UNIVERSIDADE FEDERAL DO CEARÁ

FEDERAL UNIVERSITY OF CEARÁ
OFFICE OF THE VICE PROVOST FOR UNDERGRADUATION (PROGRAD)
COORDINATION FOR PROJECT AND CURRICULUM DEVELOPMENT
CURRICULUM DEVELOPMENT DIVISION

1. Academic unit offering the curricular component (Faculty, Center, Institute, Campus)**:**

Center of Technology

2. Department offering the curricular component (when applicable)**:**

Teleinformatics Engineering Department

3. Undergraduate course(s) offering the curricular component

Code of the Course	Name of the Course	Course Degree[1]	Curriculum (Year/ Semester)	Nature of the Component[2]	Semester of Offer[3]	Habilitation[4]
91	Telecommunications Engineering	Bachelor	2015.1	Optional	-	-

4. Name of the curricular component:
Laboratory of Signal Processing for Communications

5. Code of the curricular component (filled by PROGRAD)**:**
TI0128

6. Prerequisites	No ( )	Yes (x)	
		Code	Name of the curricular component / activity
		TI0119	Digital Signal Processing

7. Corequisite	No (x)	Yes ( )	
		Code	Name of the curricular component / activity

8. Equivalences	No ( )	Yes (x)	
		Code	Name of the curricular component / activity
		TI0066	Digital Signal Processing Laboratory

9. Day period of the curricular component (more than one option can be selected)**:**
(x) Morning (x) Afternoon (x) Night

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1 **Fill with *Bachelor (Engineer), Licenciate,* or *Technologist.***
2 **Fill with *Mandatory, Optional,* or *Elective.***
3 **Fill when mandatory.**
4 **When elective, fill with the habilitation or emphasis to which the curricular component is linked.**

10. Regime of the curricular component:
(x) Semester ( ) Yearly ( ) Modular

11. Justificatory for the creation/regulamentation of this curricular component

Digital signal processing applications today are found in virtually every field in the electronics, computer and telecommunications industries, including multimedia systems, cellular telephony and broadband Internet access. In addition, many systems today aggregate digital signal processing algorithms to aid in several of their tasks.

12. Objectives fo the curricular component:

The objective of this course is to carry out practical experiments that consolidate the theory of digital signal processing, through the analysis, computational simulation and design of digital signal processing systems, providing the student with the opportunity to delve deeper into the subject, having as motivation some practical applications.

13. Syllabus:

Sampling of continuous signals and aliasing. IIR and FIR digital filter design techniques. Fourier analysis. Optimum linear filtering. Applications in various problems: adaptive noise cancellation, identification of LTI systems, interference suppression, channel equalization, modem for digital communication systems, voice signal coding.

14. Program:

1. **Sampling:** Simulation of a continuous-discrete converter, with sampling and reconstruction of a sinusoidal signal. Verification of the aliasing phenomenon from the graphical analysis on the time and frequency of the reconstructed signal. Extension of the experiment for a concrete example of an actual speech signal.

2. **Digital filters:** Design and simulation of IIR filters from continuous prototypes following given specifications. Analysis of the magnitude and phase response of the transfer function, impulse response, and group delay. Design of FIR filters by windowing and application in decimators and interpolators.

3. **Fourier analysis and notch filters:** Fourier analysis on a signal corrupted by narrow band interference (e.g., 60 Hz sinusoid) aiming to identify the interfering frequency. Design and simulation of a "notch" filter for elimination of interference. Analysis of the Fourier transform of the filtered signal.

4. **Adaptive cancellation of noise:** System simulation for noise cancellation in a voice signal. System based on two sensors, where the first one picks up the useful signal corrupted by the noise, and the second (reference sensor) only captures the source of noise. Evaluation of the impact of the signal-to-noise ratio and of the filter parameters.

5. **Optimum linear filtering:** Simulation of optimal filters (least squares and Wiener). Applications in problems of identification of LTI systems, suppression of interference, and equalization of communication channel. Evaluation of the impact of channel and filter length on the performance of the identification / equalization process.

6. **PSK / QAM modem for digital communication system:** Simulation of a digital

communication system in bandwidth, including transmission and reception filter. Fourier analysis at different points in the communication system. Inclusion of frequency offset in the demodulator (loss of carrier synchronism) and evaluation of impact on system performance.

7. **Encoders / decoders of voice signals:** Simulation of the classical coding (transmitter) and decoding (receiver) system based on PCM and LPC methods. Performance evaluation of PCM and LPC codecs in AWGN communication channel.

15. Workload description

Number of Weeks:	Number of Credits:	Total Workload in Hours:	Theory Workload in Hours:	Practice Workload in Hours:
16	02	32	-	32

16. Basic bibliography:

1- Oppenheim, A.V., Schafer, R.W., Buck, J.R., Discrete-Time Signal Processing, 3rd edition, Prentice-Hall, 2009.

2- Mitra, S.K., Digital Signal Processing: A Computer-Based Approach, McGraw Hill, 2006.

3- Mitra, S.K., Digital Signal Processing Using Matlab, McGraw Hill, 1999.

17. Complementary bibliography:

1- Ingle, V.K., J.G. Proakis, Digital Signal Processing Using MATLAB, 3rd edition, Cengage Learning, 2011.

2- McClellan, J.H., Computer-Based Exercises for Signal Processing Using Matlab 5, Prentice-Hall, 1998.

3- Embree, Paul M., Danneli, D., C++ Algorithms for Digital Signal Processing, Prentice Hall, 1998.

4- Roberts, R.A., Mullins C.T., Digital Signal Processing, Addison-Wesley, 1987.

5- Brigham, E. O., The Fast Fourier Transform and Its Applications, Prentice-Hall, 1988.