UNIVERSITAT DE VALÈNCIA - ESTUDI GENERAL

B. Eng. in TELECOMMUNICATION ENGINEERING (Electronic Systems)

2003/04 SYLLABUS

Dpt. Electronics Engineering
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1.- General Description of the High School of Engineering.

The High School of Engineering of the University of Valencia has been created very recently. In fact it was officially established on the 24th of September of 2003.

This new High School of Engineering of the University of Valencia has its origins at the common needs and desires of three Departments of our University. These Departments are Chemical Engineering, Electronical Engineering and Informatics. All these departments are involved in lecturing in several engineering and technical degrees of our University at its Campus of Burjassot. These degrees are:

- M. Sc. in Electronic Engineering
- M. Sc. in Computer Engineering
- M. Sc. in Chemistry Engineering
- B. Eng. in Telecommunications Engineering specialising in Electronic Systems
- B. Eng. in Telecommunications Engineering specialising in Telematic Systems

The High School of Engineering is in charge of an approximate number of 2800 students from which 700 are enrolled in the M.Sc in Electronics Engineering and B. Eng. in Telecommunications specialising in Electronic Systems in a total of 56000 students from all the University of Valencia.

The Electronics Engineering Department is responsible for teaching M.Sc in Electronics Engineering and B. Eng. in Telecommunications specialising in Electronic Systems. Currently, there are 60 lecturers. The Department research covers the areas of Electronics, Digital Signal Processing and Electronic Technology. There are four research groups, namely, Industrial Electronics and Instrumentation Lab (LEII), Digital Signal Processing Group (GPDS), Communication and Electronic Digital Systems Group (DSDC), and Medical Imaging Acquisition and Processing Group (SATI).

The Computer Engineering Department is responsible for teaching M.Sc in Computer Engineering and B. Eng. in Telecommunications specialising in Telematic

Systems. Currently, there are around 70 lecturers. This Department covers the areas of Architecture and Technology of Computers, Computer Science and Engineering Systems. Research work concerns Image Processing, Robotics and Traffic Technology.

2.- Location of the High School of Engineering

The university centres are located in three campuses:

- Burjassot-Paterna, with the faculties of Biology, Physics, Chemistry, Mathematics, and Pharmacy.
- Blasco Ibáñez, with the centres of the Humanities area as well as the Medicine and Odontology College, the Nursing School, and the Psychology College.
- Tarongers, which encompasses the colleges of Social Sciences, Economics, and Law.

In each campus, there are different services and research institutes. As mentioned above, the Faculty of Physics is located in the Burjassot-Paterna Campus (Science Campus). There are two ways to arrive to the Burjassot-Paterna Campus by public transportation:

- Tramway: Company "FGV (metro-tranvia)" line 4 stopping down in "Campus de Burjassot" and "Vicent Andrés Estellés" stops.
- EMT (red buses from the municipality). The line arriving to the campus is number 63, only during weekday and lective periods.

3.- Professional Skills.

Electronics and communication systems are related areas of study concerned with technology that influences nearly every aspect of modern society. Electronics deals with the science and engineering of everyday items ranging from home appliances, entertainment systems, and telecommunications to city utilities, control systems for traffic, and transport. Communication systems deal with the technology of conveying information between people using computers and/or electronic equipment such as telephones. Both these areas of study play an important role in business and manufacturing, and are about building and using systems for productive and leisure activities.

The B. Eng. degree in Telecommunications (Electronic Systems) at the University of Valencia is intended to train Technical Engineers, well-qualified for the electronic industry market and R&D activities, ready to analyse and solve technological challenges, and able to get involved and develop projects. Students might become involved in communications, commercial or industrial control systems, consumer goods, entertainment products, computers and their peripheral devices, scientific and medical equipment, wireless applications or research and development. This degree is a professional program of studies in analogue and digital electronic circuit design, signal analysis and processing, communication systems, power electronics, measurements and tests, automation and computer architecture. Furthermore, the underlying goal is to foster an engineering attitude, that is, a justified confidence in one's ability to solve technical problems.

After completing the degree, students are entitled to develop a professional activity according to the Institution of Technical Telecommunications Engineers and the attributions given by the Spanish Government. They are also able to access directly to the M.Sc. in Electronic Engineering Degree (two years).

4.- Teaching Contents.

The teaching content of the B. Eng. Degree in Telecommunications (Electronic Systems) ("ITT-SE" from now on) is organised into units called MODULES. A given number of credits are assigned to each module, so that one credit equals 10 teaching hours. There are four different types of modules:

- Core Modules: these correspond to disciplines determined by national General Guidelines imposed by the Government in order to provide uniformity of criteria along the country.
- Compulsory Modules: these correspond to disciplines determined by the University of Valencia, which are compulsory for each degree.
- Elective Modules: these correspond to disciplines determined by the University of Valencia for the Technical Engineering Degree in Telecommunications

(Electronic Systems), the student must choose from a determined number of credits depending on the student's preferences.

- Free Choice Modules: these correspond to modules which are chosen freely by the student from amongst the disciplines of various degrees offered at the University of Valencia and/or other specific degrees, of which a determined number of credits must be studied.

As regards the number of credits, the teaching content of the ITT-SE is distributed in the following way:

Core Modules	Compulsory Modules	Elective Modules	Free Choice
105 credits	40.5 credits	25.5 credits	21 credits

The teaching content is 207 credits in all, 192 of which correspond to theoretical or laboratory modules and 15 correspond to the End of Degree Project (Final Project). There are no incompatibilities between different modules but there are some hints for the better following of the modules.

The year is divided into two semesters. The first semester begins the last week of September and finishes in mid February. The second semesters starts in mid February and finishes at the end of June. The last three weeks of each semester are nor dedicated to lecturing but only to examinations. There are modules with annual and one-semester duration. There are three holiday periods during the academic year: the Christmas break, from 21st December to 8th January, the Fallas break, from 16th March to 20th March, and the Easter break, which covers one week in the end of March or beginning of April.

5.- Admission to the Studies

When students finish the secondary school they must pass an examination. The students are admitted depending on their results (marks obtained during the secondary school and final examination) until all the places, which are available annually, are filled. For the 2003/04 academic course there are 110 places.

After completing the Degree, students are allowed to have direct access to second cycle Degrees in:

- M.Sc. Electronic Engineering.
- M.Sc. Control and Industrial Electronic Engineering.
- M.Sc. Telecommunications Engineering.

6.- Subjects Map.

I.T.T.-S.E. FIRST YEAR

Code	Term	MODULE's NAME	Type[1]	Cred.	Theo	Lab
13104	both	Mathematical Analysis for Engineering	CO	12	12	0
13100	both	Analogue electronics I	CO	12	7.5	4.5
13095	both	Analysis of Circuits and Linear Systems	CO	9	7.5	1.5
13097	both	Digital Electronic Devices and Circuits	CO	10.5	6	4.5
12755	1st	Computing	CP	6	3	3
13103	2nd	Principles of Physic for Engineers	CO	6	6	0
13102	2nd	Electronic Devices	CO	6	3	3
		Elective	EL	6		
		TOTAL		67.5		

I.T.T.-S.E. SECOND YEAR

Code	Term	MODULE's NAME	Type	Cred.	Theo	Lab
13125	Both	Digital Electronic Systems	CO	12	7.5	4.5
13110	Both	Instrumentation and Electronic Equipment	CO	10.5	6	4.5
13127	Both	CAD	CP	6	0	6
13105	1st	Fundamentals of Computers Architecture	CO	6	3	3
13114	1st	Introduction to Digital Signal Processing	CP	7.5	4.5	3
13116	2nd	Microelectronics	CO	6	3	3
13101	2nd	Analogue electronics II	CP	6	4.5	1.5
		Elective	EL	9		
		Free Choice	FC	6		
		TOTAL		69		

[1] Legend: CO: Core subject
CP: Compulsory subject
EL: Elective subject
FC: Free Choice

I.T.T.-S.E. THIRD YEAR

Code	Term	MODULE's NAME	Type[2]	Cred.	Theo	Lab
13124	Both	Electronic Control Systems	CO	9	6	3
13111	Both	Introduction to Power Electronics	CP	9	6	3
13106	1st	Fundamentals on communication electronics	CP	6	4.5	1.5
13119	2nd	Projects	CO	6	4.5	1.5
13118		Final Project	CP	15	0	15
		Elective	EL	10.5		
		Free Choice	FC	15		
		TOTAL		70.5		

ELECTIVE SUBJECTS (can also be chosen as free choice subjects)

Code	MODULE's NAME	Term	Year	Cred.	Theo	Lab
13112	Intro. to Programmable Logic Controllers	1st	2nd	7.5	4.5	3
12510	Economy and industrial organization	1st	2nd	6	6	0
13115	Mathematical methods for engineering	1st	2nd	6	4.5	1.5
13123	Power supply electronic systems	2nd	2nd	7.5	4.5	3
13029	Programming tools	2nd	2nd	4.5	1.5	3
13129	Multimedia information processing	1st	3rd	4.5	3	1.5
13113	Introduction to telecommunication systems	1st	3rd	4.5	4.5	0
13121	Remote Sensing Systems	1st	3rd	4.5	3	1.5
13107	Assessment and Quality Control in Electr.	1st	3rd	6	6	0
13098	Optical communications	1st	3rd	4.5	3	1.5
13126	Distributed industrial systems	2nd	3rd	6	3	3
13122	Electronic systems with microprocessors	2nd	3rd	6	3	3
13120	Data Transmission Networks	2nd	3rd	6	3	3
13096	Power electronic devices	2nd	3rd	6	4.5	1.5
13117	Microwaves and antennas	2nd	3rd	6	4.5	1.5
13109	Virtual instrumentation	2nd	3rd	6	3	3

[2] Legend: CO: Core subject
CP: Compulsory subject
EL: Elective subject
FC: Free Choice

7.- Degree Modules

The purpose of the bachelor engineering in Telecommunications specialising in Electronic Systems is to prepare students for a variety of careers in electronics engineering. Specifically, this degree will prepare the student to

- Apply knowledge of digital number systems, logic gates, combination and sequential logic circuits.
- Describe the internal structure of a microprocessor and electrical signals.
- Interface external devices to a microprocessor system and write appropriate software to obtain desired interface performance.
- Apply working knowledge of AC and DC circuits and understand the physical principles of passive circuit devices.
- Demonstrate knowledge of the physical principles, theory and operation of solid state devices.
- Perform accurate and valid parameter measurements with industry standard test equipment while observing standard safety practices.
- Construct and troubleshoot electronic circuits from schematic diagrams.
- Demonstrate a cooperative and responsible attitude in the workplace.
- Demonstrate fundamental principles of physical phenomena.
- Design and construct analogue signal processing circuits and perform software verification through simulation.
- Solve mathematical problems relating to circuit analysis of linear and digital circuits.
- Design and construct digital electronic circuits employing microprocessors, including reduced instruction set processor and interrupt-driven systems.
- Design and construct prototype electronic circuits using schematic capture, circuit board layout software and printed circuit fabrication systems.
- Apply automated methods of signal sampling and testing, including real-time data acquisition and computer recording.

- Understand and apply methods to quantize and encode an analogue signal into a digital signal.
- Use the z-transform to specify the parameters of digital signals.
- Synthesize digital signal processing systems to perform specified tasks.
- Design, program and commission automation systems and networked industrial plants.
- Research, plan and prepare a comprehensive capstone project.
- Research, plan and prepare professional technical documents similar to comprehensive manuals.

CORE MODULES

Analysis of Circuits and Linear Systems. (9 Credits). Annual.

Fundamental concepts. Basic network elements. Network matrices. Kirchoff laws. Network theorems. Alternating current. Network frequency response. Bode charts. Laplace transform in the network theory. Network stability.

Analog Electronics I. (12 Credits). Annual.

Theory (7.5 credits)

Electronics analogue signals. Passive components: resistance, capacitors and reels. Active components: tension and current sources. Semiconductor substances. Solid devices: the diode and transistor. Other types of solid devices. Signal amplifiers with transistors: polarisation, calculating input and output gains and impedance in different configurations. Frequency response of amplifiers with bipolar transistors. Amplifiers design. Amplifiers with field effect transistors. Analysis and design. Power amplifiers: A and B type circuits. Designing power amplifiers. Integrated power amplifiers. Feedback in amplifiers. Feedback effects. Application of power amplifiers. Oscillators. Feedback applications in oscillator design. Types of oscillators. Power sources. Rectification. Filtering. Designing unregulated supplies. Regulators for power supplies. Types. Designing regulated power supplies. Using integrated regulators. Differential amplifiers. Differential gain. Common mode gain.

Common mode rejection factor. Measuring parameters of differential amplifiers. Operational amplifiers: structure, types, characteristics. Applications. Designing signal and power amplifiers, power supplies, oscillators. Radio frequency circuits. Tuned amplifiers. Mixers. Modulator circuits. Frequency, phase and amplitude modulation. Detector circuits.

Lab (4.5 Credits)

Basic laboratory equipment and general work procedures in the laboratory. Determining frequency response in passive networks. Designing and building circuits with diodes. Designing an amplifier with a bipolar transistor in common emitter. Determining its frequency response and its input and output impedance. Multi-phase amplifiers with bipolar transistors. Signal amplifiers with a field effect transistor. Designing a power phase without feedback for audio frequency. Using negative feedback in power amplifiers for audio use. Using positive feedback for creating oscillators. Designing and assembling an unregulated power supply. Designing a power supply regulator. Short-circuit protection. Designing and assembling a differential amplifier with bipolar transistors. Designing a power amplifier for audio use with operational amplifiers. Design and experimental study of radio frequency circuits.

Mathematical Analysis for Engineering .(12 Credits). Annual

Complex numbers: binary and polar form. Exponential and logarithmic functions. Linear equations systems. Gauss method. Matrixes and determinants. Cramer’s rule. Functions of one variable. Limits. Continuity. Derivability. Undefined integration. Defined integration: calculus fundamental theorem. Even and odd functions. Ordinary differential equations. Homogeneous equations: characteristic equation. Resolution methods. Linear systems of differential equations. Vector calculus. Several variables functions. Partial derivation and gradient. Chain rule. Iterated integration. Complex variable functions. Complex continuity and derivation. Taylor series. Convergence. Laplace transform. Properties. Applications of Laplace transform to differential equations. Numerical methods. Numerical integration. Periodic functions. Fourier Series. Fourier Transforms. Properties. Inverse Fourier transform. Partial derivation equations. Wave equation. Telegraph equation. Convolution. Discrete series and Fourier transform. Properties

Digital Electronic Devices and Circuits (10.5 credits). Annual

Theory (6 credits)

Numerical systems. Commutation algebra. Logic circuits. Simplifying logic functions. Bipolar logic families. MOS logic families. Combinatory MSI circuits. Logic gate bistables. Registers and counters. Analysis and design of sequential circuits. Sequential digital circuits. D/A converters. A/D converters.

Lab (4.5 credits)

Simplifying logic functions. Study of TTL and CMOS logic gates. Simulating TTL and CMOS logic gates. Design and analysis of combinatory MSI circuits. Studying bistables, registers and counters. Design and analysis of sequential circuits. Design and analysis of synchronous digital circuits. D/A and A/D converters.

Principles of Physic for Engineers (6 credits) 2nd semester

Coulomb's law. Electrostatic field. Electrostatic potential. Conductors. Capacity. Capacitors. Dielectrics. Circuits in DC. Electric current and intensity of current: continuity equation. Ohm's law: electric resistance. Joule's effect: electric power. Generators: electric circuits. Thevenin theorem. Biot-Savart's law. Magnetostatic field. Material media in magnetic field. Magnetic flux. Faraday's law. Autoinduction coefficients. Transformers. AC circuits. Capacitors and coils impedance. RLC series circuit. Work and power. Filters. Resonance. Chemical link. Crystalline solid structure. Free electrons in metals. Bands theory. Metals, isolators and semiconductors. Effective mass. Intrinsic and extrinsic semiconductors. Electric neutrality equation. Diffusion and drag current. Generation and recombination. The p-n union, characteristic magnitudes. The diode in direct and inverse polarisation. Photoelectronic diodes. Applications: the rectifier and the CD lector. Switching transistors. The union transistor. Working point. Operating mode of a transistor. The transistor as a switch. Logic gates. Biestables.

Microelectronics. (3 Credits). 2nd semester

Theory (3 credits)

Semiconductor models and devices. Statistics and transporting charge in semiconductors. Physics of the PN union. Physics of bipolar components: the transistor and thyristor. Physics of unipolar or field effect devices. Crystalline and epitaxial growth. Oxidation and deposition of layers. Diffusion and implantation of ions. Lithography techniques. Integration of passive components. Bipolar integration technology. MOSFET manufacturing technology.

Lab (3 credits)

Study of various semiconductor elements. Operating the ? -Electronics software, integrated circuit design. Logic circuit design.

Electronic control systems. (9 Credits). Annual

Theory (6 credits)

Introduction to automatic control. Systems modelling. Final and initial value theorem. Resolution of differential equations by Laplace transform. The transfer function and frequency response. Dynamic analysis of first and second order systems. Equivalent reduced system. Representation with state equations. Calculus and representation of feedback systems. Block and flux diagrams. Mason's rule. Steady analysis of feedback systems. Steady error. Position, velocity and acceleration errors. System type. Output error. Dynamic analysis of feedback systems. Absolute stability by Routh-Hurwitz. Nyquist relative stability. Phase and gain margins. Roots place. Module condition and argument condition. Analog compensators. Types. Design based on the frequency response. Asymptotic design. Design with backwards-forwards nets. Design based on the roots place. Compensation of dominants zeros with prefilters. Z transform. Discrete state equations. Static and dynamic analysis of discrete systems. Absolute stability proposition: Routh-Hurwitz. Digital compensators design.

Lab (3 credits)

Temperature control. DC motor control. Study of a phase loop, PLL. Study of system with Matlab. Frequency response. The roots place. Compensation. Digital control systems.

Electronic Devices (6 Credits). 2nd semester

Introduction to solid state conduction. Crystalline and epitaxial growth. Crystalline growth from melted material. Floating Zone Technique. Wafer formation and materials characterisation. Epitaxial Growth. Oxidation and particles deposition. Dielectric layers deposition. Polycrystalline silicon deposition. Metallic films deposition. Diffusion and ions implantation. Basic Principles. Diffusion related processes. Ions Distribution. Disorder. Implantation related processes. Lithography techniques. Optical Lithography. Electron and ion beams and X-ray lithography. Chemical etching. Passive components integration. The Resistive integrated circuit. The capacitor integrated circuit. Inductance integration. Diodes, types and characteristics. Fabrication technologies. Bipolar transistors. Signal, power and radio-frequency transistors. Fabrication technologies. Field-Effect Transistors. Power JFET, MOSFET and MOSFETs Fabrication technologies.

Instrumentation and Electronic Equipment. (10.5 Credits). Annual.

Theory (6 credits)

Introduction and basic concepts. Electronics equipment's. Digital Multimeters. Function Generators. The Oscilloscope. Measurements of electrical-physics magnitudes. Voltage and current measurements. Inductors, capacitors and resistors measurements. Measurements of non-electrical physics magnitudes. The Operational Amplifier in electronic instrumentation. Sensors. Basic conditioning circuits.

Lab (4.5 credits)

The Digital multimeter in DC. Errors. The Digital multimeter in AC. Errors. Design and verification of function generators. The arbitrary generator. Use of passive probes and basic measures with the oscilloscope. V-I converter. Instrumentation amplifier. Unbalancing in OPAM's. Electronic measure of temperature. Design of an conditioning circuit for measure of fluids with a termistor. Electronic measurement of light.

Fundamentals of computer architecture. (6 credits) 1st semester.

Theory (3 credits)

Introduction. Functional units. Computers evolution. Internal representation of the information. No numerical information. Numerical information. Computer aritmethics. The Central Processing Unit (CPU). Set of instructions. CPU structure. RISC computers and superscalars. Information transference. System buses. Memory systems. Input/Output. Operative systems. Control unit. Wired sequencing. Microprogrammed sequencing.

Lab (3 credits)

DLX architecture. Registers. Data. Addressing. Interrupts. Set of instructions. Types of instructions: Y, R, J. Instructions format. Load and save. Data Transfer. Arithmetic. Logical. Shifting. Comparing. Jumping point. Use of the DLX simulator. Using of several learning programs of every one of the simulator concepts.

Digital Electronic Systems (6 Credits). 3rd four-month period

Microcontroller systems. The CPU in a microcontroller. Input/output. 8-bit microcontrollers. 8-bit microprocessors. 16-bit microprocessors. Design of electronic systems based on microcontrollers and microprocessors. Introduction to advanced microprocessors.

Projects (6 Credits). 2nd semester

The Objective is to bring to the student into projects headquarter criteria, planning techniques, managing and project control, and the standards for electronic projects. Project management. Project kick-off: Development stages of a product. Product maintenance. Product innovation. Product planning.. Projects' evaluation: Fundamentals. Evaluation methods. Economical indexes on projects evaluation. Accuracy measurement of results. Fundamentals. Procedures' basis. Basic information: Commercial data, engineering data, manufacturing and financial data. Project management methods: Decision-Theory based models: Risk analysis, profiling methods. Linear programming. Dynamical programming. Project cancellation. General considerations. Authorisation procedures on project developing: Developing cycle of a new product. Process definition stage, production and commercialisation stages. Modifying the process. Decision and co-ordination ways. Project characterisation.

Project specifications: Specifications structure. Technical data. Applicable standards on electronic projects: Fundamentals. CE labelling. Electrotechnical laws for low tension. European directive 89/366/CE.- EMI normative: emission, immunity. Normative on low frequency harmonics emission. Quality assessment system: Quality control and quality assessment. ISO 9000 procedure. Proceeding manual. Certification. Project documentation: Project documentation organisation. Product documentation.: Documentation levels.

COMPULSORY MODULES

Introduction to Digital Signal Processing (7.5 credits) 1st semester

Applications to Digital Signal Processing. Digital vs. Analog Systems. Basic elements of a digital processing system. Basic Digital Signals. A/D y D/A Conversion. Parts of an A/D conversion. Sampling Theorem. Signal Quantization. Signal Coding. D/A conversion. Discreet Systems. Linearly and Temporal invariance. Causality and stability. Discreet systems representation: Time-domain analysis. Description of discreet signals employing impulses. Impulse response of a Time-Invariant and Linear System Convolution. Properties. Difference equations. Z-transform. Definition and properties. Convergence Region. Causality and Stability. Analysis of TIL systems performing Z-Transform. Fourier Analysis for Signals and Discreet Systems. Fourier series of a discreet and periodical signal. Representation of discreet and non-periodical signals: Fourier Transform. Discreet Fourier Transform. Frequency-response of TIL systems. Examples. Applications. Noise cancellation .Filters: Definitions and types. Different filters design. Averaging. SNR. Audio, Imaging, and Bioengineering Applications.

Analogue electronics II (6 credits). 2nd semester

Theory (4.5 credits)

Advanced audio power amplifiers. Types of amplifiers. Operational amplifiers for audio and feedback. Real cases. Impedance ratio. Foster and Cauer synthesis methods. Active impedance synthesis. Filters: Butterworth, Chebyshev and Bessel approximations. Frequency transforms. Low pass, high pass, stop band,

and all pass filters. Passive filters. Electronic structures for filter design: active filters. Filter sensibility. Practical filters. Function generators. Analog multipliers. Resolution of differential equations through analogue methods and synthesis of non linear transfer functions. Practical generators. Analogue commutators and comparators. Sample and retention circuits. Schmitt trigger. High-frequency signal generators: Meissner, Hartley, and Colpitts. Low-frequency generators: progressive dephasing and Wien. Other types of generators: multivibrators and quartz oscillators.

Lab (1.5 credits)

Audio power amplifiers for audio. Realisation of impedances. Design and implementation of filters. Pulses circuits. Oscillators.

CAD Techniques (6 Credits). Annual.

Definition of basic concepts in printed circuits boards (PCB) elaboration process. EMI-related rules. Rules to avoid the heating. Practical advises. The scheme editor “schematics” by microsim? : Program structure e interrelation with the symbols and encapsulate libraries. Description of the menus of the program. Designs with multiples pages. Blocks and hierarchy symbols. Communication between blocks/hierarchy symbols. Creation and edition of encapsulated pinouts (plb library). Program structure and interrelation with the footprints libraries, encapsulates and pad stacks. Description of the program menus. Example pf creation of a footprint. Creation of the schemes with orcad sdt. Description of principal functions: Positioning of symbols, connection tracing, edition, etc. Assignation of encapsulating (file .stf) and creation of the netlist. Principal editor functions of the layout OrCAD PCB386 editor: positioning of footprints, visualising of ratsnest, manual and automatic rooters, DRC checking, etc. AutoCAD, 2D drawings for reference, 3-D drawings: creation of 3D objects for a sum and difference of solids.

Introduction to Power Electronics. (9 Credits) Annual

Theory (6 credits)

Introduction to the Power Electronics Systems. Line-Frequency Diode Rectifiers. Line-Frequency Phase-Controlled Rectifiers and Inverters. AC

Voltage Controllers. DC Choppers. Switch-mode DC-AC Inverters. PWM Inverters. Motor Drive Applications: AC and DC Drives.

Lab (3 credits)

Design and implementation of a Single-phase full-wave rectifier. Half-controlled and full-controlled. Design and implementation of a AC Regulator with phase-control. Design and implementation of a Class-E DC Chopper. Design and implementation of a Full-bridge voltage PWM Inverter.

Final Career Project. (15 Credits)

This is a project supervised by a lecturer from the Degree course, which is defended before a board of examiners consisting of three lecturers. The work can be developed in a company. The pupil can enrol for the project during either of the two four-month periods.

Fundamentals on communication electronics. (6 credits). 1st semester

Theory (4.5 credits)

Elements of a communication system. Classification and examples. Blocks diagram of emitters and receptors. Superheterodine receptor. Signal types in communication. Units. Processing of signals for transmission: modulation. Representation of signals in the frequency domain. Time and frequency analysis of signals. Description of periodic signals using Fourier series. The Fourier transform and its use in the non-periodic signals description. Linear and angular modulation. Basic types. Techniques and basic circuits for signal modulation and demodulation. Phase-locked loops (PLLs). Sampling of signals and pulse modulation: PAM, PWM, PPM. Coding PCM. Digital signal modulation: ASK, FSK and PSK. Other modulations. Signal transmission for guiding media. Line of transmission concept. Lines type. The coaxial cable. Characteristic impedance and propagation time. Propagation of DC and AC signals in short-circuits line, in opened line and adapted line. Adaptation of impedances through Smith's chart. RLC circuit analysis. Oscillators design. LC tuned oscillators: Colpitts and

Harley configuration. High frequency amplifiers types. Broad band and tuned amplifiers. Mixers.

Lab (1.5 credits)

Representation of signals in time and frequency domains. Concepts of linear signal modulation and demodulation. Assembling of several modulation, demodulation and AM receptors circuits. Verification of performance of some circuits for modulation and demodulation of FM. Applications of phased locked loop circuits. Study of coaxial cables as a transmission line when the input frequency is high, and the wavelength of the signal is comparable to the electric longitude of the cable. Build and check a complete system of communications formed for an infrared emitter and receptor.

Computing (6 credits) 1st semester

Theory (3 credits)

Introduction to algorithmics, analysis and algorithm design. Knowledge of a structured programming language: C. Organisation of present computers. Internal representation of the information in the computer. Concept and representation of algorithms. Program. Levels of programming. Structured programming. Analysis of the problem and design of algorithms. Basic programming elements. Simple data types. Concept of static data. Concept of one variable address. Flux control structures. Subprogram concept. Ambit and pass of variables in subprograms. Modular and procedural programming. The program in the computer memory. Composed data types. Linear data structures. Multidimensional vectors and matrixes. Character chains. Structured data. Concept and types of files. Files operations. Algorithmics. Concept of efficiency and complexity. Search algorithms. Ordering algorithms.

Lab (3 credits)

Gain ability in simple programs structuring. Practice of the basic concepts introduced in theory. Knowing of the C programming language. Familiarisation with an O.S. and with tools and compilation process. The operative system and the compilation environment. Types of simple data and conditional control structures. Iterative control structures. Subprograms. Matrixes and vectors. Chains. Registers. Files.

ELECTIVE MODULES

Introduction to Programmable Logic Controllers (7.5 credits) 2nd semester

The goal of this subject is introducing the student in the use and applications of one of the devices most used in factories. OMRON was chosen as the PLC (Programmable Logic Controller) provider to make the practices, because it is the most extended manufacturer in the Comunidad Valenciana. An introduction to nano-PLCs will be given using Mitsubishi PLCs as a base. Also, big PLCs will be studied using SIMATIC S7 Siemens series. In addition, the student will learn about control elements and automatisms which are normally used and are not studied in other subjects of the engineering, for example frequency variators, inductive detectors, encoders, etc.
For the laboratory work, OMRON CPM1A series PLC's are used for the sessions.

Introduction to telecommunication systems (4.5 credits) 1st semester

Physical channels used in telecommunications. Understanding different coding types. Introduction to guided communications and radio waves. Norms and regulations. History of telecommunications. Physical channels and coding. Noise in communication systems. Amplitude modulation. Phase modulation. Digital communications. Transmission lines principles. Antennas principles. Transmission and detection systems. Radio waves transmission. Introduction to mobile communications. Regulations and norms.

Programming tools (4.5 credits) 2nd semester

Theory (1.5 credits)

> Deeper knowledge of the C programming language C. Knowledge and use of simple dynamic data structures. Knowledge of the object oriented programming to operative level. User interfaces. Internet-oriented programming languages.

Programming in C. Dynamic memory. Data structures. Modular programming. Creation and use of static and dynamic libraries.

Lab (3 credits)

Introduction to visual C/C++ compilation environment. Programming in C. Use of dynamic memory. Dynamic data structures. Modular programming. Creation and use of libraries. Design of interactive applications. Assessment of events. Dialogue windows and menus. Introduction to DreamWeaver. Design of Web pages. Introduction to JavaScript.

Multimedia Information processing (4,5 credits) 1st semester

Theory (3 credits) + Lab (1,5 credits)

Basic Principles of Multimedia. Integration of digital media. Real-time and interactivity. Definitions. Global structure. Device domain. Digital Audio. Properties and characteristics. Psychoacoustic concepts. Principles of conversion process. Storing process. Dither generation and benefits. Antialiasing filters. The sampling jitter. Notes about A/D conversion. Channel coding. Playing process. Notes about D/A conversion. Oversampling. Principles. Delta and Sigma-Delta modulation. Digital Audio effects. AES/EBU Interface. SPDIF Interface. MADI Interface. Problems about synchronization. Image and Digital Video. Bidimensional sampling. Light Detectors. Notes about image perception. Color coordinates systems. Acquisition devices. Image tube. Solid-State cameras. Image processing. Histograms. LUT. Bidimensional convolution. Digital filtering. Border detection. Pseudocolor. Principles of compression. JPEG. Coding movement. Basics of MPEG compression.

Virtual instrumentation (6 credits) 2nd semester

Theory (3 credits)

Architecture of instrumentation systems. Virtual instruments. Interconnecting systems. Control languages. Software for industrial automation. Fundamentals in data acquisition. Remote data remote. Digital input/output applications. Hardware/acquisition cards. Interpretation of specifications. Interconnecting systems: controlling devices via serial interface and IEEE488 interface. The IEEE488.x norm. The SCPI norm. Adaptation circuits for the IEEE488 bus.

Hardware/acquisition cards of the IEEE488 bus. The VXI bus: structure, architecture, protocols and control. The PXI bus: mechanic and electrical characteristics. System configuration. Structured programming in LabView: Iterative structures, condicionals and nodals. Local variables, global and attribute nodes. Data types. Arrays, clusters, chains and input/output files. Analysis and data visualisation: Graphics. Instrument drivers. Fundamentals. Design techniques.

Lab (3 credits)

Introduction to the LabView environment. Control of devices via serial interface. Control of devices via IEEE488 interface. Data acquisition. Realisation of an instrumentation system. Familiarisation with a PXI virtual instrumentation system.

Power Electronic Devices (6 credits) 2nd semester

Theory (4.5 credits)

Power devices without cut control. Power diodes: Commutation process to cut and conduction. Diode protection. Types. Thiristors: Static characterisation of the current and gate. Voltage limits. Commuting transient to conduction and cut. Trigger influence. Thyristor trigger. Resistivity and thermal impedance. Transformed thermal model. Load capacity of thyristors at low and high frequency. Overvoltage supressor nets for thyristors. Calculus of RC nets. R-D-C nets. Power devices with cut control: Power bipolar transistor: conduction, thermal and blocking characteristics. Safety and overload areas. Commutation times. Commutation process. Trigger optimisation. Bipolar transistors trigger: Classification. Practical circuits. Advanced circuits. Transistor association. Parallel connection. The Darlington as a commuter. Behaviour of a bipolar transistor in repose suffering a dv/dt gradient. Behaviour of the transistor with inverse current suffering a dv/dt gradient. Protection methods. Commutation net to cut and conduction. Design. Power MOSFET: Power MOS structure. Static and dynamic characterisation. Equivalent circuit. Characteristic data. The bipolar transistor of isolated gate (IGBT): Structure. Different types of IGBT's. Static and dynamic characterisation. Characteristic data. Trigger of MOS and IGBT: Trigger characteristics with resistive load. Same with inductive load. Trigger types. Trigger amplifier. Practical circuits. Magnetic devices characterisation: characteristic rules. Units. Magnetic properties. Loses. Magnetic circuits. Magnetic reluctance. Characteristic diagrams. Simple model of the magnetic circuit. Magnetic devices sizing. Power capacitors: characterisation, high-frequency equivalent circuit. Power resistors: characterisation, types.

Lab (1.5 credits)

Demo board for power electronic devices, simple and double trigger. Maximum values. Static characteristics. Dynamic characteristics. Static characteristics of MOSFETS, IGBT's and diodes. Dynamic characteristics of power IGBT's. Calculation of the commutation loses at ON and OFF. Variation of loses with the different parameters. Dynamic characteristics of power MOSFET. Commutation loses. Loses variation with different parameters. Dynamic characteristics of power diodes. Commutation loses. Variation with different parameters. Characteristics of capacitors, coils and power resistors.

Electronic systems with microprocessors (6 credits) 2nd semester

Theory (3 credits)

Brief history of microprocessor. Process and control. Technology implications. Application to engineering systems. Basic microprocessor structure. CPU. Memories. I/O systems. Interrupts. DMA. Parallel processing. Advanced schemes. Digital signal processors and others. Microcontrollers. Fundamentals. Classification. Commercial families. Architectural overview. Hardware description. Instruction set and addressing modes. Commercial families. Development tools. Design concepts and examples in embedded applications. I/O digital control. Sensors and actuators. ADC/DAC. Some examples: keyboard, LDC display, DC motor, etc. Interfaces, Buses, and Protocols: General concepts. On-board interfaces. Backplane buses. Special-purpose applications networks. Protocol design and examples. Programming. Design methodology. Operating systems fundamentals. Algorithmic state-machine and Petri nets.

Laboratory (3 credits)

Student project: embedded system design based on advanced microcontroller. Application study. Hardware and software design. Development, verification and test of a prototype. Written and oral reports.

Mathematical methods for engineering (6 credits).

Computer-based numerical calculus. Resolution of linear problems. Numerical integration. Function minima and maxima. Statistics, probability. Linear operator and matrixes. Vector space.

Optical Communications (4.5 credits).

Introduction to optical communications. Optical systems and sources of optical radiation. Non guided communications. Optic-fibre communications. Detectors.

Distributed Industrial Systems. (6 credits). 2nd Semester.

Theory (3 credits)

Introduction to distributed systems. Communication hierarchy and industrial network interconnection possibilities. Network topologies, links and logic structure. Error check. Local industrial networks. Field buses: MODBUS, PROFIBUS, DEVICE NET, COMPOBUS. Ethernet communications applied to industrial environment. Industrial processes based on PLC. PLC distributed model. Reliability in industrial PLC-based systems. Industrial PC's. Basic configuration and interfaces for industrial PC's. Supervisory control and data acquisition (SCADA) systems: description and usage for distributed industrial systems.

Laboratory (3 credits)

Lab sessions are developed using PC's and Omron PLC's, deploying some PLC network using RS232, RS485, PROFIBUS protocols, and programming touch panles and SCADA systems using SIEMENS systems.

8.- Qualification System

The results are expressed as numerical marks from 0 to 10. The students are graded according to the following scale: 0-5 SUSPENSO (fail), 5-7 APROBADO (pass), 7- 8.5 NOTABLE (second class), over 8.5 SOBRESALIENTE (first class). Amongst the students with a first class grade, a MATRÍCULA DE HONOR (first class grade with distinction) is awarded, at a rate of one first class grade with distinction for each group of 20 pupils.

Despite this, final marks of the Degree are computed with a different numerical value, i.e.: APROBADO=1, NOTABLE=2, SOBRESALIENTE=3, MATRÍCULA DE HONOR=4.

9.- Evaluation Methods

These can change for each subject from one academic year to another. Nevertheless, the most usual form of assessment for tutorial credits is a final examination. The laboratory credits are assessed according to the criteria of laboratory attendance, dissertations presented after the lab. sessions and, optionally, course work, continual assessment, or a final examination.

10.- ECTS-ERASMUS Coordinators

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