DIPLOMA SUPPLEMENT ATTACHMENT

POLITECNICO MILANO 1863

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1 INFORMATION IDENTIFYING THE HOLDER OF THE QUALIFICATION

1.1 Last name(s)

BONVICINI

1.2 First name(s)

GIORGIO

1.3 Date of birth (dd/mm/yyyy)

23/05/1997

1.4 Student identification number or code (if available)

865834

2 INFORMATION IDENTIFYING THE QUALIFICATION

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

Laurea in MECHANICAL ENGINEERING
Dottore

2.2 Main field(s) of study for the qualification

Industrial Engineering (L-9)
ISCED code: 0719

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

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

Description of curriculum

CALCULUS 1

Code:	081360
Credits:	10.00
Grade:	26
Date:	30/01/2017

Subject groups

MAT/05 MATHEMATICAL ANALYSIS, MAT/03 GEOMETRY

The programme

Real and complex numbers. Functions of one real variable. Elementary functions. Sequences and limits. Continuity and theorems on continuous functions. Differential calculus and applications to optimization problems. Taylor's formula. Graphs of functions. Integral calculus. Generalized integrals. First order ordinary differential equations. Vector calculus, scalar and vector products. Straight lines, cilrcles and spheres. Vector valued functions, plane and space curves, line integrals of the first kind.

INFORMATICS B

Code:	081369
Credits:	7.00
Grade:	30 L
Date:	02/02/2017

Subject groups

ING-INF/05 INFORMATION PROCESSING SYSTEMS

The programme

The main goal of the course is twofold: to provide a view of the potential of analysis and modeling techniques offered by computer science to solve real problems; to help students in understanding the basic underlying principles of such techniques so that they can use them in the future. The course presents the main concepts of programming using the C language and briefly describes the characteristics of computer systems highlighting the integration aspects. More in detail, the main topics studied in the course are the following: fundamentals of programming (algorithms and stepwise refinement of design), foundations and techniques of programming in C (programs structure, types and main instructions, subprograms, file management), basic concepts of advanced programming (recursion, dynamic data structures), composition and organization of computer systems, introduction to a numeric calculation tool. The experimental activities in the computer laboratory are used to verify the adequacy and correctness of the modeling activities.

METHODS OF TECHNICAL REPRESENTATION

Code: 081376
Credits: 7.00
Grade: 28
Date: 06/02/2017

Subject groups

ING-IND/15 DESIGN METHODS FOR INDUSTRIAL ENGINEERING

The programme

Introduction to the design process. Types of technical drawings. Standards. Graphic representation: orthographic projections, views , cuts and sections, dimensioning. Manufacturing and inspection of parts: general principles on materials and related designations, relation between technological process and shape; linear, geometric and surface tolerances. Morphology of machine elements (threaded elements, welding, bonding), transmission elements (shafts and axes, hubs, keys and splines, bearings), transformation of motion (belts, chaines, gearing). Laboratory activity: utilization of 3D solid modeler to produce models and drafts of parts and simple assemblies.

CHEMISTRY

Code: 081374
Credits: 7.00
Grade: 30 L
Date: 10/02/2017

Subject groups

CHIM/07 PRINCIPLES OF CHEMISTRY FOR APPLIED TECHNOLOGIES

The programme

Atomic structure. Electronic structure and the periodic table. Mole, molar mass. Chemical reactions and equations. Proportional relationships. Chemical bonding. Ionic bonds, covalent bonds. Shapes and properties of molecules. Types of intermolecular forces and condensed states of matter. Structure and properties of solids. The gaseous state. Liquids. Change of state. Thermodynamics. Energy, heat, work. Heat of reaction and enthalpy. Spontaneous processes, entropy and free energy. Chemical equilibrium. Factors that influence equilibrium. Chemical kinetics. Collision theory and reaction rate. Effect of temperature. Catalysis. Electrolyte solutions. Salts, acids, bases, pH. Ionic equilibria. Redox reactions. Standard reduction potentials. Electrochemical cells. Electrolysis. Preparation and refining of metals. Corrosion. Chemistry and environment. Air pollution. The photochemical smog and the acid rain. The ozone hole and the greenhouse effect.

FUNDAMENTALS OF EXPERIMENTAL PHYSICS

Code:	081389
Credits:	12.00
Grade:	30 L
Date:	27/06/2017

Subject groups

FIS/01 EXPERIMENTAL PHYSICS

The programme

Physical quantities e their measurements. Kinematics of a particle: reference frames, position, velocity, acceleration. Dynamics of a particle: Newton's laws and their applications. Work, power, energy and conservation of mechanical energy. Gravitation. Periodic motion. Dynamics of particle systems and rigid body: conservation laws, collisions, rotational motion. Temperature, heat and work: equilibrium and thermodynamics transformations, ideal gases. First law of thermodynamics. Heat engines, cycles and thermal efficiency. Second law of thermodynamics. Coulomb's law, electric field. Gauss's law. Electric potential. Charges on conductors, capacitance, capacitors. Energy of the electric field. Dielectrics. Electric current and Ohm's law, electromotive force. Magnetic field. Sources and properties of the magnetic field, Ampe're's law. Magnetic materials.

CALCULUS 2

Code:	081372
Credits:	10.00
Grade:	30
Date:	29/06/2017

Subject groups

MAT/05 MATHEMATICAL ANALYSIS, MAT/03 GEOMETRY

The programme

Vector spaces. Matrices. Linear systems. Linear and quadratic function. Linear ordinary differential equations with constant coefficients. Number serie and Fourier series. Functions of several variables. Partial derivatives, directional derivatives, gradient. Implicit functions. Optimization problems: free and with constrains. Lagrange multipliers. Double and triple integrals. Work of a vector field. Conservative fields and potentials. Sufaces, surface integrals. Stokes and divergence theorems.

METALLURGY AND NON METALLIC MATERIALS

Code: 081377
Credits: 7.00
Grade: 30
Date: 19/07/2017

Subject groups

ING-IND/21 METALLURGY

The programme

Crystals and lattice defects in metals. Phase diagrams of metallic alloys. Mechanical testing of metals and alloys. Tensile strength, hardness, fatigue, impact toughness. Bain experiences: TTT and CCT diagrams. Thermal treatments Typical microstructures of steels. Surface treatments. Metallurgy, properties and applications of steels (quench and tempering steeels, spring steels, case hardening steels, nitriding steels) and cast irons. Properties and application of selected non-ferrous alloys (Al alloys). Glasses, glass-ceramics and ceramics: properties and applications. Polymers: properties and applications. Laboratory experiences of metallography and mechanical tersts.

STATISTICS

Code: 086449
Credits: 5.00
Grade: 27
Date: 30/08/2017

Subject groups

MAT/06 PROBABILITY AND STATISTICS, SECS-S/01 STATISTICS

The programme

Descriptive statistics. Frequency distributions, histograms, box-plots. Mean, median, mode. Variance. Chebichev's inequality. Percentiles, InterQuartile Range. Random variables and probability. Continuous r.v.'s. Uniform, Normal and exponential distributions. Discrete r.v.'s. Binomial and Poisson distributions. Independence. Central Limit Theorem. Point estimation and test. Unbiased estimators. Mean square error. Tests. Type I error. z-test for the mean of a Normal. P-value. Sample size and type II error. CI for the mean of a Normal: variance known. t-test and confidence intervals for the mean of a Normal distribution: variance unknown. Tests and confidence intervals for two means. Chi-squared test for the variance of a Normal. t-test for paired data. Linear models.Simple linear regression and multiple regression. Least square estimators. Tests and confidence intervals for the parameters of a linear model. Prediction of a new observation. Diagnostics and model choice.

MACHINE DESIGN 1

Code: 083442
Credits: 10.00
Grade: 30
Date: 18/01/2018

Subject groups

ING-IND/14 MECHANICAL DESIGN AND MACHINE CONSTRUCTION

The programme

The first part of the course covers general principles of mechanics: statics and kinematics of rigid and deformable bodies; structural analysis of frames, determination of displacements and internal forces (axial force, shear force, bending moment, torsion); analysis of stress and strain in structural members like axles and shafts. Later on the student is introduced to a design methodology based on synthesis and optimization of different issues; failure criteria useful for ductile and brittle materials are established starting from the definition of static and fatigue limit-stress and safety factor. Several example on machine elements are presented.

PRINCIPLES OF ELECTRICAL ENGINEERING

Code: 083443
Credits: 8.00
Grade: 25
Date: 12/02/2018

Subject groups

ING-IND/31 ELECTRICAL ENGINEERING, ING-IND/32 POWER ELECTRONIC CONVERTERS, ELECTRICAL MACHINES AND DRIVES, ING-IND/33 ELECTRICAL POWER SYSTEMS

The programme

Operative definition of voltage and current. Electric power. Ideal two terminal elements. Kirchhoff's current ad voltage laws. Network theorems. Dc and ac steady state networks. Three-phase networks. First order transients. Faraday's law. Transformers. Principles of electromechanical energy conversion. Principles of rotating machine theory. Principles of static conversion of the electrical energy.

THERMODYNAMICS AND HEAT TRANSFER

Code: 083400
Credits: 10.00
Grade: 26
Date: 16/02/2018

Subject groups

ING-IND/10 THERMAL ENGINEERING AND INDUSTRIAL ENERGY SYSTEMS

The programme

Thermodynamic: equilibrium and thermodynamic process, ideal gas and polytropic process, first low of thermodynamic for closed and open systems; Maxwell relations, second low, entropy and irreversibility; multiphase systems, phase transitions, state diagrams; ideal mixture of gas and vapor. Energetic balances and isoentropic efficiency of turbines, pumps an compressors; gas and steam power cycles, steam refrigerating cycle; air properties and treatments. Heat transfer: the energy transport mechanism; conduction in mono-dimensional steady an unsteady state condition in planar and cylindrical geometry without power generation; steady state with power generation; fins; free and forced convection, dimensionless groups and experimental correlations; thermal radiation, black body and gray surface, view factor and radiation exchange between black and gray surfaces. Heat exchangers, log mean temperature difference.

MECHANICS

Code: 083444
Credits: 10.00
Grade: 30
Date: 20/06/2018

Subject groups

ING-IND/13 APPLIED MECHANICS

The programme

Kinematics and dynamics of a system of a rigid bodies with elements of analytical mechanics. Forces exchanged between solids, friction, rolling resistance. Forces exchanged by a solid body with a fluid stream, aerodynamic forces, elements of hydrostatic and hydrodynamic lubrication. Dynamics of a single degree of freedom machine, characteristic curves for the motor and the user, model of the mechanical transmission. Machine components, ordinary and epicicloidal gears. Belt transmissions, plane belts, V-belts, toothed belts, chains. Mechanical vibration of a single degree of freedom system.

MANUFACTURING TECHNOLOGY I

Code: 083447
Credits: 10.00
Grade: 30
Date: 09/07/2018

Subject groups

ING-IND/16 MANUFACTURING TECHNOLOGY AND SYSTEMS

The programme

Classification of primary and secondary manufacturing processes. Metal casting processes: basic modeling, sand casting, die casting, investment casting. Metal forming processes: basic modeling, rolling, drawing, extrusion, open-die and closed-die forging, sheet metal and tube forming. Machining processes: basic modeling, turning, milling, drilling, grinding. Assembly and joining processes: welding, brazing, clinching, riveting. Machine tools and workholding fixtures. Prediction and prevention of manufacturing defects. Planning of manufacturing processes. Manufacturing costs. Process tolerances and quality control.

MECHANICAL AND THERMAL MEASUREMENTS

Code: 083445
Credits: 10.00
Grade: 27
Date: 18/07/2018

Subject groups

ING-IND/12 MECHANICAL AND THERMAL MEASUREMENTS

The programme

The course objective is providing the students with knowledge required to use measurement data and moreover design measurement systems by properly selecting the transducers on the basis of static and dynamic performances. The topics covered by the course are therefore general metrology, uncertainty definition and evaluation, static and dynamic performances of measuring instruments; international standards; measurement systems, data acquisition and recording, sampling and A/D conversion; measurement of length, displacement, velocity, strain, mass, force, pressure, sound, temperature, flow characteristics. The course is strongly based on laboratory activities enabling the student to personally face the problems illustrated in the lecturing, applying the proposed solving methods, getting confident with the most common measuring instruments.

ANALYTICAL AND NUMERICAL METHODS FOR ENGINEERING

Code: 086214
Credits: 10.00
Grade: 30
Date: 14/01/2019

Subject groups

MAT/05 MATHEMATICAL ANALYSIS, MAT/08 NUMERICAL ANALYSIS

The programme

Aim of this course is to introduce the main mathematical and numerical tools for the analisi and the approximation of some typical problem in mechanical and Energy engineering. After introducing the basic concepts and techniques in numerical analisi, we introduce tools both analytic and numerical to solve some classes of differential problems that arise in the apllications to mechanical and Energy engineering.

MANAGEMENT AND INDUSTRIAL ENGINEERING

Code: 086448
Credits: 10.00
Grade: 21
Date: 31/01/2019

Subject groups

ING-IND/17 INDUSTRIAL MECHANICAL SYSTEMS ENGINEERING, ING-IND/35 BUSINESS AND MANAGEMENT ENGINEERING

The programme

Introduction to management accounting. Cost accounting: introductive concepts. Direct and indirect costs. Classifications of costs. Cost drivers and cost management. Break even analysis. Decision making. Discounted Cash flow techniques. Calculating cash flows. Companies and external environments. Financial accounting and Balance sheet. Assessment of Business Performance: Ratio Analysis. Assessment of Business Performance: Economic value and economic indicators. Budgeting and analysis of variances. General characteristics of industrial plants. Economic criteria for the dimensioning of industrial plants and facilities. Reliability, Availability and Maintenance of industrial plants. General criteria for centralisation/de-centralisation decisions in facilities design (transportation costs, upsizing and service availability). Industrial water distribution system design. Industrial electrical installations and systems (electric power supply systems, short circuit current calculation, fundamentals of electrical safety). Lighting.

THEORY OF STRUCTURES

Code: 086438
Credits: 5.00
Grade: 29
Date: 08/02/2019

Subject groups

ICAR/08 STRUCTURAL MECHANICS

The programme

The course presents an extension of the classical topics of Strength of Materials offered at the 2nd year in other courses. In particular, the following topics will be treated: beam theory in small and moderately large displacements; force and displacement methods of analysis; energy based methods; matrix formulations for beam structural problems and their computer implementation; introduction to the bending of plates. Classes will include tutorials with practical exercises on computer implementation of the methods in a Matlab environment.

FLUID MECHANICS

Code: 083503
Credits: 7.00
Grade: 28
Date: 12/02/2019

Subject groups

ICAR/01 HYDRAULICS

The programme

Continuum systems and properties of fluids; kinematics, continuity and momentum equations. Statics of fluids: the concept of pressure, pressure variation in compressible and incompressible fluids at rest; hydrostatic forces. Inviscid flow model: Euler's equation of motion, the Bernoulli equation, boundary conditions, energy and mechanical aspects, compressibility effects, flow rate and velocity measurements. Integral analysis: momentum equation, surface stresses induced by jets. Steady state viscous flows: One-dimensional models; laminar and turbulent pipe flows and velocity distributions in pipes, hydraulic design of systems. Transient flows in pipes. Viscous fluids and Stokes' model: linear and angular motion and deformation; Navier-Stokes equation; energy considerations; elementary solutions of viscous incompressible flows: steady laminar flow between parallel plates and in cylindrical pipes; lubrication theory. Similitude, dimensional analysis and models: the theorem and significant dimensionless groups for fluid motion analysis. Models and similitude. Flow around immersed bodies and fluid - structure interactions: general notation on external flows: lift and drag concepts. Laminar boundary layer: development on a plate; transition from laminar to turbulent boundary layer; turbulent boundary layer; pressure gradient effects and boundary layer separation.

MECHANICS OF VIBRATIONS

Code: 086453
Credits: 6.00
Grade: 30 L
Date: 20/06/2019

Subject groups

ING-IND/13 APPLIED MECHANICS

The programme

The fundamental elements needed for the description of the dynamic behaviour of a Mechanical System are presented, studying the problem of mechanical vibrations, their sources and effects. At this purpose are presented the modelization criteria applicable to linear mechanical systems and the linearization criteria in case of non-linear systems, the methods of deriving the free and forced motion equations for N degree of freedom lumped parameters (d.o.f.) systems, the solutions of those motion equations systems with direct and modal approach. The criteria for analyzing the stability of 1 and N d.o.f. mechanical systems, under hypothesis of small displacements, are also illustrated. The techniques of passive control of vibrations, by means of viscous or T.M.D. dampers are also presented. The fundamental elements of analysis of the critical torsional and bending speeds of rotating shafts are finally presented with discussion on the basic balancing techniques.

FLUID-MACHINES

Code: 086218
Credits: 9.00
Grade: 19
Date: 03/07/2019

Subject groups

ING-IND/08 FLUID MACHINERY, ING-IND/09 ENERGY SYSTEMS AND POWER GENERATION

The programme

Elements of fluid-machine theory and their classification. Similarity of turbomachines. Hydraulic machines (Pelton, Francis, Kaplan turbines; centrifugal, axial and volumetric pumps) and hydraulic plants: performance curves, design and selection criteria. Cavitation control. Gas compressors: operating characteristics and instability problems (surge and stall). Steam turbines and steam power plants, thermodynamic cycles, multi-stage turbine configuration; steam generators; heat rejection to the environment. Refrigerating plants. Gas-turbine power plants: design of main components (compressor, turbine, combustion chamber), maximum temperature and compression ratio effects; combined cycles. Internal combustion engines, efficiency and specific power output, application areas. Air management and turbocharging, fuels, fuel injection and combustion processes, pollutant emission control.

FINAL DEGREE TEST (MECHANICS OF VIBRATIONS)

Code: 050597
Credits: 1.00
Grade: 25
Date: 11/07/2019

Subject groups

ING-IND/13 APPLIED MECHANICS

The programme

Unavailable

FEM LAB

Code: 086463
Credits: 7.00
Grade: 24
Date: 12/07/2019

Subject groups

ING-IND/14 MECHANICAL DESIGN AND MACHINE CONSTRUCTION

The programme

Aim of the course is to introduce students to finite element structural calculation starting from the knowledge of the main concepts of structural analysis. After an introduction on matrix algebra and by limiting the program to linear elastic analysis, the main finite element types are described and the criteria for their use are critically reviewed. The numerical techniques used to solve a finite element analysis are also discussed. The numerical exercises together with the autonomous development of the finite element analysis of a mechanical element will permit to the students to develop the critical ability needed to correctly use this numerical technique.

FINAL DEGREE TEST (FEM LAB)

Code: 050600
Credits: 1.00
Grade: 28
Date: 17/07/2019

Subject groups

ING-IND/14 MECHANICAL DESIGN AND MACHINE CONSTRUCTION

The programme

Unavailable

FINAL DEGREE TEST (FLUID MACHINES)

Code:	050598
Credits:	1.00
Grade:	28
Date:	27/07/2019

Subject groups

ING-IND/08 FLUID MACHINERY, ING-IND/09 ENERGY SYSTEMS AND POWER GENERATION

The programme

Unavailable