Course Unit Descriptor

Study Programme: Food Engineering; Biotechnology; Pharmaceutical Engineering; Chemical Engineering; Materials Engineering

Course Unit Title: Unit Operations 2

Course Unit Code: O53O1

Name of Lecturer(s): Prof. Branislava Nikolovski, PhD; Assoc. Prof. Marija Radojković, PhD

Type and Level of Studies: Undergraduate Academic Studies

Course Status (compulsory/elective): Compulsory

Semester (winter/summer): Winter

Language of instruction: English

Mode of course unit delivery (face-to-face/distance learning): Face-to-face

Number of ECTS Allocated: 7

Prerequisites: /

Course Aims:
Training students to understand the mechanisms of heat and mass transfer, the study and application of individual heat and mass transfer operations used in the process industry, and to enable students to work independently on semi-industrial level during experimental exercises, in order to facilitate their integration into the drive operation in the process industry.

Learning Outcomes:
Basic knowledge of heat and mass transfer operation. Student's ability to independently solve problems from conduction, convection, radiation, condensation, boiling, evaporation, crystallization, drying of materials, distillation, rectification, absorption, extraction and adsorption. Ability to prepare relevant and transparent reports on the results of experimental exercises.

Syllabus:
Theory
Mechanisms of heat transfer (conduction, convection and radiation). Heat transfer without and with phase change, transmission coefficients. Condensation. Evaporation. Heat exchangers. Crystallization. Drying. Mechanisms of mass transfer, equilibrium, number of degrees, height and number of transmission units, working lines and transmission coefficients. Distillation. Rectification. Absorption. Liquid-liquid extraction. Solid- liquid extraction. Adsorption.
Practice
Computational exercises: solving specific calculation problems illustrated by individual components of the lectures.
Laboratory exercises: heat exchanger; evaporation; drying; rectification; absorption.

Required Reading:
C.M. Van 't Land: Drying in the process industry, John Wiley & Sons, Inc., Hoboken, New Jersey, 2012.
Cao, E.: Heat transfer in Process Engineering, , McGraw-Hill Education, 2010.
Geankoplis, Ch.: Transport processes and Unit Operations, Prentice Hall, New York, 1993.
Gorak, A. Sorensen E.: Distillation: Fundamentals and principles, Elsevier inc. 2014.
Luyben, W.L.: Distillation design and control using AspenTM Simulation, John Wiley & Sons, 2013.
McCabe. W., Smith., J., Harriott, P.: Unit Operations Of Chemical Engineering, 7th Ed, McCabe And Smith, McGraw Hill international editions, Chemical Engineering series, 2005.
Treybal, R. E.: Mass-Transfer-Operations, McGraw Hill, Tokyo, 1981.
Seader, J.D., Henley, E.J., Roper, D.K.: Separation process principles: chemical and biochemical Operations, John Wiley & Sons, 2011.

Weekly Contact Hours: 6	**Lectures:** 3	**Practical work:** 3

Teaching Methods:
Lectures and students group work

Knowledge Assessment (maximum of 100 points):

Pre-exam obligations	points	**Final exam**	points
Active class participation	5	oral exam	30
Experimental exercises	25		
Test I and Test II	20+20		