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:
Waveguides

5. Code of the curricular component (filled by PROGRAD)**:**
TI0053

6. Prerequisites	No ( )	Yes (x)	
		Code	Name of the curricular component / activity
		TI0115	Applied Electromagnetism

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

8. Equivalences	No ( )	Yes (x)	
		Code	Name of the curricular component / activity
		TI0025	Waveguides

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

Telecommunication systems use electromagnetic waves to transport information. Thus, it is of utmost importance their study. In this course, we study the behavior of electrom magnetic waves propagating in guided media, being therefore supported by structures (transmission lines) and waveguides (rectangular and cylindrical).

---

12. Objectives fo the curricular component:

Provide theoretical and practical knowledge to analyze and model the interaction of the electromagnetic wave with the medium and to the design structures that support the electromagnetic wave, such as transmission lines and waveguides.

---

13. Syllabus:

Maxwell's equations. Wave equation. Plane waves. Transmission lines. Rectangular and cylindrical waveguides. Resonant cavities. Dielectric waveguides. Cylindrical and spheric waves. Huygens' principle.

---

14. Program:

1. **Maxwell's equations**: Maxwell's equations in integral and differential forms; constituive relationship and parameters; electromagnetic energy – Poynting theorem; harmonic electromagnetic fields in time.

2. **Wave equation**: wave equation for time-varying electromagnetic fields; wave equation for harmonic electromagnetic fields in time; wave equation solution in rectangular, cylindrical and spherical coordinates.

3. **Plane waves**: Maxwell's equations for plane waves; uniform plane waves in limited media; TEM waves; wave impedance and intrinsic impedance; phase velocity and group velocity; wave polarization: linear, circular, and elliptical; normal incidence and oblique incidence of waves in boundaries; electromagnetic waves in dissipative media.

4. **Transmission lines**: TEM waves in simple transmission systems; transmission line analysis using fields; transmission line analysis using distributed parameters; lossless transmission lines; reflection coefficient; impedance at any point of the transmission line; stationary wave coefficient; ¼ wavelength transformer; Smith chart; stubes design.

5. **Rectangular and cylindrical waveguides**: basic types of waves that propagate in waveguides; rectangular waveguide: TE and TM modes, dispersion relationship for the rectangular waveguide, phase velocity and group velocity; power flux in rectangular waveguides; cylindrical waveguide: TE and TM modes, Bessel functions; dispersion relationship for the cylindrical waveguide; power flux in cylindrical waveguides.

6. **Ressonant cavities**: electromagnetic fields in rectangular and cynlindrical cavities; resonant modes; merit figure of the cavity; equivalent circuits for cavities.

7. **Dielectric waveguides**: conducting plane with dielectric layer; characteristic equation of the

waveguide with dielectric layer; graphical solution.

8. **Cylindrical and spherical waves**: wave equations for cylindrical waves; wave equations for spherical waves.

9. **Huygens' principle**: isotropic radiator; Fermat's principle; wave diffraction; Fresnel's principle.

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- Paul Diament, "Wave Transmission and Fiber Optics", Macmillan Publishing Company, 1990

2- Pozar, David M.; "Microwave Enginneering"; John Wiley & Sons; 1997

3- Gerd Keiser, "Optical Fiber Communications", McGraw-Hill., 1994

17. Complementary bibliography:

1- Ramo, Simon;. Whinnery, John R and Duzer;Theodore Van "Campos e Ondas em Eletrônica das Comunicações"; Guanabara Dois.

2- Kraus, John D. and Carver, Keith R.; "Electromagnetics", 3rd edition, McGraw-Hill

3- Collin, Robert E.; "Engineering de Microondas", Guanabara Dois.