



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:

Microwave Circuits and Devices

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

TI0132

6. Prerequisites	No ()	Yes (x)	
		Code	Name of the curricular component / activity
		TI0057	Electronic Circuits
		TI0053	Waveguides
		TI0060	Electronic and Optoelectronic Materials

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

8. Equivalences	No ()	Yes (x)	
		Code	Name of the curricular component / activity
		TI0067	Microwave Systems and Devices

9. Day period of the curricular component (more than one option can be selected):

Morning Afternoon Night

¹ Fill with *Bachelor (Engineer), Licenciante, 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: Semester Yearly Modular**11. Justificatory for the creation/regulamentation of this curricular component**

There are several telecommunication systems operating in the microwave range, such as: mobile telephones, mobile computing, high-speed computing, transmitters and receivers for radio communication systems and optical and satellite communications. Thus, for the complete understanding of the design and maintenance of such systems, the knowledge of passive and active microwave circuits is fundamental.

12. Objectives for the curricular component:

Provide the conceptual foundation and tools for analysis and design of passive and active microwave circuits.

13. Syllabus:

Analysis of quadripoles with scattering parameters S and ABCD parameters. Microwave waveguide analysis: Transmission lines, coaxial cable and stripline and microstrip tape lines. Passive microwave components. Transistors and amplifiers for microwaves. Mixers. Oscillators. Synthesizers and ring phase lock. Phase shifters. Measures in microwave.

14. Program:

1. **Analysis of quadripoles with scattering parameters S and ABCD parameters:** S parameter definition, S parameter measurement, impedance matching and stability factor. Definition of ABCD parameters, ABCD matrix of series and parallel circuits. ABCD matrix of cascaded quadripoles. Conversion Parameters.
2. **Microwave waveguide analysis:** coaxial cable and stripline and microstrip tape lines: Solutions of propagation equations in coaxial cables, stripline and microstrip.
3. **Passive microwave components:** Inductors, transformers, capacitors, varactors, resistors, filters, combiners and dividers.
4. **Transistors and amplifiers for microwaves:** Transport of loads in transistors, MOSFET, MESFET, HEMT, bipolar transistor, heterojunction bipolar transistor, BiCMOS. Topologies of amplifiers, amplifiers of low noise, amplifiers of power.
5. **Mixers:** Non-linearities and mixtures products. Noise. Topologies.
6. **Oscillators:** Theory of feedback. Theory of negative resistance, Noise. Topologies.
7. **Synthesizers and ring phase locking:** Ring phase lock theory; synthesizers of integers and fractional synthesizers.
8. **Phase shifters:** Transmission tuned transmission lines, reflective type phase shifters, vector modulators, digitally adjustable phase shifters.
9. **Measures in microwaves:** The reference impedance of 50 Ohm; signal generator, vector network analyzer; power meter; spectrum analyzer; oscilloscopes.

15. Workload description

Number of Weeks:	Number of Credits:	Total Workload in Hours:	Theory Workload in Hours:	Practice Workload in Hours:
16	05	80	64	16

16. Basic bibliography:

- 1- Ellinger, Frank; "Radio frequency integrated circuits and technologies", Springer. 2007. ISBN-10 3-540-35788-2.
- 2- Robert J. Weber "Introduction to Microwave Circuits: Radio Frequency and Design Applications", IEEE Press., 2001, ISBN-10: 0780347048.
- 3- Andrei Grebennikov, "RF and Microwave Power Amplifier Design", McGraw-Hill, 2004, ISBN-10: 0071444939.

17. Complementary bibliography:

- 1- Thomas H. Lee, "Planar Microwave Bacheloring: A Practical Guide to Theory, Measurement, and Circuits" Cambridge University Press., 2004 ISBN-10: 0521835267.
- 2- Lecture notes and scientific articles.
- 3- David M. Pozar, "Microwave Bacheloring", Wiley, 4th edition, 2011.
- 4- David M. Pozar, "Microwave and RF Design of Wireless Systems", Wiley, 2000.
- 5- Christopher Bowick, "RF Circuit Design", Newnes, 2nd edition, 2007.