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:
Introduction to Array Signal Processing

5. Code of the curricular component (filled by PROGRAD)**:**
TI0127

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 (x)	Yes ( )	
		Code	Name of the curricular component / activity

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 modern telecommunications engineer, among other tasks, must adjust and propose new structures of telecommunication in a permanent way, which meet the nomadic characteristics of the human being. The distribution of access and storage of information in interconnected network structures has been imposed as a basis for guaranteeing the fulfillment of the complex characteristics of human behavior in face of their needs in using and making information available at any time, anywhere and in any situation. This course starts the theoretical studies of signal processing for sensor arrays, essential for the support of networks in which information is transmitted for the purpose of collecting and forwarding data, voice, images, texts and other forms of phenomenological manifestations.

12. Objectives fo the curricular component:

The main objective of the course is to present to the student a comprehensive introduction of signal processing in networks or sensor arrays, focusing primarily on the following fundamentals: wave analysis and synthesis, filtering, spatial arrays, and spatial-temporal arrays. The theoretical study aims at giving minimum conditions for the student to be able to develop projects of sensor networks for applications in: radar, radio-astronomy, sonar, communications, microphone network and multi-reproduction of environmental sound; seismology, identification and separation of signal sources, tomography, among other applications.

13. Syllabus:

Introduction: network processing or sensor array processing and applications; spatial arrays and filters; synthesis of linear arrays and aperture; planar arrays and apertures; characterization of spatial-temporal processes.

14. Program:

1. **Introduction:** network processing or sensor array processing and applications in: radar, radio-astronomy, sonar, communications, source identification and separation, seismology, tomography.
2. **Arrays and Spatial Filters:** wave equation; monochrome flat wave; wave propagation; wave number; Fourier transform in the space-time domain; frequency-wave number response and beam patterns; uniform linear arrays; directional array; array performance measures; linear apertures; examples.
3. **Synthesis of Linear Arrays and Apertures:** spectral weighting; polynomial representation of arrays and the z-transform; sampling in the wave-number domain; minimum beam width for given lateral lobe level; diagram synthesis based on least squares; minimax design; directional nulling; asymmetric beams; linear arrays with non-uniform spacing; spatial beam processing; broadband arrays; examples.
4. **Planar Arrays and Apertures:** rectangular arrays; circular arrays; circular apertures; hexagonal arrays; non-planar arrays; examples.
5. **Characterization of Time-Space Processes:** introduction; snapshot models; spatial-temporal random processes; arrays and apertures; orthogonal expansions; parametric response models in

wave number domain; 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- Harry L. Van Trees, Optimum Array Processing, Wiley, 2002.

2- Dan E. Dudgeon, Fundamentals of Digital Array Processing, Proceedings of the IEEE, V. 65, Nº 6, Junho 1977;

3- Simon Haykin, Array Signal Processing, Englewood Cliffs, NJ, Prentice-Hall, Inc., 1985.

17. Complementary bibliography:

1- Pillai, S. Unnikrishna, Array Signal Processing, Springer-Verlag, 1989.

2- H. Krim, M. Viberg, Two Decades of Array Signal Processing Research: The Parametric Approach, IEEE Signal Processing Magazine, pp. 67-94, julho 1996.

3- Mark Sullivan, Practical Array Processing, McGraw-Hill, 2008.

4- Don H. Johnson, Dan E. Dudgeon, Array Signal Processing: Concepts and Techniques, Prentice Hall, 1993.

5- P. S. Naidu, Sensor Array Signal Processing, CRC Press, 2nd edition, 2009.