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

UFSC

Programa de Pós-Graduação em Engenharia Química

PLANO DE ENSINO
2024.1
(In English)

I. Course

Código/Code ENQ 3202	**Cinética de Processos Químicos/ Kinetics of Chemical Processes**	***3 credits***	***Trimester2024. 1***

II. PROFESSOR

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.

External diffusive effects in heterogeneous reactions. Internal diffusive effects: internal effectivity 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 of exams and seminars..
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. BIBLIOGRAFIC 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	Timetable	Subject	Hour charge
1	13:30 – 17:10	Kinetics of homogeneous reactions: Elementary and non-elementary reactions. Constant volume and variable volume reaction systems. Types of isothermal ideal and non-ideal reactors: batch reactors, tubular reactor and mixing reactor	4
2	13:30 – 17:10	Isothermal non-isothermal reactions Interpretation of experimental data.	4
3	13:30 – 17:10	Multiple reaction kinetics.	4
4	13:30 – 17:10	**Seminar**	4
5	13:30 – 17:10	Heterogeneous reactions: Reaction steps: adsorption, surface reaction and desorption.	4
6	13:30 – 17:10	Langmuir-Hinshelwood model. Eley Riedel model. Catalyst deactivation and regeneration	4
7	13:30 – 17:10	Application of chemical kinetics to photochemical reactions: atmospheric chemistry Interpretation of kinetic experimental data	4
8	13:30 – 17:10	**Exam 1**	4
9	13:30 – 17:10	Kinetics of non-catalyzed heterogeneous reactions: Definitions. Kinetics of solid-fluid reactions. Gas – solid reactions. Shrinking Core Model	4
10	13:30 – 17:10	Catalytic reactions and Mechanisms controlling the reaction rate: External and Internal Mass Transfer	4
11	13:30 – 17:10	Thiele modulus and effectiveness factor.	4
12	13:30 – 17:10	Trickled bed reactors(solid-liquid gas). **Seminar** (applications)	4
13	13:30 – 17:10	**Exam 2**	