Universidad Zaragoza

**Year : 2020/21**

# 28820 - Electronic Technology II

## Syllabus Information

**Academic Year:** 2020/21
**Subject:** 28820 - Electronic Technology II
**Faculty / School:** 175 - Escuela Universitaria Politécnica de La Almunia
**Degree:** 424 - Bachelor's Degree in Mechatronic Engineering
**ECTS:** 6.0
**Year:** 3
**Semester:** First semester
**Subject Type:** Compulsory
**Module:** ---

## 1.General information

### 1.1.Aims of the course

The general objective of the course is to provide the necessary knowledge to interpret and solve digital electronic circuits, especially in the areas of combinational circuits and sequential circuits.

This requires the correct use of the most common computer applications for simulation of circuits and of the measuring and feeding instruments commonly used in the electronics laboratory and correctly interpreting the technical documentation of the components used.

Indicators that the objectives have been achieved it, will be: the ability to interpret plans of commercial electronic equipment and applications and the ability to make electronic schemes according to the appropriate regulations and symbols, and finally, the preparation of technical reports on the practical activities carried out.

### 1.2.Context and importance of this course in the degree

The subject of Electronic Technology II is part of the Mechatronic Engineering Degree taught by EUPLA, framed within the group of subjects that make up the module called Electricity and Electronics. It is a subject of the third course located in the fifth semester and a mandatory character (MC), with a teaching load of 6 ECTS credits.

It is part of the subject Electronic Technology that has six associated subjects, all of them of 6 ECTS credits, of which this is the second one that is proposed in the temporal sequence of the curriculum, its content is focused on Digital Electronics.

It has the subject of Electronics Technology I, also mandatory (MC), which is taught in the fourth semester focused on Analog Electronics, both form the convenient electronic basis to successfully face the set of subjects that give continuity to training electronic courses that are taken in the sixth semester: Programmable Electronic Systems, Power Electronics and Electronic Instrumentation.

In addition, the offer of training in Electronic Technology is completed with an optional subject (OP) called Advanced Instrumentation of the eighth semester.

### 1.3.Recommendations to take this course

The development of the subject of Electronic Technology II requires putting into play knowledge and strategies, coming from subjects corresponding to the previous courses and semesters of the Degree in Mechatronic Engineering, related to:

**Mathematics, Physics, Chemistry, Technical Drawing, Computer Science, Electrical Engineering and Electronic Technology I.**

## 2.Learning goals

### 2.1.Competences

As generic and specific competence, the student will acquire:

- Knowledge of the fundamentals of electronics (EI05).
- Interpret and solve analog electronic circuits that use operational amplifiers (EE02 and EE04).
- Interpret and solve power supply circuits, adjusting their characteristics to the needs of the application where they are used (EE02 and EE04).
- GI03: Knowledge in basic and technological subjects that enable you to learn new methods and theories, and provide you with the versatility to adapt to new situations.
- GI04: Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
- GI06: Capacity to handle mandatory specifications, regulations and standards.
- GC02: Interpret experimental data, contrast it with the theoretical and draw conclusions.
- GC03: Capacity for abstraction and logical reasoning.
- GC04: Ability to learn continuously.
- GC05: Capacity to evaluate alternatives.
- GC06: Capacity to adapt to the rapid evolution of technologies.
- GC07: Ability to lead a team as well as being an active member of it.
- GC08: Ability to locate technical information, as well as its understanding and assessment.
- GC09: Positive attitude towards technological innovations.
- GC10: Ability to write technical documentation and to present it with the help of appropriate computer tools.
- GC11: Ability to communicate their reasoning and designs clearly to specialized and non-specialized audiences.
- GC14: Ability to understand the operation and develop the maintenance of mechanical, electrical and electronic equipment and installations.
- GC15: Ability to analyze and apply simplified models to technological equipment and applications that allow forecasting of their behaviour.
- GC16: Ability to configure, simulate, build and test prototypes of electronic and mechanical systems.
- GC17: Capacity for the correct interpretation of plans and technical documentation.

### 2.2.Learning goals

The student, to pass this subject, must demonstrate the following results:

- Explain the behaviour of digital electronic devices (combinational and sequential), applying fundamental principles and logical laws, using vocabulary, symbols and appropriate forms of expression.
- Analyze the operation of typical electronic circuits, which use digital functions, describing their operation by truth tables, operation tables, input-output waveforms and

transfer functions.

- Select and correctly use the components of a digital electronic circuit, both in combinational and sequential applications, detailing its function in the block where they are used.
- Analyze and interpret diagrams and plans of applications and electronic equipment of digital technology, including the function of an element or functional group of elements in the set, based on existing regulations.
- Select and interpret adequate information to raise and evaluate solutions to common technical needs and problems in the field of Digital Electronics, with a level of precision consistent with the various magnitudes involved in them.
- Choose and properly use the typical measuring devices in the Electronic Laboratory, assessing its field of application and degree of precision.
- Know how to use the general methodology and the appropriate software tools to work on applied Digital Electronics.

### 2.3.Importance of learning goals

Being the third subject that is taught in the module of Electricity and Electronics, and that complements the subject Electronic Technology I, (taught in the course and previous semester) centred that in Analogic Electronics, is complemented in this new subject with Electronics Digital.

Achieve good results in learning, will assume a base level for the student, which will facilitate the study of the other subjects of this module that are taught in semesters and/or later courses, especially in Power Electronics, Electronic Instrumentation and Systems Programmable Electronics.

Applying the descriptive methods of truth tables, state maps and timelines to the digital schemes analyzed, correctly using the main magnitudes and electrical units, are essential in the professional practice of the Engineer, for which the ability to interpret technical documentation is also required: data sheets of electronic devices, device manuals, regulations, regulations, etc.

Analyze and solve both combinational and sequential circuits are essential elements in the knowledge of Digital Electronics and necessary for any development in the field of Mechatronics, which must be made clear by knowing how to select the most suitable components and functions for the design of circuits of digital applications.

Know the management of the main electrical measuring devices: voltmeter, ammeter, ohmmeter, wattmeter, oscilloscope, etc. used in the electronics laboratory, as well as the logical analyzers and acquire manual dexterity in practical assemblies, will allow the student to consolidate the concepts taught in this subject as well as in the others that make up the Electricity and Electronics module.

## 3.Assessment (1st and 2nd call)

### 3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

To pass the course, the student must demonstrate that they have achieved the expected learning results by means of one of the following procedures:

- Continuous evaluation system:

**A continuous evaluation system,** which will be carried out throughout the entire learning period. Following the spirit of Bologna, regarding the degree of involvement and continued work of the student throughout the course, the evaluation of the subject contemplates the continuous evaluation system, as the most consistent to be in line with the guidelines set by the new EHEA framework.

The subject has two different parts, the one referring to the master class where the theory

and type exercises are taught and that is taken into account in both evaluation methods.

In order for students to be able to opt for the continuous evaluation system in the part referring to the master class, they must submit at least 80% of the tasks (exercises, summaries, simulations...) that will be sent during the class in due time and form indicated by the teacher.

In order for students to be able to opt for the continuous assessment system in the part referring to laboratory practices, students must attend at least 80% of face-to-face practical classes, as well as technical visits or seminars with interest for the subject (will be indicated by the teacher); the reports must also be delivered in the time and manner indicated.

Any task, practice, report, or simulation with a grade lower than 4 points or that is not delivered within the stipulated period and manner will be computed as not delivered for not reaching a minimum quality level or for not meeting the established delivery requirements, respectively.

The continuous assessment system consists of two parts that must be passed separately to pass the course. The first part will consist of a written test for each of the blocks where the knowledge acquired in each of the blocks of which the subject is composed will be evaluated. The second part refers to laboratory practices. Both parts must achieve a minimum grade of 4 points so that they can be averaged in the subject. Otherwise, the final grade is limited to a maximum score of 4 points.

The continuous assessment system will culminate with the weighted sum of the grade obtained in each of the three blocks, which form the content structure of the subject when the aforementioned criteria are met:

**FINAL NOTE = Block 1 (40%) + Block 2 (40%) + Block 3 (20%)**

The course will be passed when in this **weighted evaluation,** a score equal to or greater than 5 points is obtained, taking into account that the minimum grade for Block, to be included in the previous formula, will be 4 points in blocks 1, 2 and 3, otherwise the grade the maximum average grade will be 4 points. Prior to the first call, the teacher will notify each student whether or not they have passed the subject through this procedure.

Students who have passed the course may appear on the first call to upload a grade, but never to download. Similarly, students who fulfilled the requirements to opt for the continuous assessment system have not reached the minimum grade in any of the blocks may appear at the first call for the global test to recover them.

In case of not passing in this way, in the first call, the student must sit the global assessment test in the second call with all the content of the subject corresponding to blocks 1 and 2.

**TYPE OF TESTING, EVALUATION CRITERIA AND LEVELS OF REQUIREMENT**

For each of the indicated content blocks (unless expressly indicated), the types of activities described below will be controlled, applying the assessment criteria indicated:

**Exercises, theoretical questions, and proposed works:** Their approach and correct development, the writing and coherence of what is discussed, as well as the achievement of results and the final conclusions obtained, will be valued.

**Laboratory practices:** In each one of the practices the dynamics followed for its correct execution and operation will be valued, as well as the problems raised in its development, the specific weight of this section being 30% of the total mark of the practice. The remaining 70%

will be devoted to the qualification of the report presented, that is, if the required data is correct and the questions asked have been answered correctly. It is necessary to achieve a minimum grade of 4 points in the practices referring to each of the blocks to average, if this minimum is not reached, the final grade for the course will be limited to a maximum of 4 points, regardless of the average grade of the subject.

If the laboratory practices could not be carried out in person for health reasons, it would be carried out electronically, that is, it would be converted to a simulation practice format. It can even be done in a ?mixed? way.

**Written assessment test (for Blocks 1 to 2):** It will consist of solving a questionnaire, with reduced space for answers, where the student will demonstrate, through graphics, texts, equations, and/or calculation, their mastery of the concepts worked in each subject block. It is necessary to achieve a minimum grade of 4 points each of the blocks to average, if this minimum is not reached, the final grade for the course will be limited to a maximum of 4 points, regardless of the average grade for the course.

**Exercises, theoretical questions, and proposed works:** In relation to those proposed during the course, the largest possible number of those corresponding to blocks 1 and 2 must be submitted on the date set for this purpose. The teacher may reject those works where the individual effort of the student is not demonstrated.

**Group activities in class (for Block 3):** In this block, the written evaluation test is replaced by the defense and public exposition of the part of the subject assigned to each group of students. The total assessment will include the writing aspects of the paper and its oral defense. The teacher's grade may be modulated by that of the students themselves. It is necessary to achieve a minimum grade of 4 points to average, if this minimum is not reached, the final grade for the course will be limited to a maximum of 4 points, regardless of the average grade for the course.

In summary, to the above, the following points are presented where the weighting of the grading process is shown, of the different activities in which the subject evaluation process has been structured.

***BLOCKS 1 and 2:***

- Class activities, exercises, and proposed work, Moodle activities: Maximum 20%.
- Laboratory practices: 30%
- Written assessment tests: 50%-70%

***BLOCK 3***

- Progress report and practical work associated with the job: 20%.
- Activity memory: 40%.
- Public defense of activity: 40%.
- Mutual evaluation (mandatory): up to 10%. In case of not being present in the defenses of the other students, a correction factor of up to 50% of the mark obtained in the previous activities will be applied.

Remember that the weight for the final grade will attend to the formula:

**FINAL NOTE = Block 1 (40%) + Block 2 (40%) + Block 3 (20%)**

Students who have passed the course may appear on the first call to upload a grade, but never to download. Similarly, students who fulfilled the requirements to opt for the continuous assessment system have not reached the minimum grade in any of the blocks may appear at the first call for the global test to recover them.

Those students who have not passed the subject through the continuous evaluation system, and who fulfilled the requirements to opt for it, may promote the evaluation tests of the blocks with a grade higher than 4 points at the first official call.

For those students who have suspended the continuous assessment system or do not opt ?? for this system due to their personal situation, but some of their activities (except for the written assessment tests), have been carried out and have a minimum grade of four points, they may promote them to the global assessment test, and it may be the case that they only have to take the written exam.

In summary, all the activities included in the global evaluation test that reaches the minimum grade of 4 points, with the exception of the written exam, may be promoted to the next official call, within the same academic year.

- Global Assessment System / Test:

**A global assessment test** that reflects the achievement of learning results at the end of the teaching period.

In the event that the student does not opt for the continuous evaluation system, either due to his personal situation, cannot adapt to the work rate required by the continuous evaluation system, has suspended or wants to increase his grade, having participated in the said methodology of evaluation, following the regulations of the University of Zaragoza in this regard, a global test will be scheduled for both laboratory practices and a written exam.

In the same way as the continuous assessment methodology, the global assessment test must be aimed at verifying if the learning results have been achieved.

**These evaluative processes will be carried out through:**

- Direct observation of the student to know their attitude towards the subject and the work that it requires (attention in class, completion of assigned tasks, resolution of questions and problems, active participation in the classroom, etc.).
- Direct observation of skills and abilities in laboratory work.
- Checking their progress in the conceptual field (questions in class, comments in the classroom, taking exams, reporting practices, etc.).
- Periodic performance of oral and/or written tests to assess the degree of knowledge acquired, as well as the qualities of expression that, at this educational level, must be widely demonstrated.

In the same way, as for continuous assessment, the global assessment method consists of two parts that must be passed separately to pass the course. The first part will consist of a written test where the knowledge acquired in each of the blocks of which the subject is composed will be evaluated. The second part refers to laboratory practices. Both parts must achieve a minimum grade of 4 points so that they can be averaged in the subject. Otherwise, the final grade is limited to a maximum score of 4 points.

The global evaluation system will culminate with the weighted sum of the grade obtained in each of the three blocks, which form the content structure of the subject:

**FINAL NOTE = Block 1 and 2 (80%) + Block 3 (20%)**

You will have the following group of qualifying activities:

**Laboratory practice exam:** If a student decides to opt for a global assessment system partly referring to laboratory practices, they will be able to choose an exam that will consist of the practice of similar difficulty to those carried out during the course. The dynamics followed for its correct execution and operation will be valued, as well as the problems raised in its

development, the specific weight of this section being 30% of the total mark of the practical exam. The remaining 70% will be dedicated to the results obtained during it, that is if the required data is correct and the questions asked have been answered correctly. It is necessary to achieve a minimum grade of 4 points to average, if this minimum is not reached, the final grade for the course will be limited to a maximum of 4 points, regardless of the average grade for the course.

If the laboratory practice exam could not be done in person due to health reasons, it would be done electronically, that is, it would go from a practice exam format to a simulation format.

**Written exam (Blocks 1 to 2):** This test will be unique with questions similar to those raised in the written tests in the continuous evaluation. It is necessary to achieve a minimum grade of 4 points to average, if this minimum is not reached, the final grade for the course will be limited to a maximum of 4 points, regardless of the average grade for the course.

**Group activities in class (for Block 3):** In this block, the written evaluation test is replaced by the defense and public exposition of the part of the subject assigned to each group of students. The total assessment will include the writing aspects of the paper and its oral defense. The teacher's grade will be modulated by that of the students themselves. It is necessary to achieve a minimum grade of 4 points to average, if this minimum is not reached, the final grade for the course will be limited to a maximum of 4 points, regardless of the average grade for the course.

In summary, to the above, the following points are presented where the weighting of the grading process is shown, of the different activities in which the subject evaluation process has been structured.

***BLOCKS 1 and 2:***

- Laboratory practices: 30%
- Written assessment tests: 70%

***BLOCK 3***

- Progress report and practical work associated with the job: 20%.
- Activity memory: 40%.
- Public defense of activity: 40%.
- Mutual evaluation (mandatory): up to 10%. In case of not being present in the defenses of the other students, a correction factor of up to 50% of the mark obtained in the previous activities will be applied.

Remember that the weight for the final grade will attend to the formula:

**FINAL NOTE = Block 1 and 2 (80%) + Block 3 (20%)**

All the activities included in the global assessment test, with the exception of the written exam, may be promoted to the next official call, within the same academic year.

## 4.Methodology, learning tasks, syllabus and resources

### 4.1.Methodological overview

The Electronic Technology II course is designed as a set of contents but distributed in three blocks. Blocks 1 and 2 make up the core that the subject must provide to the student's training. The final block gathers further interesting complementary knowledge to complete the training in Digital Electronics.

**The first two blocks** will be dealt with under three fundamental and complementary ways:

the theoretical concepts of each didactic unit, the resolution of problems or questions and lab practice activities, supported in turn by another series of activities such as tutorials and seminars and will be tested individually, regardless of the blocks.

**The third block** will have a different treatment because the students will work in groups only previously assigned sections, they will be able to express their preferences but all the subjects will have to be assigned to some group. They will prepare presentation materials and defend their work with a public presentation, which will be valued by the rest of the students and the teacher.

**The learning process that has been designed for this subject is based on the following:**

**The teacher / student interaction** is materialized through a distribution of work and responsibilities between students and teachers. However, it will have to be taken into account that to a certain extent the students will be able to set the pace of learning according to their needs and availability, following the guidelines set by the teacher.

The organization of teaching implies the active participation of the student, and will be carried out following the following guidelines:

- **Theoretical classes:** Theoretical activities taught in a mainly expository way by the teacher, in such a way that the theoretical supports of the subject are exposed, highlighting the fundamental, structuring the concepts and relating them to each other.
- **Practical classes:** The teacher solves problems or practical cases for illustrative purposes. This type of teaching complements the theory presented in the master classes with practical aspects.
- **Seminars:** The total group of theoretical classes or practical classes may or may not be divided into smaller groups, as appropriate. They will be used to analyze cases, solve assumptions, solve problems, etc.
- **Laboratory Workshop:** The total group of theoretical classes or practical classes may or may not be divided into smaller groups, as appropriate. Students will carry out assemblies, measurements, simulations, etc. in the laboratories in the presence of the internship teacher. Twice throughout the semester, they must defend their laboratory work in front of the teacher.
- **Group tutorials:** Scheduled learning follow-up activities in which the teacher meets with a group of students to guide their autonomous learning tasks and to supervise directed work or that require a high degree of advice from the teacher.
- **Individual tutorials:** These are carried out through personalized attention, individually, from the teacher in the department.

*If classroom teaching were not possible du**e to health reasons, it would be carried out on-line.*

### 4.2.Learning tasks

**The course includes the following learning tasks:**

**Generic on-site activities:**

- **Lectures:** The theoretical concepts of the subject will be explained and illustrative practical examples will be developed as support for the theory when it is deemed necessary.

- **Practical lessons:** Problems and practical cases will be made as a complement to the theoretical concepts studied.
- **Practical tasks:** The total group of theoretical classes or practical classes may or may not be divided into smaller groups, as appropriate. Students will be guided by the teacher's tutorial action.
- **Defense and presentation of topics:** on the particular contents that are assigned to each group of students, corresponding to Block 3.

**Generic off-site activities:**

- Study and assimilation of the theory explained in the lectures.
- Understanding and assimilation of solved cases in practical lessons.
- Preparation of seminars, solving suggested problems, etc.
- Participation in Forums of the subject via Moodle, to provide links of information on the Internet.
- Preparation and development of scripts and corresponding reports.
- Preparation of written continuous assessment tests, and global assessment tests.

**Autonomous tutored activities:**

Although they will be done on-site, they have been taken into account separately because of their particular features, they will be focused mainly on seminars and tutorials under the supervision of the teacher.

**Reinforcement activities:** Off-site activities preferably, via the virtual portal of teaching (Moodle), will be designed to reinforce the basic contents of the subject. These activities can be personalized or not.

**Temporary distribution of a teaching week:**

The subject is defined in the Verification Report of the Degree Title with a low experimental degree, so the 10 hours per week are distributed as follows:

- **Theoretical-practical classes:** 3 hours per week (blocks 1 and 2)
  5 hours a week (block 3)
- **Laboratory practices:** 1 hour weekly
- **Other activities:** 6 hours a week (blocks 1 and 2)
  4 hours per week (block 3)

**Global time distribution:**

The course consists of 6 ECTS credits, which represents 150 hours of student work in the course during the semester, that is, 10 hours per week for 15 school weeks, which are distributed as follows:

- **50 hours of theory class:** 60% of exposition of concepts and 40% of type-problem solving, at a rate of 3 hours per week, except in the weeks with a control test that will be reduced by one hour and in the final weeks that increase two hours.
- **15 hours of supervised laboratory practices:** weeks 1 to 15 sessions of 1 hour.
- **15 hours of group seminars and tutorials:** to complete the practical activities of each block and especially for the preparation of block 3 (see calendar table in activities and resources).

- **66 hours of personal study:** at the rate of 4 hours in each of the 15 weeks of the semester, to prepare assignments, carry out exercises, study theory, etc ... (in the following calendar table the recommended distribution is established ).
- **4 hours of control tests** (2 controls of 2 hours), which will be carried out (approximately) in the 7th and 12th weeks.

### 4.3.Syllabus

The theoretical contents are divided into three blocks (numbers 1 to 3) preceded by a block 0 of introduction to Digital Electronic Technology. The choice of the content of the blocks has been made looking for the express clarification of the final objective, so that with the union of incidental knowledge, the student obtains a structured knowledge, easily assimilated for the Mechatronics Engineers.

Each of the blocks is composed of topics, on a weekly basis, one per course week approximately. These topics include the contents necessary for the acquisition of predetermined learning outcomes.

**Theoretical contents**

***Block 0:INTRODUCTION: DIGITAL TECHNIQUES***

***Block 1:INTRODUCTION TO DIGITAL TECHNIQUES***

**1.- Basic elements of digital technology and Integrated Circuits**

**2.- Combinational Logical Design Methods**

**3.- Combinational Logical Circuits (Encoders and Decoders, Multiplexers and Demultiplexers, and other Combinational Functions)**

**Block 2: ANALYSIS AND DESIGN OF SEQUENTIAL LOGIC CIRCUITS**

**4.- Basic and synchronized bistables**

**5.- Digital Counters and Digital Records**

**6.- P.L.D and A.S.I.C. Matrix architectures**

**Block 4: HIGH-DIGITAL INTEGRATION OF DIGITAL DEVICES**

**7.- Semiconductor memories**

**8.- A/D and D/A Converters**

**9.- Computer Systems**

**Practical Contents**

Each block exposed in the previous section has associated practices in this regard, either through practical assumptions and/or physical or simulated assembly work leading to obtaining results and their analysis and interpretation. As the topics are developed, these Practices will be proposed, preferably in the classroom and also through the Moodle platform.

Practices to be developed in the Laboratory are given below. They will be carried out by the students in one-hour sessions, except in the final practice, in which the three hours of Block 3 are accumulated.

### 4.4.Course planning and calendar

**Calendar of classroom sessions and presentation of works**

The planned development of the course includes (6 ECTS credits, or 150 hours), which will be distributed as follows:

- **50 hours of theoretical class:** 60% of exposition of concepts and 40% of problem resolution (3 hours per week), except in the weeks with a control test, which will be reduced one hour, and in the final weeks that will increase two hours.
- **15 hours of supervised laboratory practices:** 1st to 15th-week sessions of 1 hour.
- **15 hours of seminars and group work:** to complete the practical activities of each block and especially for the preparation of block 3.
- **66 hours of personal study:** at a rate of 4 hours per week during the semester, to prepare work, to solve exercises, study theory, etc.
- **4 hours of control tests** (2 controls of 2 hours), which will be carried out (approximately) in the weeks: 7th and 12th.
- To this computation of 150 hours, the hours corresponding to the **global assessment test** will be added in two calls.

The dates of the **global evaluation tests** will be those published officially at http://www.eupla.unizar.es/asuntos-academicos/examenes. Its duration is not included in the calculation of the 150 hours.

**Testing schedule**

For the evaluation tests, described in the continuous evaluation process, the following approximate calendar is proposed:

- **Test 1:** Topics 1, 2, and 3 (Week 7)
- **Test 2:** Topics 4, 5 and 6 (Week 12)

**Exhibition-Defense of Works**

Those corresponding to Block 3 (Digital devices of the high scale of integration), will be examined orally during the three weekly end of the course, at times adjusted according to the number of students and the specific development of the preparatory tasks.

The topics on which the works of block 3 will be developed (Topics 7, 8 and 9) will be assigned during the development of Block 1 (weeks 1 to 7), with delivery until the end of week 11 and the exhibition during the final weeks (13th to 15th), during the course the dates will be specified.

The weekly schedule of the subject will appear published at http://www.eupla.es/

### 4.5.Bibliography and recommended resources

**Resources:**

PWP presentations, typical problems, and Web links, all related to the syllabus, will be provided through the Moodle page of the subject.

Digital circuit simulation software and PLD development (Multisim) and manuals for their use, will be installed in a computer room or Laboratory PCs.

PCs, Multimeters, Oscilloscopes, Function Generators, Power Supplies, discrete and integrated electronic components, must be part of the Electronics Lab equipment.

**Bibliography:**