Study Plan

School: School of Sciences and Technology
Degree: Bachelor
Course: Industrial Engineering and Management (cód. 668)

1st Year - 1st Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT0900L	Linear Algebra and Geometry I	Mathematics	6	Semester	156
MAT12877L	Mathematical Calculus I	Mathematics	6	Semester	156
QUI1090L	General Chemistry	Chemistry	6	Semester	156
INF0878L	Programming	Informatics	6	Semester	156
GES2311L	Introduction to Management	Management	6	Semester	156

1st Year - 2nd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT12878L	Mathematical Calculus II	Mathematics	6	Semester	156
MAT10689L	Mathematics and Statistics Laboratory	Mathematics	6	Semester	156
MAT12619L	Introduction to Probability and Statistics	Mathematics	6	Semester	156
FIS13008L	General Physics I	Physics	6	Semester	156
FIS13011L	Technical Drawing of Mechanical Systems	Mechanical Engineering	6	Semester	156

2nd Year - 3rd Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
MAT13046L	Mathematical Analysis III	Mathematics	6	Semester	156
FIS13009L	General Physics II	Physics	6	Semester	156
ECN2314L	Principles of Microeconomics	Economy	6	Semester	156
FIS13006L	Engineering Mechanics I	Mechanical Engineering	6	Semester	156
GES0128L	Decision Models	Management	6	Semester	156

2nd Year - 4th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS13012L	Introduction to Materials Science and Manufacturing Processes	Mechanical Engineering	6	Semester	156
FIS13007L	Engineering Mechanics II	Mechanical Engineering	6	Semester	156
FIS0528L	Applied Thermodynamics	Mechanical Engineering	6	Semester	156
GES13005L	Cost Accounting	Management	6	Semester	156
GES2351L	Introduction to Business Finnance	Management	6	Semester	156

3rd Year - 5th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS13010L	Electrical Theory	Electrotechnical Engineering	6	Semester	156
FIS13045L	Fluid Mechanics	Mechanical Engineering	6	Semester	156
GES13014L	Management and Industrial Maintenance	Management	6	Semester	156
GES2332L	Operation Management	Management	6	Semester	156
FIS13460L	* Industrial Engineering and Management Project	Mechanical Engineering Management	6	Semester	156

***** TRANSLATE ME:Grupo de Optativas I *****

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GES2334L	Human Resources Management	Management	6	Semester	156
GES2310L	Entrepreneurship and Innovation	Management	6	Semester	156
GES2325L	Marketing I	Management	3	Semester	78
FIS13094L	Mechanics of Materials	Mechanical Engineering	6	Semester	156
VIS12838L	Ergonomics and Anthropometry	Design	3	Semester	78

3rd Year - 6th Semester

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
FIS13460L	Industrial Engineering and Management Project	Mechanical Engineering Management	6	Semester	156
FIS13015L	Manufacturing Processes	Mechanical Engineering	6	Semester	156
FIS0506L	Control and Automation	Electrotechnical Engineering	6	Semester	156
GES2346L	Quality and Environment Management	Management	6	Semester	156

Group of Options II

Component code	Name	Scientific Area Field	ECTS	Duration	Hours
GES0010L	Decision and Negotiation Analysis	Management	6	Semester	156
FIS10987L	Energy and Mass Transfer	Mechanical Engineering	6	Semester	156
FIS0521L	Condition Control of Mechatronic Systems	Mechanical Engineering	6	Semester	156
FIS13013L	Electrical Machines	Electrotechnical Engineering	6	Semester	156

Conditions for obtaining the Degree:

*** TRANSLATE ME: Para obtenção do grau de licenciado em Engenharia e Gestão Industrial é necessário obter aprovação a 168 ECTS em unidades curriculares obrigatórias e 12 ECTS em unidades curriculares optativas, distribuídas da seguinte forma:

1º Ano

1º Semestre

5 UC Obrigatórias num total de 30 ECTS

2º Semestre

5 UC Obrigatórias num total de 30 ECTS

2º Ano

3º Semestre

5 UC Obrigatórias num total de 30 ECTS

4º Semestre

5 UC Obrigatórias num total de 30 ECTS

3º Ano

5º Semestre

4 UC Obrigatórias num total de 24 ECTS

1 UC Optativas num total de 6 ECTS conforme quadro de Grupo de Optativas I

6º Semestre

4 UC Obrigatórias num total de 24 ECTS

1 UC Optativas num total de 6 ECTS conforme quadro de Grupo de Optativas I ***

Program Contents

Back

Linear Algebra and Geometry I (MAT0900L)

Systems of linear equations.
Matrices.
Determinants.
Vector spaces.
Linear applications.
Eigenvalues and eigenvectors.
Geometry of plane and space.
Quadratic forms.

Back

Mathematical Calculus I (MAT12877L)

1. Sequences and series.
2. Real functions of one variable.
3. Differential calculus.
4. Sequences and series of functions.
5. Integral calculus and applications.

Back

General Chemistry (QUI1090L)

Course contents1. Introduction{\}newline
1.1 Models of atoms{\}newline
The principal quantum number{\}newline
Atomic orbitals{\}newline
Hydrogen atom{\}newline
Orbital Energies{\}newline
Electronic structure of polielectronic atoms{\}newline
The building-up Principle. The Aufbau rule. Exclusion Principle of Pauli. Hund's rule{\}newline
1.2 The Periodic Table{\}newline
Periodic classification of the elements.{\}newline
Electronic structure and the Periodic Table{\}newline
Periodic variation in physical properties{\}newline
Effective nuclear charge{\}newline
Atomic and ionic Radius {\}newline
Ionization Energy, Electronegativity and electron Affinity {\}newline
{\}newline
2. Chemical Bonding{\}newline
2.1 Lewis structures. Octet Rule.{\}newline
2.2 Bond types: ionic, covalent and metallic{\}newline
2.3 The Ionic Bond{\}newline
Ionic bond formation.{\}newline
Ions interaction{\}newline
Lattice energy of ionic compounds{\}newline
Ionic solids {\}newline
Polarizability and the ionic character of ionic bonds{\}newline
2.4 The Covalent Bond {\}newline
2.4.1 Lewis structure for polyatomic species{\}newline
The concept of Resonance {\}newline
Formal charge{\}newline
Electronegativity and Polar bonds {\}newline
2.4.2 Covalent bond strength. {\}newline
The variation of bond strength. Dissociation energy. Bond length.{\}newline
2.4.3 Exceptions to the Octet Rule: radicals and biradicals; expanded valence shell, incomplete octet {\}newline
2.4.4 Coordinative covalent bond. Complexes and coordination compounds.{\}newline
Ligands. Coordination number.{\}newline
Chelate; bi- and polidentate ligands.{\}newline
2.4.5 Molecular shape and structure {\}newline
The VSEPR model{\}newline
Molecules with lone pairs on the central atom{\}newline
Valence Bond Theory{\}newline
Hybridization of orbitals{\}newline
Hybridization in a more complex molecules{\}newline
Characteristics of double bonds{\}newline
Benzene ring and Kekule structures{\}newline
Polyatomics molecules{\}newline
Polar molecules{\}newline
2.5 Metallic bond{\}newline
Band theory. Conductor and semiconductors.{\}newline
Metals properties{\}newline
{\}newline
3. Properites of gases, Liquids and Solids {\}newline
3.1.1 Properties of gases{\}newline
Pressure{\}newline
Boyle's Law. Charles and Gay-Lussac's Law{\}newline
Avogadro Principle.{\}newline
3.1.2 The Ideal Gas model. Equation of Ideal Gases.{\}newline
Gas density{\}newline
3.1.3 Mixture of gases. Partial Pressure and Dalton's Law{\}newline
3.1.4 Real Gases. Deviation from linearity.{\}newline

Back

Programming (INF0878L)

Introduction to programming in Python.
Using the interpreter in script and interactive mode.
Variables, expressions and instructions.
Definition and Use of Functions.
Control structures.
Native data structures.
Sequential data structures: lists, tuples, and strings.
Associative data structures: dictionaries.
Basic concepts of input / output (I / O).
File manipulation.
Graphic interface.
Using to libraries / modules.
Libraries with advanced functionality for scientific calculation.
Program development.

Back

Introduction to Management (GES2311L)

Back

Mathematical Calculus II (MAT12878L)

1. Differential Calculus in Rn
Algebraic and topological structure of Rn. Functions from Rn to Rm: Continuity and the notion of limit. Differentiability. Partial derivatives. Chain rule. Taylor's theorem in Rn and applications to the study of extreme values. Inverse and implicit function theorems. Extreme values of functions with constrained variables
2. Integral Calculus in Rn
Multiple integrals: Fubini's theorem, change of variables theorem, applications to the computation of physical quantities. Line integrals: Integrals of scalar fields and vector fields. Fundamental theorem of calculus for line integrals, conservative fields and scalar potentials. Green's theorem. Surface integrals: surface integrals of a scalar field, flux of a vector field, divergence theorem and Stokes' theorem.

Back

Mathematics and Statistics Laboratory (MAT10689L)

The programming in interactive system of symbolic and numerical calculation, and manipulation and visualization of data (mathematical packages SymPy, NumPy, Matplotlib and SciPy in Python, among others).
Introduction to the numerical methods of solving the nonlinear equations, data interpolation, numerical integration and differentiation, graphical visualization of the functions of one and two variables and optimization.
Introduction to Excel and R software. Elaboration of small functions in R.
Review of the basic concepts of statistics: population, sample and type of variables.
Univariate descriptive statistics: grouping of data, frequency table, graphical representation and summary statistics (location, dispersion, asymmetry, kurtosis and concentration). Empirical distribution function.
Bivariate descriptive statistics: graphical representation and contingency table.

Back

Introduction to Probability and Statistics (MAT12619L)

Theoretical Component

What is Statistics and its role in scientific work; population, sample. Probability: definitions, axiomatic and properties, conditional probability, Bayes' theorem; discrete models: uniform in n points, binomial, Poisson, geometric and hypergeometric; continuous models: uniform, exponential, normal, t-Student, chi-square; discrete random pair; central limit theorem. Descriptive statistics: graphical representation of data, sample characteristics. Statistical Inference: estimation by confidence intervals (for mean value, variance and difference of mean values of normal populations); hypothesis tests: on the mean value in normal populations and with large samples (t-tests); on variance in normal populations; adjustment; on the mean value based on small samples and on non-normal populations (Wilcoxon and signal test); for comparison of two populations, based on two independent samples and two paired samples (t-tests, Mann-Whitney, Wilcoxon's and signs). Simple Linear Regression.

Practical Component

Resolution of exercises involving the theory exposed in the theoretical classes and using the programs, whenever possible, SPSS or R. These exercises are chosen so as to illustrate the best possible the application of statistics in the area of Engineering and Industrial Management

Back

General Physics I (FIS13008L)

I. Mechanics

• Scientific method. Measurements, units and dimensions.
• Kinematics and dynamics of mass points. Newton's laws and applications.
• Work and energy. Collisions and momentum. Conservation laws.
• Systems of many particles. The rigid body. Angular momentum.
• Universal gravitation.

II. Oscillations and waves

• Periodic and simple harmonic motion. Forced oscillations and resonance.
• Coupled oscillators. Normal modes.
• Progressive waves. The Doppler effect.
• Superposition and interference. Standing waves.

III. Option

A.Thermodynamics

• Thermal equilibrium and temperature.
• The ideal gas. The equation of state. Internal energy, heat and work.
• Calorimetry. Work and heat in thermal processes.
• The kinetic theory of gases.
• The 2nd law of thermodynamics. Heat engines. Reversible and irreversible processes. Entropy.

B.Topics on mechanical properties of solids

• Stress, deformation, elasticity and Hooke's law.
• Microscopic model for mechanical constant of solids.

Back

Technical Drawing of Mechanical Systems (FIS13011L)

1. Technical Drawing as a language. The concept of projection, orthogonal projections and representations using multiple views. Freehand drawing. Main associated standardization and its justification.
2. Reading of drawings with multiple views representations and execution of perspectives.
3. Computer aided drafting.
4. Section views.
5. Auxiliary views and intersections.
6. Construction of parametric three dimensional computer models of parts and systems.
7. Phases of the design process. The importance of the material properties and brief introduction to the manufacturing processes.
8. Dimensioning.
9. Standardized mechanical parts. Assembly of parts and assembly drawings.
10. Dimensional tolerances and mating.
11. Introduction to the geometrical product specification.
12. Surface finish and edge requirements.

Back

Mathematical Analysis III (MAT13046L)

1. Introduction to Complex Analysis.
2. Ordinary Differential Equations.
3. Systems of ordinary differential equations.
4. Fourier series. Fourier integrals.

Back

General Physics II (FIS13009L)

I. Electromagnetism
Electrostatics. Electric charges and forces. Gauss's law
Electric potential. Capacitors
Electric current. Kirchhoff's rules. RC circuits
Magnetic fields and the Lorentz force
Sources of the magnetic field. Magnetism in matter
Electromagnetic induction. Faraday's law
AC-current
Maxwell's equations
Electromagnetic waves. Polarization
II. Optics
Nature of light. Geometric optics. Image formation by mirrors and lenses
Wave optics. Double-slit experiment. Diffraction and interference
III. Modern physics
Special relativity. Time dilation and Lorentz contraction. Relativistic momentum and energy
Introduction to quantum physics. Particle properties of light. Photoelectric effect and Compton scattering. Waveparticle duality. Uncertainty principle. Wave function
Atoms. Atomic spectra. Hydrogen atom in quantum mechanics. Periodic table of the elements
Nuclear physics. Stability and instability of nuclei. Elementar particles. Contemporary physics.

Back

Principles of Microeconomics (ECN2314L)

Back

Engineering Mechanics I (FIS13006L)

1. Revisions: the concept of force, parallelogram law for the addition of forces, vectors, static equilibrium of particles in 2D and 3D.
2. Rigid body. Moment of a force about a point. Couple of forces. Equivalent systems of forces. Distributed forces. Reduction to a resultant force or force-couple.
3. Free body diagram. Equations governing the static equilibrium of rigid bodies in 2D and 3D.
4. Center of gravity, mass and centroid.
5. Static analysis of rigid body trusses, structures and mechanisms in 2D and 3D. Static determinacy.
6. Determination of internal force resultants in bars, beams and cables.
7. Analysis of rigid body structures in the presence of dry friction. Study of wedges, screws, sliding bearings, belts and cables.
8. Second moments of area. The parallel axis theorem. Principal axis of an area.

Back

Decision Models (GES0128L)

•Introduction
oSteps in the problem solving process
oSteps in model building process
oUsing Excel to model and solve problems
oSensitivity analysis and Excel tools for sensitivity analysis
•Linear Programming models
oElements of an optimization model
oLinear programming: graphical solution
oGraphical sensitivity analysis
oThe logic behind the Simplex algorithm
oFormalization, solution using Solver and interpretation of the results
oSensitivity analysis using Solvertable
oApplications of linear programming to Marketing, Finance an Operations Management
oLinear programming with integer and binary variables
•Project Management
oThe project management objectives
oPlanning, programming and controlling projects
oProgramming projects with deterministic activity durations
oProgramming projects with stochastic activity durations
oCost – Duration tradeoff
oSoftware for project management
•Waiting lines models
oThe structure of the waiting line system
oSingle channel, single phase model
oMultiple channel, single phase model
oWaiting and service costs
oImproving the waiting line system
oOther waiting line models
•Simulation models
oRisk analysis: scenario analysis versus simulation
oBuilding a simulation model, verification and validation
oSimulation using Excel and @Risk
oExamples of simulation models (project management and waiting lines simulation models)

Back

Introduction to Materials Science and Manufacturing Processes (FIS13012L)

1) Industrial Materials and Materials Science: Properties. Polymers, Metal Alloys, Ceramic Materials, Magnetic Materials, Semi-conductive Materials.
2) Crystaline materials, imperfections
3) Binary phase diagrams
4) Electric properties of metals and semiconductors
5) Mechanical and Thermal properties, rheology
6) Magnetic and dielectric materials
7) Non-crystaline materials
8) Polymeric and composite materials
9) Introduction to surface Engineering
10) Mechanical testing: tension, compression, hardeness, fractura, fatigue

Back

Engineering Mechanics II (FIS13007L)

1. Revisions of kinematics and kinetics of particles. Equations of motion in different coordinate systems. Numerical solutions of ordinary differential equations.
2. Kinematics of rigid bodies in 2D and 3D. Frames of reference in motion. Planar mechanisms, kinematic joints and constraint equations. Numerical solution of systems of nonlinear equations.
3. Motion of a continuum body, deformation gradient, polar decomposition, deformation and rotation. The axioms of conservation of mass, linear momentum, angular momentum and conservation of energy. Application to a rigid body. Centre of mass, inertia tensor.
4. Kinetics of rigid bodies and mechanical systems in planar motion.
5. Applications of the conservation of energy and impulse and momentum principles.
6. Kinetics of rigid bodies in 3D. Motion of a gyroscope.
7. Introduction to the dynamical analysis of mechanical system using a computer program. Applications to robotics and attitude mechanics in aerospace systems.

Back

Applied Thermodynamics (FIS0528L)

Back

Cost Accounting (GES13005L)

1. Introduction
2. Fundamentals of accounting and financial information
3. Cost – Volume – Profit relationships
4. Manufacturing costing
5. Cost assignment and cost accumulation methods
6. Joint production costing
7. Costing systems
8. Cost centers
9. Activity-Based Costing
10. Standard costing

Back

Introduction to Business Finnance (GES2351L)

1. Introduction
2. The Role of Financial Markets
3. Financial Diagnostic
4. Fundamental Concepts of Financial Management
5. Analysis of Investment Projects
6. Study of Financing Mix (Funding Sources)

Back

Electrical Theory (FIS13010L)

1. Introduction

Applications of Maxwell's equations.

2. Stationary Electric Current

Ohm's law. Electrical energy sources. Joule's law.
Direct current circuit analysis. Kirchhoff's laws. Circuit analysis theorems.

3. Magnetostatics

Magnetic circuits analysis using Maxwell equations.

4. Varying Electromagnetic Field

Applications of Faraday's law: ideal transformer, electrical generator and motor.

5. Quasi Steady State Circuits

Sinusoidal voltages and currents; complex representation.
Analysis of alternating current circuits. Kirchhoff's law. Circuit analysis theorems.
Active, Reactive and Apparent Power.
Dynamic behavior of electric circuits.

6. Three-Phase Systems

Star and Triangle connections. Transformations. Circuit analysis with different loads. Unbalanced loads.

Back

Fluid Mechanics (FIS13045L)

Introductory concepts: fluid properties, stresses, viscosity, surface tension, Newtonian and non-Newtonian fluids, flow classification. Fluid statics: hydrostatic equation, hydrostatic pressure distribution, hydrostatic force, hydrostatic moment, buoyancy and Archimedes principle, equilibrium and stability of immersed bodies. Volume control analysis, conservation of mass, momentum and energy, momentum equation, angular momentum equation. Differential forms: continuity, Navier-Stokes and energy equations. Simple analytic solutions of the Navier-Stokes equations. Pipe and ducts flow: head loss, turbulence, flow in multiple path pipe and duct systems, Moody diagram. Similitude and Modelling.

Back

Management and Industrial Maintenance (GES13014L)

1. Concepts and systems of industrial maintenance
Corrective and preventive maintenance, global efficiency indexes, TPC, RCM, condition based maintenance.
2. Failure analysis methodologies
Introduction to the physical phenomena of degradation and breakdown. Logics and cause-effect relations in fault analysis and the development of cause-effect diagrams (Ishikawa, 5 whys), RCA, FTA, FMEA.
3. Reliability based maintenance
Systems reliability, dependent and common cause failures. Probabilistic models. FMECA, design of experiments.
4. Maintenance planning and control
Business competitiveness centred maintenance. Project planning and control methodologies (PERT and CPM), inventory management, estimation and budgeting of maintenance costs.
5. Establishment of maintenance plans
Maintenance decisions optimisation strategies, optimal replacement intervals, minimisation of operation cost, maximization of the availability. Software supporting maintenance management.

Back

Operation Management (GES2332L)

Part 1 - Introduction to Operations Management

What is operations management?
Operations Strategy
Demand forecasting methods

Part 2 - Design, analysis and improvement of the operating system

Quality management and statistical quality control
Product/service design
Processs design and tecnhology choice

Part 3- Operations system management

Supply chain management
Independent demand stocks management
Aggregated production planning
Resources planning: MRP, CRP and ERP
Lean production systems
Production Scheduling
Theory of constraints

Back

Industrial Engineering and Management Project (FIS13460L)

The work plan that each student will have to develop will be defined by the teacher who supervises the student in coordination with the head of the course, respecting and fulfilling the general objectives and skills to develop in the course. The activities to be developed can be broadly divided into the following topics:
1. participation in research activities or in a business environment;
2. attendance at seminars, workshops or courses;
3. undertaking of a study or project;
4. writing of a monograph, following the standards and practices of academic writing.
The development of the essay will be done at two levels; at the conceptual and theoretical level, with the appropriate analytical critical framework, and at the applied level through the use of tools of industrial engineering management.

Back

Human Resources Management (GES2334L)

Module 1 - Organizational Behavior and Human Resource Management: definition and areas of confluence of the two areas
Module 2 - Trends in organizational models
Module 3 - Human Resource Management (HRM) as a subsystem of the management system: the phases of the evolution of HRM policies and the main dimensions of HRM
Module 4 - Strategic Planning of Human Resources and Career Management
Module 5 - Recruitment, Selection and Integration
Module 6 - Management and evaluation of performance
Module 7 - Reward Systems
Module 8 - Health Systems and Safety at Work
Module 9 - Systems Training and Human Resource Development
Module 10 - Human Resource Management Information Systems (HRMIS)

Back

Entrepreneurship and Innovation (GES2310L)

Module 1 – Introduction to Entrepreneurship and Innovation
a. Definitions and concepts of Entrepreneurship
b. Profile and characteristics of entrepreneurs
c. Social entrepreneurship and intrapreneurship
d. What is innovation? Types of innovation
d. Dynamics of innovation

Module 2 – Conception and Structuring business ideas
a. Process and techniques of generating ideas
b. Design Thinking tool
c. Evaluation of business ideas
d. The process of creating a business idea and firm
e. Simulation games- from ideas to business formation

Back

Marketing I (GES2325L)

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Mechanics of Materials (FIS13094L)

1) Strain tensor, compatibility equations.
2) Stress tensor, equilibrium equations, Cauchy's lemma.
3) Generalized Hooke's Law.
4) Longitudinally loaded members.
5) Bending: normal stresses and shear stresses. Displacement equation. Integration methods.
6) Torsion of circular sections, torsion of open and closed thin-walled profiles.
7) Introduction to the Kirchhoff-Love theory applied to circular plates.
8) Structural stability. Introduction to Euler's Theory.
9) Energy theorems.

Back

Ergonomics and Anthropometry (VIS12838L)

• The concept of Ergonomics
• The importance of Ergonomics in Design
• Ergonomics and the Human Factor
• Functions of the human organism
• The contributions of Anthropometry
• Anthropometry: measures and applications • Static and dynamic anthropometry
• The contributions of Physiology and Biomechanics • Principles of applied biomechanics
• Types of movements and positions.
• The contributions of Cognitive Psychology
Types of managements and controls
• Organization and perception of information • Lighting
• Noise, Temperature and Air Quality
• Safety at work
• Inclusive Design
• Ergonomics and Anthropometry in Household and Office Involvement • Kitchens
• Living room
• Non-smoking rooms
• Hygienic spaces • Office work

Back

Manufacturing Processes (FIS13015L)

1) Technological processes of plastic forming: complements of Bulk and sheet forming.
2) Technological cutting processes by CNC cutting and punching.
3) Numerical simulation of plastic deformation processes.
4) Machining; main features. Machine tools.
5) Welding, brazing and bonding processes.
6) Casting.
7) Molding and injection of plastics.
8) Simulation software for manufacturing processes: stamping, forging, plastics injection, casting.
9) Composites manufacturing: advanced fiber deposition, textile fiber deposition, spray deposition, filament winding, Lanxide, stitching and tufting and Z-pinning processes.
10) Rapid prototyping / 3D modeling.

Back

Control and Automation (FIS0506L)

PART I: Control Systems: 1) The Control of dynamic systems. Fundamental control types. Feedforward Control and Feedback Control. 2) Analysis of Transfer Function described systems: i) Time-domain analysis (1st order systems, 2nd order systems and multiple order systems). Project characteristics of 1st-order systems. Project characteristics of 2nd-order systems. System stationary response. Steady-state error. Stability criteria (Routh, Root Locus). P-Controller design using the Root Locus method. ii) Frequency-domain analysis. Bode diagram. Bode factors: 1st-order elementary factors, 2nd-order elementary factors. Bode stability criteria. Gain margin and phase margin. P-Controller design using the Bode method. iii) The PID controller. Usual design methods.3) Analysis of State-space described systems: Linear systems stability. Liapunov stability criteria. PART II: Industrial Automation: 1) Industrial logic components: pneumatic technology, electrical technology, electronic technology. 2) The Programmable Logic Controller (PLC). 3) Elementary components of an automatic system (sensors and actuators). 4) Combinatory systems and sequential systems. 5) Design of sequential automatic systems using the GRAFCET methodology. 6) Design and implementation of sequential automatic systems using Siemens LOGO PLCs. Programming with Simatic Ladder Logic Diagram (LADDER).

Back

Quality and Environment Management (GES2346L)

Module 1 - Quality Management:
1. The Concept and its Evolution
1.1. The global approach of the concept "Quality"
1.2. The evolution of the concept and the main "gurus"
2. Total Quality Management and continuous improvement
2.1. Behavioral variables of Total Quality Management
2.2. Philosophy and methods of continuous improvement
3. The Quality Management System (QMS)
3.1. Implementation of QMS
3.2. Documentation of QMS
3.3. Process approach
4. Standardisation, Accreditation and Certification
4.1. The series of ISO 9000 standards
4.2. Process of accreditation and certification of management systems, products/services and People
5. Models and quality tools
5.1. Structured resolution of problems
5.2. Basic quality tools
5.3. Other quality tools: the QFD, FMECA, SPC to 6 sigma
5.4. Quality models

Module 2 - Environmental Management:
1. Interaction between Organizations and Environment: the main environmental problems
2. Environmental Legislation
3. Environmental Management Systems - ISO 14001 NP EN

Back

Decision and Negotiation Analysis (GES0010L)

1. Introduction
2. Individual decision making under uncertainty
2.1. The elements of a decision problem
2.2. Representation of decision problems
2.3. Choice criteria without probabilities
2.4. Expected monetary value criterion
2.5. Expected utility theory
2.6. Methods for preferences extraction
2.7. Analysis of sequential decision problems
2.8. Software for decision analysis (Precision Tree)
3. Individual decision making with multiple objectives
3.1. Objectives and attributes
3.2. Efficient alternatives and tradeoffs among objectives
3.3. Utility function and selection of the best alternative
4. Decisions in the presence of strategic interdependency
4.1. Strategic and extensive form representation of a game
4.2. Static games with complete information
4.3. Dynamic games with complete information
4.4. Applications of game theory to management and economics
5. Negotiation Analysis
5.1. Characteristics of negotiation analysis
5.2. Bilateral negotiation with one issue and several issues

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Energy and Mass Transfer (FIS10987L)

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Condition Control of Mechatronic Systems (FIS0521L)

Syllabus: 1) Introduction to preventive and predictive maintenance. Condition-based maintenance. Classification of maintenance techniques, planning and the weight of the economic factor. Primary and Secondary functions, reliability.2) Measurements and information gathering methods. Instrumentation.3) Damage and degradation of Industrial equipments. Illustrations. Fatigue, plastic flow, creep and rupture. Typical mechanical failure: shafts, gearing, pipes, etc.4) Mechanical vibrations in the context of maintenance: 1 DOF4a) D'Alembert principle and the use of inertial forces in the free-body diagrams. Energy and energy-based methods to obtain the equilibrium in the sense of d'Alembert..4b) Second-order ODEs: characteristic equation, types of response, stable and unstable systems. Damped and non-damped frequencies, damping ratio. Superposition principle and response shift.4c) Response to non-zero initial conditions.4d) Constant right-hand side. Static displacement. Harmonic right-hand side, critical frequency, phase diagram and frequency ration. Periodic right-hand side: Truncated Fourier series.4e) Response to an arbitrary excitation: Dirac-Delta, equivalence to an initial velocity inversely proportional to the mass. Duhamel integral. General response.4f) ODE integrators: reduction to a first-order system. Superposition response to a first-order ODE, central difference numerical integration, critical time step, Courant number. 4g) Stationarity of the Lagrangian, Euler-Lagrange equations. 5) Machine components as rigid bodies:5a) Basis change and vector transformation: alibi-alias and orthogonal matrices.5b) Rigid-body DOF. Euler angles and general rotation matrix. Euler theorem. Rotation matrix eigensystem. Chasles theorem. Angular velocity and acceleration, general case.5c) General motion of a rigid body. 5d) Inertia matrix, general motion equations. 5e) Typical inertia matrices and solutions 5e) Bidimensional case. 6) N degrees-of-freedom:6a) General motion equations by the Euler-Lagrange method.6b) Free undamped case: orthogonality, eigenshapes and frequencies, modal basis. 6c) Modal decoupling in the proportional case. General response.6d) Frequency response and basis motion. Accelerometer modus-operandi.7) Fourier Series and Gibbs phenomenon. How to filter it. 8) Fourier transforms in detail. 9) Continuous media. Second order PDEs: classification and characterization of the solutions. Functional spaces and internal products, the introduction of a metric.10) Beams and plates: modal basis and general solution. Boundary conditions by using distributions and integration of the motion equations.11) Sensitivity analysis.12) Lubricants: viscosity, indices, maintenance role.13) Practical works and papers done by the students.{\}newline

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Electrical Machines (FIS13013L)

1. Introduction to the study of Electrical Machines
Electromagnetic concepts and circuit analysis revisited.
Principles of electromechanical energy conversion.

2. Transformer
One-phase transformer.
Three-phase transformer.
Special transformers. The self-transformer. Measurement transformers.

3. DC Machines
Introduction and functioning principles. Generator functioning. Main characteristics. Application fields.
Motor functioning. Main characteristics. Application fields.

4. Asynchronous Machine.
Constructive aspects and functioning principles.
Three-phase induction machine.
One-phase induction machine.

5. Synchronous Machine.
Constructive aspects and functioning principles.
Generator study.
Synchronous motor.

6. Small motors
DC motors. Servomotor. Stepper motors.
Pulse Width Modulation (PWM). H bridges. Encoders.
Speed, direction and position control using microcontrollers.