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	Mandatory	05	-

4. Name of the curricular component:
Digital Signal Processing

5. Code of the curricular component (filled by PROGRAD)**:**
TI0119

6. Prerequisites	No ( )	Yes (x)	
		Code	Name of the curricular component / activity
		TI0116	Signals and Systems

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

8. Equivalences	No ( )	Yes (x)	
		Code	Name of the curricular component / activity
		TI0055	Digital Signal Processing

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

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

The digital signal processing techniques find applications in medicine, remote sensing, meteorology, telecommunications, embedded systems, etc. In face of the multidisciplinarity of its application areas, it becomes necessary to develop competences in signal processing through human resource formation as to promote innovation and the regional scientific and technological development.

12. Objectives fo the curricular component:

Introduce and develop the main tools used in digital signal processing, providing to the student the based mathematical theory about this topic so that the student be able to apply it to different areas of knowledge.

13. Syllabus:

Introduction to discrete signals and systems. Discrete signals and systems. Z-transform. Sampling of continuous time signals. Analysis of linear invariant systems. Structure of discrete systems. Filter design techniques. Discrete Fourier Transform. Fast algorithms for Fourier transform. Design of digital filters. Simulation of digital filters.

14. Program:

1. **Review of discrete signals and systems**: mathematical representation of the continuous and discrete signals, periodic and aperiodic signals, basic continuous and discrete signals, operations over discrete signals, convolution, properties of discrete systems. Examples.
2. **z-transform**: z-transform definition, poles and zeros, convergence region and inverse transform, z-transform properties, solution of difference equations with constant coefficients. Examples.
3. **Sampling of continuous time signals**: representation of a continuous time signal by its samples, sampling using impulse train, sampling theorem, aliasing, reconstruction of continuous time signals from its samples, subsampling, oversampling, introduction to multirate signal processing. Digital processing of analog signals. Quantization and coding. Examples.
4. **Analysis of linear invariant systems**: frequency response of LTI systems; system characterization by difference equations with constant coefficients; frequency response of systems characterized by rational functions; magnitude and phase relationships; all-pass, minimum phase, and linear phase systems. Examples.
5. **Structure of discrete systems**: representation by block diagrams of difference equations with constant coefficients; basic structures for IIR systems; transpose forms; basic network structures FIR systems; finite precision and quantization effects; noise propagation in digital filters; fixed point analysis and floating point analysis in digital filter design. Examples.
6. **Digital filter design**: IIR and FIR filters, IIR filter design from analog filters, bilinear transformation, FIR filter properties, FIR filter design using windows, comparison of analog and digital filters, filter design with application to signal noise reduction. Examples.

7. **Discrete Fourier transform**: periodic signals and its representation by the discrete series, Fourier transform representation of finite sequences, convergence, Discrete time Fourier transform properties, inverse transform, linear systems described by difference equations with constant coefficients, applications. Examples.
8. **Fast algorithms for Fourier transform**: Goertzel's algorithm, decimation algorithm in time and frequency. Examples.
9. **Digital filter simulation**: IIR and FIR digital filter simulation. Simulation and comparative analyses among digital filters. Optimal filter simulations. Examples.

15. Workload description

Number of Weeks:	Number of Credits:	Total Workload in Hours:	Theory Workload in Hours:	Practice Workload in Hours:
16	04	64	64	-

16. Basic bibliography:

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

2- Diniz, P.S.R., da Silva, E.A.B., Netto, S.L., Digital Signal Processing: System Analysis and Design, 2nd edition, Cambridge University Press, 2010.

3- Proakis, J.G., Manolakis, D.G., Digital Signal Processing: Principles, Algorithms, and Applications, 4a Ed. Prentice-Hall, 2006.

17. Complementary bibliography:

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

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

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

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

5- Lyons, Richard G., Understanding Digital Signal Processing, 3rd edition, Prentice Hall, 2010.