
	UNIVERSITY OF EAST SARAJEVO Faculty of Technology Zvornik					
	<i>Study programme: Chemical Engineering and Technology</i>					
	Cycle I	Year IV				
Course title	NATURAL AND SYNTHETIC ZEOLITES, TECHNOLOGY AND APPLICATION					
Department	Department for Chemical Technology – Faculty of Technology Zvornik					
Course code	Course status	Semester	ECTS			
04-2-041-7	Elective	VII	5			
Teacher	Dr Dragana Kešelj, Associate Professor					
Teaching assistant	Dr Dragana Kešelj, Associate Professor					
Number of classes/ teaching workload (per week)		Individual student workload (in hours per semester)		Student workload coefficient S₀		
Lectures	Auditory exercises	Laboratory exercises	Lectures	Auditory exercises	Laboratory exercises	S₀
2	0	2	45	0	45	1.5
$2*15 + 0*15 + 2*15 = 60$ hours			$2*15*1,5 + 0*15*1,5 + 2*15*1,5 = 90$ hours			
Total course workload 60 + 90=150 hours per semester						
Learning outcomes	<p>After finishing the course, students will be able to:</p> <ol style="list-style-type: none"> 1. demonstrate theoretical knowledge in the fundamentals of chemical processes that are the basis of zeolite production technologies 2. calculate the material and energy balance of NaA zeolite production 3. demonstrate knowledge of the working conditions of the basic stages of NaA zeolite production 4. demonstrate basic knowledge about the fields of application of zeolite depending on the type of zeolite 					
Prerequisites						
Teaching methods	Lectures, auditory and laboratory exercises, mid-term tests (colloquia).					
Syllabus outline per week	<ol style="list-style-type: none"> 1. Evolution and development of porous materials (From natural to synthetic zeolites); Application of porous materials; Development of the chemistry of molecular sieves and porous materials; 2. Structure of zeolite; The structure of the building unit of zeolite (primary, secondary building unit); Characteristics of building unit cages; 3. Chemical composition of zeolite; Position of cations in the zeolite structure; 4. Pores and channels in the zeolite structure; Density of the unit cell (skeleton) of zeolite; 5. Hydrothermal and solvothermal synthesis of zeolite; 6. Hydrothermal synthesis of zeolite; 7. Raw materials in zeolite synthesis; Sources of silicon as a raw material in zeolite synthesis; Sources of aluminium as a raw material for obtaining zeolite; 8. Influence of working conditions (composition of the reaction mixture, alkalinity, aging, mixing, temperature, crystallization time, chemical agents) on hydrothermal synthesis of zeolite; 9. Zeolite crystallization (zeolite crystallization mechanisms) 10. Procedures for the production of detergent zeolite (obtaining from hydrogel, clay materials, other natural substances); Characteristics of raw materials for obtaining detergent zeolite; 11. Technological procedure for the production of NaA zeolite; Devices for crystallization, filtration and drying 12. Calculation of the batch for the production of NaA zeolite using water glass as raw materials and alumina solution; Material balance of NaA zeolite production; 13. Energy balance of detergent zeolite production; Waste materials during production of NaA zeolite; 14. Modification of NaA zeolite by ion exchange; Characteristics of ion-modified NaA zeolite; Dealumination of zeolite; 15. Application of zeolites as adsorbents (drying, separation and purification of gases, catalyst); Application of zeolites in detergents; Application of zeolites in medicine and agriculture. <p>Mid-term tests are taken after the 8th week and the 15th week. Semester verification is required after the 15th week.</p>					
Obligatory reading						

Author	Title, publisher	Year	Pages	
Xu, R., Pang, W. , Yu, J. , Huo, Q. , Chen, J.	Chemistry of Zeolites and Related Porous Materials: Synthesis and Structure, John Wiley & Sons, New York	2009	1-326	
Savčić, M., Nenadić, M.	Tehnologija zanimanja, proizvodnja zeolita, Energoinvest Sarajevo	1985	1-104	
Additional reading				
Author	Title, publisher	Year	Pages	
A. W. Chester, E. G. Derouane	Zeolite Characterization and Catalysis, A Tutorial, Springer, New York	2009	1-349	
Donaldson, D., Raahauge, B.	Essential readings in light metals – Alumina and bauxite, John Wiley & Sons, New Jersey	2013	1-973	
Obligations, assessment methods and grading system	Type of student evaluation		Grade points	Percentage
	Pre-exam obligations			
	Attendance		6	6 %
	Laboratory exercises		10	10%
	Mid-term test (Colloquium) 1		27	27%
	Mid-term test (Colloquium) 2		27	27%
	Final examination			
	Final examination (oral)		30	30 %
Total		100	100 %	
Web page	www.tfzv.ues.rs.ba			
Date				