Rzeszów University of Technology

The Faculty of:	The Faculty of Electrical and Computer Engineering
Field of study:	Electronics and Telecommunications
Speciality:	
Study degree (BSc, MSc):	BSc

COURSE UNIT DESCRIPTION

Course title:	Electronic devices
Lecturer responsible for course: Elżbieta Machowska-Podsiadło **Contacts: phone(017)8651112** **e-mail: elamp@prz.edu.pl**	
Department : Department of Electronics Fundamentals	

Semester	Weekly load	Type of classes				Number of ECTS credits
		L Lectures	C Theoretical Classes	Lb Laboratory	P Project	
III IV	2 1.3	1.3	0.7	 1.3		5 6

Course description
Lecture: (in Polish) Physical fundamentals of the semiconductor devices. The junctionless devices - thermistor, piezoresistor, magnetoresistor and Hall generator. PN junction and the rectifying metal/semiconductor contact. Various kinds of diodes: rectifying, stabilizing, capacitive, switching, and for microwave applications. Bipolar transistors and the field effect transistors (JFET, MOSFET). Field-effect tetrodes. Two-terminal current stabilizers. The isolated gate bipolar transistor (IGBT). SIT transistors. Thyristors, diacs and triacs. Unijunction transistors and the programmable UJT. Charge coupled devices. Passive devices of the monolithic integrated circuits. The elements of the micro-electro-mechanical systems (MEMS).
Classes: (in Polish) Solving the circuits with the nonlinear devices. Analysis of the circuits with the rectifying diodes - taking the use of the linear models describing the diodes I-V characteristics. Zener diode circuits; the analysis of the parametric voltage stabilizer. Bipolar transistors – circuits for the transistors biasing and the operation point calculations, describing the thermal stability of the circuits and the temperature coefficients determining. Field Effect Transistors (JFET, MOSFET) – solving the circuits for the transistors biasing.

Laboratory: (in Polish)

Rectifying and switching diodes (silicon, germanium and Schottky diodes);

I-V curves measurements, junction parameters determining, testing the simple diodes circuits. The measured circuits simulations and the SPICE diode model refining (taking the use of PSPICE or MultiSim environment).

Zener diodes and parametric voltage stabilizers;

Zener diode I-V curves measurements. Parametric voltage stabilizers - fitting the elements of the circuits and testing if the predicted conditions for the stabilizers are fulfilled (the transfer and the output characteristics measurements). The analysis of the measured circuits in PSPICE /or MultiSim/ - testing how the temperature changes affect the properties of the stabilizers.

Bipolar transistors (BJT);

the common emitter and the common base I-V characteristics measurements, determining the parameters of BJT small-signal equivalent circuit. The analysis of the measured circuits with the help of the available simulation tools (PSPICE or MultiSim environments).

Field Effect Transistors: JFET, MOSFET;

I-V characteristics measurements, determining the parameters of the transistors small-signal equivalent circuits and taking the use of them in the SPICE models of the transistors.

Simple applications of FETs; NMOS inverter with the active and the resistive loads; the transfer characteristics measurements, i.e U_{out} (and I_{out}) versus U_{in}. The analysis of the measured circuits with the help of PSPICE or MultiSim.

Optoelectronic devices – LED, fotodiode, fototransistor, optocoupler;

the light emitting diode, the fotodiode and the fototransistor I-V characteristics measurements, determining the parameters of the devices (i.e. gce of the fototransistor and the Current Transfer Ratio of the optocoupler). Testing the optocoupler circuit for the small signal transfer (sine and pulses), verifying the results obtained on the oscilloscope with the results of PSPICE (or MultiSim) simulations.

Switching circuits with diodes and the bipolar transistors;

testing the diodes switching circuits which work with and without the capacitive load. Analysis of the circuits with PSPICE (or MultiSim) simulation tools, refining the dynamical diode's parameters in its SPICE model. The bipolar transistor switching circuit – fitting the input resistor to ensure the turn-off and the saturation turn-on states of the transistor. Determining the time delays introduced by the transistor (delay time, rise time, storage delay time, fall time). Reducing the switching time of the circuit with the help of the input capacitance and the Schottky diode. Analysis of the circuits with PSPICE (or MultiSim) simulation tools.

Circuits for the bipolar transistor biasing;

fitting the resistors in the basic circuits ensuring the active mode biasing of the transistor. Verifying how the temperature influences the basic parameters of the transistor. Testing the stability of the transistor's operation point while temperature changes. Determining the temperature coefficients which describe the measured circuits. The thermally compensated current source measurements.

Controlled switching devices: thyristor, triac;

I-V characteristics measurements, devices parameters determining. The thyristor's and the triac's circuits with an ac supply – performing simulations in PSPICE (or MultiSim) environment. Adjusting the SPICE models of the devices.

Project:

Objectives of the course

The student should obtain fundamental knowledge about electronic devices, i.e about their structures, functional principles, characteristics, models, equivalent circuits and basic applications.

The student should acquire practical skills to calculate the simple electronic circuits and during the laboratories the student should learn to use the helpful measuring devices.

Examination method
Lecture – written test at the end of the semester. Seminar – two written tests during the semester. Laboratory – average notes of particular laboratories, and two written tests during the semester. Final written exam at the end of the course.

Bibliography
W. Marciniak, Przyrządy półprzewodnikowe i układy scalone, WNT, Warszawa, 1985 A. Kusy, Podstawy elektroniki, Cz.I. Przyrządy półprzewodnikowe, Wydawnictwa Uczelniane PRz, Rzeszów J. Hennel, Podstawy elektroniki półprzewodnikowej, WNT, Warszawa, 2003 Z. Bielecki, A. Rogalski, Detekcja sygnałów optycznych, WNT, 2001 The web page: http://www.multimems.com/Training/MEMS_Resources.htm /recommended links MemsEdu and SensEdu under MEMS_Devices bookmark/ A. W. Stadler, A. Kolek, Elektronika. Zbiór zadań., Oficyna Wydawnicza PRz, Rzeszów, 2005 Z. Nosal, J. Baranowski, Układy elektroniczne. Część I. Układy analogowe liniowe., WNT, Warszawa, 1997 A. Filipkowski, Układy elektroniczne analogowe i cyfrowe, WNT, Warszawa, 2006 P. Horowitz , W. Hill, Sztuka elektroniki. Część 1 i Część 2, WKŁ, 2006 Saburo Muroga, Projektowanie układów VLSI, WNT, 1986 The web page : http://www.datasheetcatalog.com/ Bart Van Zeghbroeck, Principles on semiconductor devices, the electronic book on the page: http://ecee.colorado.edu/~bart/book/

Lecturer signature	
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