COURSE GUIDE

2019 - 2020

1. Program info

1.1 Higher education institution	"Gheorghe Asachi" Technical University of Iaşi
1.2 Faculty / Department	Electronics, Telecommunications and Information Technology
1.3 Department	Fundamentals of Electronics
1.4 Field	Electronics, Telecommunications and Informatio Technology Engineering
1.5 Study level	Bachelor
1.6 Study program / Qualification	Telecommunications Systems and Technologies

2. Course info

2.1 Course name ELECTRONIC DEVICES							
2.2 Course organizer (lecturer)		conf. dr. Ing. Cristian M. Neacsu Code: EDIS201					
2.3 Teaching assistants		conf. dr. ing. Cristian M. Neacsu; drd. ing. Gabriel Bonteanu;					
2.4 Year of study	2	2.5 Semester	3	2.6 Assessement	Continuous Exam	2.7 Category	DID

3. Estimated total time (hours per semester for teaching activities)

3.1 Number of hours per week	7	3.2 lecture	4	3.3 seminar/laboratory	3
3.4 Total number of hours in curricula	98	3.5 lecture	56	3.6 seminar/laboratory	42

Time distribution	hours
Textbook, course support, references and course notes study	21
Library, electronic platforms and on site documentation	7
Seminar/laboratory preparation, homework, reports, portfolios and essays	21
Tutoring	7
Assessment	4
Other activities	10

3.7 Total individual study hours	70
3.9 Total hours per semester	168
3. 10 Number of credit points	7

4. Prerequisites (where applicable)

4.1 curricula type	Semiconductor Physics, Linear Circuit Theory, Passive Devices
4.2 competence type	Basic knowledge of computer using for PSpice software

5. Infrestructure (where applicable)

5.1. for lectures	Blackboard, videoprojector
5.2. for laboratories	Workplaces with oscilloscope, signal generator, DC regulated power supply, multimeter, probes, electronic components, prototyping boards, computers with

	Pspice software (student version)

6. Specific competences

Total number of credits	7	Credits by competences
Professional competences	• Theoretical knoeledge The knowledge of the physical structure and the understanding of the operation of the electronic devices and of their behavior in different operating regimes The knowledge of the parameters that characterize the semiconductor devices and the correlation between them, the models of the devices and the circuits performances	2
	Ability in understanding circuit operation and solving analysis and design of electronic circuits • Demonstrate the ability to use proper techniques of design and analysis of some basic applications of semiconductor devices using their models	3
	• The creation of the electronic circuits analysis and design skills regarding the sizing and the stress assessing of the semiconductor devices • The creation of skills necessary to use the electronic circuits test equipments and simulation software environments • The creation of the basic capabilities of critical understanding, explanation, design and testing of some complex electronic systems or parts thereof •	1
	• The creation of specific communication skills in microelectronics and electronics fields	0.5
Transversal competences	• Getting teamwork and understanding its necessity and advantages along with the responsibilities involved as a member of a team Concern for further training as part of lifelong learning and to prepare to work in an international context	0.5

7. Course targets (as resulting from 6. Specific competences table)

7.1 Course main target	Study the theoretical, methodological and practical aspects for the construction, operation and application of the main semiconductor devices

7.2 Course specific targets	• Introduce concepts on the characterization of electronic devices and their behavior in different operating regimes • Study the theoretical and practical aspects of modeling of semiconductor devices including their non-ideal behavior • Introduce concepts on capacitive effects in electronic devices followed by modeling the operation under variable small signal, high-frequency • presentation of some devices using examples that highlights the correlation between the devices characteristics and the circuits performances, focusing on analysis and design of basic amplifier stages

8. Contents

8. 1 Lectures	Teaching methods	Notes
1. **Getting intoductive** - Defining concepts of circuit element, component, device, model and characterize each; specific notations used in electronics for electric values 2. **Characterization of semiconductor diodes** - physical structure, Shockley's equation, piecewise linear models, analysis of DC circuits with diodes, diode circuits under variable high signal (voltage limiters, rectifier circuits), small signal operation, small signal model, small signal analysis of diode circuits 3. **Characterization of n-channel MOS type enhancement field effect transistor (n-channel enhancement MOS FET)** - Physical structure: operating regions; static characteristics; DC analysis of MOSFET circuits 4. **Achieving amplification using n-channel enhancement MOS FET** – transfer characteritic, conditions for ac signals amplifications, large and small sinusoidal signal response, MOS FET small signal model, example of analysis of a small signal MOS FET amplifier 5. **Characterization of npn-type bipolar junction transistor (npn BJT)** - physical structure, Ebers-Moll equations and model, operating regions, piecewise linear models, DC analysis of BJT cicuits	Teaching the course is done by exposing the theoretical concepts accompanied by examples and applications and the projection of demonstration simulation or of materials available to students via the website. It seeks to initially understand the phenomena on an intuitive basis, supplemented by rigorous justification and demonstration of the key issues, highlighting the relevant issues in the engineering practice. During the lecture, an active dialogue with students is stimulated as a mechanism for setting the information submitted in the lecture.	1 = 1 lecture 2 = 3 lectures 3 =2 lectures 4 =2 lectures 5 = 4 lectures 6 = 1 lecture 7 = 1 lecture 8 = 1 lecture 9 = 2 lectures 10 = 3 lectures 11 = 4 lectures 12 = 1 lecture 13 = 2 lectures

6. **Small signal operation of BJT** – simplified π-hybrid small signal model, sample analysis of small signal amplifiers with BJT 7. **Other types of transistors** – pnp BJT, n-channel depletion MOSFET, n-channel junction FET (J-FET), p-channel MOSFET, C-MOS Technology, Power MOSFET 8. **Other electronic devices and their applications** – Thyristor, optoelectronic devices 9. **Bias circuits** – bias circuits for discrete BJT and FET, **specific bias circuits for integrated circuits** 10. **Basic amplifier stages with BJT and FET** – midband analysis (common emiter, common base, common colector, common emiter with emiter degenerating resistor, common source, common gate, common drain) 11. **Semiconductor devices phisics** - semiconductor materials, transport of charge carriers, the injection of minority carriers, physical processes in pn junction, the Shockley equation deduction, physical processes in BJT biased in active forward region (AFR), the deduction of the currents expressions and of the current amplification factor β, physical processes in MOSFET for different operating regions, the corresponding drain current expressions deduction 12. **Non-ideal devices characteristics** – temperature effects, **Early effect, β-factor dependence on DC colector current, short channel effect, body effect; including some of these effects in small signal models** 13. **Capacitances of semiconductor devices** – small signal high frequency models of diode, BJT and FET		

Lectures references

1. P. E. Gray şi C. L. Searle, **Fundamentals of Modern Electronics, vol.I**
2. P. R. Gray şi R. G. Meyer,**Analog Integratd Circuits Analysis and Design**;
3. A. Sedra, K. Smith, **Microelectronic Circuits 5-th edition** (Oxford Universitz Press, 2004)

8. 2 Laboratory	Teaching methods
Knowledge of laboratory equipment Study parameters that characterize an amplifier Static characteristics of semiconductor diode for direct and reverse bias Simple circuits with diodes; Small signal diodes regime; BJT - static characteristics - determination of parameters of interest BJT bias On going Test Basic BJT amplifier stages Common source FET stage Two stages amplifiers Applications of thyristors and optocouplers Final test laboratory practical evaluation	Experimental tests Exercises Discussions

8. 3 Seminar	Exercises
Solving problems with the content focused on the main chapters of the course aimed at strengthening and creative use of knowledge taught Course	Discussions

9. Course contents corroboration with the expectations of the epistemic community representatives, professional associations and relevant employers in the field of the program

It was intended to correlate the electronic devices discipline with that of similar disciplines taught in prestigious universities in the country and abroad and with expectations of the main employers in Romania, with which we collaborate constantly.

On one side, this course requires a series of knowledge introduced in some previous courses like Physics, Materials and passive components and circuits, Fundamentals of electrical engineering or Signals circuits and systems and, on the other side, it contributes to the understanding of subjects from other courses, such as Computer-aided analysis of electronic circuits, Fundamental electronic circuits, Digital integrated circuits or Analog integrated circuits.

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10. Assessment

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Percentage of final grade
10.4 Lectures	Theoretical knowledge acquired (quantity, correctness, accuracy)	On going tests: one written test in the 8-th week (one subject theory and two problems Final assessment: exam - written (2 theoretical subjects and two problems); Students can choose to answer the theory subjects from a short list (arround 40%), including the fundamentals, to the maximum grade 7 to those topics	20% 50% (minimum 5)
10.5 Seminar/laboratory	Seminar Frequency / relevance of interventions or answers	Records of speeches	10%
	Laboratory Knowledge of the equipment and how to use specific tools; assessment of some tools or achievements, processing and interpretation of results	• Oral Answer • laboratory notebook (experimental works, essays) • Practical demonstration (individual final test)	20% (minimum 5)
10.6 Minimum performance standard			
• • Knowledge of the fundamentals of theory (answers evaluated min. 5 for topics chosen from the short list) • The correct construction of the DC and small signal equivalent schemes using proper models of the devices, for circuits proposed to be solved in problem, followed by the correct spelling of at least two equations on the respective circuits which could lead to resolution of one of requirements in each issue			

Completion date
September 2, 2019

Course organizer signature,
conf. dr. ing. Cristian M. Neacsu

Teaching assistant signature
dr. ing Gabriel Bonteanu

Department approval date

Department director signature
Prof.dr.ing. Victor Grigoraș