POLITEHNICA University of Bucharest
Faculty of Electronics, Telecommunications and Information Technology

COURSE DESCRIPTION

1. Program identification information

1.1 Higher education institution	University Politehnica of Bucharest
1.2 Faculty	Faculty of Electronics, Telecommunications and Information Technology
1.3 Department	Telecommunications
1.4 Domain of studies	Electronic Engineering, Telecommunications and Informational Technologies
1.5 Cycle of studies	License
1.6 Program of studies/Qualification	Technologies and Systems of Telecommunications (TSTeng)

2. Course identification information

2.1 Name of the course				Signal Processors for Communications			
2.2 Lecturer				Assoc. Prof. PhD. Eng. Radu Mihnea Udrea			
2.3 Instructor for practical activities				Assoc. Prof. PhD. Eng. Radu Mihnea Udrea			
2.4 Year of studies	IV	2.5 Semester	7	2.6 Evaluation type	Exam	2.7 Course choice type	Mandatory

3. Total estimated time (hours per semester for academic activities)

3.1 Number of hours per week, out of which	3,5	3.2 course	2	3.3 practical activities	1,5
3.4 Total hours in the curricula, out of which	49	3.5 course	28	3.6 practical activities	21

Distribution of time	hours
Study according to the manual, course support, bibliography and hand notes	21
Supplemental documentation (library, electronic access resources, in the field, etc)	10
Preparation for practical activities, homework, essays, portfolios, etc.	20
Tutoring	0
Examinations	4
Other activities	0

3.7 Total hours of individual study	55
3.9 Total hours per semester	104
3.10 Number of ECTS credit points	4

4. Prerequisites (if applicable)

4.1 curricular	Programming Language Microprocessors Architecture Microcontrollers Digital Signal Processing
4.2 competence-based	general knowledge of digital signal processing, microprocessors and programming in C and Matlab

5. Requisites (if applicable)

5.1 for running the course	None
5.2 for running of the applications	Compulsory attendance at labs

6. Specific competences

Professional competences	Application, in typical situations the basic methods of acquisition and signal processing. Implement average complex procedures on signal processors
Transversal competences	-

7. Course objectives (as implied by the grid of specific competences)

7.1 General objective of the course	The study of general characteristics of signal processors in order to achieve digital signal processing systems and real-time applications for telecommunications. Architectures of different families of signal processors are presented. Specific DSP assembly language, adaptation and optimization techniques for applications written in C language are described. Also are introduced design methods of signal processing systems and applications for signal processing and the development of embedded systems for signal processing.
7.2 Specific objectives	Highlighting architectural attributes for family Freescale StarCore DSPs 140. Application will be designed in which students will be involved both to the component of the software and hardware.

8. Content

8.1 Lectures	Teaching techniques	Remarks
General features of digital signal processors. Comparison microprocessors - General purpose signal processors. Examples of specific applications in telecommunications. Fixed-point signal processor and floating point.	Teaching is based on the use of the projector (covering communication and demonstration function) used oral communication methods are expository method and problem-method used front. Course materials are lecture notes and presentations, themes and examples proposed (theoretical and solving computer). All materials are available electronically on the course website	2 hours
Numbers formats of representation for the signal processors. Numbering Systems. Representation of signed numbers. Fixed point arithmetic of binary numbers. Representation of floating point numbers		2 hours
Starcore 140 DSP. Overview of architecture. Arithmetic and logic unit data. Forms of representation. Arithmetic and logical instructions. Addressing unit. Registers and addressing modes. Program execution control unit. Execution pipeline stages. Execution loops. Stack. Conditional statements.		4 hours
Optimization techniques for C programs for SC140 DSP. Moving from floating point to fixed point. Adapting C code SC140 data format. Compiler extensions. Optimization techniques. Loop merging. Loop unrolling. Split computation. Multisample. Examples		6 hours

Generating waveform using the signal processor. Generating sinus using Taylor series expansion. Generating sinus using a lookup table. Recursive generation of sinusoidal signals. Digital oscillator method. Generate DTMF tones. Digital oscillators in quadrature.		4 hours
Effects of finite representation of numbers. The effects of limiting the number of bits. Quantization by truncation and rounding. Errors due to arithmetic operations. Overflow the capacity registers. Scaling rules		2 hours
Implementation of digital filters with signal processors. Implementation of finite impulse response filters (FIR). Implementation of infinite impulse response filters (IIR). Cascade form. Parallel form. Lattice form.		4 hours
Implementations and applications of the fast Fourier transform. Fast algorithms for computing PDT. FFT implementation on fixed-point processors. Optimizing Performance FFT. Inverse Fourier transform. Fourier transform of real data. Goertzel algorithm.		4 hours

Bibliography

R.M. Udrea, D. N. Vizireanu, "Procesoare de semnal în comunicaţii - algoritmi şi aplicaţii", Editura Electronica 2000, ISBN 978-973-7860-20-0, 185 pag., 2009

A. Mateescu, S. Ciochina , N. Dumitriu, Al. Serbanescu, L. Stanciu, "Prelucrarea numerica a semnalelor", Editura Tehnica, 1997.

S.Ciochina, "Prelucrarea Numerica a Semnalelor", partea II, U.P.B. 1996

***, SC140 DSP Core, Reference Manual, Revision 4.1, September 2005, Freescale Semiconductor

***, StarCore® C Compiler User Guide for CodeWarrior™ Development Studio, 2003-2008, Freescale Semiconductor

***, Digital Sine-Wave Synthesis Using the DSP56001/DSP56002, Freescale, APR1/D.

***, Implementation of Fast Fourier Transforms on Freescale's DSP56000/DSP56001, Freescale, APR4/D.

Note curs: Procesoare de semnal in comunicatii - MOODLE http://electronica07.curs.ncit.pub.ro/ http://www.comm.pub.ro/psc/

8.2 Practical applications	Teaching techniques	Remarks
Lab 1. Introduction to the StarCore140 DSP projects.	Teaching is based on the use of the projector (covering communication function and demonstration) Oral communication method used is problem-method, students simulate, implement, test and evaluate independently the same problems with continued use of the computer and software environment. The teaching materials are included in the tutorial lab platforms	3hr
Lab 2. Creating programs in C for SC 140		3hr
Lab 3. C Optimization techniques for SC 140		3hr
Lab 4. Generating sinusoidal signals		3hr
Lab 5. Implementation of digital filters FIR and IIR		3hr
Lab 6. Implementation of the Fourier transform		3hr
Final Oral Examination Laboratory		3hr

	laboratory.	

Bibliography

D. N. Vizireanu, R. M. Udrea, L. Topoloiu: "Aplicaţii ale procesoarelor de semnal in comunicatii - Indrumar de laborator", Editura Electronica 2000, Bucureşti, 2003

E. Roy and D. Crawford, "Introduction to the StarCore™ SC140 Tools: An Approach in Nine Exercises, Rev. 1", Freescale Semiconductor, Application Note, AN2009, Rev. 1, 11/2004.

*** CodeWarrior™ Development Studio IDE 5.7 User's Guide, 2004-2008 Freescale Semiconductor.

9. Bridging the course content with the expectations of the epistemic community representatives, professional associations and employers representatives for the domain of the program

Evolution of signal processors architectures allow development of complex applications digital signal processing for telecommunication equipment. National and multinational companies which design or develop software applications for such telecommunications equipment manufacturers have a strong demand for qualified engineers with specializations related to signal processing with a solid foundation in electronics, technology and telecommunications systems, such that it can maintain the pace of development of new hardware and software. The course syllabus "Communications Signal Processors" concrete answer these existing requirements development and evolving European economy subscribed services in the Electronics and Telecommunication (ETC).

This provides graduates with the appropriate skills and training needs of current scientific skills and modern technical, quality and competitive enabling rapid employment after graduation, being perfectly placed in the University Politehnica of Bucharest policy, both in terms of content and structure and in terms of skills and international openness for students.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final mark
10.4 Lectures	- knowledge of the application of theory to specific problems;	Two homework with equal weights on projects in C for implementation of signal processing functions and digital filters	30%
	- knowledge of fundamental theoretical concepts; - differential analysis techniques and theoretical methods.	Final written exam with open books	40%
10.5 Practical applications	- knowledge of how to design a signal processing algorithm to solve a given problem; - knowing how to code C transposition of signal processing functions; - demonstrate the operation of an algorithm by running the program in CodeWarrior development environment		30%
10.6 Minimal performance standard			

- creating a C project adapted for number representation formats of signal processor Starcore140 - design, implementation and testing of signal processing functions, fixed point, for the SC140 processor

Date	Lecturer	Instructor for practical activities
01.10.2016	Assoc.Prof.PhD.Eng. Radu Mihnea Udrea	Assoc.Prof.PhD.Eng. Radu Mihnea Udrea

Date of department approval

07.10.2017

Director of Department,

Assoc. Prof. PhD. Eng. Eduard Popovici