



1 INFORMATION IDENTIFYING THE HOLDER OF THE QUALIFICATION

1.1 Family name(s)

xxxxxxx

1.2 Given name(s)

xxxxxxx

1.3 Date of birth (day/month/year)

dd/mm/yyyy

1.4 Student identification number or code (if available)

xxxxxxx

2 INFORMATION IDENTIFYING THE QUALIFICATION

2.1 Name of the qualification and (if applicable) title conferred (in original language)

Laurea in INGEGNERIA FISICA
Dottore

2.2 Main field(s) of study for the qualification

10 Industrial Engineering

2.3 Name and status of awarding institution (in original language)

Politecnico di Milano (Università statale), Piazza Leonardo da Vinci 32, 20133 Milano

Pre



Description of curriculum

CHEMISTRY A

Code: 060003
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

CHIM/07 FOUNDATIONS OF CHEMISTRY FOR TECHNOLOGIES

The programme

Basis concepts: elements and compounds, chemical formulae, mole, simple reactions, stoichiometry. Atomic structure: nucleus and electrons. Electronic structure of atoms and the periodic system. The chemical bond: Ionic bonding: crystal structure and properties of ionic compounds. Covalent bonding: molecules and covalent solids. The metallic bond: conductors and semiconductors. States of matter: description of the gaseous state by the ideal-gas equation of state and of solids and liquids by phase diagrams. Chemical thermodynamics: First and second principles of thermodynamics. Enthalpy, entropy and Gibbs free energy state functions, and their application to the calculation of the heat, spontaneity and equilibrium conditions of chemical reactions. Chemical kinetics: reaction rate. The molecular collision model of chemical reactions. Parameters affecting reaction rates. Catalysts. Reactions and equilibria in aqueous solutions: Acids, bases and acid-base equilibria. Autoprotolysis of water and the pH. Red-ox reactions. Electrochemical cells, electromotive force, standard reduction potentials, electrolysis.

EXPERIMENTAL PHYSICS A

Code: 060027
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

FIS/01 EXPERIMENTAL PHYSICS

The programme

Physical quantities and measurements: dimensions, standards and units, International System Kinematics of point-like particles: reference frames; motion in one dimension; freely falling bodies; vectors; periodic motion: harmonic motion and uniform circular motion; relative motion; Galilean and Lorentz (hints) transformation Dynamics: Newton's law of motion: principle of inertia and 2nd principle; mass and (linear) momentum; 3rd principle. Fundamental interactions. Forces: weight, constraints, friction, elastic force, central forces, inertial forces (pseudoforces) Work, power, energy: work; power; work and kinetic energy; conservative forces and potential energy Oscillatory motion: harmonic oscillator (free, damped and forced); resonance; composition of harmonic motions System of particles: impulsive forces and collisions; angular and mechanical momentum Gravitation: planetary motion and Kepler's laws; Newton's law of gravitation, potential energy; qualitative discussion of orbits; gravitational field; representation of scalar and vector fields; circulation and flux of a vector field; Gauss's law



MATHEMATICAL ANALYSIS A AND GEOMETRY.

Code: 072434
Credits: 10.00
Grade: nn
Date: dd/mm/yy

Subject groups

MAT/05 MATHEMATICAL ANALYSIS, MAT/03 GEOMETRY

The programme

Basics of logic and set theory. Real numbers. Numerical sequences and series. Cartesian coordinates. Planar and spatial vectors. Vector space and scalar product. Straight lines and planes. Parallelism and orthogonality. Linear applications. Matrices and determinants. Methods for solving linear systems. Eigenvalues and eigenvectors. Matrix diagonalization. Changes of planar and spatial coordinates. Polar coordinates. Conic sections and quadric surfaces: canonical forms. Complex numbers: operations and representations, Euler formula. Real functions of one real variable: limits and continuity (metric definition), properties of continuous functions on intervals, derivatives and differentiation rules, properties of differentiable functions on intervals, searching maxima and minima, differential, Taylor polynomial and Taylor formula, convex functions, qualitative study of the graph of a function, Riemann proper integral. Fundamental Theorem of Calculus. Integration methods. Riemann improper integrals and comparison tests.

COMPUTER SCIENCE A

Code: 061202
Credits: 10.00
Grade: nn
Date: dd/mm/yy

Subject groups

ING-INF/05 DATA PROCESSING SYSTEMS

The programme

Introductory concepts: computers architecture, algorithms, programs, languages, programming chain. C language. Base structure of a program. Variables: base types, constant, operators and type conversion. Conditional instruction: logical expressions, cycles. Functions: value and reference parameters, visibility rules, local and global variables, recursion. Vectors and matrices: data storage and access, strings. Pointers and dynamic memory: pointers as function parameters. Structures: assignment, structures as function parameters, comparison, pointers and structures. Dynamic data structures: simple list, queue, stack, double linked list, trees. Files: binary and text files, life cycle of a file. The C++ language. Objects-oriented programming: classes, methods and attributes. Visibility rules of methods and attributes. Methods and operators overloading. Constructor and destructor. Dynamic objects. Inheritance. Polymorphism. Dynamic binding. Dynamic lists and objects.



MATHEMATICAL ANALYSIS B

Code: 060098
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

MAT/05 MATHEMATICAL ANALYSIS

The programme

Topology of Euclidean Spaces. Differential and integral calculus for real functions of several variables: limits, continuity, partial derivatives, gradient, differential; unconstrained optimization; implicit functions and constrained optimization. Parametric curves, curvilinear integrals of scalar fields. Multiple integrals, parametric surfaces and surface integrals, differential forms and conservative fields. Gauss, Green, and Stokes theorems. Sequences and series of functions: pointwise and uniform convergences. Fourier series of periodic functions.

BUSINESS ECONOMICS AND ORGANIZATION D

Code: 061204
Credits: 10.00
Grade: nn
Date: dd/mm/yy

Subject groups

ING-IND/35 ENGINEERING AND MANAGEMENT

The programme

The firm: aims and context. Monitoring, planning and control tools: analysis and interpretation of the balance sheet, balance indexes, cost accounting and costing systems; investment analysis; elements of budgeting and budget variance analysis. Business management: economic value of a firm as a measure of that firm's results; main typologies of markets; business areas; decisional context, competitive differentials and basic competitive strategies. Business processes and functions; customer care process and marketing process; new product and technology development; supply management; operations. Elements of organisational designing; work division, articulation and co-ordination; main typologies of organisation and organisational methodologies.



EXPERIMENTAL PHYSICS B+C

Code: 061203
Credits: 10.00
Grade: nn
Date: dd/mm/yy

Subject groups

FIS/01 EXPERIMENTAL PHYSICS

The programme

Electric interaction: Coulomb's law and the electric field. Principle of conservation of charge. Gauss' law and the electric potential. Properties of a conductor placed in an electric field, electric capacitance and capacitors. Energy of the electric field. Behaviour of dielectric materials. Electric current in conductors: Ohm's law, electromotive force. Electrical resistance and combination of resistors. Magnetic interaction: Magnetic field. Source and properties of the magnetic field. Energy of the magnetic field. Behaviour of magnetic materials. Mechanics (part II): Dynamics of systems of particles. Elements of dynamics of a rigid body. Properties of the materials. Elasticity. Density. Pressure. Elements of fluid mechanics. Kinetic theory of gases: Ideal gas. Thermodynamics: Elements of thermology. Thermodynamic transformations. Work and heat, Joule-calorie equivalence. First law of thermodynamics. Reversible and irreversible processes. Carnot cycle and thermal engines. Second law of thermodynamics. Entropy.

STATISTICS

Code: 060103
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

MAT/06 PROBABILITY AND MATHEMATICAL STATISTICS

The programme

"Descriptive statistics. Data types. Histograms. Location indices. Dispersion indices. Chebichev inequality. Percentiles. Boxplot. Shape indices. Random variables and probability. Discrete and continuous random variables: probability density, distribution function, mean and variance. Binomial, Poisson, Uniform and Normal distributions. Poisson process and exponential distribution. Joint distributions and independence. Central Limit Theorem. Normal approximation. Point estimation. Unbiased estimators. Mean square error; relative efficiency. Tests: general setting; types of errors. Z-test for the mean of a normal population. P-value. Confidence intervals for the mean of a normal population: variance known. T-test and confidence intervals for the mean of a normal population. Tests and confidence intervals for two means. T-test for paired data. Linear models. Properties of the least square estimators. Tests and confidence intervals for the parameters of a linear model. Diagnostics; analysis of residuals. "



EXPERIMENTAL PHYSICS D

Code: 061385
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

FIS/01 EXPERIMENTAL PHYSICS

The programme

Electromagnetic induction and Faraday-Neumann-Lenz law. Self-inductance and mutual inductance. Energetic balance. Maxwell-Faraday law. Maxwell's equations. Electromagnetic waves. Waves in the absences of sources. Plane waves. Electromagnetic potentials and gauge invariance. Waves with currents and charges. Electromagnetic waves properties: intensity, polarization, phase and group velocity. Reflection and refraction. Complex refraction index, dispersion and absorption. Poynting vector and radiation pressure. Optical phenomena and light spectrum. Interference of 2/N sources. Huygens principle and Fraunhofer diffraction. Diffraction grating and prism dispersion. Elements of geometrical optics. Lecture hours: 27, Practice hours: 22, Laboratory hours 8.

ELECTRICAL ENGINEERING

Code: 060115
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

ING-IND/31 ELECTROTECHNICS

The programme

Definitions and units. Current and magnetic field: Ampe're's Law; Mechanical forces. Linear and non-linear resistors. Joule's law. Series and parallel connection, wye-delta transformation. Voltage and current division. Voltage and current sources, V-I characteristic, power, losses and efficiency. Series and parallel connection. D.C. Analysis of Electrical Circuits. Ohm's law. Kirchhoff's laws. Superposition, Thevenin, Northon theorems. Conservation of energy. Non-linear circuits. Properties of dielectric materials. Capacitance. Properties of magnetic materials. Farady's law. Inductance. Self and mutual inductance. Coupled inductors. Transient Analysis: First order Circuits. Steady-state A.C. Circuits. Rms value. Complex numbers, phasor notation and graphic representation. Impedance and admittance. Equivalent circuits. Power in the sinusoidal steady-state: instantaneous and average power; active and reactive power. Boucherot's method.



MATHEMATICAL ANALYSIS D

Code: 061217
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

MAT/05 MATHEMATICAL ANALYSIS

The programme

Analytic functions of one complex variable and power series. Banach and Hilbert spaces. Lebesgue integral. Elementary theory of distributions. Convolution product. L1 and L2 Fourier. Fourier transform of tempered distributions. Laplace transform. Z-transform. Linear difference equations: solutions in closed form, discrete convolution. Linear filters, causal filters. Fundamental theorem of filters. Transfer function. Stability. Shannon sampling theorem. Fourier transform of impulse trains and periodic signals. Sobolev spaces of periodic functions.



FUNDAMENTALS OF AUTOMATIC CONTROL I

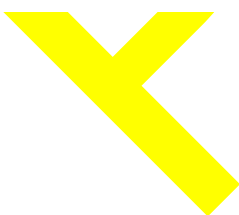
Code: 061146
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

ING-INF/04 AUTOMATICS

The programme

Introduction to control problems: basic concepts and examples; open and closed loop control; the role of feedback. Continuous time dynamic systems: state and input-output representations; movement; equilibrium; stability; linearization; frequency and time domain analysis of time invariant linear systems. Control systems: stability and performance analysis of a control system; outline of the controller design problem; industrial PID controllers.





MATHEMATICAL ANALYSIS C

Code: 061382
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

MAT/05 MATHEMATICAL ANALYSIS

The programme

Ordinary differential equations: Cauchy problem, existence and uniqueness, continuous dependence on data, regularity and extension of the solution. Qualitative study of solutions to first order differential equations. Representation of solutions to linear systems of differential equations. Continuous dynamical systems: phase space, stability of first order autonomous systems, stability analysis in the linear case and in the nonlinear case (linearization and Lyapunov method). Discrete dynamical systems: graphical and qualitative analysis, equilibria and periodic orbits, stability criteria, bifurcation, logistic growth, chaotic phenomena.

ELECTRONIC MEASUREMENTS

Code: 061213
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

ING-INF/07 ELECTRIC AND ELECTRONIC MEASUREMENT SYSTEMS

The programme

Metrology: principles of measurements; International System of units (SI); reference standards based on quantum phenomena and natural constants; logarithmic units; graphic representation of experimental data. Analysis of measurement data: probability density function, mean, variance, correlated variables, and measurement uncertainty; compatibility between measurements and weighted mean value. Interpolation and regression of measurement data. Data acquisition systems: sampling and A/D conversion; characteristics and working principles of ADCs (speed, resolution, quantization uncertainty, number of equivalent bits); structure of the most common A/D and D/A converters; properties and use of DAQ systems; use of LabVIEW for automated measurements. Instrumentation: oscilloscopes (analog and digital); power meters (electrical and optical); spectrum analyzers (digital and analog; optical spectrum analyzers); the monochromator; the autocorrelator for measuring optical pulses.



FUNDAMENTALS OF THE PHYSICS OF MATTER

Code: 061386
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

FIS/01 EXPERIMENTAL PHYSICS

The programme

Introduction of the spin and the discussion of the hydrogen atom in the presence of spin (with experimental evidences). The general methods of quantum mechanics: the correspondence between observables and operators, the meaning of the eigenvalues, the expectation values. The identical particles in quantum mechanics. The two electron system: the one dimensional box and the Helium atom with experimental evidences. The atoms with many electrons in the mean field description. The periodic table of the elements. The quantum description of the chemical bond. The hydrogen molecule. Fundamentals on the optical spectroscopy of molecules.

INTRODUCTION TO ELECTRONICS

Code: 070487
Credits: 10.00
Grade: nn
Date: dd/mm/yy

Subject groups

ING-INF/01 ELECTRONICS

The programme

Basics of physics and engineering of electronic devices: semiconductors, doping, Fermi diagrams, charge transport, junction diode, bipolar transistor, MOS structure, MOSFET, CCDs. Integrated circuit technology and corresponding parasitic devices. Elementary circuits: electrical modeling of electronic devices; large- and small-signal equivalent circuits. Sample&hold; basic digital gates in n-MOS and CMOS technology; elementary BJT and MOS amplifiers; power and speed estimates. Circuit simulators and their use. Operational amplifiers: definitions, most important linear and nonlinear applications; interpretation as a feedback system; frequency and step response, stability and compensation, positive feedback circuits. Nonidealities and their effects. Cascaded amplifiers: impedance load, overall gain. Circuits for data acquisition: examples; sensors, semiconductor detectors, introduction to noise filtering.



THERMAL SCIENCE

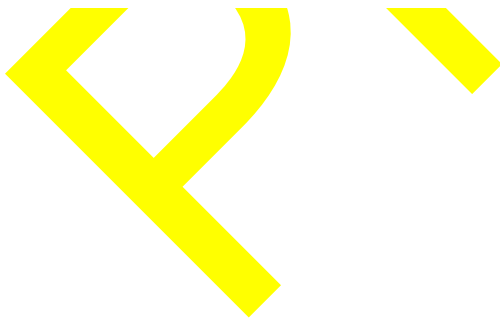
Code: 060108
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

ING-IND/10 TECHNICAL PHYSICS

The programme

Fundamentals: systems, states and properties; processes and interactions between systems; first law: internal energy, energy balance; equilibrium and not-equilibrium states; second law: available energy; entropy, highest-entropy principle, entropy balance; conditions for mutual equilibrium between systems: temperature and pressure; U-S graph, quasi-static processes. Properties of substances: enthalpy; specific heats and volumetric coefficients; state equations for homogeneous systems: ideal gases and incompressible liquids and solids; heterogeneous systems: phases and phase transitions, the phase rule, triple point; critical state; p-T and T-s state diagrams. Engineering thermodynamics: control volume; mass, energy and entropy balances; availability functions; shaft work; analysis of conversion devices: turbines, compressors, pumps, throttles; cycles and processes for power and refrigeration plants: air-standard cycles (Otto, Joule-Brayton); vapor-power cycle (Rankine); vapor-compression cycle. Conduction: heat flux; the Fourier's law; thermal conductivity; the heat diffusion equation; one-dimensional steady-state solutions for plane and cylindrical geometry; electrical analogy and equivalent thermal network; extended surfaces; transient conduction: the lumped capacitance method, dimensionless heat-conduction parameters. Convection: introductory concepts; dimensional analysis and dimensionless parameters; forced convection in internal and external flows; some correlations for heat transfer coefficient and friction factor; introduction to free convection. Heat exchangers. Electronics cooling. Radiation: thermal radiation; black body radiation; surface absorption, reflection and transmission; the Kirchhoff law; the gray surface; radiation exchange between gray surfaces; selective surfaces.





PHYSICS OPTICS

Code: 079729
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

FIS/01 EXPERIMENTAL PHYSICS

The programme

Non-linear optics. Radiation-matter interaction in non-linear regime: the anharmonic oscillator model and its solution in the perturbation regime. Calculation and property of second order non linear susceptibility. Plane wave propagation in non linear media and phase matching problem. Second order non-linear effects: (i) second harmonic generation (efficiency and propagation in anisotropic media); (ii) parametric effects; (iii) sum frequency generation. Vibrational modes in crystals and Raman effect. Calculation of third order non linear susceptibility. Third order non-linear effects: (i) third harmonic generation; (ii) Kerr effect. Diffractive optics. Scalar diffraction theory and plane wave spectrum. Fresnel and Fraunhofer approximations. Fourier transforming properties of lenses and spatial filtering. Impulsive response of a lens and of an optical system. Holography (hints).

QUANTUM MECHANICS

Code: 061387
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

FIS/01 EXPERIMENTAL PHYSICS

The programme

The crisis of classical physics (in particular: photoelectric effect, Compton effect, electron diffraction). The De Broglie formula. The Heisenberg principle and its experimental basis. The principle of superposition of the states. The wave function and the probabilistic interpretation. The equation for the energy eigenvalues. The temporal evolution. Simple Schrodinger problems in one dimension for one electron: potential wells and potential barriers. Harmonic oscillator. General properties of wave function of a single electron in a potential well in one dimension. Experimental evidence connected with the above problems (quantum wells and barriers). The classical limit of quantum mechanics. Problems in spherical symmetry: hydrogen-like systems in the approximation without spin. Fundamentals of spectroscopy of the hydrogen atom.



PHYSICAL TECHNOLOGIES

Code: 061395
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

FIS/01 EXPERIMENTAL PHYSICS

The programme

The course is aimed to give an overview of all the most relevant experimental methods used in the field of material science, with a special emphasis on its application to nanotechnologies. The guidelines of the course will be the realization of an experiment whose different aspects will be considered. More precisely, the course will cover the following topics: 1) technique for obtaining and maintaining vacuum; 2) thin films deposition techniques; 3) X-rays and electron diffraction; 4) electron spectroscopies for characterizing the chemical composition and the valence electron states; 5) electron microscopy techniques; 6) magnetic properties characterization techniques; 7) computer assisted data acquisition and experiment control.

STAGE

Code: 072428
Credits: 9.50
Grade: nn
Date: dd/mm/yy

Subject groups

Unavailable

The programme

Unavailable

Credits validated for activities carried out during an international exchange period at:

xxxxxxxxxxxxxxxxxxxxxx - xxxxxxxxxxxxxxxxxxxx (FRANCIA)

Type of scheme: DOPPIA LAUREA UE

Period: from dd/mm/yyyy to dd/mm/yyyy

Courses

STAGE OPERATEUR



PRINCIPLES OF LASERS

Code: 061392
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

FIS/03 MATERIAL PHYSICS

The programme

Spontaneous decay, stimulated emission, absorption. Condition for laser oscillation. Energy levels, radiative and non radiative transitions in atoms, ions, molecules, and semiconductors. Gaussian Beam propagation and modes of stable optical resonators. Stable and unstable resonators. Optical and electrical pumping systems. Rate equations and continuous wave laser behavior. Multimode oscillation and single mode selection. Transient laser behavior: relaxation oscillations, Q-switching, Mode-locking.

Credits validated for activities carried out during an international exchange period at:

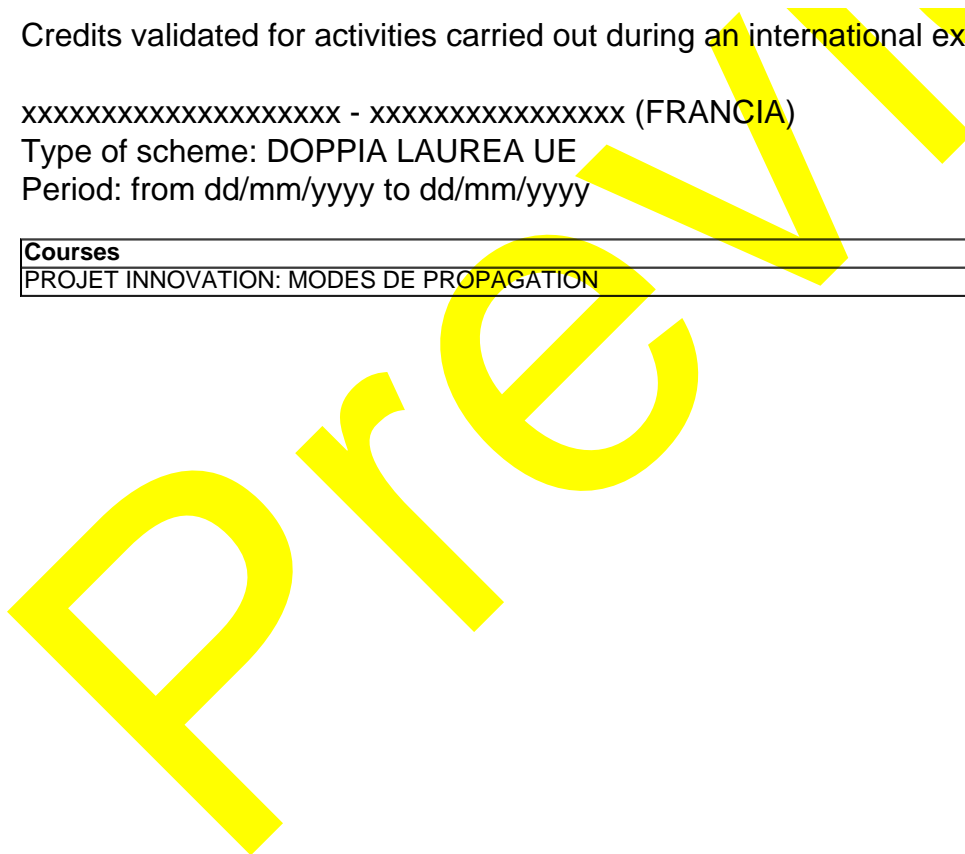
xxxxxxxxxxxxxxxxxxxxxxxx - xxxxxxxxxxxxxxxxxxxx (FRANCIA)

Type of scheme: DOPPIA LAUREA UE

Period: from dd/mm/yyyy to dd/mm/yyyy

Courses

PROJET INNOVATION: MODES DE PROPAGATION





FUNDAMENTALS OF TELECOMMUNICATIONS I

Code: 061388
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

ING-INF/03 TELECOMMUNICATIONS

The programme

Introduction to communication systems: system model, sources of information and signals. Signal classification. Fourier analysis for continuous signals. Sampling theorem. Impulse response and frequency response of a linear time-invariant system. Logarithmic representation: Decibel. Fundamentals of probability and random processes. Analog to digital conversion (Pulse Code modulation): sampling, quantization and coding. The Entropy of a numerical source, lossy and lossless source coding, examples of real compression techniques. Baseband pulse transmission: matched filter, error rate due to noise, intersymbol interference, Nyquist criterion, multilevel transmission. Passband digital transmission: transmission model, coherent amplitude or phase or frequency shift keying, quadrature amplitude modulation schemes. Basic notes on error-control coding (channel coding). Multiple-access techniques: time division, frequency division, code division. Examples of transmission systems.

Credits validated for activities carried out during an international exchange period at:

xxxxxxxxxxxxxxxxxxxxxx - xxxxxxxxxxxxxxxxxxxxx (FRANCIA)

Type of scheme: DOPPIA LAUREA UE

Period: from dd/mm/yyyy to dd/mm/yyyy

Courses
SYSTEMES D'INFORMATION
SYSTEMES EMBARQUES



MANUFACTURING

Code: 070485
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

ING-IND/16 PRODUCTION TECHNOLOGIES AND SYSTEMS

The programme

Industrial manufacturing processes and related problems. Machining errors and imposed tolerances. Design of mechanical parts. Materials of relevant interest. Quality control of a manufactured part. Measuring systems of macro and micro geometrical errors. Analysis of manufacturing processes. Foundry processes with permanent and transient models. Forming processes. Chip removal processes: turning, milling, drilling and grinding. Basics of industrial application of lasers to material processing. Plastic materials processing: injection moulding.

Credits validated for activities carried out during an international exchange period at:

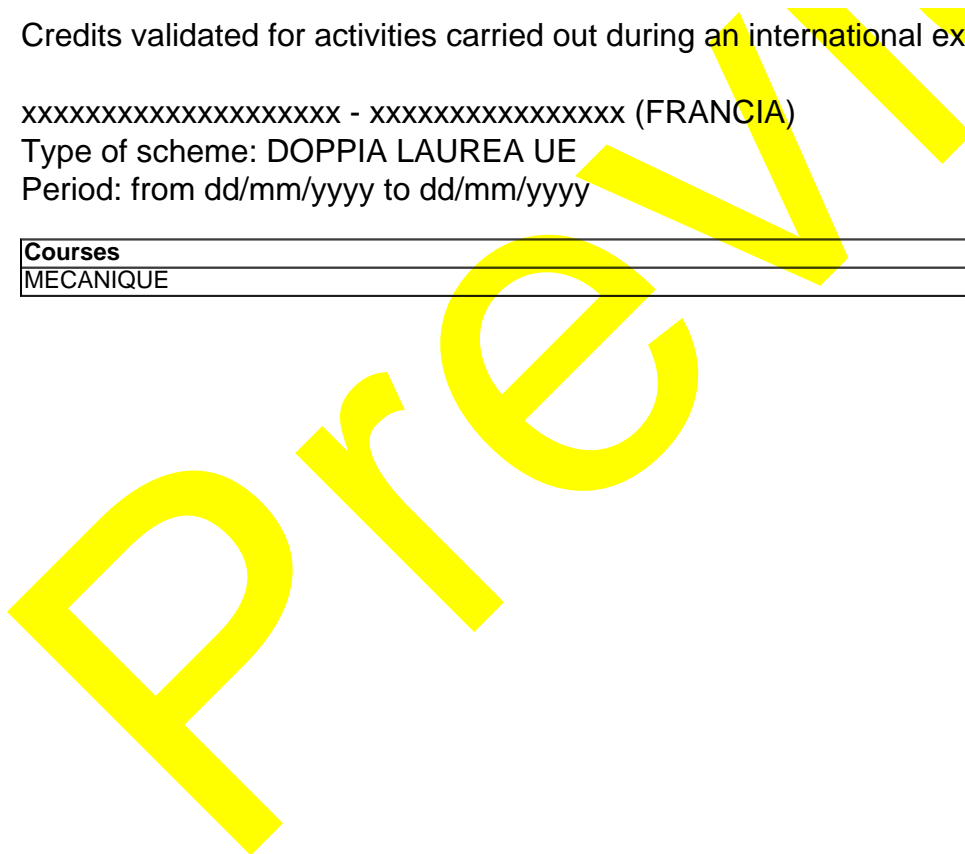
xxxxxxxxxxxxxxxxxxxxxxxx - xxxxxxxxxxxxxxxxxxxx (FRANCIA)

Type of scheme: DOPPIA LAUREA UE

Period: from dd/mm/yyyy to dd/mm/yyyy

Courses

MECANIQUE





STRUCTURE OF MATTER

Code: 061394
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

FIS/03 MATERIAL PHYSICS

The programme

Elementary statistical mechanics. Phase space and Gibbs method. Classical (Maxwell-Boltzmann) and quantum (Bose-Einstein e Fermi-Dirac) distributions. Examples: perfect gas, equipartition of energy, superfluid He, blackbody radiation, Heat capacity of solids and of free electrons, Pauli paramagnetism. Elementary solid state physics. Crystal structure and reciprocal lattice. Crystal vibrations and phonons. Drude-Lorentz and Sommerfeld models for free electrons in metal. Bohr waves and energy bands. Density of states. Semiconductors: impurity states, electrons and holes. Semiconductor statistics. Optical and magnetic properties of materials. Microscopic models for dielectric and magnetic susceptibility. Dielectric function (real and imaginary part). Classical models: Lorentz oscillators, Larmor theorem, Langevin function. Quantum theory: Hamiltonian in electromagnetic field; perturbation theory; golden rule; Heisenberg model of ferromagnetism.

Credits validated for activities carried out during an international exchange period at:

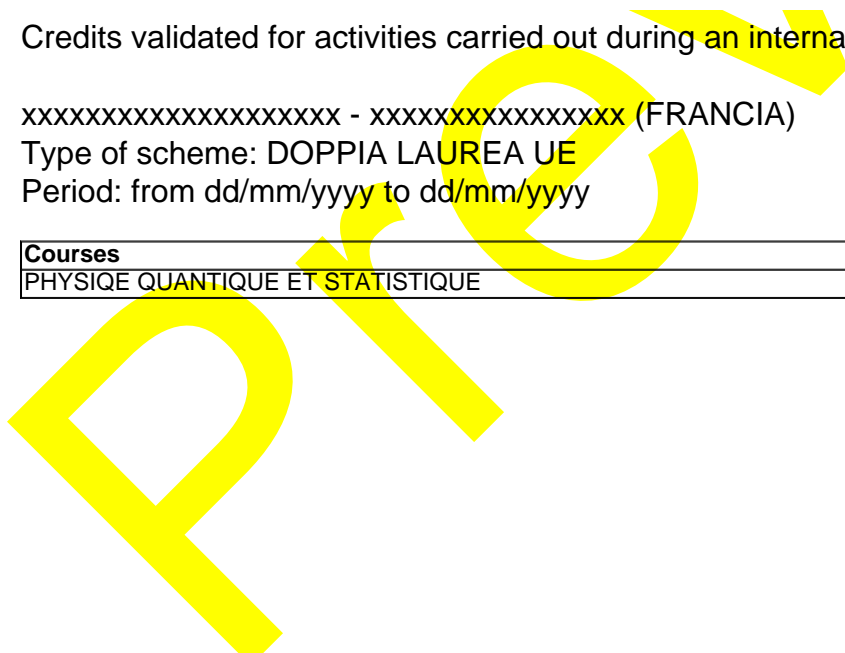
xxxxxxxxxxxxxxxxxxxxxxxx - xxxxxxxxxxxxxxxxxxxx (FRANCIA)

Type of scheme: DOPPIA LAUREA UE

Period: from dd/mm/yyyy to dd/mm/yyyy

Courses

PHYSIQUE QUANTIQUE ET STATISTIQUE





MATERIALS SCIENCE AND TECHNOLOGY

Code: 060116
Credits: 10.00
Grade: nn
Date: dd/mm/yy

Subject groups

ING-IND/22 SCIENCE AND TECHNOLOGY OF MATERIALS

The programme

General Introduction to Materials. Interatomic and intramolecular forces and potentials in the framework of molecular mechanics. Equilibrium structures, potentials with many minima and molecular flexibility. . Crystalline structures, X ray diffraction ,space and molecular symmetry, principles of group theory and group representations and applications. Review of energy quantization (electronic and vibro-rotational) . Transitions among quantum states and related experiments. Metals, band theory and mechanical properties. Polymers, polymer flexibility and consequences on the mechanical properties. Quantum mechanical aspects of molecular structure. Examples of computations with electronic computers. Principles of Materials characterization. New materials and their applications.

Credits validated for activities carried out during an international exchange period at:

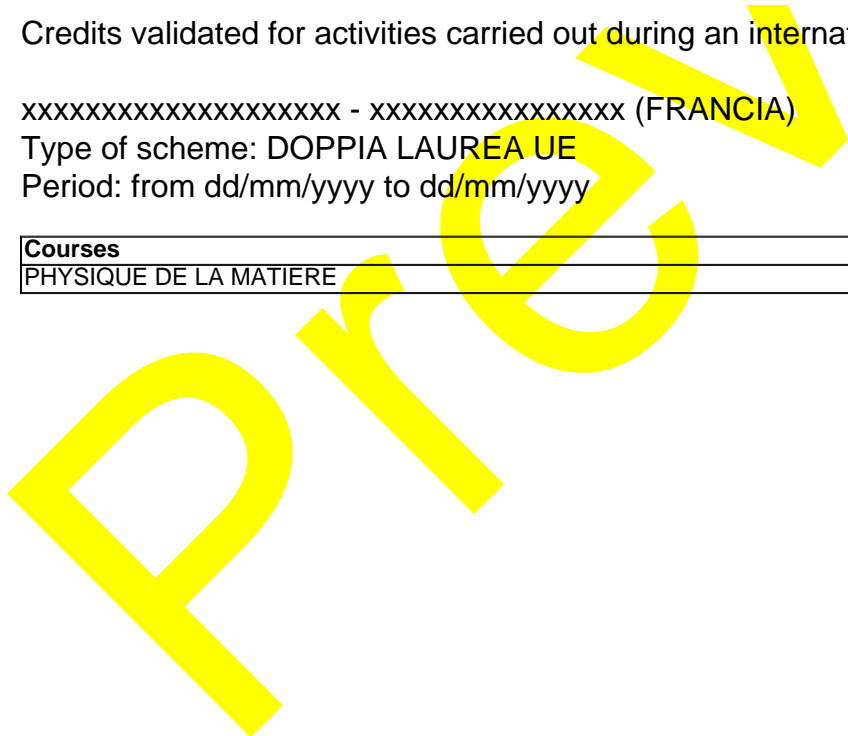
xxxxxxxxxxxxxxxxxxxxxx - xxxxxxxxxxxxxxxxxxxx (FRANCIA)

Type of scheme: DOPPIA LAUREA UE

Period: from dd/mm/yyyy to dd/mm/yyyy

Courses

PHYSIQUE DE LA MATIERE





PROBABILITY THEORY

Code: 070489
Credits: 5.00
Grade: nn
Date: dd/mm/yy

Subject groups

MAT/06 PROBABILITY AND MATHEMATICAL STATISTICS

The programme

Sample space and axiomatic definition of a probability measure. Probabilistic model of an experiment with a finite or countable number of outcomes and elements of combinatorics. Probabilistic models of the real line. Conditional probability and independence. Random variables and probability distributions. Main discrete and continuous random variables. Expectation, moments and characteristic functions. Random vectors and covariance matrix. Independence of random variables. Multidimensional gaussian laws. Different kinds of convergence of sequences of random variables. Law of Large Numbers and Central Limit Theorem.

Credits validated for activities carried out during an international exchange period at:

xxxxxxxxxxxxxxxxxxxxxxxx - xxxxxxxxxxxxxxxxxxxx (FRANCIA)

Type of scheme: DOPPIA LAUREA UE

Period: from dd/mm/yyyy to dd/mm/yyyy

Courses
MATHEMATIQUE

FINAL EXAMINATION

Code: 074089
Credits: 8.00
Grade: nn
Date: dd/mm/yy

Subject groups

Unavailable

The programme

Unavailable