COURSE SYLLABUS

Academic year 2024-2025

1. Programme Information

1.1. Higher education institution	**Lucian Blaga University of Sibiu**
1.2. Faculty	Faculty of Engineering
1.3. Department	Department of Computer Science and Electrical and Electronics Engineering
1.4. Field of study	Computer Science and Information Technology
1.5. Level of study[1]	Master
1.6. Programme of study/qualification	EMBEDDED SYSTEMS

2. Course Information

2.1. Name of course	**Advanced DSP Methods**			Code	ES.302.RO
2.2. Course coordinator	Assist. Prof. Mihai NEGHINĂ, PhD				
2.3. Seminar/laboratory coordinator	Assist. Prof. Mihai NEGHINA, PhD				
2.4. Year of study[2]	2	2.5. Semester[3]	3	2.6. Evaluation form[4]	E
2.7. Course type[5]	O	2.8. The formative category of the course[6]			R

3. Estimated Total Time

3.1. Course Extension within the Curriculum – Number of Hours per Week					
3.1.a. Lecture	3.1.b. Seminar	3.1.c. Laboratory	3.1.d. Project	3.1.e. Other	Total
2	0	2	0	0	**4**
3.2. Course Extension within the Curriculum – Total Number of Hours within the Curriculum					
3.2.a. Lecture	3.2.b. Seminar	3.2.c. Laboratory	3.2.d. Project	3.2.e. Other	Total[7]
28	0	28	0	0	**56**

Time Distribution for Individual Study[8]	**Hours**
Learning by using course materials, references and personal notes	24
Additional learning by using library facilities, electronic databases and on-site information	20
Preparing seminars / laboratories, homework, portfolios and essays	56
Tutorial activities[9]	15
Exams[10]	4
3.3. Total Individual Study Hours[11] *($NOSI_{sem}$)*	**119**
3.4. Total Hours in the Curriculum *($NOAD_{sem}$)*	**56**
3.5. Total Hours per Semester[12] *($NOAD_{sem} + NOSI_{sem}$)*	**175**
3.6. No. of Hours / ECTS	**25**
3.7. Number of credits[13]	**7**

4. Prerequisites (if needed)

4.1. Courses that must be successfully completed first (from the curriculum)[14]	Mathematics, Data Acquisition, Signals and Systems, Microcontrollers, **Digital Signal Processing.**
4.2. Competencies	Matlab and C programming

5. Conditions (where applicable)

5.1. For course/lectures[15]	Whiteboard, projector, computers. Active participation, reading support material, individual study, additional documentation, preparing labs and homework. To achieve all course objectives, students are expected to work at a greater level of intensity.
5.2. For practical activities (lab/sem/pr/app) [16]	Room equipped with computers installed with the necessary tools to support laboratory work. Develop and support the planned work

6. Specific competencies acquired[17]

		Number of credits assigned to the discipline[18] 7	Credits distribution by competencies[19]
6.1. Professional competencies			
	PC9	prepare production prototypes	2
	PC12	promote the transfer of knowledge	2
	PC13	perform data analysis	2
6.2. Transversal competencies	TC2	show initiative	1

7. Course objectives (resulted from developed competencies)

7.1. Main course objective	Advanced DSP curse has two main objectives: • To complement the fundamentals in DSP with introductory treatments of several advanced techniques including adaptive filtering, and stochastic process data filtering • To study and understand techniques to make the algorithms to run faster, enabling their use in real time processing.
7.2. Specific course objectives	• Least squares techniques algorithms. • Improving the algorithm's speed, can be done by: - Using the most appropriate sampling parameters (sampling frequency and level of quantization) in order to process as much data as possible. - Using the appropriate data type and microcontroller architecture. - Finding the most rapid algorithms, by choosing between FIR and IIR type of filter's algorithms. - Using the fixed point data format. - Parallelizing MAC operations

8. Content

8.1 Lectures[20]		**Teaching methods[21]**	**Hours**
Lecture 1	**DSP background:** Signals and systems		2
Lecture 2	**DSP background:** Continuous and Discrete Fourier Transforms		2
Lecture 3	**DSP background:** Time domain and frequency domain analysis		2

Lecture 4	**DSP background:** Z Transform		2
Lecture 5	**DSP background:** FIR and IIR filter design		2
Lecture 6	**Adaptive filters:** Theory and processing principle		2
Lecture 7	**Adaptive filters:** Filter design using least-squares techniques		2
Lecture 8	**Speed improving:** Principles to increase filter performances		2
Lecture 9	**Speed improving:** Floating point data vs. Fixed point data		2
Lecture 10	**Speed improving:** Implementation for fixed point data computation		2
Lecture 11	**Speed improving:** DSP architecture, instructions		2
Lecture 12	**Speed improving:** DSP – multiply and accumulate (MAC)		2
Lecture 13	**Speed improving:** DSP – FIR & IIR filter implementation		2
Lecture 14	**Speed improving:** DSPs in real time processing systems		2
		Total lecture hours:	**28**

8.2 Practical activities

8.2.b. Laboratory		**Teaching methods**[22]	**Hours**
Laboratory 1	Signals and systems. Use of Matlab.		2
Laboratory 2	Fourier theorem and sampling theorem.		2
Laboratory 3	Spectral representations and spectrograms.		2
Laboratory 4	Z-transform and pole-zero diagrams		2
Laboratory 5	Filter Designer toolbox		2
Laboratory 6	Adaptive filters		2
Laboratory 7	Filter design using least-squares techniques		2
Laboratory 8	Project (part 1): Filter design and implementation in an audio signal processing application		2
Laboratory 9	Kalman Filters.		2
Laboratory 10	Fixed point computation.		2
Laboratory 11	DSP architecture, instructions		2
Laboratory 12	DSP – multiply and accumulate (MAC)		2
Laboratory 13	DSP – FIR & IIR filter implementation		2
Laboratory 14	Project (part 2): Optimal fixed point filter implementation in the audio signal processing application from part 1		2
		Total laboratory hours:	28

9. Bibliography

9.1. Recommended Bibliography	Manolakis G. D., Vinay K. I., *„Applied Digital Signal Processing - Theory and practice"*, ISBN 978-0-521-11002-0, Cambridge University Press, 2011.
	Mihu I. P. *Procesarea Numerică a Semnalelor - Noţiuni Esenţiale* - Ed. Alma Mater, Sibiu, 2005, ISBN 973-632-195-1
	C. Neghină, A. Sultana, M. Neghină, "MATLAB. Un prim pas spre cercetare", Editura ULBS, 2016
	Porat B. "*A course in Digital signal Processing*", Prentice-Hall
9.2. Additional Bibliography	Kamen E. W., Heck B. S. "*Fundamentals of Signals and Systems Using the Web and Matlab*", Second Edition, Prentice Hall, Incorporated, 2000

	Manolakis G. D., Vinay K. I., *„Applied Digital Signal Processing - Theory and practice"*, ISBN 978-0-521-11002-0, Cambridge University Press, 2011.

10. Conjunction of the discipline's content with the expectations of the epistemic community, professional associations and significant employers of the specific study program[23]

Periodic discussions with representatives of companies, both in formal and informal contexts.

11. Evaluation

Activity Type	11.1 Evaluation Criteria	11.2 Evaluation Methods		11.3 Percentage in the Final Grade	Obs.[24]
11.4a Exam / Colloquy	• Theoretical and practical knowledge acquired (quantity, correctness, accuracy)	Tests during the semester[25]:	%	60%	
		Homework:	%		
		Other activities[26]:	%		
		Final evaluation:	100%		
11.4c Laboratory	• Knowledge of the equipment, how to use specific tools; evaluation of tools, processing and interpretation of results	• Written questionnaire • Oral response		40%	nRFE
11.5 Minimum performance standard[27] At least 50% of weighted sum (according to percentages)					

The Course Syllabus will encompass components adapted to persons with special educational needs (SEN – people with disabilities and people with high potential), depending on their type and degree, at the level of all curricular elements (skills, objectives, contents, teaching methods, alternative assessment), in order to ensure fair opportunities in the academic training of all students, paying close attention to individual learning needs.

Filling Date: 13.09.2024

Department Acceptance Date: 16.09.2024

	Academic Rank, Title, First Name, Last Name	Signature
Course Teacher	Assist. Prof. Mihai NEGHINĂ, PhD	
Study Program Coordinator	Prof. Arpad GELLERT, PhD	
Head of Department	Assoc. Prof. Radu George CREȚULESCU, PhD	
Dean	Prof. Maria VINȚAN, PhD	

[1] *Bachelor / Master*
[2] *1-4 for bachelor, 1-2 for master*
[3] *1-8 for bachelor, 1-3 for master*
[4] *Exam, colloquium or VP A/R - from the curriculum*
[5] *Course type: R = Compulsory course; E = Elective course; O = Optional course*
[6] *Formative category: S = Specialty; F = Fundamental; C = Complementary; I = Fully assisted; P = Partially assisted; N = Unassisted*
[7] *Equal to 14 weeks x number of hours from point 3.1 (similar to 3.2.a.b.c.)*
[8] *The following lines refer to individual study; the total is completed at point 3.37.*
[9] *Between 7 and 14 hours*
[10] *Between 2 and 6 hours*
[11] *The sum of the values from the previous lines, which refer to individual study.*
[12] *The sum (3.5.) between the number of hours of direct teaching activity (NOAD) and the number of hours of individual study (NOSI) must be equal to the number of credits assigned to the discipline (point 3.7) x no. hours per credit (3.6.)*
[13] *The credit number is computed according to the following formula, being rounded to whole neighbouring values (either by subtraction or addition*

$$No.credits = \frac{NOCpSpD \times C_C + NOApSpD \times C_A}{TOCpSdP \times C_C + TOApSdP \times C_A} \times 30\ credits$$

Where:

- NOCpSpD = Number of lecture hours / week / discipline for which the credits are calculated
- NOApSpD = Number of application hours (sem./lab./pro.) / week / discipline for which the credits are calculated
- TOCpSdP = Total number of course hours / week in the Curriculum
- TOApSdP = Total number of application hours (sem./lab./pro.) / week in the Curriculum
- C_C/C_A = Course coefficients / applications calculated according to the table

Coefficients	**Course**	**Applications (S/L/P)**
Bachelor	2	1
Master	2,5	1,5
Bachelor - foreign language	2,5	1,25

[14] *The courses that should have been previously completed or equivalent will be mentioned*
[15] *Board, video projector, flipchart, specific teaching materials, online platforms, etc.*
[16] *Computing technology, software packages, experimental stands, online platforms, etc.*
[17] *Competences from the Grids related to the description of the study program, adapted to the specifics of the discipline*
[18] *From the curriculum*
[19] *The credits allocated to the course are distributed across professional and transversal competences according to the specifics of the discipline*
[20] *Chapter and paragraph titles*
[21] *Exposition, lecture, board presentation of the studied topic, use of video projector, discussions with students (for each chapter, if applicable)*
[22] *Practical demonstration, exercise, experiment*
[23] *The relationship with other disciplines, the usefulness of the discipline on the labour market*
[24] *CPE – Conditions Exam Participation; nCPE – Does Not Condition Exam Participation; CEF - Conditions Final Evaluation; N/A – not applicable*
[25] *The number of tests and the weeks in which they will be taken will be specified*
[26] *Scientific circles, professional competitions, etc.*
[27] *The minimum performance standard in the competence grid of the study program is customized to the specifics of the discipline, if applicable*