UNIVERSIDAD DE BURGOS

COURSE DESCRIPTIONS
Degree in Mechanical Engineering and Industrial Electronics

➢ First year:

7711 Calculus

PART I. NUMERICAL SETS

THE REAL NUMBER

Successive extensions of the number concept. Topological definitions of the real straight line.
The absolute value.

THE COMPLEX NUMBER

Definitions. Operations with complex numbers.

PART II. REAL FUNCTIONS OF REAL VARIABLE

CONTINUITY.

First definitions. Limits, properties. Continuity and properties. Theorems
on continuous functions.

DERIVABILITY

First definitions. Theorems on derivable functions. Graphical representation of functions

PART III. INTEGRATION OF FUNCTIONS

THE DEFINITE INTEGRAL

Definition of primitive. The indefinite integral: Properties. Calculation of primitives.

THE DEFINITE INTEGRAL

Integrable function on an interval [a, b]: The definite integral. The mean value theorems, the fundamental theorem of integral calculus and Barrow's rule. 1st, 2nd improper integrals.
Improper integrals: convergence, divergence and oscillation. Applications of the defined integral to the calculation of areas, lengths and volumes.

PART IV. NUMERICAL AND FUNCTIONAL SERIES

NUMERICAL SERIES

Definitions. Criteria of convergence. Sum of number series.

FUNCTIONAL SERIES

Functional series: Definitions. Power Series. Development in power series of certain functions.

7712 Algebra and differential equations

PART I. LINEAR ALGEBRA

INTRODUCTION: LINEAR SYSTEMS. MATRICES AND DETERMINANTS

Solving linear systems
Matrices: Definitions and properties.
Determinants
Inverse matrix.
Rank of a matrix.

VECTOR SPACES

Real vector space.
Subspaces.
Linear dependence and independence.
Generating set, bases and dimension.

LINEAR APPLICATIONS

Linear map.
Image and nucleus of a linear map.
Matrices associated with a linear map.
Theorem of similarity.

DIAGONALIZATION

Eigenvalues and Eigenvectors.
Characteristic polynomial, multiplicity of eigenvalues; eigen subspace.
Diagonalization of matrices and endomorphisms

PART II. DIFFERENTIAL EQUATIONS

INTRODUCTION TO THE STUDY OF DIFFERENTIAL EQUATIONS. SYSTEMS OF DIFFERENTIAL EQUATIONS

Differential Equation Systems: First definitions.
Solution of a D.E. system. General solution and particular solution.
Homogeneous Linear Differential Equation Systems.
Complete Linear Differential Equation Systems.

DIFFERENTIAL EQUATIONS OF ORDER N

Differential equations of order n
Properties of homogeneous linear equations.
Linear equations of constant coefficients.
Complete linear equations.

FIRST ORDER DIFFERENTIAL EQUATIONS AND LINEAR DIFFERENTIAL EQUATIONS

Solution of a D.E.: general solution and particular solution.
First, Order Differential Equations.
Linear Differential Equations of nth order.
Properties of the homogenous linear equations.
Linear equations of constant coefficients.
Complete linear equations.

LAPLACE TRANSFORM

Definition of the Laplace Transform.
Properties of the Laplace Transform.
Solution of Differential Equations and Systems of Differential Equations by means of the Laplace Transform.

7713 Physics I

PART I. INTRODUCTION

TOPIC 1. SCALAR AND VECTORIAL MAGNITUDES - UNITS

PHYSICS

1.1. Introduction.
1.2. Scalar and Vectoral Magnitudes.
1.3. Basic operations with vectors.
1.4. Magnitudes and dimensions.
1.5. Dimensional analysis.
1.6. Units and systems of units.

PART II. MECHANICS OF THE PARTICLE AND THE SOLID

TOPIC 2. KINEMATICS OF THE PARTICLE

2.1. Introduction.
2.2. Position Vector.
2.3. Velocity Vector.
2.4. Acceleration Vector. Intrinsic components.
2.5. Circular movement. Angular velocity.
2.6. Relative movement.

TOPIC 3. PARTICLE DYNAMICS

3.1. Introduction.
3.2. Newton´s Laws.
3.3. Linear momentum

3.4. Habitual forces in Mechanics.
3.5. Free body diagram.
3.6. Inertial and non-inertial frames of reference.
3.7. Inertial Forces.

TOPIC 4. WORK AND ENERGY

4.1. Introduction.
4.2. Field Concept.
4.2. Work of a force. Power.
4.3 Kinetic energy. Theorem of the kinetic energy.
4.4. Conservative forces. Potential energy.
4.5. Principle of energy conservation.

TOPIC 5. DYNAMICS OF THE RIGID BODY

5.1. Introduction.
5.2. Particle Systems. Rigid Body Concept.
5.3. Centre of Masses.
5.4. Centre of Mass Theorem.
5.5. Momentum of a Force.
5.6. Fundamental Equation of Rotation Dynamics.
5.7. Momentum of Inertia.
5.8. Angular Momentum of a Rigid Body.
5.9. Work and Energy in Rotation Motion.
5.10. Rolling Movement.

TOPIC 6. HARMONIC OSCILLATOR

6.1. Introduction.
6.2. Simple Harmonic Movement.
6.3. Dynamic Solution of Simple Harmonic Movement.
6.4. Harmonic Oscillator Energy.
6.5. Examples of Harmonic Oscillator.

TOPIC 7. MECHANICAL WAVES

7.1. Introduction.
7.2 Undulatory movement. Longitudinal and cross-sectional waves.
7.3. Mathematical description of a wave.
7.4. Examples of mechanical waves.
7.5. Energy in the undulatory movement.
7.6. Static waves.

PART III. FLUID MECHANICS

TOPIC 8. FLUID MECHANICS

8.1. Introduction.
8.2. Properties of the fluids.
8.3. Pressure.

8.4. Fundamental hydrostatic equation.
8.5. Archimedes' Principle.
8.6. Measurement of pressure. Barometers and manometers.
8.7. Continuity Equation.
8.8. Bernoulli's equation. Applications.

7714 Chemistry

UNIT 1. INTRODUCTION TO CHEMICAL CONCEPTS.
Atomic theory and nuclear atom. Periodic table and properties of the elements.
Chemical bond. Types of compounds. Acid-base reactions and oxidation-reduction.
Adjustment of oxidation-reduction reactions.

UNIT 2. GASEOUS STATE
Nature of gases. Pressure. Gas laws:
Avogadro's principle. Ideal gas law. Density of gases. Mixtures of gases. Reactant gas stoichiometry. Deviations from ideality. Real gases.

UNIT 3. CONDENSED MEDIA
Intermolecular forces and processes in solution. Raoult's Law. Liquid vapor balance. Binary liquid mixtures. Phase diagram. Gas solubility: Law of Henry. Colligative properties. Osmosis. Colloidal mixtures.

UNIT 4. CHEMICAL THERMODYNAMICS
Heat and work. First Law of Thermodynamics. Determination of enthalpies of reaction. Standard enthalpies. Entropy Criterion for spontaneous change. Second Thermodynamic Law. Gibbs energy. Equilibrium and law of mass action. Equilibrium constant. Alternative forms in gas phase. Le Chatelier Principle.

UNIT 5. REACTION SPEED
Reaction speed. Speed law and reaction orders. Constants of velocity. Determination of kinetic orders. Half-life times. Effect of temperature. Activation energy.

UNIT 6. ACID / BASE, PRECIPITATION AND COMPLEXATION REACTIONS
Strength of acids and bases. PH concept. Common ion effect. Solutions regulatory. Acid-base titration curves. Dissolution / Precipitation Equilibria: solubility product, Modification of solubility. Formation and stability of complex.

UNIT 7. ELECTROCHEMISTRY
Electrode potentials and their measurement. Standard reduction potentials. Cells galvanic. Electromotive force. Nernst equation. Concentration cells. PH measurement. Solubility of poorly soluble salts. Electrolytic cells. Batteries Corrosion.

UNIT 8. ENVIROMENTAL CHEMISTRY

Water: importance and properties. Composition of natural waters. Water contamination. Water quality criteria. Pollution indicators. Composition of the atmosphere. Atmospheric pollutants. Quality criteria of the air. Greenhouse effect. The ozone layer.

7715 Graphic expression I

PLANE GEOMETRY.

- Projection systems, foundations, flat figures and surfaces.
- Perspectives.
- Standardized Representation. Views, cuts, sections, breaks, dimension, basic elements and schemes.
- Basic concepts of Joints, Sets and Disassemblies.
- 2D CAD.
- 3D initiation.

7716 Extended calculus and geometry

PART I. DIFFERENTIAL CALCULUS

UNIT 1. DIFFERENTIAL AND INTEGRAL CALCULUS

- Basic definitions.
- Real function of several real variables. Limits and continuity.
- Directional and partial derivatives. Differentiation.
- Vector functions of several variables.
- Compound function. Chain rule.
- Implicit function and inverse function.
- Extremes: relative, conditioned and absolute.
- Relative extremes in implicit functions.

PART II. INTEGRAL CALCULUS

UNIT 2. DOUBLE AND TRIPLE INTEGRALS

- Double Integrals.
- Triple integrals.
- Applications of double and triple integrals: centers of mass and moments of inertia

UNIT 3. LINE INTEGRAL

- Curves
- Line integral.
- Independence of the way.
- Green's theorem.

UNIT 4. SURFACE INTEGRAL

- Surfaces.
- Orientation of a surface.
- Integral of surface.
- Stokes theorem.
- Gauss's theorem or divergence.

7717 Basic computing

UNIT 1. INTRODUCTION TO COMPUTER SCIENCE

- History and Basic Concepts
- Information encoding

UNIT 2. INTRODUCTION TO OPERATIVE SYSTEMS

- Memory and processes
- File and User Management

UNIT 3. INTRODUCTION TO PROGRAMMING

- Basic concepts.
- Programming.

UNIT 4. COMPUTER NETWORKS AND INTERNET

- Networking
- Internet.

UNIT 5. OFFICE AUTOMATION

- Text processors
- Spreadsheets

UNIT 6. INFORMATION SOURCES IN MECHANICAL ENGINEERING AND ELECTRONIC ENGINEERING INDUSTRIAL AND AUTOMATIC

- Documentary Techniques

7718 Physics II

PART I. THERMODYNAMICS

TOPIC 1. TEMPERATURE AND HEAT

1.1. Introduction.
1.2. Concept of temperature.
1.3. Thermometers and temperature scales.
1.4. Dilation of solids and liquids.
1.5. Heat. Calorimetry.
1.6. Heat Transmission.

TOPIC 2. PRINCIPLES OF THE THERMODYNAMICS

2.1. Introduction.
2.2. Thermodynamic systems. Ideal gas.
2.3. Internal energy. First principle of Thermodynamics.
2.4. Thermodynamic processes of an ideal gas
2.5. Second principle of Thermodynamics. Thermal machines.

PART II. ELECTROMAGNETISM

TOPIC 3. ELECTRIC FIELD IN A VACUUM

3.1. Introduction.
3.2. Coulomb's Law.
3.3. Electrical field strength.
3.4. Potential Energy and Electrical Potential.
3.5. Gauss's Law. Applications.

TOPIC 4. ELECTRIC FIELD IN A MATERIAL MEDIA

4.1. Introduction.
4.2. Conductors and dielectrics.
4.3 Electric field in conductors.
4.4. Electric field in dielectrics.
4.5. Capacitors.

TOPIC 5. DIRECT CURRENT

5.1. Introduction.
5.2. Electric current. Current Intensity.
5.3. Ohm's Law. Electrical resistance.
5.4. Association of resistance.
5.5. Energy of the electric current. Joule's Law.
5.6. Generators. Electromotive force.
5.7. Kirchhoff's Laws.
5.8. Ammeters and voltmeters.

TOPIC 6. MAGNETIC FIELD

6.1. Introduction.
6.2. Magnetic field. Lorentz Force.
6.3. Force of a magnetic field on a current.
6.4. Sources of magnetic field.
6.5. Ampère's Law.
6.6. Magnetic force between conductors.
6.7. Magnetic field in material media. Magnets.

TOPIC 7. ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT

7.1. Introduction.
7.2. Flow of a magnetic field.
7.3. Faraday and Lenz Laws.

7.4. Generation of alternating currents.
7.5. Self-induction.
7.6. Mutual induction.
7.7. Energy associated with a coil.
7.8. Transformers.

PART III. FUNDAMENTALS OF OPTICS

TOPIC 8. FUNDAMENTALS OF OPTICS

8.1. Introduction.
8.2. Nature of light. Electromagnetic spectrum.
8.3. Propagation of light.
8.4. Reflection and refraction.
8.5. Interference and diffraction.

7719 Materials science: structure and properties

PART I. MATERIALS SCIENCE.

UNIT 1. ATOMIC STRUCTURE AND INTERATOMIC BONDING

Introduction. Atomic structure. Atomic bonding in solids

UNIT 2. STRUCTURE IN CRYSTALLINE SOLIDS

Introduction. Fundamental concepts. Unit Cells Crystalline structure of Density Calculations. Polymorphism and allotropy. Crystalline systems. Crystallographic directions and planes. Crystalline and non-crystalline materials Non-crystalline solids

UNIT 3. ATOMIC DIFFUSION IN SOLIDS

Introduction. Mechanisms of diffusion. Dissemination in stationary and non-stationary
Diffusion Factors. Diffusion and material treatment

UNIT 4. PHASE DIAGRAM

Phase diagram of pure substance Gibbs phases rule. Engineering Isomorphic binary alloy system. Binary eutectic systems. Iron-carbon System.

MATERIAL PROPERTIES

- Mechanical properties of materials.
- Electrical properties of materials.
- Magnetic properties of materials.
- Optical properties of materials.
- Thermal properties of materials.

7720 Business economics

PART I. INTRODUCTION TO THE COMPANY

UNIT 1. THE COMPANY AND THE ENTREPRENEUR

PART II. BUSINESS MANAGEMENT

UNIT 2. THE MANAGEMENT OF THE COMPANY AND THE MANAGEMENT PROCESS

UNIT 3. DEVELOPMENT AND GROWTH OF THE COMPANY

PART III. HUMAN RESOURCES

UNIT 4. INTRODUCTION TO HUMAN RESOURCES

UNIT 5. FINANCIAL SUBSYSTEM IN THE COMPANY AND ACCOUNTING

UNIT 6. INTRODUCTION TO THE FINANCIAL FUNCTION IN THE COMPANY AND ACCOUNTING

UNIT 7. INTRODUCTION TO INVESTMENT-FINANCING DECISIONS OF THE COMPANY

PART IV. COMMERCIAL SUBSYSTEM

UNIT 8. INTRODUCTION TO BUSINESS MANAGEMENT

UNIT 9. THE MARKETING-MIX

PART V. CURRENT TRENDS IN BUSINESS MANAGEMENT CURRENT TRENDS IN BUSINESS MANAGEMENT AND MODELS OF DEAL

PART VI. COMPANY CREATION

7721 Graphic Expression II

UNIT 1. MECHANICAL SETS

- Introduction to industrial drawing.
- Drawing of assembly, cutting and standardized designation of materials.
- Thread dimension representation.
- Removable joints. Types of joints. Designation of normalized elements.
- Springs. Classes and representation of springs.
- Bearings. Representation, designation, election and elements of fixing and protection of bearings.
- Representation of welded joints.

UNIT 2. FUNCTIONAL DIMENSIONING

- Surface qualities. Roughness. Surface classes. Symbols. Indications in the drawing of the quality and the class of surface.
- Dimensional tolerance. Definitions. Way to indicate tolerances in the dimensions.
- Calculation of the magnitude of the tolerance zone. Systems and choice of adjustments.
- General dimensional tolerances.
- Geometric tolerances. Introduction. Application of geometric tolerances.

- Tolerances of form, orientation, situation and oscillation. Indication in the drawings of geometric tolerances.
- Application of the principle of maximum material. General geometric tolerances.
- Functional dimensioning. General approach to the problem. Chain of dimensions. Calculation of the condition dimension. Distribution of tolerance in the chain of dimensions. Influence of geometric tolerances on the dimensional chain. Transfer of dimensions.

UNIT 3. DRAWING AND DESIGN OF INSTALLATIONS

- Drawing and design of pneumatic installation. Bases for the design and interpretation of Actuators. Distribution valves. Blocking valves.

Types of schemes. Symbology. Design of simple schemes.

- Electrical drawing in the building. Symbols of electrification in the building. Electrical diagrams in the building. Installation of link between the public network and the interior installation.
- Electrical drawing in industrial installations. Electric circuits of controlling motors. Symbols of electrical circuits. Types of electrical circuit diagrams. The main and control circuit.

UNIT 4. DRAWING AND COMPUTER AIDED DESIGN.

- Drawing of plans and diagrams of 2D installations.

➢ Second Year:

7722 Thermal engineering I

PART I. INTRODUCTION

TOPIC 1: **ENERGY, TECHNOLOGY AND SOCIETY**

Useful Power Production. Energy models in history. Sources of energy. Power Production Systems. Thermal and nuclear power plants. Energy and environment

THERMODYNAMICS

TOPIC 2: FUNDAMENTAL CONCEPTS.
TOPIC 3: PRINCIPLE 0. EQUATION OF THERMAL STATE AND TEMPERATURE.
TOPIC 4: FIRST PRINCIPLE OF THERMODYNAMICS.
TOPIC 5: THERMODYNAMIC PROPERTIES OF PURE SUBSTANCES.
TOPIC 6: 2ND PRINCIPLE OF THERMODYNAMICS.
TOPIC 7: PROCESSES IN OPEN SYSTEMS. CYCLES OF HEAT TRANSMISSION.
TOPIC 8: INTRODUCTION TO HEAT TRANSFER.

THERMOPHYSICAL PROPERTIES OF MATERIALS.

TOPIC 9: STATIONARY ONE-DIMENSIONAL CONDUCTION.
TOPIC 10: TWO-DIMENSIONAL FACTORS
TOPIC 11: FINS AND ADDITIONAL SURFACES
TOPIC 12: CONVECTION
TOPIC 13: RADIATION

7723 Fundamentals of electrical engineering

PART I. ELECTRICAL CIRCUITS

TOPIC 1. INTRODUCTION TO ELECTRICAL CIRCUITS.
TOPIC 2. CIRCUITS IN CONTINUOUS CURRENT.
TOPIC 3. CIRCUITS IN SINUSOIDAL ALTERNATING CURRENT.
TOPIC 4. THREE-PHASE CIRCUITS.
LOW VOLTAGE ELECTRICAL INSTALLATIONS.

PART II. LOW VOLTAGE ELECTRICAL INSTALLATIONS

TOPIC 5. LOW VOLTAGE ELECTRICAL INSTALLATIONS.
TOPIC 6. INTRODUCTION TO ELECTRICAL MACHINES.
TOPIC 7. ELECTRICAL SAFETY.

UNIVERSIDAD DE BURGOS

7724 Materials Elasticity and resistance

TOPIC 1. INTRODUCTION TO ELASTICITY AND STRENGTH OF MATERIALS

1.1 Introduction.

1.2. Object of Elasticity and Strength of Materials.

1. 3 Tensions and Deformations.

TOPIC 2. REVIEW OF STATIC

2.1 Introduction.

2.2 Types of supports and charges.

2.3 Equilibrium equations of the rigid solid.

2.4 Calculation of internal reactions and efforts.

2.4 Mechanical properties of a section. Area, centre of gravity and moments of inertia.

TOPIC 3. DIAGRAMS OF EFFORTS

3.1 Introduction

3.2 Internal stresses in a section: axial, shear, bending and torsion moment.

3.3. Calculation of stress diagrams.

3.4. Relationship between shear force (V) and bending moment (M)

TOPIC 4. TRACTION AND COMPRESSION

4.1 Introduction.

4.2 Tensions and Deformations. Bernouilli's Hypothesis.

4.3 Relationship between load and elongation.

4.4 Diagrams, N, sye.

4.5 Hyperstaticity (grade 1).

4.6 Temperature variations.

TOPIC 5. UNIFORM TORSION

5.1. Introduction.

5.2. Diagrams of torsional moments.

5.3. Tensions in circular and tubular section axes.

5.4. Power transmission in circular axes.

5.5. Hyperstaticity in torsion.

5.6. Tension distribution in other types of sections.

TOPIC 6. GENERAL THEORY OF BENDING

6.1 Introduction. Types of bending.

6.2 Previous hypotheses.

6.3 Tensions in pure flexion. Navier's Law.

6.4 Resistant module of a section. Sizing sections.

TOPIC 7. SHEARING

7.1. Introduction.
7.2. Elementary theory of shearing.
7.3. Deformations produced by pure shear.
7.4. Calculation of feather keys and grooved axes.
7.5. Calculation of screwed and riveted joints.
7.6. Calculation of welded joints.
7.7. Tangential tensions due to shear stress.

TOPIC 8. COMBINED REQUESTS

8.1 Introduction.
8.2 Simple Bending.
8.3 Deflected bending.
8.4 Complex Bending.
8.5 Thin wall tanks.

TOPIC 9. TRANSFORMATION OF TENSIONS AND FAULT CRITERIA

9.1. Introduction.
9.2 Graphical representation of the tensional state. Mohr's Circle.
9.3 Stresses and main directions.
9.4 Fault criteria.

TOPIC 10. BUCKLING

10.1. Introduction.
10.2. Stability analysis.
10.3. Critical buckling load.
10.4. Influence of Links.
10.5. Critical efforts. Euler's Formula.

7725 Statistics and numerical calculus

PART I. STATISTICS

UNIT 1. DESCRIPTIVE STATISTICS.

- Statistical description of a variable.
- Measures associated with a distribution.
- Joint description of two variables.
- Introduction to simple linear regression.

UNIT 2. PROBABILITY AND RANDOM VARIABLES

- Probability.
- Discrete random variables. Usual models.
- Continuous random variables. Usual models.

UNIT 3. STATISTICAL INFERENCE

Random and Statistical Samples.

Specific estimation.

Estimation by confidence intervals (normal populations and proportions).

Statistical hypothesis testing (normal populations and proportions).

PART II. NUMERICAL CALCULUS

UNIT 4. INTRODUCTION TO NUMERICAL ANALYSIS

Origins and objectives of Numerical Calculus. Need for Numerical Analysis in the Engineering. Mistakes. Operating cost and efficiency. Introduction to Matlab.

UNIT 5. INTERPOLATION

- Global interpolation: Newton and Lagrange. Segmental interpolation: Linear,
- Quadratic and Splines

UNIT 6. QUADRATURE AND NUMERICAL DIFFERENTIATION

Introduction. Quadrature rules and degree of accuracy. Simple quadrature rules and composite. Obtaining and errors of the numerical derivation.

UNIT 7. SOLVING NONLINEAR EQUATIONS

Introduction. Methods using intervals: Bisection. Iterative methods: Newton

UNIT 8. NUMERICAL RESOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS.

Euler's method. Runge-Kutta method.

7726 Production management

PART I.

TOPIC 1. THE PRODUCTIVE FUNCTION OF THE COMPANY.

TOPIC 2. PROJECTS MANAGEMENT

PART II. STRATEGIC PILLARS

TOPIC 3. PRODUCT AND PROCESS.

TOPIC 4. MEDIA CAPACITY AND DISTRIBUTION

TOPIC 5. PRODUCTIVE LOCATION AND RELOCATION

PART III. TACTICAL DECISIONS

TOPIC 6. ORGANIZATION OF FLOWS

TOPIC 7. PRODUCTION MEANS PLANNING

TOPIC 8. ORGANIZATION OF PEOPLE

TOPIC 9. THE EXCELLENCE OF PRODUCTION SYSTEMS

7727 Renewable energies and environment

PART I. RENEWABLE ENERGY

UNIT 1. RENEWABLE ENERGIES AND THE PRESERVATION OF THE ENVIRONMENT

Energy resources - Non-renewable resources: environmental problems - Renewable resources - Energy panorama in Spain and in the world.

UNIT 2. SOLAR RADIATION

Characteristics of solar radiation - Magnitudes - Movement of the Sun in the dome celestial - insolation data. Solar maps.

UNIT 3. THERMAL SOLAR ENERGY

Photothermic effect - The flat solar collector - Efficiency curve - Installations oflow temperature.

UNIT 4. PHOTOVOLTAIC SOLAR ENERGY

Photovoltaic effect - Photovoltaic cells and modules - Photovoltaic installations - Applications

UNIT 5. WIND POWER

Winds: wind speed and energy - Wind machines - The wind turbine three-bladed - Wind installations

UNIT 6. HYDRAULIC ENERGY

Hydroelectric plants - Usable energy and power - Turbines and alternators - Pumping stations - Mini-stations

UNIT 7. BIOMASS ENERGY

Biomass concept - Techniques based on combustion - Other processes thermochemicals - Energy crops - Biofuels – Biogas

UNIT 8. GEOTHERMAL ENERGY

Terrestrial heat - Geothermal manifestations - High temperature technologies - Medium and low temperature technologies - Very low temperature technologies: heat pump

UNIT 9. NUCLEAR FUSION

Fusion Reactions - Controlled Fusion: Requirements - Confinement - Objective: commercial centers.

PARTI II. ENVIRONMENT

UNIT 1. NATURAL WATER TREATMENT

Composition and quality parameters of natural waters. Main pollutants to eliminate in the purification of water. Quality criteria for natural waters. Water purification processes. Desalination processes marine waters. Quality criteria for industrial waters.

UNIT 2. SEWAGE TREATMENT

Characterization of urban wastewater. Treatment of waste water urban. Pretreatment and primary treatment. Secondary treatments. Tertiary treatments. Sludge treatment. Small treatment plant systems. Reuse of treated wastewater. Discharge of wastewater debugged. Legislation on discharges: the discharge fee.

UNIT 3. CONTROL / TREATMENT OF ATMOSPHERIC POLLUTION

Main air pollutants and emission sources. Quality criteria of the air: emission and immission. Dispersion of pollutants in the atmosphere. Models of diffusion. Meteorological conditions. Purification of atmospheric pollutants: purification of gaseous pollutants and purification of particles. Control of pollutants in stationary sources. Transport control. Contamination in indoor environments. Pollution by energy sources: radiation electromagnetic.

UNIT 4. URBAN WASTE MANAGEMENT

Urban waste: composition and characterization. Treatments: waste dump non-hazardous, incineration, composting, recycling. Comprehensive treatment plants.

UNIT 5. HAZARDOUS WASTE MANAGEMENT

Hazardous waste: characterization. Treatment: physical-chemical treatments, incineration, hazardous waste landfill. Minimization techniques.

UNIT 6. SOIL CONTAMINATION AND TREATMENT TECHNIQUES

Contaminated floors. Treatment techniques: thermal technologies, physicochemical technologies, biological technologies.

7728 Electrical circuits theory

TOPIC 1 WAVEFORMS - BEHAVIOR OF PASSIVE ELEMENTS

TOPIC 2 CIRCUIT ANALYSIS METHODS

- Circular methods
- Nodal methods

TOPIC 3. ACTIVE ELEMENTS EXTENSION.

- Dependent sources

TOPIC 4. EXPANSION OF PASSIVE ELEMENTS

- Magnetic couplings
- Transformers

TOPIC 5. RESONANCIA

- Series resonance
- Parallel resonance
- Resonance with real elements

TOPIC 6. EXTENSION OF ELECTRICAL CIRCUITS THEOREMS

- Reciprocity theorem

- Compensation theorem
- Maximum power theorem

TOPIC 7. COMPLETE RESPONSE OF CIRCUITS IN TIME

- First order linear circuits
- Second order linear circuits

7729 Fundamentals of electronics

UNIT 1. INTRODUCTION TO THE DIFFERENT TYPES OF ELECTRONICS: ANALOG, DIGITAL, INSTRUMENTATION, COMMUNICATIONS, ENERGY CONVERSION.
UNIT 2. INTRODUCTION TO THE TYPES OF SIGNALS AND STRATEGIES OF THE DIFFERENT "ELECTRONICS"
UNIT 3. FUNDAMENTALS OF SOLID-STATE SEMICONDUCTOR DEVICES
UNIT 4. PN UNION
UNIT 5. THE JUNCTION DIODE. ELECTRICAL CHARACTERIZATION
UNIT 6. SECOND ORDER EFFECTS
UNIT 7. DIODES, MODELS, RESOLUTION TECHNIQUES
UNIT 8. CIRCUITS WITH DIODES: APPLICATIONS
UNIT 9. SINGLE PHASE RECTIFIERS
UNIT 10. PASSIVE FILTERS
UNIT 11. STABILIZED POWER SUPPLIES
UNIT 12. REFERENCE VOLTAGE SOURCES

PRACTICES

1. **Introduction to the laboratory system.**
2. **Instrumentation-I**
3. **Instrumentation-II. Function Generator and Oscilloscope**
4. **Introduction to the Or CAD Electronic Simulator**
5. **Study of the Rectifier Diode**
6. **Simulation of circuits with diodes**
7. **Creation of your own library of components in Or CAD and Creation of own components**
8. **Simulation and assembly of the double wave rectifier with capacitor filter, and with LC filter**
9. **Zener diode stabilized power supply**
10. **Various assemblies with voltage regulators**

7730 Mechanisms

1. Topological analysis of mechanisms.
2. Articulated mechanisms.
3. Graphic synthesis of mechanisms.
4. Graphic and algebraic kinematics of flat mechanisms.
5. Machine static.
6. Machine Dynamics.

7732 Automatisms and industrial control

1. Introduction to Automatisms and Industrial Control.
2. Electrical Automatisms.
3. Pneumatic Automatisms.
4. Electro-Pneumatic Automatisms.
5. Hydraulic Automatisms.
6. Control with industrial programmable controllers (PLCs).

- **Third year:**

7733 Materials engineering

MATERIALS ENGINEERING

THEORY OF ALLOYS.

General concepts of alloys. Phase Diagram. Hardening treatments.

FERROUS ALLOYS

General concepts of steels. Types of steels. Foundries. Types of foundries.

NON-FERROUS ALLOYS

Light alloys. Common alloys. Super-alloys.

CORROSION

General principles. Types of corrosion.

WELDING

General principles. Types of welding. Inspection of welded joints.

CERAMIC MATERIALS.

Shaping of ceramic materials. Properties of ceramic materials.

POLYMERIC MATERIALS

Types of polymeric materials. Properties of polymeric materials.

COMPOSITE MATERIALS

Theory of composite materials.

7734 Thermal engineering II

PART I. ENERGY AND EXERGETIC ANALYSIS OF POWER PRODUCTION FACILITIES, PRODUCTION COOLING AND COGENERATION

UNIT 1. ANÁLISIS EXERGÉTICO

UNIT 2. POWER PRODUCTION SYSTEMS

UNIT 3. COLD PRODUCTION SYSTEMS

UNIT 4. COGENERATION AND ENERGY SAVING

PART II. AIR CONDITIONING SYSTEMS AND HEAT PRODUCTION

UNIT 5. IDEAL GAS MIXTURES. MOIST AIR

UNIT 6. COMBUSTION AND BOILERS

PART III. HEAT TRANSMISSION

UNIT 7. HEAT TRANSMISSION CONCEPTS REVIEW

UNIT 8. CONVECTION

UNIT 9. HEAT EXCHANGERS

UNIT 10. RADIATION IN NON-ABSORBENT MEDIUM

7735 Materials elasticity and resistance II

UNIT 1. BASIC CONCEPTS OF ELASTICITY AND RESISTANCE OF MATERIALS

1.1 Introduction and objectives
1.2 Types of unions and reactions
1.3 Static equilibrium equations
1.4 Application of equilibrium equations
1.5 Internal forces in a section. Stress diagrams
1.6 Types of solicitations in a section
1.7 Distribution of stresses. Simple stresses (Tension or compression, Bending pure, pure cut, pure torsion)
1.8 Distribution of stresses. Combined stresses (Deflected deflection, Compound deflection)
1.9 Equivalent stresses and resistance criteria
1.10 Proposed exercises

UNIT 2. DESPLAZAMIENTOS AND GYROS CALCULATION

2.1 Introduction and objectives of the theme
2.2 Estimation of the approximate deformation
2.3 Moment-curvature relation
2.4 Differential equation of the elastic curve
2.5 Circulation of displacement and girders mediating the differential equation of the elastic
2.6 Mohr theorems for the motion series
2.7 Principle of superposition
2.8 Exercised prophecy

UNIT 3. CALCULO OF RETICULADED STRUCTURES

3.1 Introduction
3.2 Degree of hyperesthesia
3.3 Power method
3.4 Resolution of continuous lines
3.5 Intraslational points
3.6 Structures with cables
3.7 Temperature variations
3.8 Exercised prophecy

UNIT 4. CALCULO OF ARTICULAR ARTICLES

4.1 Introduction and Objectives
4.2 Structures of isostatic and hyperesthetic articulations
4.3 Calculation of spheres in isostatic structures (Method of nudes, Method of the sections)
4.4 Calculation of displacement by energy theorems (Castigliano theorem, Cargo Unit Method)
4.5 Resolution of hyperesthetic articular structures
4.6 Temperature variations
4.7 Symmetry and antimetry
4.8 Exercises resulted
4.9 Exercises propuestos

UNIT 5. MATRICIAL CALCULATION OF ARTICULATED STRUCTURES

5.1 Introduction
5.2 Nomenclature
5.3 Load matrix of a load in local coordinates.
5.4 Stiffness matrix of a load in global coordinates.
5.5 Structure rigidity matrix
5.6 Cargo vector and displacement vector.
5.7 Resolution of the matrix equation.
5.8 Calculation of reactions at lows.
5.9 Calculation of loads at the end of the load (Axils).
5.10 Particular Cases in Matrix Calculation (Temperature Variations, Apoyos elastics)

7736 Mechanisms II

TOPIC 1.-ALGEBRAIC SYNTHESIS OF MECHANISMS

- Two-position synthesis.
- Three-position synthesis.
- Fixed and mobile pivot circumferences.
- Synthesis of more than 3 positions.
- Synthesis of generation of trajectories.
- Synthesis of generation of functions.

TOPIC 2.-SPACE MECHANISMS

- Homogeneous transformations.
- Representation of Denavit-Hartemberg.
- Direct and inverse kinematic problem of an MRI.
- Application to Stanford industrial robot.

TOPIC 3.-CAM AND FOLLOWER MECHANISMS

- Classification of cams and followers
- Design of kinematic diagrams of the follower.
- Cam design.

• Desmodromic cams.

TOPIC 4.-GEAR THEORY
• Involute profiles.
• Cylindrical-straight gears
• Helical gears.
• Concurrent gears.
• Cross gears.

TOPIC 5.-GEAR TRAINS
• Fixed gear trains.
• Planetary gear trains.
• Gearboxes.

7737 Analog electronics

THEORETICAL TOPICS
Transistors.
Amplification.
Feedback.
Operational amplifier and applications.
Wave generation.
Active filters.
Analog Integrated Circuits.

7738 Digital electronics

PART I. INTRODUCTION TO DIGITAL ELECTRONICS

UNIT 1. NUMBERING SYSTEMS AND CODES
Numbering systems: hexadecimal, decimal, octal and binary. Binary codes.

UNIT 2. BOOLEAN ALGEBRA. LOGICAL FUNCTIONS AND SIMPLIFICATION.
Boolean algebra. Logic functions. Function simplification.

PART II. VHDL PROGRAMMING LANGUAGE

INTRODUCTION TO VHDL LANGUAGE
Introduction to VHDL language.
Advantages of using VHDL for hardware description.
Styles of VHDL description.
VHDL LANGUAGE SYNTAX.

SYNTACTIC ELEMENTS OF VHDL.
1. Operators and expressions.
2. Data types.
3. Attributes.
4. Declaration of constants, variables and signals.
Instructions in data flow architecture.
Instructions in algorithmic behavioural architecture.
Instructions in structural architecture.

PART III. VHDL LANGUAGE STRUCTURE

ENTITY DECLARATION.

ARCHITECTURE DECLARATION.

Data flow description.

1. Data flow execution structures.
2. Examples of data flow description.

Algorithmic behavioural description.

1. Difference between variable and signal.
2. Structures of series execution.

Structural description.

1. Components, reference and link.
2. The configuration unit.

Subprograms, packages and libraries.

PART IV. DESIGN METHODS

COMBINATION SYSTEMS

Basic components:
Logic gates.
Functional blocks:
Multiplexer and demultiplexer.
Encoder and decoder.
Comparators.
Generators and parity detectors.
Arithmetic circuits: addition, ALU and multiplication.
Design of combinational circuits.

SEQUENTIAL SYSTEMS

Basic components:
Flip-flop.
Functional blocks:
Records.
Counters.
Design of sequential circuits.
Status machines.

MEMORIES

Classification.
Parameters of a memory.
Memory structure.
Memory operations.
Circuit design with memories.

PART V. VHDL FOR SYNTHESIS

SYNTHESIS

Introduction to synthesis.
Methodology of synthesis in a logical device.
Integration of the design in a logical device.
Restrictions and optimization.

7739 Industrial production and fabrication systems

INDUSTRIAL PRODUCTION AND MANUFACTURING SYSTEMS

STANDARDIZATION

1. Definition and purpose of standardization.
2. Advantages of the standardization.
3. General principles of the standardization.
4. National standardization bodies.
5. Standardization in Spain. UNE standards.
6. The international standardization.

ISO standards.

NORMAL NUMBERS

1. Introduction. 2. Fundamental series. 3. Properties of normal numbers.
2.

DIMENSIONAL TOLERANCES

1. Introduction. 2. The system of fundamental ISO tolerances. Fundamental Concepts
3. Group of nominal ISO sizes up to 500 mm. 3.1. Fundamental tolerances.
3.2. Tolerance positions. 3.2.1. Fundamental reference differences
3.2.2. Fundamental reference differences in holes.
3.2.3. Standard tables of tolerance positions. 4. Group of nominal ISOs.
4.1. Fundamental tolerances. 4.2. Tolerance positions.
5. Designation of dimensions with tolerance. 6. Measurement of Free tolerances.

7740 Electric machines

PART I. TRANSFORMERS

SINGLE-PHASE TRANSFORMERS.

Study of single-phase transformers, definition, fundamental parameters, regulation, characteristic tests, parallel coupling.

INSTRUMENT TRANSFORMERS.

Definition of voltage and current transformers, definition, basics and basic characteristics, use, advantages and disadvantages.

AUTOTRANSFORMERS.

Definition, comparison with a transformer, characteristics, use, advantages and disadvantages.

THREE-PHASE TRANSFORMERS.

Definition, constitution, forms of connection, currents, connections, hourly indices, parallel coupling.

PART II. ASYNCHRONOUS MACHINES

GENERAL CONCEPTS.

General constitution of rotating electric machines, coils, types of coils, induced emf in alternating current coils, parameters on which emf depends, rotating magnetomotive force, electromagnetic torque.

ASYNCHRONOUS MOTORS.

Constitution, operating principle, slip, induced emf and electromagnetic torque, characteristic curves, vacuum and load operation, balance of power, performance, asynchronous motor start-ups, start-up current and start-up stop.

PART III. DIRECT CURRENT MACHINES

GENERAL CONCEPTS.

Definition, alternating sine emf, basic alternator, coils, classes of coils, electrical bonding, induced reaction, switching.

DIRECT CURRENT GENERATORS

Definition, basic characteristics, balance of power, dynamo or independent excitation generator, shunt generator, series generator, compound generator, comparison of direct current generators, applications of dc generators.

DIRECT CURRENT MOTORS

Definition, balance of power, starting dc motors, characteristics of DC motors, series motors, shunt motor, composite motor, operational stability, braking, reversal of rotation direction, application of DC motors

7741 Automatic regulation

PART I. REGULATION.

- Introduction to control systems.
- Mathematical representation y modelling systems.
- Temporary response.
- Basic control actions.
- Control System Stability.
- Root place.
- Frequency response.
- Status space control.
- Control system design.

7742 Microprocessor based systems

UNIT I. PROGRAMMABLE SYSTEMS

Introduction to programmable systems.
Architecture of microprocessor systems.
Operation of a microprocessor-based system.
Microcontroller architecture.
Microcontroller operation.

UNIT II: MICROPROCESSOR SOFTWARE

Software Tools.
Assembler programming.
High level language programming.

UNIT III: PERIPHERALS: INPUT AND OUTPUT DEVICES
Input and output devices
Types of peripherals.

7743 Machine design I

- Introduction to machine design.
- Criteria de fallo cargo aesthetics
- Theories of falling fluctuating cargo. (Fatiga).
- Transmission and acoplamation irons.
- Rodadura joints.
- Lubrication systems and friction bearings.

➢ Fourth year:

7744 Power electronics

PART I. INTRODUCTION TO POWER ELECTRONICS

•Revision of power poles.
•Transitional Revision.

Applications of Power Converters
•General information on Power electronics applications.

PART II. ENERGY CONVERTERS

AC/DC converters
• Uncontrolled rectifiers.
• Fully controlled rectifiers.
• Semi-controlled rectifiers.
• AC/DC analysis.
•Internal voltage drops.
• Negative effects created on the AC network.

Static Switches
• DC Static Switches.
• AC Static Switches.
• Resonant switches.

DC/DC converters
• General information.
• DC/DC converters, working in a single quadrant.
• DCI converters, working in a several quadrants.
• DC/DC converters, capacitor switching.
• Transformer coupled DC/DC converters.

DC/AC converters
• General information.
• Topologies of DC/AC converters.
• Multilevel DC/AC converters.
• DC/AC converter control.
• Resonant inverters.

AC/AC converters
• AC regulators.
• Cycloconverters.
• Matrix converters.

7745 Machine design II

- Calculation and design of gears.
- Brakes and clutches.
- Flexible elements of power transmission.
- Springs.
- Power screws and bolted connections.
- Mechanical transmission sets.

7746 Electronic instrumentation

INTRODUCTION TO ELECTRONIC MEASUREMENT SYSTEMS
UNIT 1. SENSORS.
Resistive sensors.
Generator sensors.
Variable Reactance Sensors.

UNIT 2. SIGNAL CONDITIONING
Amplification.
Interference and Noise.
Insulation.

UNIT 3. DATA ACQUISITION
A/D Conversion.
D/A Conversion.
Data Acquisition Systems.

7747 Graphic Engineering

- INTRODUCTION TO DESIGN WITH HIGH LEVEL CAD TOOLS.
- BASIC PART DESIGN.
- CATALOGUE OF PARTS AND DESIGN TABLES.
- BASIC SURFACES.
- ADVANCED SURFACES.
- CREATION AND MANAGEMENT OF ASSEMBLIES.
- FUNCTIONAL AND 3D ASSEMBLY SIMULATION. LAYOUT AND CREATION OF PLANS.
- REVERSE ENGINEERING.
- VERTICAL 3D CAD APPLICATIONS.
- MANAGEMENT OF DATA IN CONCURRENT ENGINEERING.

7748 Technology of electronics systems

REGULATIONS.
LOGICAL FAMILIES.
Characteristics.

POWER SEMICONDUCTOR DEVICES
Semiconductor Thermal Protection.

OPTOELECTRONIC ELEMENTS.
COMMUNICATION ELEMENTS.

ELECTRONIC TECHNOLOGY PRACTICES
Passive and active electronic components.
PCB design and manufacture.

7749 Mechanical Technology I

INTRODUCTION TO PLASTIC DEFORMATION PROCESSES
1. Introduction. 2. The tensile trial. 2.1. Conventional or Technological deformation stress curve. 2.2. Creep curve. 3. Elastic behaviour of the metals. 3.1. Tensions in a point. 3.2. Flat state stresses. 3.3. Mohr' Circle in a flat stress state. 3.4. Three-dimensional stress state. 3.5. Mohr's Circle in three dimensions. 3.6. Types of deformation. 3.7. Stress/deformation relations. 3.8. Spherical components or strain and deformation reliefs. 4. Creep criteria in ductile metals. 4.1. Tresca Criterion. 4.2. Von Misses Criterion. 5. Plastic behaviour of metals. 5.1. Justification and objectives of plastic deformation processes. 5.2. Tests to determine the creep stress. 5.3. Load required to produce creep in homogeneous deformation. 5.4. Work formula for the calculation of loads in homogeneous deformation. 5.5 Slip line field theory. 5.6. Effect of temperature on deformation processes. 5.7. Effect of speed of deformation on plastic deformation processes. 5.8. Friction and lubrication.

FORGING
1. Description of the process. 2. Calculation of stresses in forging. 2.1. Free forging. 2.2. Stamping. 3. Upsetting and heading

LAMINATION
1. Description of the process. 2. Variations of the process. 3. Forces and geometric relationships in lamination. 4. Approximate calculation of the load, torsion and power of lamination in homogeneous deformation.

STRETCHING
1. Description of the process. Elemental analysis of stretching efforts.

CONTINUOUS EXTRUSION OF METALS
1. Description of the process. 2. Variations of the basic process. 3. Elementary analysis of the efforts in the extrusion.

PLATE BENDING AND CURVING

1. Definition. 2. Fundamental problems of bending. 3. Minimum bending radius. 4. Determination of neutral fibre. 5. Calculation of developments. 6. Marking of pieces. 7. Calculation of efforts in bending. 8. Elastic recovery. 9. Bending procedures. 10. Bending machines. 11. Other bending operations.

SHEARING, CUTTING AND PUNCHING

1.Definition of the process. 2. Sheet metal cutting operations. 3. Shearing. 4. Relationship between the thickness of the sheet and the dimensions of the cross section of the punch. 5. Parts of a die. 6. Play between the punch and the matrix. 7. Use of the sheet. 8. Calculation of the efforts in die-cutting. 9. Calculation of punch buckling. 10. Structural classification of punches.

DEEP DRAWING

1. Definition. 2. Rounding of the die and punch. 3. Play between the die and the punch. 4. Calculation of the primitive disk. 5. Calculation of the number of deep drawings. 6. Forces of deep drawing and the press plate. 7. Deep drawing speeds. 8. Lubrication. 9 Defects of deep drawn pieces.

THE LATHE

1. The machine tool. 2. Axle systems for machines — tools. 3. Parallel lathe: standardized description and terminology. 4. Tailstock. 5. Lathe carriages. 6. Kinematic chain to move the carriages. 7. Advances of the main carriage. 8. Advances of the transversal carriage.

GEOMETRY OF CUTTING TOOLS

1. Introduction. 2. Single-cutting tool. 3. ISO Regulations for the nomenclature of cutting tools. 4. Influence of the effective angles in machining. 5. Constant profiling tools. 6. Nomenclature of lathe tools. 7. Chip breaker.

CUTTING TOOL MATERIALS

1. How to choose the material of the tool. 2. General properties of cutting tool materials. 3. Materials used in the construction of cutting tools. 4. Study of the cut. 5. Choosing the blades at work in series. 6. Wear of cutting tools.

CUTTING SPEED

1. Introduction. 2. Cutting speed. 3. Taylor's theory. 4. Generalized Taylor equation. 5. Kronenberg theory. 6. Denis theory. 7. Economics of machining.

CUTTING EFFORTS

1. Introduction. 2. Geometry of the cut. 3. Chip types and study models of cutting efforts. 4. Shear plane Model. 5. Three-dimensional cut. 6 Specific cutting pressure method. 7. Cutting power. 8. Times of machining.

TURNING OPERATIONS

1. Introduction. 2. Turning. 3. Facing. 4. Grooving and bucking. 5. Eccentric turning. 6. Knurling. 7. Shape turning. 8. Degree of roughness in turning. 9 Calculation and construction of cones.

EVALUATION OF MEASURE UNCERTAINTY

1.Terminology. 2. Calibration. 3. Measurement methods. 4. Law of propagation of uncertainty or law of propagation of variances. 5. Assessment of measure uncertainty of input estimates. Estimation of typical uncertainty. 5.1. Typical Type A evaluation of uncertainty. 5.2. Typical Type B evaluation of uncertainty. 5.3. Input quantities related to more than one source of uncertainty. 5.4. Correlated input magnitudes. 5.4.1. Estimation of covariance through functional relationships between correlated variables and those that influence them. 5.4.2. Estimation of the covariance from n pairs of independent, repeated and

simultaneous observations. 6. Calculation of expanded uncertainty. 6.1. Calculation of the coverage coefficient through normal distribution. 6.2. Calculation of the coverage coefficient from Student's t-distribution. 7 Expression of the measurement result.

CALIBRATION

1. Calibration. 2. Local calibration or calibration of a point on the scale of the instrument. 2.1. Calibration operation. 2.2. Calculation of measure uncertainty in the environment of the calibrated point. 3. Global calibration of the measuring instrument. 3.1. Linear interpolation method. 3.2. Common correction method. 3.3. Maximum uncertainty method. 4. Measuring instruments of double direction. 5. Proper uncertainty of a measuring instrument. 6. Rejection Criteria.

INDIRECT MEASUREMENTS

1. Indirect measures: dimensions and angles. 1.1. Dimension measuring knowing angles. 1.2. Calculation of angles of known dimensions. 1.3. Measurement of dimensions and angles by means of shoes. 2. Radius measurement. 2.1. Two-roll method. 2.2. Fixed roll probe method. 2.3. Three-point method. 2.4. Chord deflection method. 2.5. Measurement of lenses with a spherometer. 3. Conicity and inclination. 3.1. Measurement and verification of cones.

THREAD MEASUREMENT

1. Definition. 2. Normalized terminology. 3. Classification of threads. 4. Thread systems. 4.1. Whitworth system. 4.2. Sellers system. 4.3. ISO metric thread. 4.4.1. Diameter series and ISO steps. 4.4.2. Tolerances of ISO thread system. 4.4.3. Tolerances for the screw tolerance qualities. 4.4.4. Tolerances for the nut tolerance qualities. 4.4.5. Tolerance positions of the ISO thread. 4.4.6. Complete designation of the ISO metric thread. Measurement and verification of threads. 5.1. Measurement of external threads. 5.1.1. Measurement of the outside diameter. 5.1.2. Measurement of the internal diameter. 5.1.3. Measurement of the average diameter. 5.1.4. Measurement of the angle of the thread. 5.1.5. Measurement of the pitch of the thread. 5.2. Internal thread measurement.

MEASUREMENT OF DENTED GEARS

1. Introduction. 2. Classification of dented gears. 3. Cylindrical gears with straight teeth. Standardized terminology. 3.1. Calculation of fundamental magnitudes. 4. Cylindrical gears of helical teeth. 5. Straight-tooth conical wheels. 6. Verification of cogwheels. 7. Measurement of tooth thickness. 7.1. Measurement of tooth thickness by means of a Vernier calliper. 7.2. Measurement of the base thickness by means of a micrometre of saucers. 8. Step measurement. 9 Verification of profile shape. 10. Measurement of eccentricity. 11. Measure of distortion.

PRACTICES

PRACTICE 1. Calibration of the calliper.
PRACTICE 2. Calibration of the outdoor micrometre.
PRACTICE 3. Measurement of an outer cone.
PRACTICE 4. Measurement of an inner cone.
PRACTICE 5. Measurement of a thread.
PRACTICE 6. Measurement of a cylindrical straight-tooth gear.

7750 Industrial Processes control

- Control input at discrete time
- Sampling and reconstruction of seals
- Mathematical representation of discrete systems
- Stability of discrete systems
- Design of discrete controllers
- Design of discrete advanced controllers

7751 Industrial installations I

- BUILDING ENVELOPE.
- TRANSPORTATION OF FLUIDS.
- THERMAL INSULATION OF EQUIPMENT AND DUCTS.
- NOISE AND VIBRATIONS IN INSTALLATIONS.
- INDOOR WATER INSTALLATIONS.
- VENTILATION FACILITIES.
- HEATING FACILITIES.
- ELECTRICAL INSTALLATIONS.
- FIRE INSTALLATIONS.

7752 Industrial Computing

Industrial Computing
1. Introduction to industrial computer science.
2. Programmable controllers and Industrial PCs.
3. Basic PLC programming.
4. Industrial communications.
5. Human Machine Interfaces (HMI).
6. SCADA Systems.

7753 Structural analysis I

Metallic materials and structures
Structural steel and structural steel products. Behaviour of structural steel

Bases of calculation, project regulations and frequent typologies of building metal structures
Safety and service structures
Actions (normative) and stresses (analysis models) on construction structures
Particular calculation bases for metal structures of construction.
Structural configuration of industrial buildings. Preliminary structural analysis.

Analysis and sizing of metallic structural elements
Uniform, warping and mixed twist of pieces with thin wall section
Buckling of compressed ideal and real pieces. Elastic and plastic analysis of tensioned and flexed parts. Instability phenomena in the flexed parts (lateral buckling and panel dent).

Joints in metal building structures
Frequent typologies and global behaviour of the joints.
Local analysis, sizing and execution of bolted joints.
Local analysis, sizing and execution of welded joints.

7763 Hydraulic Machines

HYDRAULIC TURBINES.

TOPIC 1.-INTRODUCTION. BASIC CONSIDERATIONS.

- Introduction.
- Resistant curves in hydraulic installations
- General concepts of fluid mechanics
- of Fluid Machines.
- General equation of turbomachines.
- Semejanza equations

TOPIC 2. PUMPS AND FANS.

- Centrifugal and axial bombs.
- Positive displacement bombs.
- Axial and Centrifugal Ventilators
- Calculation and dimension of bomb systems.
- Calculation and dimension of ventilation systems.
- Bomb and fan regulation

TOPIC 3. POWER PLANTS. HYDRAULIC TURBINES.

- Introduction to the study of electricity demand.
- Hydraulic energy in Electricity Generation Mix

TOPIC 4. ELECTRICITY PRODUCTION CENTERS. TURBINES HYDRAULICS

- Hydroelectric power plants.
- Bomb exchanges.
- Hydraulic turbines.
- Action turbines
- Reaction turbines

➢ Fifth year:

7754 Technical office work

BACKGROUND

Professional C.V. or resumé.

THEORETICAL AND PRACTICAL KNOWLEDGE

Basic concepts on the project and its classification.

Project documents.

Project environment.

Industrial project regulations.

1st case study. Implementation and project study (to be specified during the course).

2nd case study. Implementation and project study (to be specified during the course).

KNOWLEDGE ONLY THROUGH PRACTICAL APPLICATIONS

Practices

Specific techniques for assuring the correct operation of the industrial product. Analysis of preliminary risks. Failure mode and effects analysis of

User demands. Product quality. Quality function deployment. Direction, planning and management of projects. Multidisciplinary projects. “concurrent engineering”. Documentation-gathering work.

7755 Industrial automation

1. Introduction to industrial automation.
2. Industrial automatisms.
3. Advanced PLC programming.
4. Modelling and programming of Discrete Event Systems (DEVs).
5. Field buses for industrial process control.
6. Industrial automation and control projects.

7756 Structural analysis II

1. - Structures of Reinforced Concrete: combination of actions and safety factors.
2. - Reinforced Concrete Structures: materials.
3. - Reinforced Concrete Structures: Ultimate Limit States.
4. - Reinforced Concrete Structures: Service Limit State.
5. -Reinforced Concrete Structures: structural regions. Crank and tie rod method. Short cantilevers. Foundations. Walls.
6. - Foundations and walls: constructive general information. Floor slabs.

7757 Thermal machines

TOPIC 1 GENERALITIES ON THERMAL MACHINES
Initial definitions. Classification of thermal machines.

TOPIC 2 CYCLES OF WORK IN ALTERNATIVE INTERNAL COMBUSTION ENGINES
Introduction. Actual or indicated cycle. Theoretical cycles. Performance. Indicated parameters of the AICE.

TOPIC 3 DETERMINATION OF THE FUNDAMENTAL MAGNITUDES
Engine testing. Characteristic curves of an engine. Energy balance in the engine. Cooling systems. Lubrication.

TOPIC 4 PROCESSES OF RENEWAL OF LOAD
Renewal of load in four-stroke Engines. Renewal of load in two-stroke Motors. Overfeeding of engines.

TOPIC 5 COMBUSTION IN AICES
Fuels. Combustion in SIM. Combustion in CIM. Feeding systems. Ignition system. Diesel injection systems.

TOPIC 6 STEAM TURBINES
Introduction. Thermodynamic cycles in steam turbines. Real energy balance of a steam turbine power plant.

TOPIC 7 GAS TURBINES
Introduction. Brayton cycle. Real energy balance of a gas turbine. Combined cycle power plants.

TOPIC 8 JET ENGINES
Rocket engine. Expression of thrust. Jet injectors. Turbojets.

TOPIC 9 INTRODUCTION TO COGENERATION
Cogeneration systems. Fundamental parameters Fuel cells.

TOPIC 10 ENVIRONMENTAL IMPACT OF THERMAL MACHINES
Environmental impact of energy development. Environmental impact of fuels. Environmental impact of thermoelectric and nuclear energies.

7758 Industrial robotics

Robotics
1. Introduction to robotics.
2. Robot Kinematics.
3. Robot Dynamics.
4. Trajectory Planning.
5. Robot Control.
6. Programming of industrial robots.

7761 Final project (mechanical engineering)
7762 Final project (industrial electronics and automation engineering)
7759 External placements
7760 English for mechanical engineering