial</i>, D. Maravall Gómez-Allende, RAMA 1993. 3. <i>Reconocimiento de voz y Fonética acústica</i>, J. Bernal Bermúdez, J. Bobadilla Sancho, P. Gómez Vilda, , España, Rama 2000. 4. <i>Reconocimiento automático del habla</i>, F. Casacuberta, Enrique Vidal, España, Marcombo. 5. <i>Fuzzy Control</i>, K.N. Pasino, S. Yurkoiah, .. Addison-Wesley Ed., 1998. <p>An introduction to Fuzzy Control, Driankow,. Hellendorn, Reinkrave. Springer Ed. 1994..</p>
Professor	Antonio Adán Oliver y Gloria Bueno García
Teaching Method	Classroom teaching and laboratory assignments
Evaluation Method	Mid-term and final exams

Subject Code	86125
Subject Name	Projects I
Subject term	Second term of 2 nd cycle, preferentially on 4 th year
Hours per week	4
Subject type	Libre Configuración (elective, subject not required)
Credits	6 UCLM credits (5 ECTS credits)
Description	
Objectives	Academically supervised research projects or industry related work.
Contents	Depends on the area of knowledge related to the supervised project.
Bibliography	Depends on the area of knowledge related to the supervised project.
Professor	Javier Contreras Sanz (subject coordinator)
Teaching Method	Project related work
Evaluation Method	Evaluation of the work by the supervisor

Subject Code	86126
Subject Name	Projects II
Subject term	First term of 2 nd cycle, preferentially on 5 th year
Hours per week	4
Subject type	Libre Configuración (elective, subject not required)
Credits	13.5 UCLM credits (11 ECTS credits)
Description	
Objectives	Academically supervised research projects or industry related work.

Contents	Depends on the area of knowledge related to the supervised project.
Bibliography	Depends on the area of knowledge related to the supervised project.
Professor	Javier Contreras Sanz (subject coordinator)
Teaching Method	Project related work
Evaluation Method	Evaluation of the work by the supervisor