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
Class10	Heat transfer by convection; Heat exchangers	1
Class11	Isothermal performance of Continuous stirred tank reactor and Plug-flow reactor	1
Class12	Isothermal performance of Batch reactor	1
Class13	Non-isothermal performance of ideal reactors	1
Class14	Non-isothermal performance of ideal reactors	1
Class15	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*CL+0.4*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, Cambrige University Press 2012

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

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