1st Year

Common Courses

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1. 5500001 Calculus I
2. 5500002 Algebra
3. 5500003 General Physics I
4. 5500004 Chemistry I
5. 5500005 Engineering Graphics I
6. 5000006 General Physics II
7. 5500007 Computer Science
8. 5500008 Calculus II
9. 5500009 Engineering Graphics II
10. 5500010 Chemistry II

55000001 - CALCULUS I

CREDITS:	6 ECTS
DEPARTMENT:	Industrial and Applied Mathematics (MAT)
COURSE COORDINATOR:	Víctor Muñoz Villarragut
TYPE:	Common
YEAR AND SEMESTER:	1st Year / Fall

LIST OF TOPICS

MODULE 1. Basic preliminary notions

- 1) Mathematical notation. Logical implications. Quantifiers. Mathematical induction. Problem solving techniques.
- 2) The real line. Equations, inequalities. Absolute value, distance. Functions, composition, inverse.

MODULE 2. Limits and continuity

- 3) Limits of functions. One-sided and infinite limits. Indeterminate forms. Basic notions of sequences.
- 4) Continuous functions. Intermediate value theorems. Weierstrass theorem. Continuity of the inverse.

MODULE 3. Differentiable functions

- 5) Derivative. Physical and geometric interpretation. Linear approximations. The chain rule. Differentiation of the inverse function. Leibniz's rule.
- 6) Rolle's theorem. Lagrange's mean value theorem. L'Hôpital's rule. Indeterminate forms resolution.

MODULE 4. Applications of the derivative

- 7) Graphic of a function. Computation of extrema.
- 8) Newton-Raphson's method.

MODULE 5. The integral

- 9) Construction and properties of the Riemann integral. Integrable functions. Mean value theorems for integrals.
- 10) Functions defined by integrals. Fundamental theorem of Calculus. Barrow's rule.
- 11) Computation of primitives. Integration by parts. Change of variable. Integration of rational functions.
- 12) Basic notions of improper integrals.

MODULE 6. Applications of the integral

- 13) Area under a curve. Arc length. Revolution surfaces and volumes. Moments, centers of mass and centroids.
- 14) Separable variables differential equations. The logistic equation. First order linear differential equations. Second order linear differential equations with constant coefficients. Simple and damped harmonic motions.

MODULE 7. Taylor's polynomials and series

- 15) Taylor's polynomial. Infinitesimal and Lagrange's remainders. Taylor's polynomials for elementary functions.
- 16) Basic notions of numerical series. Error estimation. Taylor's series.
- 17) Power series. Cauchy-Hadamard formula. Differentiation and integration of power series. Abel's theorem.

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC: Pre-university knowledge

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

Course Syllabi. Elective

- Manipulation of simple algebraic identities.
- Ability to operate numerically with ease.
- Knowledge of the rules of mathematical logic: equivalence, necessary and sufficient conditions, etc.
- Abstract reasoning.
- Study skills and concentration.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Ability to draw general conclusions from specific problems.
- Ability to understand the concepts of derivative and integral from a geometic and physical point of view, together with its application in problem solving.
- Ability to express in mathematical language phenomena and properties that come from the scientific world.
- To make students acquainted with inductive-intuitive reasoning, showing through geometric, physical or economic situations the need to build a mathematical model.
- Training in the reasoning of infinitesimal calculus.
- Provide students with skills in calculations with limits, derivatives and integrals of elementary functions.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

BIBLIOGRAPHY

TEXT BOOKS

R.A. Adams, C. Essex, Calculus: A Complete Course, Pearson Canada (2018).

J. de Burgos, Cálculo Infinitesimal de Una Variable, McGraw-Hill (2007).

T.W. Koerner, Calculus for the Ambitious, CUP (2014).

R.E. Larson, B.H Edwards, D.E. Heyd, R.P. Hostetler, Cálculo y geometría analítica. McGraw-Hill (1999).

OTHER MATERIALS

Colección de problemas de exámenes/ MATLAB (licencia campus)/ Fondos bibliográficos del Dpto. de Matemáticas/ Problemas de examen en la plataforma MOODLE/ Apuntes de la asignatura en MOODLE

INDUSTRIALES
ETSII | UPM

55000002 – ALGEBRA

CREDITS:	6 ECTS
DEPARTMENT:	Industrial and Applied Mathematics (MAT).
COURSE COORDINATOR:	María Elena Domínguez Jiménez
TYPE:	Common
YEAR AND SEMESTER:	1st Year / Fall

LIST OF TOPICS

MODULE 1. 1. Matrices, vector spaces and linear systems of equations

• 1) 1.1. The vector spaces Rn and Cn. 1.1.1. Vector spaces. Linear combination of vectors. Linear span. Linear dependence and independence. Vector subspaces. Intersection and sum of subspaces. Direct sum. Supplementary subspaces. 1.1.2. Basis. Dimension. The Grassmann formula.
• 2) 1.2. Matrices and linear systems of equations. 2.1. Linear applications. Matrix of a linear application. 1.2.2. Matrices. Composition of linear applications and product of matrices. Image and kernel of a matrix. Kernel and injectivity. 1.2.3 Rank. Gaussian reduction to row echelon form. Change of basis matrix. 1.2.4. Linear systems of equations. Structure of the solutions. Rouche-Frobenius theorem. Solving systems by Gaussian reduction.

MODULE 2. 2. Scalar or dot product of vectors and orthogonality

• 3) 2.3. Scalar or dot product of vectors and orthogonality. 2.3.1. Dot product and associated norm in Rn. Cauchy-Schwarz and triangular inequalities. 2.3.2. Orthogonality. The supplementary orthogonal subspace. The orthogonal projection theorem. Orthogonal sets. Orthonormal basis. Orthogonal matrices. The Gram-Schmidt ortonormalizacion method. QR factorization. 2.3.3. Extension to Cn.
• 4) 2.4- Orthogonal projections and their applications. 2.4.1. Matrix of the orthogonal projection onto a subspace. 2.4.2. The problem of least squares. Least-squares solution of a system of linear equations . Minimum norm solution of an indeterminate and compatible system. Solution of least squares and minimum norm of a system. 2.4.3. Matrix of orthogonal symmetry with respect to a subspace. 2.4.4. Rotation matrices in R2 and R3.

MODULE 3. 3. Diagonalization by similarity and unitary similarity transformations.

• 5) 3.5. Reduction by similarity of a matrix. 3.5.1. Similar matrices and diagonalizable matrices. 3.5.2. Eigenvalues and eigenvectors. Characteristic polynomial. 3.5.3 Diagonalization of matrices..Characterization of diagonalizable matrices.
• 6) 3.6 Diagonalization of real symmetric matrices. 3.6.1. Orthogonal diagonalization. Spectral theorem. Spectral decomposition. 3.6.2. Rayleigh quotient. 3.6.3. Reduction of conic equations to canonical form. 3.6.4. Condition number. Well conditioned matrices.
• 7) 3.7 Applications of diagonalization to Differential Equations and Mechanics.

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC: high school mathematics

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Geometry of the plane and 3-D space.
- arithmetic of complex numbers
- Notions of theory of sets and applications between sets.
- Polynomials: operations and calculation of roots.
- Matrices: sum, product and inversion of matrices
- Solving systems of linear equations.
- Calculation of determinants of square matrices

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Understanding of the diagonalization of matrices and their applications. Understanding of the concept of eigenvalue and eigenvector.
- Understanding of the concept of vector space and its applications.
- Understanding of changes of basis in vector spaces and their applications.
- Ability to relate linear applications between vector spaces and their associated matrices
- Concept and geometric meaning in vector spaces of projections and orthogonal symmetries and rotations.
- Understanding of the meaning and applications of the least squares and minimum norm solutions of systems of linear equations

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_3. An ability to communicate effectively with a range of audiences
- ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

OTHER MATERIALS

- Notebook written by the Professor, containing the required theory and exercises, available for the students at Moodle.
- Exams of other years, also available in Moodle.

55000003 - GENERAL PHYSICS I

CREDITS:	6 ECTS
DEPARTMENT:	Applied Physics and Materials Engineering (P&M)
COURSE COORDINATOR:	Linarejos Gámez
TYPE:	Common
YEAR AND SEMESTER:	1st Year / Fall

LIST OF TOPICS

MODULE 1. Introductory subjects

- 1) Physical magnitudes. Units and measurements
- 2) Vectors

MODULE 2. Static Physical elements

- 3) Static physical moments. Center of mass. Equilibrium equations. Friction

MODULE 3. Kinematics

- 4) Kinematics of a material point
- 5) Kinematics of rigid bodies
- 6) Relative motion

MODULE 4. Dynamics of a Material Point

- 7) Fundamental theorems of Dynamics
- 8) Work and energy (part I): gradient and potential function
- 9) Work and energy (part II): conservative forces
- 10) Central forces and gravitational field

MODULE 5. Introduction to Material Systems Dynamics

- 11) Fundamental theorems
- 12) Moments of inertia.Rotation around a fixed axis

MODULE 6. Introduction to Mechanics of Deformable Solid Body and Fluid Mechanics

- 13) Deformable solid bodies. Fluids: the hydrostatic equation
- 14) Fluids: continuity equation, Bernoulli's principle

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC: Physics and Mathematics in Bachelor.

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

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SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Know the set of physical magnitudes of interest in the context of qualifications, their definitions, measurement units and the fundamental laws involved.
- Acquire skills for answering conceptual questions and make short demonstrations, or small steps of larger ones, on set out matters, in a short period of time.
- Exercise the deductive method for demonstrations of the theorems relating to a matter and it's applications, paying special attention to the discussion of solutions.
- Solve short and long problems by applying the basic laws and definitions of the various physical concepts described.
- Acquire a unified view in different areas of physics knowing the relationships between them.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

Física Universitaria vol.1
Sears, F.W., Zemansky, M.W., Young. H.D. y Freedman, R.A. Editorial Addison-Wesley-Longman/Pearson Education.

Física General I
Sánchez Pérez, A.M. Editorial Sección de Publicaciones ETSII-UPM, 2000

Física para la Ciencia y la Tecnología
P.A. Tipler Editorial Reverté, 5ª edición Vol 1 2003 y 2

Física
M. Alonso y E.J. Finn Editorial Fondo Educativo Interamericano, Vol 1

OTHER MATERIALS

Exámenes anteriores:
http://faii.etsii.upm.es/dfaii/Docencia/Asignaturas/ALUMNOS_PRINCIPAL.html

55000004 - CHEMISTRY I

CREDITS:	6 ECTS
DEPARTMENT:	Chemical and Environmental Engineering
COURSE	(CHE)Jorge Ramírez
COORDINATOR: TYPE:	Common
YEAR AND	1st Year / Fall

LIST OF TOPICS

MODULE 1. Foundations of the chemical bond

- 1) Types of chemical bonds. Characteristics and derived properties. Intermolecular forces. (7 h)

MODULE 2. Basics of chemical processes

- 2) Introduction to mass balances. (4 h)
- 3) Mixtures and solutions. Distillation. (6 h)
- 4) Chemical kinetics. (6 h)
- 5) Chemical thermodynamics. (6 h)

MODULE 3. Chemical equilibria

- 6) Chemical equilibrium. (3 h)
- 7) Acid-base equilibria. (9 h)
- 8) Solubility equilibria. (4 h)
- 9) Electrochemistry. (8 h)
- 10) Introduction to separation processes. (2 h)

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC: Handling experimental data

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Chemical Formulation
- Basic calculus and systems of linear equations.
- Basic handling and plotting of experimental results.
- Responsibility and safety when working in the chemical laboratory.
- Solving basic chemistry exercises.
- Stoichiometry.
- Correct balancing of chemical equations.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Problem solving
- Working in the chemical laboratory (safety,data adquisition, instrumental equipment handling)
- Relationship between studied topics and everyday life

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

BIBLIOGRAPHY

TEXT BOOKS

Química. La ciencia básica.
M.D.Reboiras Editorial Thomson, 2006

Química General. Principios y aplicaciones modernas.
Petrucci y Hardwood Editorial Prentice Hall, 2002

Química. La Ciencia Central
Brown, Lemay, Bursten Editorial Prentice Hall

Química
Chang Editorial McGraw-Hill

OTHER MATERIALS

Apuntes de los Temas de la Asignatura (Servicio de Publicaciones de la ETSII), también disponibles en AulaWeb. Otro material en AulaWeb: Exámenes. Documento de Problemas resueltos. Guiones de Practicas y otras herramientas para el laboratorio. Documentación de la Biblioteca de la ETSII.

55000005 - ENGINEERING GRAPHICS I

CREDITS:	6 ECTS
DEPARTMENT:	Mechanical Engineering (MEC)
COURSE COORDINATOR:	Berta Suarez Esteban
TYPE:	Common
YEAR AND SEMESTER:	1st Year / Fall

LIST OF TOPICS

MODULE 1. Representation Systems

- 1) Introduction to technical drawing
- 2) Representation Systems
- 3) Fundamentals of descriptive geometry: point, line and plane
- 4) Distances. Leeways, twists and turns of plane
- 5) Axonometric System Fundamentals. Measuring in perspectives

MODULE 2. Operations with bodies and surfaces

- 6) Surfaces. Polyhedra, Prism, pyramid, cone, cylinder, torus
- 7) Constructive geometry of bodies
- 8) Intersections of surfaces

MODULE 3. Basic standardization

- 9) Standardization in technical drawing. European and American system of representation.
- 10) Orthogonal views. Simplified views. Selection of views. Particular views. Single uxiliary views. Simplified representations.
- 11) Cuts and sections. More frequent cuts. Special cuts.
- 12) Dimensioning: fundamental principles and procedure for dimensioning. Functional dimensioning.

MODULE 4. Introduction to drawing assemblies

- 13) Assembly Drawings. Standardization. Parts lists. Designation of standard elements.
- 14) Dismountable joints. Bolts and nuts.

MODULE 5. Principles of CAD systems

- 15) Parametric CAD systems
- 16) 3D design of parts
- 17) Development of 2D drawings from 3D parts
- 18) Practices with computer program

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:	
TOPIC:	Bachelor with technical drawing: Descriptive geometry and standard views. Vocational training: systems of representation and technical drawing

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Spatial vision
- Use of drawing instruments

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Analyze and relate the basic components (geometric primitives) of an object to understand it and define it correctly.
- Understand part drawings.
- Understand simple assembly drawings.
- Make part drawings with correct representation and dimensioning, mainly based under geometric criteria.
- Incorporate the use of technical terms in the language.
- Use computer tools to draw technical drawings.
- Graphic problem-solving.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_3. An ability to communicate effectively with a range of audiences

BIBLIOGRAPHY

TEXT BOOKS

Dibujo Técnico. Normas Básicas
Editorial AENOR, 1999

Ingeniería gráfica y diseño
Félez, J., Martínez, ML. Editorial Síntesis, 2008

OTHER MATERIALS

Own resources:

http://moodle.upm.es/titulaciones/oficiales
www.gig.etsii.upm.es/indice_gigcom.htm

Exams and additional material:
http://www.gig.etsii.upm.es

55000006 - GENERAL PHYSICS II

CREDITS:	6 ECTS
DEPARTMENT:	Applied Physics and Materials Engineering (P&M)
COURSE COORDINATOR:	Álvaro Lavín Hueros
TYPE:	Common
YEAR AND SEMESTER:	1st Year / Spring

LIST OF TOPICS

MODULE 1. Thermodynamics

- 1) Thermodynamics I
- 2) Thermodynamics II

MODULE 2. Electricity and magnetism

- 3) Electric fields I
- 4) Electric fields II
- 5) Direct electric currents
- 6) Magnetic fields I
- 7) Magnetic fields II
- 8) Electromagnetic Induction
- 9) Alternating currents

MODULE 3. Waves

- 10) Introduction to waves and mechanical waves
- 11) Maxwel equations and electromagnetic waves
- 12) Optics

MODULE 4. Modern physics

- 13) Special relativity
- 14) Introduction to the structure of matter

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE: General Physics I

TOPIC: Kinematics and Mechanics of material points and systems including the concepts of work and energy.

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Ability to study the movement of material points subjected to forces, as well as express physical, scalar or vector magnitudes, using the Cartesian, cylindrical or spherical coordinate systems.
- Basic knowledge of mathematics: solution of equations or systems of algebraic equations; elementary differential and integral calculus; properties of functions and limits.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Learn about the set of physical quantities of interest in the framework of the qualification, their definitions, units of measurement and fundamental laws involved.
- Acquire skills to answer conceptual questions and perform short demonstrations, or small steps of large demonstrations, on the matters set forth, in a short time.
- Exercise the deductive method to perform full demonstrations of theorems relating to the subject and corresponding applications, paying special attention to the discussion of its solutions.
- Solve short and long problems applying basic laws and definitions of the various described physical concepts
- Get a unified view of different areas of physics knowing the relationships between them.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

BIBLIOGRAPHY

TEXT BOOKS

Física Universitaria (con Física Moderna) Vol. 1 y 2
Young, Freedman, Sears, Zemansky Editorial Pearson Educación, 2009 (12ª Ed.)

Física para la Ciencia y la Tecnología (vol. 1, 2 y Física Mod.)
Tipler, Mosca Editorial Reverté, 2012 (6ª Ed.)

OTHER MATERIALS

- Students have at their disposal an extensive collection of pedagogical materials in the MOODLE of the subject General Physics II that include: class presentations, lessons and questionnaires of exercises and problems.
- Other teaching material provided by the physics department: previous exams with their solutions: http://faii.industriales.upm.es/docencia/asignaturas/FG2(GITI)/FG2-GITI.html

55000007 - COMPUTER SCIENCE

CREDITS:	6 ECTS
DEPARTMENT:	Automatic Control, Electrical and Electronics Engineering and Industrial Informatics (AEE)
COURSE COORDINATOR:	Raquel Martínez Fernández
TYPE:	Common
YEAR AND SEMESTER:	1st Year / Spring

LIST OF TOPICS

MODULE 1. Fundamentals.

- 1) Introduction to computer science. Coding. Working environment..

MODULE 2. Basic Programming.

- 2) Structure of a program.
- 3) Scalar data.
- 4) Expressions and operators
- 5) Flow of control.

MODULE 3. Advanced Programming

- 6) Functions.
- 7) Arrays and strings.
- 8) Pointers.
- 9) Struct data type.
- 10) Text files.
- 11) Dynamic variables and structures.

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Pre graduate mathematical knowledge and basic computer skills

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Verify the correct operation of a program
- Define the data types needed to represent the information
- Describe the concept of Operating System
- Describe the basics of programming
- Interpret the operation of the source code of a program
- Design scientists algorithms
- Implement an algorithm with a programming language

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

Programacion Estructurada en C
Antonakos, James L.; Mansfield, Kenneth Editorial Pearson Prentice Hall, 1997

Programación estructurada en C
García-Bermejo Giner, José Rafael Editorial Pearson Prentice Hall, 2008

Fundamentos de programacion en C
S.Tapia, A. Garcia-Beltran, R. Martinez, J.A. Jaén y J. del Álamo (iv Edition) Editorial Publicaciones, 2015

El lenguaje de programación C
Kernighan, Brian W. y Ritchie, Dennis M. Editorial Prentice Hall, 1991

C: Manual de Referencia (4a Edición)
Schildt, Herbert Editorial McGraw-Hill, 2001

C: A Reference Manual (5th Edition)
Harbison, Samuel y Steele, Guy Editorial Prentice-Hall, 2002

Algoritmos más Estructuras de Datos = Programas
Wirth, N. Editorial Ed. Castillo, 1996

Manual del Alumno – AulaWeb
A. García-Beltrán y R. Martínez , 2004

Introducción a la Informática
Prieto, A., Lloris, A. y Torres, J.C Editorial Editorial McGraw-Hill, 2001

Fundamentos de Informática
Ureña, L.A., Sánchez, A.M., Martín, M.T. y Mantas, J.M. Editorial Editorial RA-MA, 1997

Fundamentos de programación, Algoritmos y Estructuras de Datos
Joyanes, L Editorial McGraw-Hill, 1996

Problemas resultados de Programación en Lenguaje C
Fernández Muñoz, Javier Editorial Paraninfo, 2004

Fundamentos Estructura y Tecnología de Computadores I
Carlos de Mora Buendia y otros Editorial Editorial UNED, 2002

A Book on C: Programming in C (4th Edition)
Kelley, Al, Pohl, Ira Editorial Addison Wesley, 2000

Ejercicios de programación en C
Raquel Martínez, Angel García-Beltrán, Santiago Tapia, J.Alberto Jaén, Javier del Álamo (2 edition) Editorial Servicio de publicaciones de la ETSII , 2013

OTHER MATERIALS

Recursos propios:
http://aulaweb.etsii.upm.es

55000008 - CALCULUS II

CREDITS:	6 ECTS
DEPARTMENT:	Pablo Gómez Mourelo
COURSE COORDINATOR:	Industrial and Applied Mathematics (MAT)
TYPE:	Common
YEAR AND SEMESTER:	1st Year / Spring

LIST OF TOPICS

MODULE 1. The R^n linear space. Functions of several variables.

1.1 The R^n linear space. Inner product and Euclidean norm. Schwarz and Minkowski inequalities. Basic topology in R^n.
1.2 Graphs of functions. Parametric and implicit equations of curves and surfaces. Level sets. Limits and continuity. Compact sets and connected sets. Maxima and minima of functions.

MODULE 2. Differentiable functions (I)

2.1. Partial derivatives. Envelope of a family of curves.

2.2. Linear approximation. Differentiability. Jacobian. C^1-class functions.

2.3. Chain rule. Leibniz's formula.

2.4. Gradient. Relationship between gradient and level sets. Mean value theorem.

MODULE 3. Differentiable functions (II)

3.1. C^k-class functions. Hessian. Second-order Taylor polynomial.

3.2. Laplace's, heat and wave equations.

3.3. Inverse function theorem. Implicit function theorem.

MODULE 4. Maxima and minima of functions.

4.1. Critical points.

4.2. Quadratic forms. Sylvester's criterion.

4.3. Restricted extrema and Lagrange multipliers.

MODULE 5. Multiple integral.

5.1. Double and triple integrals. Geometric meaning and properties. Fubini's Theorem.

5.2. Change of variables. Geometric meaning of the Jacobian. Polar, elliptic, cylindrical and spherical coordinates.

5.3. Computation of areas and volumes. Moment of inertia. Pappus's centroid theorem.-

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE: Cálculo I

TOPIC: One-variable Calculus

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Being familiar with mathematical language.
- Spatial vision.
- Abstract reasoning.
- Proficiency in the use of elementary techniques of Calculus: derivatives, chain rule, antiderivatives.
- Linear Algebra.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Capacity for abstraction.
- Ability to express in mathematical language problems from the physical world and engineering.
- Ability to obtain numerical results to allow a better understanding and interpretation of natural phenomena related to the different fields of industrial engineering.
- Ability to apply analytical methods to known technical problems which appear in other fields.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_2. An ability to apply engineering design to produce solutions that meet specified needs with consideration fo public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions
- ABET_7. An ability to acquire and apply new knowledge as needed using appropriate learning strategies

BIBLIOGRAPHY

TEXT BOOKS

Cuestiones de Cálculo
Ruiz J. Editorial UPM.

Matemática superior. Problemas resueltos
Liashkó I.I. et al. Editorial URSS

Cálculo Infinitesimal
R. Riaza y A. Alvarez Editorial Sociedad de Amigos de la ETSII.UPM

Cálculo Vectorial
J. Marsden y Tromba Editorial Addison-Wesley

Introducción al Cálculo y al Análisis Matemático.
R. Courant y F. John Editorial Limusa

OTHER MATERIALS

Colección de problemas de exámenes

MATLAB (licencia campus)

Fondos bibliográficos del Dpto. de Matemáticas

Problemas de examen en la plataforma MOODLE

55000009 - ENGINEERING GRAPHICS II

CREDITS:	6 ECTS
DEPARTMENT:	Mechanical Engineering (MEC)
COURSE COORDINATOR:	Berta Suarez Esteban
TYPE:	Common
YEAR AND SEMESTER:	1st Year / Spring

LIST OF TOPICS

MODULE 1. Joint systems

- 1) Dismountable joints.
- 2) Screw/nut. Types of threads. Movement transformation by means of threaded fasteners. Bolts and screws. Nuts. Asparagus. Washers. Pins. Immobilization of screws and nuts.
- 3) Welding.

MODULE 2. Standard elements

- 3) Representation and selection of standard items. Application to:
  - Shafts
  - Keys
  - Rolling bearings
  - Gears

MODULE 3. Tolerances

- 4) Dimensional tolerances
- 5) Geometrical tolerances

MODULE 4. CAD systems

- 6) 3D Assembly designs.

MODULE 5. Creativity

- 6) Techniques of creative thinking.

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Spatial vision.
- Basic knowledge of the Solid Edge program

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Understand assembly drawings. Decomposition of an Assembly drawing in its different components.
- Make part drawings with correct representation and dimensioning.
- Incorporate the use of technical terms in the language.
- Precalculate standardized elements.
- Determination of the operating conditions of parts that fit together.
- Use computer tools
- Graphic problem-solving.
- Creativity

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_3. An ability to communicate effectively with a range of audiences

BIBLIOGRAPHY

TEXT BOOKS

Dibujo Técnico. Normas Básicas
Editorial AENOR, 1999

Tablas de elementos normalizados
Editorial Servicio de publicaciones de la ETSII

Ingeniería gráfica y diseño
Félez, J., Martínez, ML. Editorial Síntesis, 2008

OTHER MATERIALS

Own resources: http://moodle.upm.es/titulaciones/oficiales
www.gig.etsii.upm.es/indice_gigcom.htm

Exams and additional material:
http://www.gig.etsii.upm.es

55000010 - CHEMISTRY II

CREDITS:	6 ECTS
DEPARTMENT:	Chemical and Environmental Engineering (CHE)
COURSE COORDINATOR:	Pilar García Armada
TYPE:	Common
YEAR AND SEMESTER:	1st Year / Spring

LIST OF TOPICS

MODULE 1. Basics: Balances

- 1) Balance of matter and energy (7 h)

MODULE 2. Inorganic chemistry

- 2) Obtaining, properties and compounds of the elements non-metals (8 h)
- 3) Obtaining, properties and compounds of representative metals and transition (6 h)
- 4) Obtaining, properties and compounds of the semi-metallic elements (2 h)
- 5) Industrial processes of inorganic chemistry (6 h)

MODULE 3. Organic chemistry

- 6) Fundamental concepts of organic chemistry (4 h)
- 7) Hydrocarbons. (3 h)
- 8) Organic compounds: functional groups with single bond (5 h).
- 9) Organic compounds: functional groups with multiple bond (6 h).
- 10) Industrial processes of organic chemistry. (4 h)
- 11) Applications of Instrumental Analysis (5)

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC: Fundamentals of the chemical bond and chemical processes

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Elementary calculations
- Introduction to the treatment and representation of experimental results
- Spatial visualization
- Skill in the planning and resolution of problems and exercises
- Ability to organize, interpret, assimilate and develop information
- Creativity in the approach to organic synthesis

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Calculation of material and energy balances
- Work in chemical laboratory
- Instrumental equipment management
- Use of instrumental techniques and treatment of data
- Related to molecular structure and properties of the various materials
- Move the theoretical knowledge to the laboratory
- Resolution guided troubleshooting using different types of exercises
- The content studied with real-world relationship

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

BIBLIOGRAPHY

TEXT BOOKS

Organic Chemistry
Morrison y Boyd, Pearson Educación, 1998

General Chemistry. Modern Principles and Applications
Petrucci y Hardwood, Prentice Hall, 2002

Descriptive Inorganic Chemistry 2nd Ed
Geofrey Rainer-Canham, Pearson Education - Prentice Hall, 2000

Organic Chemistry. Structure and Function 5th Ed
K.P.C. Vollhardt, N. E. Schore, Omega, 2008

Introduction to Chemical Engineering
Guillermo Calleja Pardo, Síntesis, 1999

Inorganic Chemistry 4th Ed.
Shriver y Atkins, McGraw-Hill, 2008

OTHER MATERIALS

Notes, solved exams from previous courses and exercises. All available in AulaWeb, Moodle and the Department's web pages.