



Universidade Federal de Santa Catarina
Centro Tecnológico
Departamento de Engenharia Química e
Engenharia de Alimentos



Programa de Pós-Graduação em Engenharia Química

PLANO DE ENSINO

2022.1

(In English)

I. Course

Código/Code ENQ 3202	Cinética de Processos Químicos/ Kinetics of Chemical Processes	3 credits	Trimester 2022. 1
---------------------------------------	---	------------------	------------------------------------

II. PROFESSOR

Agenor de Noni Jr: Agenor.junior@ufsc.br

Regina de Fatima Peralta Muniz Moreira: regina.moreira@ufsc.br

III. Teaching assistant

N/A

IV. Graduated students

MSc and PhD in Chemical Engineering

V SYLLABUS

Kinetics of homogeneous reactions. Kinetics of heterogeneous reactions. Catalyst deactivation and regeneration kinetics. External diffusive effects in heterogeneous reactions. Internal diffusive effects on porous solids. Kinetics of multicomponent systems - Application to Atmospheric Chemistry.

VI. OBJECTIVES

Enabling the Master's or PhD students in Chemical Engineering to carry out research on the kinetics of homogeneous chemical reactions and heterogeneous chemical reactions. Improve the knowledge of heterogeneous reaction systems with simultaneous mass transfer.

VII. Program

Kinetics of homogeneous reactions: Elementary and non-elementary reactions, Velocity laws, Constant volume and variable volume reaction systems. Isothermal non-isothermal reactions. Multiple reaction kinetics. Ideal and non-ideal reactor types: batch reactors, tubular reactor and mixing reactor.

Kinetics of heterogeneous reactions: Definitions. Kinetics of solid-fluid reactions. Shrinking core model. Mechanisms controlling the reaction rate: internal, external mass transfer, intrinsic chemical reaction.

Kinetics of heterogeneous catalytic reactions. Mechanisms of heterogeneous catalytic reactions. Langmuir-Hinshelwood Model. Eley Riedel model.



Universidade Federal de Santa Catarina
Centro Tecnológico
Departamento de Engenharia Química e
Engenharia de Alimentos



Programa de Pós-Graduação em Engenharia Química

External diffusive effects in heterogeneous reactions. Internal diffusive effects: internal effectiveness factor, kinetics of reactions controlled by internal diffusion. Overall effectiveness factor. Estimation of the controlling steps of the reaction rate: Weiz-Prater criterion for internal diffusion. Mears criteria for external diffusion.

Catalyst deactivation and regeneration - Deactivation kinetics and application of the shrinking core model in catalyst regeneration. Application of chemical kinetics to photochemical reactions: atmospheric chemistry.

VIII. Teaching methodology

The course will be taught in person at UFSC.

IX. Evaluations and exams

- a) The final grade will be composed of the arithmetic average published by each teacher.
- b) The application of the Early Assessment Examination will be offered (a single test), according to Normative Resolution PósENQ 01/2021, considering all topics of the Course. The assessment grade will replace the other assessments and will be applied in the first week of class, at a time to be defined after the first class.

X. BIBLIOGRAPHIC REFERENCES

Fogler HS, Elements of Chemical Reaction Engineering, Prentice Hall, New Jersey , 1992.

Froment, G.F.; Bischoff, K.B., *Chemical Reactor Analysis and Design*, John Wiley & Sons, New York,

1990 Boudart, M. *Kinetics of Chemical Processes*, Butterworth-Heinemann, Stoneham, MA, 1991.

Steinfeld, J.I.; Francisco, J.S.; Hase, W.L. *Chemical Kinetics and Dynamics*, Prentice Levenspiel, O.

Engenharia das Reações Químicas. Ed Edgard Blücher Ltda.

Complementar

SCHMAAL, R (ed). **Chemical Kinetics of Homogeneous Systems**. 1st ed. 1974. Dordrecht: Springer Netherlands:

Imprint:

Springer, 1974. x, 180 p ISBN 9789401022019. Disponível em: <https://doi.org/10.1007/978-94-010-2201-9>

JOYNER, R.W; VAN SANTEN, R.A (ed). **Elementary Reaction Steps in Heterogeneous Catalysis**. 1st ed. 1993.

Dordrecht: Springer Netherlands: Imprint: Springer, 1993. ix, 492 p (Nato Science Series C:, Mathematical and Physical Sciences, 1389-2185 ; 398). ISBN 9789401116930. Disponível em:

<https://doi.org/10.1007/978-94-011-1693-0> Weblinks disponibilizados via Moodle.

<http://umich.edu/~elements/5e/lectures/umich.html>

<http://umich.edu/~elements/>

UFSC – Graduated Program and Chemical Engineering

Class number	Professor and Timetable		Subject	Hour charge
1	Agenor 08/03/2022	13:30 – 17:10	Kinetics of homogeneous reactions: Elementary and non-elementary reactions, Laws of velocity. Constant volume and variable volume reaction systems. Types of isothermal ideal and non-ideal reactors: batch reactors, tubular reactor and mixing reactor	4
2	Agenor 15/03/2022	13:30 – 17:10	Isothermal non-isothermal reactions Interpretation of experimental data.	4
3	Agenor 22/03/2022	13:30 – 17:10	Multiple reaction kinetics.	4
4	Agenor 29/03/2022	13:30 – 17:10	Seminar	4
5	Agenor 05/04/2022	13:30 – 17:10	Heterogeneous reactions: Reaction steps: adsorption, surface reaction and desorption.	4
6	Agenor 12/04/2022	13:30 – 17:10	Langmuir-Hinshelwood model. Eley Riedel model. Catalyst deactivation and regeneration	4
7	Agenor 19/04/2022	13:30 – 17:10	Application of chemical kinetics to photochemical reactions: atmospheric chemistry Interpretation of kinetic experimental data	4
8	Agenor 26/04/2022	13:30 – 17:10	Exam 1	4
9	Regina 03/05/2022	13:30 – 17:10	Kinetics of non-catalyzed heterogeneous reactions: Definitions. Kinetics of solid-fluid reactions. Gas – solid reactions. Shrinking Core Model	4
10	Regina 10/05/2022	13:30 – 17:10	Catalytic reactions and Mechanisms controlling the reaction rate: External and Internal Mass Transfer	4
11	Regina 17/05/2022	13:30 – 17:10	Thiele modulus and effectiveness factor. Trickled bed reactors(solid-liquid gas)	4
12	Regina 24/05/2022	13:30 – 17:10	Exam 2	4

