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)**:**

Hydraulics and Environmental 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	04	-

4. Name of the curricular component:
Transport Phenomena

5. Code of the curricular component (filled by PROGRAD)**:**
TD0943

6. Prerequisites — No ( ) — Yes (x)

Code	Name of the curricular component / activity
CD0327	Fundamentals of Physics
CB0801	Introduction to Ordinary Differential Equations

7. Co-requisite — No (x) — Yes ( )

Code	Name of the curricular component / activity

8. Equivalences — No ( ) — Yes (x)

Code	Name of the curricular component / activity
TD0918	Transport Phenomena

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

---

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.**

(x) Morning (x) Afternoon (x) Night

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

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

The Transport Phenomena course is basic for understanding and solving issues related to fluid movement, as well as heat, mass and energy transmission.

12. Objectives for the curricular component:

General - Understand the relationship between phenomena and mathematical instruments used for their formulation.
Specific - Empower the student to understand and solve problems related to Transport Phenomena. After completing the course, the student is expected to be able to apply the theoretical knowledge to solve real questions involving practical aspects of the problems related to the subject, and to be able to link the Transport Phenomena to other related areas.

13. Syllabus:

Introduction. Basic Properties of Fluids. Fluid Statics. Kinematics. Conservation Laws. Loss of load in conduits. Similarity and Dimensional Analysis. Heat Transfer by Conduction. Molecular Mass Transfer. Convection Transfer. Heat Transfer by Radiation.

14. Program:

1. INTRODUCTION:
- The tasks of the Transport Phenomena course;
- Unit Systems: MKS and FSS.

2. TRANSPORT IN FLUIDS:
- **Fluid properties:** static pressure (tensions, static pressure); compressibility; surface tension and capillarity; steam pressure; viscosity (definition, units); temperature effect; boundary layer effects.
- **Fluid Statics:** basic hydrostatic equation; fluids in a gravitational field; vector equation of static pressure; forces on submerged surfaces; flat surfaces; curved surfaces.
- **Fluid kinematics:** flow classification (laminar / turbulent; viscous / non-viscous; compressible / incompressible); Lagrange and Euler mechanics (control volume).
- **Conservation laws:** continuity equation - one-dimensional, two-dimensional (integral and differential forms); circulation and vorticity; Euler and Bernoulli equation for perfect fluids (conservation of mechanical energy); Bernoulli equation for real fluids; conservation of linear momentum: forces; conservation of angular momentum: torques; mass transport by diffusion.
- **Similarity and model theory, dimensional analysis:** model problem; dimensional analysis; applications.

3. HEAT TRANSFER
- **Introduction:** fundamental concepts.
- **Conduction:** Fourier law, general conduction equation, thermal conductivity; conduction of heat in permanent regime; one-dimensional driving - simple and composite walls (flat, cylindrical and spherical), system with internal heat source, fins.
- **Convection:** forced convection on flat plate, forced convection internally and externally to

tubes; natural convection, dimensionless numbers, heat transfer coefficient for natural convection.

- **Radiation:** processes and properties, radiation intensity; black body; Planck and Boltzmann laws; radiation property between surfaces; solar energy.
- **Applications:** heat transmission by combined effect of conduction, convection and radiation; thermal circuit.

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- Fox, R. W., McDonald, A. T.: Introdução à Mecânica dos Fluidos; 5ª edição, Editora LTC, Rio de Janeiro, 2001.

2- Incropera, F. P., Witt, D. P.: Fundamentos de Transferência de Calor e de Massa. 3ª edição, Guanabara-Koogan Editora, Rio de Janeiro, 1990.

3- Lopes Roma, W. N.: Fenômenos de Transporte para Engenheiros, Editora RiMa, São Carlos, 2003.

4- Vennard, J. K., Street, R. L.: Elementos de Mecânica dos Fluidos; Editora Guanabara Dois, Rio de Janeiro, 1978.

17. Complementary bibliography:

1- Roma, W. N. L.: Fenômenos de Transporte para Engenharia. RIMA, São Carlos/SP, 2003.

2- Sissom, E. L., Pitts, D. R.: Fenômenos de Transporte. Editora Guanabara Dois, Rio de Janeiro, 1979.