

FACULTY CHEMISTRY**SUBJECT CARD**

Name of subject in English: Introduction to chemical engineering
 Main field of study (if applicable): Specialization (if applicable):
 Profile: academic
 Level and form of studies: 2nd level – supplementary semester, full-time
 Kind of subject: obligatory for candidates without BSc degree in chemical engineering
 Subject code: ICC024025
 Group of courses: NO

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	Crediting with grade	crediting with grade			
For group of courses mark (X) final course					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes		2			
including number of ECTS points for direct teacher-student contact (BK) classes	1	0,5			

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of physics and mathematics on the Bachelor level in chemical engineering or related fields (technics or science)

SUBJECT OBJECTIVES

C1 Familiarization with material and energy balancing of equipment and processes
 C2 Cognition of quantitative description of fluid flow processes in apparatus
 C3 Familiarization with mass transfer methods and apparatus
 C4 Familiarization with heat transfer methods and apparatus
 C5 Cognition of construction rules and operation of selected equipment and apparatus.
 C6 Familiarization with basics of chemical reactor design

SUBJECT LEARNING OUTCOMES**Related to knowledge:**

PEK_W01 Is familiar with material and heat balancing of equipment and processes
 PEK_W02 Is familiar with momentum, mass and heat transfer
 PEK_W03 Can calculate pressure drop in pipeline and apparatus
 PEK_W04 Is familiar with construction rules and influence of operating parameters on the processes in selected apparatus: pumps, sedimentors, filters, cyclones, mixers, chemical reactors, and distillation, absorption, extraction, adsorption, drying apparatus.
 PEK_W05 Is introduced into design of chemical reactors

Related to skills:

PEK_U01 Student is able to make material and energy balances of equipment and processes

PEK_U02 Student is able to calculate power requirements of pumps		
PEK_U03 Student is able to calculate main parameters of selected mass and heat transfer apparatus		
PEK-U04 Student is able to calculate chemical reactor volume or contact time applying models of ideal reactors		
Related to social competences:		
PEK_K01 Student gained knowledge that will enable him/her successful continuation of master studies in chemical engineering related fields		
PROGRAMME CONTENT		
Lectures		Number of hours
Lec 1	Concept of momentum transfer and continuum; Thermodynamic properties of fluids; Types of fluids; Ideal gas; Real gas; Equations of State: van der Waals, Redlich-Kwong, Soave and Peng-Robinson EOS for pure components and mixtures	2
Lec 2	Material balances of equipment and processes	2
Lec 3	Energy balances of equipment and processes	2
Lec 4	Flow in pipes and Bernoulli's equation; pressure drop in pipeline and in selected apparatus. Pumps – characteristics of pump and pipeline; power requirements of pumps	2
Lec 5	Distillation of binary mixtures; Rectification column; McCabe-Thiele method	2
Lec 6	Batch distillation; Extraction – ternary diagrams; One stage and multistage extraction	2
Lec 7	Absorption processes; Film theory; Design of absorbers – physical absorption and chemisorption	2
Lec 8	Mixing, Fluidisation and Filtration; Basic parameters for apparatus design	2
Lec 9	Drying processes; Mollier diagram; Heat transfer by conduction	2
Lec 10	Heat transfer by convection; Heat exchangers	2
Lec 11	Stoichiometry of a chemical reaction; Rate of chemical reaction; Mathematical models of ideal chemical reactors	2
Lec 12	Isothermal performance of Continuous stirred tank reactor, Plug-flow reactor and Batch reactor	2
Lec 13	Non-isothermal performance of Continuous stirred tank reactor, Plug-flow reactor and Batch reactor	2
Lec 14	Reactor selection for parallel and consecutive reactions	2
Lec 15	Non-ideal flow: Residence time Distribution and Model of total segregation	2
	Total hours	30
Classes		Number of hours

Class 1	Equations of State: van der Waals, Redlich-Kwong, Soave and Peng-Robinson	1
Class 2	Material balances of equipment and processes	1
Class 3	Energy balances of equipment and processes	1
Class 4	Pressure drop in pipeline; power requirements of pumps	1
Class 5	Rectification column; McCabe-Thiele's method	1
Class 6	Batch distillation; Extraction – ternary diagrams; One stage and multistage batch extraction	1
Class 7	Design of absorbers – physical absorption and chemisorption	1
Class 8	Mixing, Fluidisation and Filtration; Basic parameters for apparatus design	1
Class 9	Heat transfer by conduction	1
Class 10	Heat transfer by convection; Heat exchangers	1
Class 11	Isothermal performance of Continuous stirred tank reactor and Plug-flow reactor	1
Class 12	Isothermal performance of Batch reactor	1
Class 13	Non-isothermal performance of ideal reactors	1
Class 14	Non-isothermal performance of ideal reactors	1
Class 15	Non-ideal flow: Residence time Distribution and Model of total segregation	1
	Total hours	15
TEACHING TOOLS USED		
N1. Informational lecture		
N2. Multimedia presentations		
EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation (F – forming (during semester), P – concluding (at semester end))	Learning outcomes number	Way of evaluating learning outcomes achievement
CL (lecture)	PEK_W01 – PEK_W05	Exam
CC(class)	PEK_U01 - PEK_U04	Colloquium
$P = 0.6 \cdot CL + 0.4 \cdot CC$ 3.0 if $3.00 \leq P < 3.25$ 3.5 if $3.25 \leq P < 3.75$ 4.0 if $3.75 \leq P < 4.25$ 4.5 if $4.25 \leq P < 4.75$ 5.0 if $4.75 \leq P$		
PRIMARY AND SECONDARY LITERATURE		

PRIMARY LITERATURE:

- [1] J. M. Coulson and J. F. Richardson, J. R. Backhurst J. H. Marker, Fluid Flow, Heat Transfer and Mass Transfer, Coulson & Richardson's Chemical Engineering, Volume 1, Sixth edition, Butterworth –Heinemann 1999.
- [2] J. R. Welty, C. E. Wicks, R. E. Wilson, G. L. Rorrer, Fundamentals of Momentum, Heat, and Mass Transfer, Fifth edition, Wiley 2008
- [3] R.K. Sinnott, Chemical Engineering Design, Coulson & Richardson's Chemical Engineering Series Volume 6, Fourth edition, Elsevier, 2005
- [4] O. Levenspiel, Chemical Reaction Engineering, Third edition, John Wiley & Sons 1999.

SECONDARY LITERATURE:

- [1] J.F. Richardson, J.H. Harker, J.R. Backhurst, Particle Technology and Separation Processes, Coulson & Richardson's Chemical Engineering Series Volume 2, Fifth edition, Butterworth – Heinemann 2002.
- [2] D. Morton, Chemical Engineering An Introduction, Cambridge University Press 2012

SUBJECT SUPERVISOR (NAME AND SURNAME, E-MAIL ADDRESS)

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