SYLLABUS[1]

1. **Information about the Program**

1.1 Higher education institution	„Politehnica" University of Timişoara
1.2 Faculty[2] / Department[3]	Automation and Computers / Applied Electronics Department
1.3 Chair	-
1.4 Domain of study	Computers and Information Technology
1.5 Study level	Bachelor
1.6 Study programme / Qualification	Computers / Engineer

2. Information about the Course

2.1 Course			Electronic Devices				
2.2 Lecturer			Ș.l. dr. ing. Marllene Dăneți				
2.3 Academic staff for seminars/labs			As. dr. ing. Radu Mîrșu				
2.4 Study year	1	2.5 Semester	2	2.6 Assessment type	E	2.7 Course type	Mandatory

3. Total time estimated (hours/ semester of didactical activities)

3.1 Hours / week	4	of which: 3.2 lecture hours	2	3.3 seminar/lab hours	2
3.4 Total curriculum hours	97	of which: 3.5 lecture hours	28	3.6 seminar/lab hours	28
Time distribution					hours
Study using manuals, support materials, bibliography and notes					16
Supplementary documentation in library, speciality electronic platforms and on site					9
Supplementary preparation for seminars/labs, homeworks, reviews, portofolios and essays					16
Tutoring activities					7
Exams					6
Other					

3.7 Total - hours of individual study	41
3.8 Total - hours per semester	110
3.9 Credits	4

4. Prerequisites (if appropriate)

4.1 curriculum	• Electrical engineering fundamentals
4.2 competencies	• Using basic concepts learned in high-school from Physics and Mathematics • Communicating in English (reading, writing, conversation) at average level

5. Conditions (if appropriate)

5.1 for lectures	• Large classroom, blackboard/ whiteboard, colored chalk/ markers
5.2 for seminars/labs	• Spacious elctronic lab, organized into four workstations, each equipped with dual power supplies, signal generators, two-channel oscilloscopes, digital multimeters, test boards, computer, PSpice simulation program, catalog sheets, blackboard, colored markers.

[1] Formularul corespunde Fişei Disciplinei promovată prin OMECTS 5703/18.12.2011 (Anexa3);

[2] Se înscrie numele facultăţii care gestionează programul de studiu căruia îi aparţine disciplina;

[3] Se înscrie numele departamentului căruia i-a fost încredinţată susţinerea disciplinei şi de care aparţine titularul cursului;

6. Specific competencies acquired

Professional competencies[4]	• Operating with fundamentals of sciences, engineering, and computer science • Designing hardware, software and communication components • Problem solving using the instruments of computer science and engineering
Transversal competencies	• Honorable, responsible and ethical behavior, in the spirit of the law, ensuring the reputation of the profession • Demonstrating initiative and engaging in updating one's professional, economic and organizational knowledge

7. Objectives of the course (issued from the list of the comptenecies acquired)

7.1 Aim	• To give students knowledge for the main types of semiconductor devices and to allow them to acquire the basic skills in using them, in order to be able to work in an area where electronic circuits are part of the equipment
7.2 Specific objectives	• **Knowing and understanding terms and concepts specific to Electronics** - Giving a qualitative description of electrical conduction in semiconducting materials - Explaining the current-voltage characteristic of the *pn* junction - The ability to use linear diode models in simple circuits - The ability to analyze the main circuits using diodes - Explaining the transistor effect in biploar junction transistors (*BJT*). Describing the operating principle of Field Effect Transistors (*FET*) - Interpreting the *BJT* characteristic curves and extract large-signal model parameters from these curves - Identifying the operating state of a transistor from measured data and determine its operating point - Using small signal models of the transistors to construct small signal amplifier models, from which voltage gain, input and output resistances can be computed - Qualitatively evaluating the frequency response characteristic of a transistor amplifier - Listing the main properties of an ideal operational amplifier (*op-amps*) - The ability to analyze simple circuits using *op-amps* • **Building the experimentation capacities** - The ability to correctly and safely use the specific tools and equipment - The ability to carry out simple experiments using electronic devices - The ability to process and interpret the experimental data - The ability to work in a team - Learning to creatively address problems and situations encountered in practice (own methods for problem solving, critical judgment, reasoning, etc.) - Learning to work in an organized manner • **Building the communication capacities** - Using the terminology of Electronics in various contexts of communication in English - Using the specific electronic symbols and schematics • **Knowing and applying the safety measures for protection** - Knowing the effects of physical phenomena on beings and the environment - Learning to follow and implement the specific safety measures - Anticipating the effects of specific actions on beings and the environment

8. Content

8.1 Lecture	Hours	Instruction methods
1. Semiconductors and Diodes 1.1. Electrical Conduction in Semiconductor Devices 1.2. The *pn* Junction and the Semiconductor Diode 1.3.Circuit Models for the Semiconductor Diode 1.4. Practical Diode Circuits	8	• **Exhibit and heuristic methods** - Exposure (explanation, university lecture) - Conversation (catehetical, heuristic) - Demonstration - Modeling - Case study • **Algorithmic methods** - The algorithm • **Methods for stimulating creativity** - The analogy and the extrapolation
2. The Bipolar Junction Transistor (*BJT*) 2.1. Construction, Symbols, Nomenclature and the Transistor Effect 2.2. Fundamental Relationships. *BJT* Large Signal Model 2.3. Operating Modes, Connections and *i-v* Characteristics 2.4.The Load Line and the Operating Point 2.5. *BJT* Biasing Circuits. The Self-Bias Circuit 2.6. *BJT* Small Signal Models for Low and Midband Frequency 2.7. Small Signal Amplifiers with *BJT*.	8	
3. **Field Effect Transistors (*FET*)**	6	

[4] Aspectul competenţelor profesionale va fi tratat cf. Metodologiei OMECTS 5703/18.12.2011. Se vor prelua competenţele care sunt precizate în Registrul Naţional al Calificărilor din Învăţământul Superior RNCIS (http://www.rncis.ro/portal/page?_pageid=117,70218&_dad=portal&_schema=PORTAL) pentru domeniul de studiu de la pct. 1.4 şi programul de studii de la pct. 1.6 din această fişă.

3.1. Junction Field Effect Transistors (*JFET*) - Construction, symbols and nomenclature - *JFET* operation, *DC* characteristics and basic relationships - *JFET* biasing and the operating point - *JFET* small signal, midband frequency model - Applications 3.2 Metal Oxide Semiconductor Field Effect Transistors (*MOSFET*) - Construction, symbols and nomenclature - Operation of the *n* - channel enhancement mode *MOSFET* - *MOSFET* characteristics and basic equations - *MOSFET* biasing and the operating point - *MOSFET* small signal midband frequency model. The common source amplifier. - *p* - Channel *MOSFET*s and *CMOS* devices. Transistor gates and switches		
4. **Operational Amplifiers** 4.1. The open - loop model. Ideal amplifier characteristics. Physical limitations of Op-Amps 4.2. The operational amplifier in the closed- loop mode. The voltage follower; The inverting amplifier, the op-amp summer and the D/A converter; The noninverting amplifier; Integrator and differentiator circuits; Comparators and A/D converters	6	

References

[1] C.D. Căleanu,V. Maranescu, V. Tiponuţ, A.Filip, *Electronic Devices*, Ed. „Politehnica" Timişoara, 2010
[2] S. Ionel, *Fundamente de inginerie electronică*, Ed . „Politehnica" Timişoara, 2013
[3] S.Ionel, *Dispozitive electronice şi optoelectronice*, Ed . „Politehnica" Timişoara, 2013
[4] P. Horowitz, W Hill, *The Art of Electronics*, 2nd Edition, Cambridge Universitz Press, 1994
[5] HyperPhysics project, *Semiconductor*s, http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

8.2 Seminar/lab	Hours	Instruction methods
1. **Introductory Application**. Lab equipment, tools and parts description. Safety measures. Introduction to Pspice	2	• **Exhibit and heuristic methods** - Conversation (catehetical, heuristic) - Problem – solving - Discovery - Demonstration - Modeling - Case study - Independent observation - Simulation - Practical work • **Algorithmic methods** - The algorithm - Exercise • **Methods for stimulating creativity** - The analogy and the extrapolation - The inversion
2. **The semiconductor diode** 2.1. The current- voltage (*i-v*) characteristic 2.2. The half-wave and full-wave rectifier 2.3. *DC* power supplies. Zener diodes and voltage regulation 2.4. Signal processing applications. The diode clipper 2.5. Light emmiting diodes (*LED*)	8	
3. **The Bipolar Junction Transistor (*BJT*)** 3.1. The *BJT i-v* characteristics 3.2. The *BJT* biasing circuits 3.2. The *BJT* common-emmiter small-signal amplifier	8	
4. **Field Effect Transistors (*FET*)** 4.1. The *i-v* characteristics 4.2. *JFET* and *MOSFET* biasing circuits 4.3. *FET* applications	4	
5. **Operational Amplifiers** 5.1. The inverting amplifier, the op-amp summer and the D/A converter 5.2. Comparators and A/D converters	4	
6. **Recovery of laboratory works**	2	

References

[1] C.D. Căleanu**,** A. Filip, V. Tiponuţ**,** *Dispozitive şi Circuite Electronice. Experimente şi Simulare*, Ediţia a doua revizuită şi adăugită, Ed. Politehnica, Timişoara, 2010.
[2] S.Ionel, *Fundamente de inginerie electronică*, Ed . „Politehnica" Timişoara, 2013
[3] S.Ionel, *Dispozitive electronice şi optoelectronice*, Ed . „Politehnica" Timişoara, 2013
[4] S.Ionel, *Pspice Schematic Capture*, Ed . „Politehnica" Timişoara, 2008
[5] P.Scherz*, Practical Electronics for Inventors*, Mc. Graw-Hill, 2000

9. Correlation between the course content and the requirements of the specialists in the field and the expectations of the main employers

- Electronic Devices is a basic subject that forms and equips students with theoretical and practical fundamentals of electronics, designed to assist them in understanding and addressing the complex systems encountered in practice
- The proposed themes in this course are taught at most universities in our country and abroad in the first years of study
- Currently, there is an increasing requirement of engineers able to combine the quality of beeing a good programmer with the ability to solve complex practical problems, involving hardware and software type of equipment
- Teaching the course in English provides opening and increased opportunities for employment

10. Assessment

<table>
<tr><th>Activity type</th><th>10.1 Assessment criteria</th><th>10.2 Assessment methods</th><th>10.3 3 Weight in final mark</th></tr>
<tr><td>10.4 Lecture</td><td>• Knowing and understanding terms and concepts specific to Electronics
- Satisfactory: - Describe and explain, from a qualitative point of view, the main phenomena involved in the operation of electronic devices studied; Apply basic quantitative relationships (e.g. definitions) using the correct units of measurement; Recognize and give examples of applications of the devices studied.
- Good: - In addition- Use generalizations and classifications in describing the principles/ phenomena in Electronics; Perform direct calculations using the key relationships studied; Explain and critically describe the main applications and phenomena studied
- Very good: - In addition- Demonstrate knowledge of concepts studied in related disciplines and proove the ability to link with new concepts and phenomena; Correctly apply the concepts learned, to solve problems and interpret results
• Building the communication capacities
- Satisfactory: - Communicate orally and in writing the acquired information, using the basic terminology
- Good: -In addition - Use appropriate scientific language; use diagrams, graphic symbols and quantitative relations to support conclusions and arguments.
- Very good: - In addition - Demonstrate clarity and brevity in presenting arguments, results; demonstrate conscientiousness, self-study interest, good frequency classes, actively participate in class,etc.</td><td>• Review assessment (summative):

- Parţial exam
- Written exam</td><td>66%</td></tr>
<tr><td rowspan="2">10.5 Seminar /labs</td><td rowspan="2">In addition to the criteria in section 10.4:
• Building the experimentation capacities
- Satisfactory: - Measure values of electrical quantities using simple devices (e.g. multimeter); Use simple texts to find information; Perform simple experiments, following instructions; Record data and explain simple regularities found; Implement a simple circuit in Pspice
- Good: - In addition - Make relevant observations as directed; evaluate and synthesize information obtained from indicated sources; measure values of electrical quantities using more complex devices (e.g. oscilloscope); appreciate critically the accuracy of the measurements; run a simple PSpice circuit diagram, making appropriate settings, and correcting errors.
- Very good: - In addition - Use independently a variety of sources to synthesize information; decide the level of precision required in relation to the purpose and measure electrical quantities using various instuments; use knowledge and understanding gained to draw relevant conclusions from the results obtained; demonstrate creativity in addressing theoretical and practical problems encountered; demonstrate teamwork</td><td>• Diagnostic assesment:
- Initial test/ oral questioning</td><td>0%</td></tr>
<tr><td>• Training evaluation:

- Verbal assessment
- Oral questioning
- Laboratory reports

• Review assessment (summative):

- Summative tests</td><td>34%</td></tr>
<tr><td colspan="4">10.6 Minimal performance standards (minimal specific knowledge required for passing the exam, the means to assess mastering the specific knowledge)</td></tr>
<tr><td colspan="4">• The written exam contains 2 topics of theory and 2 problems, covering the theoretical and practical study. Giving mark 5 on the written exam, requires proper treatment of at least 50% of each subject.
• Giving mark 5 on laboratory involves performing all laboratory work, a minimum grade of 5 on the lab portfolio and a minimum grade of 5 to each of the summative tests.</td></tr>
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11. **International compatibility**

- Carnegie Mellon University http://www.ece.cmu.edu/courses/items/18220.html
- University of Michigan, http://www.eecs.umich.edu/eecs/academics/courses/eecs-311.html
- Georgia Tech, School of Electrical and Computer Engineering, http://www.ece.gatech.edu/academics/courses/course_listing.php

Date	Signature of the course instructor	Signatures of the academic staff for seminars/labs
10.10.2013	Ş.l. Dr. Ing. Marllene Dăneţi	As. Dr. Ing. Radu Mîrşu
	……	……

Date of approval in the Department

Signature of the Department Director

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