TEACHING PLAN – 2025-3

COURSE IDENTIFICATION			
CODE	**NAME**	**PERIOD**	**TOTAL TIME**
EAL10019	Processos com membranas	08:20 – 11:50 Wednesday	45 h

PROFESSORS	**CONTACT**
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GRADUATE PROGRAM COURSE
Pós-Graduação em Engenharia de Alimentos

COURSE SYLLABUS

Fundamentals of membrane separation processes. Applications of membranes processes. Membrane preparation materials and techniques. Characterization techniques. Classical and emerging processes using membranes. Transport, concentration polarization, and fouling phenomena in membrane processes. Integrated membrane processes.

OBJECTIVES

Understand the fundamentals of membrane processes. Understand the techniques for the preparation/manufacturing of membranes. Know the membrane characterization techniques and the main parameters to be evaluated. Know the main techniques that use membranes and emerging processes. Distinguish the appropriate membrane technique for a given application. Understand the transport across membranes and the effects of concentration polarization and fouling.

COURSE PROGRAM

Topic 0 – Introduction to the course

Topic 1 – Introduction to membrane processes

Membrane and membrane processes, main applications, scientific journals.

Topic 2 – Basic concepts

Classification, main characteristics, membrane modules, terminology, flow configuration, operating configuration, operating modes, and operating parameters.

Topic 3 – Membrane preparation

Polymeric membrane preparation. Inorganic membrane preparation.

Topic 4 – Membrane characterization

Membrane performance, selectivity morphology, pore size and pore size distribution, mechanical, chemical, and thermal resistance, hydrophilic/hydrophobic character, crystallinity, glass transition temperature.

Topic 5 – Transport characteristics

Transport fundamentals of MF, UF, RO, PV, and PG.

Topic 6 – Membrane phenomena

Phenomena associated with the membrane processes: compaction, concentration polarization, film theory, cake theory, fouling.

Topic 7 – Emerging Processes and Integrated Systems

Emerging membrane processes such as FO, PRO, RED, etc., and integrated systems.

SCHEDULE

Week 1	
In-class (24-Sep)	Topic 0 – Introduction to the course Topic 1 – Introduction to membrane processes Activity 1 – Membrane + Scientific journals (1.0)
Week 2	
In-class (1-Oct)	Topic 2 – Basic concepts (remote activity) Activity 2 – Where can I apply Membranes in my research area? Search (2.0)
Week 3	
In-class (8-Oct)	Activity 2 – Presentation Topic 2 – Basic concepts
Week 4	
In-class (15-Oct)	Topic 2 – Basic concepts
Week 5	
In-class (22-Oct)	Topic 3 – Membrane preparation
Week 6	
In-class (29-Oct)	Topic 3 – Membrane preparation
Week 7	
In-class (5-Nov)	Activity 4 – How is a membrane prepared? (2.5) Topic 4 – Membrane characterization
Week 8	
In-class 12-Nov	Topic 4 – Membrane characterization
Week 9	
In-class (19-Nov)	Activity 5 – How is a membrane characterized? (2.5) Topic 5 – Transport characteristics
Week 10	
In-class (26-Nov)	Topic 6 – Membrane phenomena

Week 11	
In-class (3-Dec)	Activity 5 – Which phenomena can impact my process? (2.0) Topic 6 – Membrane phenomena
Week 12	
In-class (10-Dez)	Topic 7 – Emerging processes & Integrated systems

TEACHING METHODOLOGY / PROGRAM DEVELOPMENT

a) Communication: communication with students will be through the Moodle virtual learning environment, by email and WhatsApp group.
b) Classroom lectures: slide presentation and materials. In addition, solving of exercises, discussion of cases and presentation of seminars will take place simultaneously. The seminars will be used as a form of creative learning and in-depth reflection on the covered topics.
c) It is recommended to the student to bring laptop or tablet to be used during the classes.

STUDENT LEARNING ASSESSMENT

Student learning will be assessed throughout the semester from the various activities proposed. The assessment will be based on the quality of the content presented. The final grade (NF) will be calculated as follows:

NF = sum of points of each activity presented in the schedule – 0.1*n° missed class*.

* each class missed without justification decreases 0.1 of the final grade

Student performance (according to PPGEAL Internal Resolution/2022)
If NF ≥ 7.0 the student is approved
If 3.0 < NF < 7.0, the student can do a recovery exam (Rec)
If NF < 3.0 the student is not approved

The Rec will be composed of all the topics studied on the course.
If (NF + Rec)/2 ≥ 7.0 the student is approved
If (NF + Rec)/2 < 7.0 the student is not approved

A minimum attendance of seventy-five percent (≥75%) is required for approval.

BASIC REFERENCES

Habert AC, Borges CP, Nobrega R. Processos de Separação por Membranas. UFRJ editor. Esc. Pilot. em Eng. Química. Rio de Janeiro: e-papers; 2006.

Baker RW. Membrane technology and applications. 3rd ed. Chichester, England: John Wiley&Sons, Ltd; 2012.

Mulder M. Basic Principles of Membrane Technology. Dordrecht, The Netherlands: Kluwer Academic Publishers; 1996.

COMPLEMENTARY REFERENCES

Weblinks are available via Moodle or in the course's Google Drive.

Gitis V, Rothenberg G. Ceramic Membranes: New Opportunities and Practical Applications. Weinheim: Wiley-VCH; 2016.

Li K. Ceramic Membranes for Separation and Reaction. 1st ed. Chem. Eng. Chichester, England: John Wiley & Sons, Ltd.; 2007.

Porter MC. Handbook of industrial membrane technology [Internet]. Noyes Publications; 1990.

OBSERVATIONS

The proposed Teaching Plan may have minor modifications, which will be discussed with students.

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