UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

FACOLTÀ DI INGEGNERIA

ACADEMIC YEAR 2012/2013

STUDY GUIDE

(Pursuant to *D.M. n.270 del 2004*,
to *Regolamento didattico di Ateneo*,
to *Regolamenti didattici dei Corsi di laurea*)

Napoli, July 2012

Laurea degree course in Aerospace Engineering
Class of degrees in Industrial Engineering, No. L-9

Targets of the Laurea Course and job opportunities

Aerospace Engineering is certainly one of the most advanced areas of Industrial Engineering. Stringent requirements in weight, safety and performance require continuous updating and improvement of aerospace systems design, construction and operation procedures. As a consequence, Aerospace Engineering, although focussing very specialist and dedicated topics, acts as a driving force for many sectors of engineering. As an example, it is worth noting relevant developments in propulsion, structural design and manufacturing, electronics and telecommunications recently determined by aerospace research and industrial projects.
Laurea degree in Aerospace Engineering provides necessary basics in mathematics, physics, chemistry, informatics, electrical engineering, industrial drawing, material science and technology, reliability and quality, along with adequate insights in aerospace sciences and engineering. The laurea course is aimed at furnishing a formation adequate to deal with basic problems of Industrial Engineering and to get a job in high technology and specific areas, although operating at a first level. The goal is to allow graduates in Aerospace Engineering to be able to follow technology and market evolutions which, it is worth stressing, are particularly fast in the aerospace global arena.
Typically, the graduates in Aerospace Engineering find a job in aerospace industries, in high velocity transportation systems industries, in manufacturing industries and in plant operation entities where fluid dynamics, light structures, system control, computer aided design, advanced technologies are noteworthy, in aerospace certification and air traffic management authorities, in air forces, in companies for operation of aerospace systems and relevant payloads (from airlines to small research firms for land use mapping and management), in private engineering companies.
Reference cultural areas are fluid dynamics, flight mechanics, aerospace constructions, structures, technologies, plants, systems, propulsion.
Proposed studies cover, at a first level of investigation, theoretical, numerical and experimental aspects, thus allowing the graduate to handle specific problems. In particular, the graduate in Aerospace Engineering is trained to the use of basic knowledge and methods, techniques and tools to interpret, describe and solve problems, although mainly directed to a specific area of Industrial Engineering and at first level of detail.
Finally, a graduate in Aerospace Engineering will be able to use English and be able to use basic informatics tools required for his sector of competence and for the exchange of general information.

Curriculum of the study course

The courses in *italic* indicate the activities shared by the class of laurea degrees L-9 (Industrial Engineering)

Course Title	Module Title (if applicable)	ECTS	SSD	Classification (*)	Required prior knowledge	Semester
I Year						
Calculus I		9	MAT/05	1		1st
Geometry and Algebra		6	MAT/03	1		1st
Industrial Engineering Drawing		6	ING-IND/15	2		1st
Calculus II		9	MAT/05	1	Calculus I	2nd
Chemistry		6	CHIM/07	1		2nd
General Physics	*General Physics I*	6	FIS/01	1		1st
	General Physics II	6	FIS/01	1		2nd
Elements of Computer Science		6	ING-INF/05	1		2nd
II Year						
Mathematical Physics		6	MAT/07	4	Calculus I Geometry and Algebra	1st
Gasdynamics	Thermofluidynamics	6	ING-IND/06	2	Calculus II General Physics	1st
	Gasdynamics	6	ING-IND/06	2		2nd
Aerodynamics		9	ING-IND/06	2	Calculus II General Physics	1st
Aerospace systems	Aerospace systems I	6	ING-IND/05	2	Calculus II Geometry and Algebra General Physics	1st
	Aerospace systems II	6	ING-IND/05	2		2nd
Aerospace Structures		9	ING-IND/04	2	Mathematical Physics	2nd
Flight Mechanics I	Flight Performances	6	ING-IND/03	2	Aerodynamics	1st
	Aircraft Aerodynamic Derivatives and Static Stability	6	ING-IND/03	2		1st
English language		3		5		2nd
III Year						
Electrotechnics		6	ING-IND/31	2	Calculus II General Physics	2nd
Aerospace Materials Technology	Special Technology I	3	ING-IND/16	4	Chemistry	1st
	Aerospace Materials Science and Technology	3	ING-IND/22	4		1st
Numerical Methods in Aerospace Engineering		9	ING-IND/06	2-6	Elements of Computer Science Aerodynamics Gasdynamics	1st
Aerospace propulsion		9	ING-IND/07	2	Chemistry Gasdynamics	1st
Aerospace Structural Design I		9	ING-IND/04	2	Aerospace Structures	2nd
Reliability and Quality		9	SEC-S/02	4	Calculus II	2nd
Electives		12		3		1st-2nd
Final examination		3		5		

Classification of didactical activities according to DM 270/04

Classification	1	2	3	4	5	6	7
ref. DM270/04	Art. 10 comma 1, a)	Art. 10 comma 1, b)	Art. 10 comma 5, a)	Art. 10 comma 5, b)	Art. 10 comma 5, c)	Art. 10 comma 5, d)	Art. 10 comma 5, e)

First semester electives

Course title	SSD	ECTS	Required prior knowledge
Computer Aided Aerospace Design	ING-IND/15	6	Industrial Engineering Drawing
Aerospace Structural Design II	ING-IND/04	3	Aerospace Structures
Aircraft Manufacturing Technologies	ING-IND/04	3	Aerospace Structures

Second semester electives

Course title	SSD	ECTS	Required prior knowledge
Special Technology II	ING-IND/16	3	Aerospace Materials Technology
Aviation Rules	ING-IND/04	3	
Aircraft Maintenance	ING-IND/04	3	
Structural Testing	ING-IND/04	6	Aerospace Structures

Didactic activities of the Laurea Course

Course title: Calculus I	
Course module (if applicable):	
ECTS: 9	**SSD:** MAT/05
Lectures (hrs): 40	**Tutorials (hrs):** 40
Year: I	
Course objectives: The course aims at to introduce the students to the basic concepts and methods of differential and integral calculus for real functions of one variable in order to get logic formalization and an operational aware ability	
Course content: Real number system. Complex number system. Elementary functions. Real functions of one variable: limits and their basic properties. Continuous functions : properties and main theorems. Differentiation of real functions of one variable : differentiable functions and geometrical meaning of the derivative, main theorems of differential calculus, local and global extrema, monotone criteria, concave and convex functions, study of the graph, Taylor formula.Integration : antiderivative ; techniques of integration ; definite integral ; area of a region. Numerical sequences and series. **Teacher:** *Anna Mercaldo, Anna Verde*	
Code:	**Semester:** I
Required/expected prior knowledge: None	
Education method: Lectures and tutorials	
Textbooks and learning aids: A.Alvino-G.Trombetti - *Elementi di Matematica I*, Liguori Ed.; A.Alvino -L.Carbone -G.Trombetti - *Esercitazioni di Matematica,* Vol I (parte 1e 2), Liguori Ed.; P. Marcellini - C. Sbordone - *Elementi di Analisi Matematica I*, Liguori Ed.; P. Marcellini - C. Sbordone - *Esercitazioni di Matematica,* Vol I (parte 1 e 2) Liguori Ed.;	
Assessment: written and oral examination	

Course title: Geometry and Algebra	
Course module (if applicable):	
ECTS: 6	**SSD: MAT/03**
Lectures (hrs): 40	**Tutorials (hrs): 15**
Year: I	
Course objectives: *The aim of this course is to acquire the basic notions and tecniques of Linear Algebra (matrices, determinants, linear systems) and Elementary Geometry (vectors, lines and planes).* *At the end of this course, the use of adequate methods and a correct language should improve the student skills in approaching formal problems, and in finding solutions for some problems typically arising in Geometry, by using classical Linear Algebra tools.*	
Course content: *Pointed geometric Vectors. Equivalence relations and free vectors. Operations on vectors. Few Notions on algebraic structures. Vector spaces over a field. Coordinate vector spaces and standard scalar product. Linear dependance,*	

generators, bases and dimension. Vector subspaces. Linear maps. Kernel and Image. The coordinate isomorphism. Matrices. The vector space of matrices over a field. Transposed Matrix. Symmetric, diagonal or triangular square matrices. Rank. The ordinary row-column product. Determinants: definition and main properties.
Calculation methods. Laplace and Binet theorems. Computing the rank through minors. Elementary operations on rows and columns. Triangulation methods. Invertible matrices. Linear Systems. Solvability, equivalent systems. Rouché-Capelli and Cramer theorems. How to solve a linear system. Linear systems with parameters. Matrices representing a linear map. Endomorphisms, Eigenvalues, Eigenvectors. Characteristic Polynomial. Algebraic and geometric multiplicity. Spectral theorem.
Planar geometry. Parametric and cartesian representation of a line. Direction vectors. Lines sheaves. Few notions on affine problems inside a plane: parallelism, intersection between lines. Some euclidean problems: angles, orthogonality, distances. Few notions on conics: the projective plane, classification, polarity.
Spatial geometry. Parametric and cartesian representation of a line and of a plane. Direction vectors of a line, orthogonal vectors of a plane. Plane sheaves. Few notions on
Affine problems inside a space: parallelism, intersection between lines, between a line and a plane, between planes. Some euclidean problems: orthogonality, distance between a line and a plane, how to find the common perpendicular.

Teacher: *Alma D'Aniello, Isabella Ramella*

Code:	**Semester: I**

Required/expected prior knowledge:

Education method: Lectures and tutorials

Textbooks and learning aids: L. A. Lomonaco, Un'introduzione all'algebra lineare, Ed. Aracne; lecture notes.

Assessment: Written and oral exam.

Course title: Industrial Engineering Drawing

Course module (if applicable):

ECTS: 6	**SSD: ING-IND/15**
Lectures (hrs): 25	**Tutorials (hrs): 35**

Year: first

Course objectives:
Recognize the importance of standards for reading the technical engineering drawings, taking into account shape, function, machinability, roughness and dimensional tolerance. Correct engineering drawings of parts, simple assemblies and mechanical fasteners, according to standards. Recognize that the engineering drawings and product technical documentation are closely related to design process development from the conceptual to the production phases.

Course content:
Graphic language and Design. Standardization and rules (ISO, UNI, ANSI, ecc.). Drafting standard : Sheet format (A0, ecc.), Meaning of lines, Scale of Drawing, ecc.. Classification of Projections : orthogonal, oblique, perspective. Instrumental drawing. Multiview projection and orthographic views. First angle & Third angle methods. Basic geometrical constructions. Intersection of planes and surfaces (cones, cylinders). Conic sections. Developable surfaces : parallel and radial line techniques. Development of cylinders and cones. Sectional views: full sections, half & broken out sections, offset sections, ecc.. Representation of surfaces and edges in sectional views. Conventional sectional view. Auxiliary views. Dimensioning. Basic dimension symbols. Dimension text placement. Functional, manufacturing and check dimensioning. Introduction to tolerance specification. Dimensional Tolerances. Limit dimensions, deviations and tolerances. International tolerance grade; fundamental deviations; basic hole and shaft systems. Preferred fits; general tolerances. Dimensional check : gauges and vernier calipers. Calculation of tolerances and fits. Micro geometric errors. Surface Roughness (Ra, Rz) and its representation. Classification of fasteners. Thread specifications and standards. Representation of threaded fasteners with cap screw, stud and bolt. Devices to prevent spontaneous unscrewing. Commercial bolts and nuts. Nonthreaded fasteners. Keys, feathers, pins, splined fits,

transverse keys, washers, snap rings. Classification of spur gears : shape of tooth and pitch. Gear train and its representation. Permanent fasteners. Welding representation and welding symbols. Representation of hot and cold riveted joints. Feature recognition. Execution of engineering drawings, with increasing difficulties, of parts belonging to mechanical devices and equipments.
Teacher: *Fabrizio Renno, Esamuele Santoro*
Code: / **Semester: I**
Required/expected prior knowledge:
Education method: *lectures, guided practices, discussion and comparison of case studies.*
Textbooks and learning aids: *text-books, UNI, ISO, EN Standards. Practice themes and tutorials available on teacher web-site.*
Assessment: *Evaluation of engineering drawings executed during practices, graphical personalized test and final discussion.*

Course title: Calculus II	
Course module (if applicable):	
ECTS: 9	**SSD:** MAT/05
Lectures (hrs): 45	**Tutorials (hrs):** 35
Year: I	
Course objectives: The aim of this course is to provide students with the basic concepts, aimed to applications, of differential and integral calculus for real functions of several variables in order to get an operational aware ability.	
Course content: Function sequences and series. Real and vector functions of several variables: limits, continuity and main related results. Differential calculus for real functions of several variables: differentiability and main related results, Taylor formula. Local and global extrema : necessary conditions and sufficient conditions. Multiple integration: double and triple integrals of continuous functions over a compact set, iterated integrals formula and change of variables. Regular curves and surfaces: the tangent line and the tangent plane, length of a curve and area of a surface. Line and path integrals. Gradient and irrotational vector fields. Surface integrals. Flux integrals. Divergence theorem and Stokes theorem. Implicit functions and Dini theorems. Ordinary differential equations and Cauchy problem. The existence-uniqueness theorems. First-order linear and separable differential equations. Linear differential equations. First-order linear systems.	
Teacher: *Bianca Stroffolini*	
Code:	**Semester:** II
Required/expected prior knowledge: Calculus I.	
Education method: Lectures, tutorials	
Textbooks and learning aids: N. Fusco -P. Marcellini - C. Sbordone - *Elementi di Analisi Matematica II*, Liguori Ed.; P. Marcellini - C. Sbordone - *Esercitazioni di Matematica,* Vol II (parte 1 e 2) Liguori Ed.; lecture notes.	
Assessment: written and oral examination	

Course title: Chemistry	
Course module (if applicable):	
ECTS: 6	**SSD: CHIM/07**
Lectures (hrs): 38	**Tutorials (hrs): 16**
Year: first	
Course objectives: *The knowledge of the matter nature and transformations, basis of technologies and engineering problems: materials, environment, energy...* *Identification of common features and both thermodynamic and mechanistic interpretation of the different phenomena studied in chemistry.*	
Course content: *The fundamental laws of chemistry and the atomic theory. Atomic weight. Mole and molecular weight. Chemical formulas. Balanced chemical equation and stoichiometry. Atoms electronic structure. Atomic orbitals. Periodic table. Chemical bonds. Polar covalent bonds and polar molecules. Inorganic compounds nomenclature. Ideal gas low. Gas mixtures. Gas kinetic-molecular theory. Maxwell-Boltzmann distribution. Real gases. Intermolecular forces. Liquid state. Solid state. Cohesion forces in solids. Type of solids: covalent, molecular, ionic and metallic. Amorphous solids.* *Basic elements of chemical thermodynamics. Phase changes and phase diagram of pure substances. Solubility. Mass balance in the mixing and the diluting of solutions. Solution and their properties. Chemical reactions: thermodynamics and kinetics. Collision theory. Chemical equilibrium. Equilibrium constant. Homogeneous and heterogeneous equilibrium. Acids and bases. Half-reactions. Galvanic cell. Reduction potentials. Main organic compounds.*	
Teacher: *Francesco Branda, Aniello Costantini*	
Code: 00194	**Semester: II**
Required/expected prior knowledge:	
Education method: *Lectures, tutorials*	
Textbooks and learning aids: *textbooks*	
Assessment: *Written and oral examination*	

Course title: Elements of Computer Science	
Course module (if applicable):	
ECTS: 6	**SSD: ING-INF/05**
Lectures (hrs): 45	**Tutorials (hrs): 15**
Year: 1st	
Course objectives: Learning the elements about computer architectures, fundamental data structures, tools and methods for small and medium scale computer programming for technical and scientific applications. Becoming able to designing and coding algorithms using the C++ language.	
Course content: Introduction to computer systems: hardware and software. Elementary and structured data types. Elements of Boolean algebra. Techniques for data representation in computer memory. Program development techniques. The C++ language. Tools and methods for structured programming. Functions: information exchange and variable scope. 1-D and 2-D array processing: fundamental algorithms and their computational complexity. Iterative techniques for numerical calculus.	
Teacher: *Luigi P. Cordella*	
Code:	**Semester: II**
Required/expected prior knowledge: none	

Education method: Lectures, exercises and laboratory practice.	
Textbooks and learning aids: Notes on specific topics, and the code of all the programs developed during the course are available. One or more of the following texts can be used: - B. Fadini, C. Savy, Elementi di Informatica, Liguori Ed., 1998 - S. Ceri, D. Mandrioli, L. Sbattella - Istituzioni di Informatica, linguaggio di riferimento ANSI-C, McGraw-Hill Editore, Milano, 2004 - Herbert Schildt, Guida al C++ (2a edizione), Mc Graw-Hill Editore, 2000	
Assessment: Development of a computer program and oral examination.	

Course title: General Physics	
Course module (if applicable): General Physics I	
ECTS: 6	**SSD: FIS01**
Lectures (hrs): 38	**Tutorials (hrs): 14**
Year: I	
Course objectives: *The student will acquire the fundamental concepts of Classical Mechanics, with particular reference to methodological and phenomenological aspects. Moreover he will be able to solve simple numerical exercises.*	
Course content: *Kinematics in one dimension. Vectors. Kinematics in two and three dimensions. The principle of relativity. Newton's laws of motion. Il principio di relatività galileana. The force of gravity, projectile motion. Contact forces: tension force, normal force and friction force. The inclined plane. Elastic force, harmonic oscillator. Simple pendulum. Linear momentum of a particle and impulse of a force. Angular momentum of a particle and moment of a force. Work done by a force; the theorem of kinetic energy; conservative forces and potential energy; the conservation of mechanical energy. Kepler's laws and Newton's law of universal gravitation. Dynamics of a system of particles; cardinal equations; center of mass; conservation of linear and angular momentum. Elements of dynamics of a rigid body. Elements of statics of fluids.*	
Teacher: *Riccardo Bruzzese, Salvatore Amoruso*	
Code:	**Semester: I**
Required/expected prior knowledge:	
Education method: *Lectures, tutorials*	
Textbooks and learning aids: *Textbooks*	
Assessment: *written examination*	

Course title: General Physics	
Course module (if applicable): General Physics II	
ECTS: 6	**SSD: FIS01**
Lectures (hrs): 38	**Tutorials (hrs): 14**
Year: first	
Course objectives: *The student will acquire the fundamental concepts of Electromagnetism, with particular reference to methodological and phenomenological aspects. Moreover he will be able to solve simple numerical exercises.*	

Course content: *Electric interaction. Electric charge and its conservation. Coulomb's law. Principle of superposition. Electric field. Electric potential. Electric dipole. Flux of a vector field. Gauss's law. Electric field in presence of conductors. Capacitors. Energy density of the electric field. Dielectrics. Steady currents. Ohm's law. Joule's law. Electromotive force of a battery. Kirchhoff's rules. RC circuit. Magnetic interaction. Lorentz force. Magnetic force on a current. Torque on a current loop. Moving electric charge in a magnetic field. Magnetic field of a stationary current. Magnetic field of a loop at great distance. Magnetic dipole moment. Gauss's magnetic law. Ampère's law. Magnetic materials. Faraday's law. Mutual inductance and Self-inductance . LR circuit. Energy density of the magnetic field. Displacement current. Maxwell's equations. Electromagnetic waves.*
Teacher: *Riccardo Bruzzese*

Code:	**Semester: II**
Required/expected prior knowledge: *General Physics I*	
Education method: *Lectures, tutorials*	
Textbooks and learning aids: *textbooks*	
Assessment: *written examination*	

Course title: Mathematical Physics	
Course module (if applicable):	
ECTS: 6	**SSD: MAT/07**
Lectures (hrs): 26	**Tutorials (hrs): 26**
Year: second	
Course objectives: *Acquire the basic concepts of mass geometry which allow to use at best the material and the form of the structure's elements.* *Acquire the basic concepts of statics which enable the student to analyze a structure verifying its actual isostaticity and the equilibrium.* *Provide the theoretical and practical tools and the operational strategies to calculate the constrain reactions and the stress' internal characteristic through the Cardinal Equations of Statics, the Virtual Work Principle, the Knots and Ritter methods and other graphic methods*	
Course content: **First part: Vector theory** Free vectors, dot product, cross product and mixed product. Orthogonal component, coplanarity. Double cross product. Analysis of the vectorial equation vxa=b. Applications. Fixed vectors, polar and axial moment. Variation's law of the polar moment with the point. Central axle. Vectorial field. Vector's set equivalent. **Second part: mass geometry** The centroid of a vectors set. Barycentre. Axial moment of inertia for a set of material points or continuous body, product of inertia, inertia's radius. Variation's law of the inertia's moment and of inertia's product for parallel axis and for incident axis. Central directions of inertia in one plane. Mohr's circle. Culmann's central ellipse. Inertia's tensor. Computation of the inertia's moment through inertia's tensor. Central core of inertia. Applications. **Third part: Static of structures** Lagrangian kinematic: freedom degree and lability degree. Constraint equations. Kinematical matrix. Kinematical analysis of a structure. Virtual displacement, centroid of instantaneous rotation, alignment theorems. Kinematical analysis of a structure through the centroids of instantaneous rotation. Examples of structures where the kinematical analysis calculated by centroids of instantaneous rotation is at fault. Cardinal Equations of Statics (ECS), external forces and internal forces with respect to a structure's share. Computation of the constraint reactions through the ECS and the Knots' and Ritter's methods, also related to generic trusses subject	

to every kind of forces. Gerber beams.
Virtual Work Principle (PLV), analysis of structure's equilibrium through PLV. Computation of the constraint reactions with the PLV, through Lagrange's method or Kinematic chains, also related to labile structures in equilibrium.
Inner stress (MNT) for plane structures. Computation, through the ECS, of the variation's laws of inner stress and verification of resulting values with PLV. Inner stress diagram on simple structures

Teacher: *Maurizio Gentile, Gaetano Fiore*

Code:	**Semester: I**

Required/expected prior knowledge:
Calculus I, Geometry and Algebra

Education method:
Lectures, numerical tutorials and numerical applications, seminars

Textbooks and learning aids:
Lessons' notes and guides to edit the papers are freely downloadable from the teacher's Web site: http://www.docenti.unina.it/docenti/web/index.php?id_prof=607.
Official statics coursebook: "Elementi di Statica" by B.D'Acunto and P. Massarotti - De Frede Editore Napoli. Editions: 2002 or following versions.

Assessment:
The student's knowledge will be tested through an interview. During the examination, the student is required to provide the three personalized exercises assigned to him/her in the course of the year (also known as "papers"). The verification of the student's knowledge will start with the discussion on these papers. We recommend (optional) the use of computer to edit the papers, including their graphic components (with file formats such as: Word, Latex or Power Point) and to attach a short technical description in order to improve their clarity and completeness and to make the presentation more effective. If the student does not provide the three papers, he/she will need to undergo a written test focused on the three groups of topics dealt with in the papers. In order to pass this exam, the student must provide correct answers to all submitted problems. If the student successfully discusses the papers or passes the written test, he/she will be questioned about his/her knowledge of the theoretical arguments developed during the course, which are available in the following section.
Papers acad. year 2007/08

Paper # 1 --- Fixed vectors
Analytical and graphical determination of the central axle of a system made of fixed vector and of vectorial fields.

Paper # 2 --- Mass geometry
Barycentre, inertia moments and inertia products of a composite figure built on elementary homogeneous figures, analytically calculated and graphically verified through the Mohr's circle and the Culmann's ellipse.

Paper # 3 --- Static of structures
Kinematical analysis of a structure, computation of the constrain reactions with the ECS and verification of some of these reactions through the Knots method, the Ritter method and the PLV.

Course title: Aerodynamics

Course module (if applicable):

ECTS: 9	**SSD: ING-IND/06**
Lectures (hrs): 45	**Tutorials (hrs): 35**

Year: second

Course objectives:
This course is intended to provide a basic understanding of the principles of Aerodynamics, to explain the fundamentals of the aerodynamic forces, to introduce the basic equations of the different flow regimes, to give the basic knowledge to study different aerodynamic problems, providing general concepts, such as the dimensionless characteristic numbers, the orders of magnitude analysis, the small perturbation theory.

Course content:
Introduction to flight. Lift and drag. Magnus effect. Friction and pressure drag. Earth Atmosphere. Eulerian and Lagrangian form of the equations of motion. Dimensionless characteristic numbers. Fluids kinematics. Crocco's

theorem. Bernoulli's theorem. Flow and circulation. Vorticity. Stokes, Helmholtz and Kelvin's theorems. Inviscid flows. Isoentropic relationships. Velocity-potential. Incompressible flows. Stream-function. Laplace's equation. Uniform flow. Source and sink. Vortex. Doublet. Superposition of basic solutions. The flow around a circular cylinder. Case of rotating cylinder. Small perturbation theory for thin airfoils. Airfoils nomenclature. Aerodynamic coefficients. Introduction to compressibility effects in subsonic and transonic flows. Critical Mach number. Boundary layer theory. Introduction to turbulence. Lancaster-Prandtl's theory of finite wings. Lift-drag polar of the aircraft.

Teacher: *Raffaele Savino, Renato Tognaccini*

Code:	**Semester: I**

Required/expected prior knowledge:
Calculus II, General Physics

Education method:
Lectures; tutorials with pocket calculators and personal computers; multimedia material shown with videoprojector; tutorials in laboratory using wind tunnel for measurements of aerodynamic coefficients and pressure distributions on airfoils at different angles of attack.

Textbooks and learning aids:
Book: Aerodinamica Parte I e Parte II R. Monti e R. Savino (Liguori Editore). Slides. CD with multimedia material. Photocopies of pictures and charts

Assessment:
multiple answers questions; oral examination

Course title: Flight Mechanics I

Course module (if applicable): Flight Performances

ECTS: 6	**SSD: ING-IND/03**
Lectures (hrs): 40	**Tutorials (hrs): 14**

Year: second

Course objectives:
The course goal is to furnish methodologies for the evaluation of flight and ground (take-off and landing) airplane performances. The students should be able to calculate aircraft performances (max speed, range, endurance) and to understand influence of geometrical, mass (weight) and aerodynamic parameters.

Course content:

Property of atmosphere.

Principle of aircraft flight.
Basic aircraft aerodynamics. Drag polar and parabolic drag polar.
Diagram of required thrust and required power in leveled flight.
Piston engine, turboprop and turbofan characteristics.
Thrust, power, propellers.
Level flight performances. Range and Endurance.
Climb performances. Gliding flight.
Turning performances.
Take-off and landing performances.

Teacher: *Fabrizio Nicolosi, Domenico Coiro*

Code:	**Semester: 1**

Required/expected prior knowledge:
Calculus II, Geometry and Algebra, General Physics

Education method: Lectures with exercises

Textbooks and learning aids: Course notes
Assessment: Oral examination

Course title: Flight Mechanics I	
Course module (if applicable): Aircraft Aerodynamic Derivatives and Static Stability	
ECTS: 6	**SSD: ING-IND/03**
Lectures (hrs): 40	**Tutorials (hrs): 14**
Year: second	
Course objectives: *Main scope of the course is to illustrate how to build-up the complete forces and moments acting on airplane related to both aerodynamics and propulsion.* *Furthermore semi-empirical methodologies are deeply illustrated to predict all the loads acting on the aircraft. Stick fixed and free stability is fully illustrated.* *Solved examples; Written and oral exam.*	
Course content: *Longitudinal and lateral-directional stability derivatives and their prediction.* *Longitudinal and lateral-directional manoeuvres.* *Introduction to propellers effects.* *Propulsion effect on aircraft force and moments (propellers,jets).* *Definitions of equilibrium and stability.* *Static Stability: stick fixed and stick-free.* *Control surfaces and loads (elevator, rudder, ailerons, etc.).* *Neutral point.* *Lateral-directional equilibrium and static stability.*	
Teacher: *Agostino De Marco*	
Code:	**Semester: II**
Required/expected prior knowledge: Calculus II, Geometry and Algebra, General Physics	
Education method: Lectures with exercises	
Textbooks and learning aids: Course notes	
Assessment: Oral and written examination	

Course title: Aerospace Structures	
Course module (if applicable):	
ECTS: 9	**SSD: ING-IND/04**
Lectures (hrs): 60	**Tutorials (hrs): 20**
Year: second	
Course objectives: *The course presents the basic element of the theory of elasticity with specific attention devoted to the aerospace structural concepts. At the end of the lessons, the student should be able to* ▪ *fully verify plane trusses and plane*	

- *design within a given safety margin such structures*
- *verify the shear flows in thin-walled multiconnected structure*

idealize a structure by using concentrated elements

Course content:
Stress and strain analysis. The problem of the elastic equilibrium. Local resistance criteria. De Saint Venant Theory (Simple Beam). Longitudinal Stress (centered traction/compressio). Bending. Shear. Torsion. Remarks on the solution of the isostatic structures. Classification of the structural problems. Thermal distortions and cedimenti. Remarks on the solution of the hyperstatic structures. Energy methods. Full analysis of thin-walled open and closed structures. Idealization for concentrated elements.

Teacher: *Enrico Ferrante, Sergio De Rosa*

Code:	**Semester: II**

Required/expected prior knowledge:
Mathematical Physics

Education method: *lessons, test in laboratory*

Textbooks and learning aids: *lectures prepared by Prof. E. Ferrante*

Assessment: *test, written test, final oral exam*

Course title: Gasdynamics

Course module (if applicable): Thermofluidynamics

ECTS: 6	**SSD: ING-IND/06**
Lectures (hrs): 42	**Tutorials (hrs): 12**

Year: second

Course objectives:
The introduction of physical principles of equilibrium Thermodynamics and of thermodynamic cycles; the providing of basic knowledge required for the study of Fluid Mechanics, with emphasis on its connections with Thermodynamics; the description of fundamental mechanisms of Heat Transfer.

Course content:

Equilibrium Thermodynamics. Internal Energy function. Equations of state. Gas models. First and second laws. Elementary transformations. Axiomatic approach to Thermodynamics. Fundamental relation. Stability of thermodynamic systems. Specific heats and speeds of sound. Thermodynamic Potentials. Integral balance equations for open and closed systems. Transport theorem. Mass and energy conservation. Entropy balance (second law). Momentum balance. Stress Tensor. Newtonian fluid. Stationary one-dimensional flows. Bernoulli theorem for compressible and incompressibile flows. Fluid thrust calculation. Thermodynamic cycles. Efficiency. Basics of Heat Transfer. Solution of simple one-dimensional problems in heat conduction. Thermal radiation. Emission of radiation, fundamental laws, view factors, radiation shields. Forced convection. Basics of boundary layer theory. Reynolds analogy. Nusselt number calculation for internal and external flows in both laminar and turbulent regimes. Natural convection.

Teacher: *Luigi De Luca, Giuseppe De Felice*

Code: 12940	**Semester: I**

Required/expected prior knowledge:
Calculus II, General Physics

Education method:
lectures, numerical applications, seminars

Textbooks and learning aids:
Lecture notes available for download *on the teacher website*
E. Fermi, Thermodynamics, Dover N.Y.
M.C. Potter, C.W. Somerton, Termodinamica per ingegneri, McGraw-Hill

G.M. Carlomagno, Fluidodinamica, Liguori *F.M. White, Viscous Fluid Flow, McGraw-Hill* *H.D. Baher, K. Stephan, Heat and Mass Transfer, Springer*
Assessment: *Oral examination*

Course title: Gasdynamics	
Course module (if applicable): Gasdynamics	
ECTS: 6	**SSD: ING-IND/06**
Lectures (hrs): 42	**Tutorials (hrs): 10**
Year: second	
Course objectives: *To get the student acquainted with the fundamentals of Gasdynamics and in particular the analysis of compressible flows. Training to the use of the basic methods to compute supersonic and onedimensional flows. Integral methods to solve dissipative flows with momentum and energy exchange.*	
Course content: *Molecular mean free path. Continuum assumption. Maxwellian distribution of molecular velocities. Mach number. Elements of the kinetic theory of gases. Transport coefficients. Stagnation conditions. Energy ellipse. Propagation of small pressure disturbances. Flows in variable area ducts. Normal shock waves. Normal shock waves in a perfect gas. Unsteady normal shock waves. Oblique shock waves. Supersonic flow around a wedge. Shock polar. Shock wave reflection. Conical shock waves. Prandtl and Meyer expansion. Double wedge airfoil. Nozzles. Velocity and mass flow rate in a nozzle. Convergent nozzle connected to a tank. Mass flow rate solid. Discharge of an underexpanded convergent nozzle. Convergent-divergent nozzle connected to a tank. Mass flow rate through a convergent-divergent nozzle. Discharge from a convergent-divergent nozzle. The discharging of a tank. Shock wave stability in a variable area duct. Supersonic wind tunnels. Subsonic inlets. Supersonic inlets. Rockets. Breathing engines. Fanno flow. Influence of the Mach number on a Fanno flow. Duct with a Fanno flow connected to a convergent nozzle. Duct with a Fanno flow connected to a convergent-divergent nozzle. Isothermal flow. Adiabatic wall temperature. Rayleigh flow. Influence of the Mach number on a Rayleigh flow. Duct with a Rayleigh flow connected to a convergent nozzle. Duct with a Rayleigh flow connected to a convergent-divergent nozzle.*	
Teacher: *Tommaso Astarita*	
Code:	**Semester: II**
Required/expected prior knowledge: *Calculus II, General Physics*	
Education method: *Classes and tutorials*	
Textbooks and learning aids: *G. M. Carlomagno, Fluidodinamica, Liguori Ed. (2004); Slides projected during the course*	
Assessment: *Written and oral examinations*	

Course title: Aerospace systems	
Course module (if applicable): Aerospace systems I	
ECTS: 6	**SSD: ING-IND/05**
Lectures (hrs): 40	**Tutorials (hrs): 12**
Year: second	
Course objectives:	

The course is aimed at furnishing basic elements of mathematical and physical modelling required for dynamics and control description and performance analysis of aerospace systems. Some practical integrated realizations are dealt in detail, with particular reference to aeronautics, in order to give basic knowledge adequate to design, at a preliminary stage, a controller.

Course content:

Basic elements of avionic systems: importance, functionalities, characteristics, goals. State vector concept and mathematical and physical system modelling with the state space analysis. Equilibrium points, their stability analysis, state and output equations, state transition and transfer function matrices, performance of linear or linearized systems in terms of their impulse, step and frequency response, steady state conditions. Graphical design techniques to study system performance. Applications to first and second order systems. Open and closed loop systems, linear feedback control, compensation, PID controller design by making use of analytical and graphical methods. Hydraulic actuators and servoactuators: modelling and possible realizations, mechanical and fly-by-wire solutions, application to rotation of aerodynamic control surfaces, application to design of an autopilot for longitudinal flight and pitch rotation control by introducing stiffness and damping.

Teacher: *Antonio Moccia, Giancarlo Rufino*

Code:	**Semester: I**

Required/expected prior knowledge:

Calculus II, Geometry and algebra, General Physics

Education method: *lectures and tutorials*

Textbooks and learning aids: *lecture notes*
Textbooks for further insights:
Blakelock, J.H., Automatic Control of Aircraft and Missiles, 2nd ed.,1991, John Wiley & Sons, 0-47-15065-16.
Hale, F.J., Introduction to control system analysis and design, 1988, Prentice-Hall International, ISBN 0-13-479767-1.
McLean, D., Automatic Flight Control Systems, 1990, Prentice Hall International, ISBN 0-13-054008-0.
Oppenheim, A.V., Willsky, A.S., e Young, I.T., Signals and systems, 1983, Prentice-Hall International, ISBN -0-13-811175-8.
Palm III, W.J., Modeling, analysis, and control of dynamical systems, 1983, John Wiley & Sons, ISBN 0-471-05800-9.

Assessment: *written and oral examination*

Course title: Aerospace systems

Course module (if applicable): Aerospace systems II

ECTS: 6	**SSD: ING-IND/05**
Lectures (hrs): 40	**Tutorials (hrs): 12**

Year: second

Course objectives:

The course is aimed at furnishing basic elements of mathematical and physical modelling required for studying aerospace systems astrodynamics and attitude stabilization. Some classic operative conditions are dealt in detail, with particular reference to astronautics, in order to give basic knowledge of spacecraft orbit and attitude adequate to carry out, at a preliminary stage, mission analysis of a space system.

Course content:

Fundamentals of astrodynamics: reference systems, time systems, n-body and 2-body problems, energy and angular momentum, Kepler laws and conical orbits, two- and three-dimensional trajectory equation, Kepler problem. Basics on

orbital perturbations. Examples and applications.
Fundamentals of attitude dynamics: reference systems, angular momentum and rotational kinetic energy, Euler equations and angles, transformation matrices for attitude definition, attitude kinematic equations. Linearized attitude models for three-axis stabilized spacecraft. Application to spacecraft attitude dynamics with zero external torques, axialsymmetrical and non-axialsymmetrical cases, stability conditions. Disturbing torques modelling: torques generated by aerodynamic drag, gravity gradient, magnetic field and solar radiation pressure. Stability analysis for a gravity gradient three-axis stabilized satellite in circular and elliptic orbits. Steady state gyroscopic precession and spin stabilization. Examples and applications.

Teacher: *Antonio Moccia, Michele Grassi*

Code:	**Semester: II**

Required/expected prior knowledge:

Calculus, Geometry and algebra, General Physics

Education method: *lectures and tutorials*

Textbooks and learning aids: *lecture notes*
Textbooks for further insights:
Bate, R.R., Mueller, D.D., e White, J.E., Fundamentals of astrodynamics, 1971, Dover, ISBN 0-486-60061-0.
Chobotov, V.A., Spacecraft attitude dynamics and control, 1991, Krieger, ISBN 0-89464-031-3.
Kaplan, M.H., Modern spacecraft dynamics & control, 1976, John Wiley & Sons, ISBN 0-471-45703-5.
Thomson, W.T., Introduction to space dynamics, 1986, Dover, ISBN 0-486-65113-4.
Wertz, J.R., ed., Spacecraft attitude determination and control, 1980, D. Reidel, ISBN 9-027-71204-2.

Assessment: *written and oral examination*

Course title: Aerospace Materials Technology

Course module (if applicable): Special Technology I

ECTS: 3	**SSD: ING-IND/16**
Lectures (hrs): 26	**Tutorials (hrs):**

Year: III

Course objectives:
The main scope of the course is to give the basic principia for mechanical testing procedure and the analysis of the results, the basic knowledge about Foundry Technology, plastic deformation and chip metal removal processes.

Course content:

Basic principia of metals structures
Structures and crystal lattices of metals. Crystal Defects. Defect Behaviour in metals. Plastic deformation mechanism of metals.
Mechanical characterisation of Materials
Tensile Test, Indentation Hardness Test. Impact Test. Creep Test. Fatigue Test.
Foundry Technology
Basic principia of foundry technology. Defect and remedy in foundry products.
Sand casting , shell moulding, investment casting, polycast, low and high pressure die casting , squeeze casting.
Plastic deformation: principia and process
Plastic deformation principia. Relation between work-Hardening and slip. Dislocation behaviour during plastic deformation. Ultimate stress and ultimate strain with temperature and strain rate. Deformation energy, effect of friction and complex load state. Rolling, extrusion, drawing of wire and tube and forging: processes and products.
Large-chip metal removal
Cutting-tool geometry, cutting-tool materials. Chip formation and cutting parameters. Tool Wear process and tool-life assessment. Mill and milling, turn and turning, drill and drilling

Teacher: *Carmine Colella*	
Code:	**Semester: I**
Required/expected prior knowledge: *Chemistry*	
Education method: *Lesson and laboratory tutorials*	
Textbooks and learning aids: *Course slides, Books*	
Assessment: *Written and oral examination*	

Course title: Aerospace Materials Technology	
Course module (if applicable): Aerospace Materials Science and Technology	
ECTS: 3	**SSD: ING-IND/22**
Lectures (hrs): 24	**Tutorials (hrs):**
Year: second	
Course objectives: *The main scope of the course is to highlight the relationship between physical and chemical structure of materials and their main structural and functional properties.* *Moreover the course aims at giving the basic principia about the effect of transformations on the structure of the materials.*	
Course content: *Macromolecules: atomic structure, chemical bonds, monomers and their functionality, primary structure of polymers, linear and network polymers, molecular weight determination. Synthesis of thermoplastic polymers, methods of industrial synthesis of polymers: examples of industrial polymers and their application. Solid state in polymers. Crystal state and polymorphism, amorphous state. Phase transition of polymeric materials, equilibrium conditions, I and II order transitions, crystallization and melting, glass transition temperature. Thermosetting polymers. Composite Materials.. Ceramic materials: structure and properties. Glasses: composition, structure, properties and manufacture technologies. Refractive ceramics: composition, structure, properties and manufacture technologies. Polymer and ceramic matrix composites.*	
Teacher: *Luigi Carrino*	
Code:	**Semester: I**
Required/expected prior knowledge: *Chemistry*	
Education method: *Lessons*	
Textbooks and learning aids: *Course slides, Books*	
Assessment: *Written and oral examination*	

Course title: Numerical Methods in Aerospace Engineering	
Course module (if applicable):	
ECTS: 9	**SSD: ING-IND/06**

Lectures (hrs): 12	**Tutorials (hrs): 70**
Year: III	
Course objectives: *To let the students acquire skills and ability in the usage of computers, for the resolution of elementary computing problems -associated to algebraic as well as integro-differential equations- by means of numerical techniques and symbolic tools.*	
Course content: *Scientific computing and MATLAB programming (and/or common open source dialects, e. g. OCTAVE). Elements of Linear Algebra, with reference to the numerical solution of linear systems. Employment of symbolic tools for the resolution of simple calculus problems. Theory of 1D Lagrangian interpolation. Basics of Hermitian and Spline interpolation. Theory of numerical derivation. Principles of finite differences. Basic notions of finite volumes and finite elements methods. Applications to differential equations modeling steady and unsteady convection-diffusion transport phenomena. Methods for the numerical solution of ordinary differential equations. Boundary value problems for ordinary differential equations: shooting techniques. Exercises aiming to acquire the ability of writing and testing functions and codes oriented to the simulation of 1D space-time transport phenomena and their validation by means of comparisons with analytical and symbolic solutions and/or with solutions obtained by using the above mentioned numerical tools.*	
Teacher: *Gennaro Coppola*	
Code:	**Semester: I**
Required/expected prior knowledge: Elements of Computer Science, Aerodynamics, Gasdynamics	
Education method: Lectures, Laboratory and Tutorials	
Textbooks and learning aids: *Lectures Slides*	
Assessment: Computer test and discussion	

Course title: Aerospace Propulsion	
Course module (if applicable):	
ECTS: 9	**SSD: ING-ING/07**
Lectures (hrs): 80	**Tutorials (hrs):**
Year: third	
Course objectives: *The aim of the Course is to give fundamentals in Aerospace propulsion field. Thermodynamic cycle is described and one-dimensional aero-thermo-dynamics of rigid ducts and turbo-machines is analyzed in order to give elements of all the present and future aerospace propulsion systems working . Design parameters are characterized and off design working conditions are discussed. The main problems can happen while the engine works and possible solutions are analyzed. The Course give the knowledge of the performance of the main air breathing and rocket engines nowadays used and proposed for the future in order to make students able to select the best propulsion system for a given mission.*	
Course content: *Aerospace propulsion system classification, Main propulsive parameters, Thermal engine Thermodynamic cycle. Combustion process: Equilibrium conditions. Turbo-machine fluid-dynamics: compressor, Euler theorem of turbo-machines, Turbine, compressor functional diagram.* *Fluid-dynamics of air intakes and nozzles: divergent, converging-divergent, plug nozzles, Aerospike. Off design working conditions: working line, compressor surge. Air-breathing engines: Thrust generators: nozzle: thrust reverse system, noise suppression. Propeller: blade element theory. Combustion chamber, Injectors. Turbojet, Turbofan, Turboprop, Ramjet, Scramjet. Rocket engines: chemical rockets: solid, liquid and hybrid propellants. Unconventional rockets: thermal and electrical engines. Walls thermal protection: heat transfer mechanism. Unsteady heat transfer. Main wall protection and cooling systems.*	

Teacher: *Annamaria Russo*	
Code:	**Semester: I**
Required/expected prior knowledge: Chemistry, Gasdynamics, Aerodynamics	
Education method: Lectures	
Textbooks and learning aids: Corse notes	
Assessment: write test and oral exam	

Course title: Electrotechnics	
Course module (if applicable): Electrotecnics	
ECTS: 6	**SSD: ING-IND/31**
Lectures (hrs): 38	**Tutorials (hrs): 16**
Year:	
Course objectives: The course aims to equip students with an understanding of the essential scientific and technical background for the modeling, design and operation of power electrical and electronic systems, with particular reference to the transformer and the low voltage power systems.	
Course content: The contents of the course include: i) fundamentals on circuit theory, basic laws and quantities, analysis of simple circuits; ii) fundamentals on topological analysis of circuits and formulations; iii) linear resistive circuits; iv) Analysis of linear circuits in the frequency domain. Resonance. Multiports. The ideal transformer and the mutually coupled two ports. v) Three-phase networks; vi) introduction to electrical machines; vii) transformer; viii) introduction to low voltage power systems.	
Teacher: *Claudio Serpico, Giuseppe Gentile*	
Code:	**Semester: II**
Required/expected prior knowledge: Fundamentals of linear algebra, Calculus II and General Physics	
Education method: Lectures and tutorials	
Textbooks and learning aids: Reference to textbooks and further learning aids: available on web site www.elettrotecnica.unina.it	
Assessment: The students must be able to solve simple circuits and understand the basic concepts, methodologies and theoretical results. The students have to pass a written test and an oral exam. The written test is the analysis of linear circuits and simple related problems. The oral exam is the discussion of one or more topics of the syllabus	

Course title: Aerospace Structural Design I	
Course module (if applicable):	
ECTS: 9	**SSD: ING-IND/04**
Lectures (hrs): 60	**Tutorials (hrs): 20**
Year: third	
Course objectives:	

The course introduces the fundamental methods for the aircraft and aerospace vehicles structural design and analysis. Load conditions are analyzed and calculation methods given for aerospace structures sizing and verification. Moreover, finite element and standardized calculation methodologies are introduced for non conventional structures (sandwiches, advanced composites, etc.)

Course content:
Aircraft and aerospace vehicle structural architecture. Principles of stressed skin structures. Airframe loads, flight envelope and airworthiness (EASA airworthiness standards). Theory of thin plates – small displacements (Kirchhoff). Plates subjected to bending, twisting, distributed transverse and in-plane loads. Structural instability: elastic and inelastic buckling of columns and plates. Local instability and crippling. Failure of stiffened panels. Complete and incomplete diagonal tension. Effects of structural constraints: restrained warping in thin-walled, open and closed section beams subjected to torsion and shear lag in thin-walled section beam subjected to bending and shear. Analysis of typical aircraft structural elements: flat and curved stiffened panels, bulkheads, ribs, etc. Synthesis of wing and fuselage structural design. Concepts for the design of pressurized fuselages. Introduction to the finite element method: linear static analysis of rods and beams. Introduction to aero-elasticity, fatigue and composite materials and their influence on the structural design.

Teacher: *Fabrizio Ricci*

Code:	**Semester: II**

Required/expected prior knowledge:
Aerospace Structures I

Education method: *Lessons, practical laboratory test*

Textbooks and learning aids: *Course Notes, References:*
T.H.G. Megson, Aircraft Structures for Engineering Students (Edward Arnold Edition)
Supplementary Course Material: see instructor web site http://www.docenti.unina.it/fabrizio.ricci or contact the course's instructor fabrizio.ricci@unina.it

Other references:
Michael Chun-Yung Niu, Airframe Stress Analysis & Sizing
F. Bruhn, Analysis and Design of Flight Vehicle Structures - Jacobs Publishing Inc.
P. Kuhn, Stresses in Aircraft and Shell Structures - McGraw Hill
R.M. Rivello, Theory and Analysis of Flight Structures, McGraw Hill
S. Timoshenko and S. Woinowsky-Krieger, Theory of Plates and Shells, - McGraw Hill
S. Timoshenko and J.M. Gere, Theory of Elastic stability, - McGraw Hill

Assessment: *Written tests and optional oral discussion of a course topic*

Course title: Reliability and Quality

Course module (if applicable):

ECTS: 9	**SSD: SECS-S/02**
Lectures (hrs): 60	**Tutorials (hrs): 18**

Year: third

Course objectives:
Acquisition of probabilistic and statistical methods in order to: evaluate component and system failure risks in design and management phases; check and test Reliability; choice the maintenance policy and evaluate the Life Cycle Cost; control and improve the quality of manufacturing processes; use sampling plans for deciding the quality of a lot.

Course content:
Basic concepts of probability theory. Random variables. Reliability function and its properties. Mean time to failure. Failure rate. Reliability models: origins and probabilistic approach. Drift and stress failures. Stress-Strength model. Transformation of Random Variables. Delta method.
Reliability of unrepairable system: series, parallel and stand-by structures. Fault Tree Analysis. Reliability allocation.
Reliability of repairable systems. Availability and maintainability. Renewal theory. Maintenance policies.
Experimental study of random variables and parametric inference. Failure data analysis. Complete and censored samples. Maximum Likelihood Method. Probability Plots. Non-parametric inference methods.
Reliability and economic analysis of failures. Forecasting models for Life Cycle Cost.

Basic concepts of statistical quality process control: control charts, process capability indices and acceptance sampling plans. *Seminars on RAMS (Reliability, Availability, Maintainability, Safety).*	
Teacher: *Biagio Palumbo*	
Code:	**Semester: II**
Required/expected prior knowledge: *Calculus II*	
Education method: *lectures, tutorials and seminar*	
Textbooks and learning aids: *P. Erto, 2008, Probabilità e statistica per le scienze e l'ingegneria 3/ed, McGraw-Hill*	
Assessment: *Individual written test and oral discussion focused on it.*	

Course title: Computer Aided Aerospace Design	
Course module (if applicable):	
ECTS: 6	**SSD: ING-IND/15**
Lectures (hrs): 24	**Tutorials (hrs): 36**
Year: third	
Course objectives: *To be able to utilize CAD system for obtaining geometric modelling of parts and/or assemblies. Recognize the importance and role of geometric modeling phase into the CAD/CAM process. Demonstrate an ability to use CADD system to obtain complete drawings of aerospace components, as the flat parts. Demonstrate a knowledge of ISO standards for obtaining a correct CAD drawings and understand and apply the dimensioning and tolerancing standards.*	
Course content: *Development of CAD system with reference to commercial systems. Role of CAD system to produce technical documentation: marketing, manual, customer assistance, maintenance. Introduction to Computational Geometry. Parametric formulation of lines e surfaces in three dimensional space. Ferguson's parametric cubic curves. The Bernstein polynomials and the Bézier curves. B-spline functions and B-spline curves. NURBS (Non uniform rational B-splines). Spline fitting curves . Parametric Surfaces of : revolution, Bézier, B-spline. Ruled Surfaces. Coons Surfaces. Bilinear surfaces. Offset Curves and surfaces. Developable surfaces. Geometric Modeling : wireframe, B-rep, CSG. Eulero's formula. Parametric CAD model. Co-ordinate transformations : translation, rotation, scaling. Homogeneous co-ordinates. Transformation matrices. Exchange data between CAD systems : IGES, STEP, ecc..* *Importation ed exportation of files between CAD systems. CAD modeling of parts . Analysis and build of CAD assembly modelling. . Execution of engineering drawings, with CAD systems. Mold lines (IML, OML) and flat part development. Determination of developed width of a flange. Joggling. Utilizations of parametric CAD systems (CATIA, ecc..). Drawings with CAD systems of aerospace components.* *Tolerance analysis : worst-case arithmetic and worst-case statistical methods. Relationship between cost/tolerances and introduction to tolerance synthesis. Geometric tolerancing: datums, types of geometric tolerances and their representation by CAD system.*	
Teacher: *Fabrizio Renno*	
Code:	**Semester: I**
Required/expected prior knowledge: *Technical Engineering Drawing*	
Education method: *lectures, guided practices, discussion and comparison of case studies.*	
Textbooks and learning aids: *text-books, CAD Manuals. Practice themes and tutorials available on teacher web-site.*	
Assessment: *Evaluation of engineering drawings executed during practices, graphical test and final discussions.*	

Course title: Aviation rules	
Course module (if applicable):	
ECTS: 3	**SSD: ING-IND/04**
Lectures (hrs): 20	**Tutorials (hrs): 6**
Year: third	
Course objectives: *The course presents the most significative aspects of the National and International applicable aviation rules, together with the definition of the role played by the aviation agencies in order to guarantee the compliance with them. It allows the student to become familiar with the procedure for the issueing of new rules, with the methodology implemented for their application and with the certification process of manufacturing factories, parts and products in aviation.*	
Course content: *The program course is articulated on the following topics:* *Purpose and objectives of the aviation rules and correlation between civil aviation authority and aeronautical industry or aircraft transportation companies. Navigation code and its impact on the aviation rules and aeronautical industry. ICAO: goals, rules and reccomendations. ENAC: role inside the italian and International aeronautical scenario. FAA and FAR: its influence on the italian and european aviario rules. JAA and JAR: its impact on the european rules. EASA: the role of the airworthiness agency and presentation of the main community regulations (Reg. (CE) 1592/02 ; Reg (CE) 1702/03; Reg. (CE) 2042/03). Considerations on the influence of the main aviation rules with regard to the aircraft design. Correlation between the Quality Certification System and the compliance of the design, production, maintenance and operation industries of the aeronautical product.* *Airport and airport management. Links among ENAC, ENAV, airport management systems. Regulations for the building and operation of airports. Airport certification.* *The program will address reference to real cases and will discuss real life example*	
Teacher:	
Code:	**Semester: II**
Required/expected prior knowledge:	
Education method: *Lessons, tutored visit to aircraft airworthiness agency*	
Textbooks and learning aids: *Course Notes*	
Assessment: *Oral discussion with preparation of a small engineering report*	

Course title: Aircraft Manufacturing Technologies	
Course module (if applicable):	
ECTS: 3	**SSD: ING-IND/04**
Lectures (hrs): 20	**Tutorials (hrs): 6**
Year: third	
Course objectives: *The course of Aircraft Manufacturing technologies will provide an overview of the most recent techniques of manufacturing and assembly, starting from the illustration of the principal requirements of aeronautic product up to the analysis of the in service problem solution.*	
Course content: *The program course will be articulated on:* o *Design requirements of aeronautic product with particular emphasis to the commercial aircraft problematic.* o *Metallic Alloys for aeronautic application*	

- *Composite materials for aeronautic application (from hand lay-up application up to advanced low cost techniques*
- *Manufacturing and assembly of large scale aircraft production*
- *Surface treatment*
- *Joining techniques (from classical riveting up to advanced modern welding)*
- *Testing and certification of aeronautic structures*
- *Methodology for the management of the aeronautic product and configuration control through the design evolution.*
- *Production Industrial organization*
- *Non destructive control for damage analysis*
- *Repair techniques*

The program will make reference to practical cases and will illustrate with real life example the problematic of the modern aeronautic manufacturing, making reference to the fundamentals of General Design of Aircraft, Material technology, Certification requirements and Aeronautic Structure Design.

Teacher: *Antonio Sollo*	
Code:	**Semester: I**
Required/expected prior knowledge: *Aerospace Structures I*	
Education method: *Lessons, tutored visit to aircraft factories*	
Textbooks and learning aids: *Course Notes*	
Assessment: *Oral discussion with preparation of a small industrial report*	

Course title: Structural Testing	
Course module (if applicable):	
ECTS: 6	**SSD: ING-IND/04**
Lectures (hrs): 40	**Tutorials (hrs): 12**
Year: third	
Course objectives: *The Course is a predominantly application one and provides information, tools and methods to perform experimental tests on structures and materials for aerospace applications. The course provides a curriculum that starting from the principles of experimentation, introduces the concepts of static testing, fatigue, dynamic and vibro-acoustic test of aerospace structures. Classroom lessons will be integrated with laboratory sessions for the student's direct management of the experiments.*	
Course content: *Data acquisition Systems, displacement, deformation, load, speed and acceleration transducers. Local and global experimental techniques. Standards of proof. Analysis and interpretation of experimental data. Tests on coupons and complex structures. Static tests and fatigue tests. Organizing a static test: loads analysis, methods of loads application, measurement systems. Analysis of the experimental measures and formulation of a test report. Machines for full-scale tests. Not destructive tests. Principles of dynamic and vibro-acoustic experimentation: instrumentation and measurement techniques. The laser Doppler vibrometry. Managing a test set-up: data analysis and preparation of technical reports according to the main reference standards.*	
Teacher: *Massimo Viscardi*	
Code:	**Semester: II**
Required/expected prior knowledge: *Aerospace Structures I*	

Education method: *Lessons, laboratory test, seminars*
Textbooks and learning aids: *Course Notes, References:*
Assessment: *Oral discussion with preparation of a small test report*

Course title: Special Technologies II	
Course module (if applicable):	
ECTS: 3	**SSD: ING-IND/16**
Lectures (hrs): 24	**Tutorials (hrs): 2**
Year: third	
Course objectives: *The main scope of the course is to give the basic principia of composite materials and their production technology; non conventional machining processes; non destructive testings, and the sheet working and assembly processes.*	
Course content: ***Composite materials*** *Basic principia of composite materials, Matrix and Fibres properties. Lamina properties. Production technology: Autoclave, Filament Winding, Resin Transfer Moulding – Pultrusion, Vacuum Bagging and Liquid infusion process, Compression molding, Hand lay-up e spray up, SMC e BMC.* ***Non conventional Manufacturing*** *Electro Discharge Machining (EDM). Electro Chemical Machining (ECM). Chemical Machining (CM). Ultrasound Machining (UM).* ***Non Destructive Testing*** *Ultrasound inspection. Acoustic emission. X and γ Ray. Liquid Penetrant. Eddy current. Magnetic inspection.* ***Sheet process*** *Sheet cutting. Sheet bending. Sheet drawing. Sheet forming.* ***Sheet joint process*** *Fasteners.* *Adhesive bonding.* *Arch welding (MIG e Mag).* *Laser welding.*	
Teacher: *Luigi Carrino*	
Code:	**Semester: I**
Required/expected prior knowledge: *Aerospace Materials Technology*	
Education method: *Lesson and laboratory tutorials*	
Textbooks and learning aids: *Course slides, Books*	
Assessment: *Written and oral examination*	

Course title: Aerospace Structural Design II	
Course module (if applicable):	
ECTS: 3	**SSD: ING-IND/04**

Lectures (hrs): 20	**Tutorials (hrs): 6**
Year: third	
Course objectives: *The course introduces and analyze the numerical methods for fatigue and fracture mechanics problems.*	
Course content: *Energy balance in fracture mechanics. Stress intensity factor. Crack growth rate. Safe life, fail safe and damage tolerant design criteria. Cumulative damage fatigue theories and structural life estimation. Mechanical joints.*	
Teacher: *Enrico Ferrante*	
Code:	**Semester: I**
Required/expected prior knowledge: *Aerospace Structures*	
Education method: *Lessons, exercises*	
Textbooks and learning aids: *Course Notes*	
Assessment: *written and oral exam*	

Course title: Aircraft Maintenance	
Course module (if applicable):	
ECTS: 3	**SSD: ING-IND/04**
Lectures (hrs): 28	**Tutorials (hrs):**
Year: third	
Course objectives: *To acquaint Students with Technical Operations in the field of Civil Aviation Safety, completing the aircraft design and construction virtuous circle.* *To lay emphasis on Engineering role within Air Operator / MRO Organizations and to underline the opportunities for graduates.*	
Course content: *The mission and requirements of Air Operator, operating aeroplanes for the purpose of commercial air transportation.* *The Air Operator Organization outline in the light of entrepreneurial principles and Civil Aviation Common Rules.* *The significance of aircraft "Continuing Airworthiness" and the aims of relevant Technical Operations, closely examining "Engineering" role and duties.* *The outline of Aircraft Maintenance as the most effective tool targeted on "Continuing Airworthiness".* *The Maintenance Philosophy evolution; " Maintenance Significant Items" and Maintenance tasks identification and definition criteria.* *The "Maintainability" as a primary gift of aircraft design; the Maintenance Programme development from "Maintenance Design Data" and "Constructor Instructions" through the "Maintenance Review Board" process.* *The Maintenance processes carrying out as regards aircraft, its components and engines.* *The basic factors affecting Aircraft Maintenance Reliability; "Human Factors" significance and "Quality/Safety Management System" effectiveness inside Maintenance processes and Air Operator Organization.*	
Teacher:	
Code:	**Semester: II**
Required/expected prior knowledge: *Knowledge of Construction and Airframe Theory; basic knowledge of Aircraft Systems, basic knowledge of Aircraft Engines and relevant functioning; knowledge of Aerospace Technology and fatigue/corrosion/stress-corrosion phenomena.*	
Education method: *lectures*	
Textbooks and learning aids: *slides & film clips*	
Assessment: *oral examination*	

Academic Year 2011/2012 Calendar

	Start	**End**
1st Semester	September 24, 2012	December 21, 2012
1st Exam session	December 22, 2012	March 02, 2013
2nd Semester	March 04, 2013	June 07, 2013
2nd Exam session	June 08, 2013	August 03, 2013
3rd Exam session	August 26, 2013	September 28, 2013

Representatives of the Laurea Course

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