Information sheet for the course: Ceramic Materials

University: Alexander Dubček University of Trenčín	
Faculty: Faculty of Industrial Technologies in Púchov	
Course unit code: MI-I-P-15	**Course unit title:** Ceramic Materials
Form, scope and method of educational activity: **Form of study:** Lecture / Seminar / Laboratory tutorial **Recommended number of lessons (hours):** **Weekly:** 2 / 1 / 3 **During the semester:** 24 / 12 / 36 **Method of study:** attendance method	
Number of credits: 6	
Recommended semester: The 3rd	
Degree of study: The 2nd degree of study	
Course prerequisites: -	
Assessment methods: Assessment during the semester: Summary assessment of work results during the semester = 40 points Semester work - project and independent work during the semester. Development of a project in the field of ceramic materials and its presentation at exercises. Completion of laboratory exercises on the subject, preparation and submission of protocols. Final assessment: Assessment of exam results = 60 points Completion of a written examination and an oral examination focusing on the knowledge acquired during the semester Grading scale: Grade A: 91 – 100 points Grade B: 81 – 90 points Grade C: 71 – 80 points Grade D: 61 – 70 points Grade E: 55 – 60 points Grade FX: less than 55 points	
Learning outcomes of the course unit: The student has knowledge of ceramic materials, controls and understands the relationship between the properties of ceramic materials, their structure and chemical composition. He has knowledge about types of ceramic materials, raw materials for their production and technological procedures of shaping, heat treatment and finalization of products. As part of the laboratory exercises, the student will acquire knowledge and manual skills in the field of shaping, drying and firing of ceramic products. He has knowledge and practical experience in the field of determining the structure and basic properties of ceramic materials.	
Course contents: Definition of ceramics. Properties of ceramic materials - advantages, limitations. Types of ceramics – Classical ceramics, structural ceramics. Oxide ceramics (Al2O3, ZrO2), non-oxide ceramics (SiC, Si3N4, BN, MoSi2) Use of structural ceramic materials - wear-resistant components, hybrid ceramic motor, abrasive materials, cutting tools, bearings, bioceramic materials, electrical equipment, heat exchangers, coatings, military and space applications, high-tech ceramics. Raw materials for the production of ceramics - classification: according to origin, according to function in the ceramic mixture. Plastic raw materials - types of clay raw materials, properties of clay raw materials, plasticity, possibilities applications. Clay minerals - structure, types of clay minerals. Non-plastic raw materials - distribution. Sharpeners - types, function in ceramic mixture. Fillers (lights) - types, function in ceramic mixture.	

Fluxes - types (K feldspar, Na feldspar, Ca feldspar), function in ceramic mixture.
Processing of raw materials.
Grinding of ceramic mixtures - mills, grinding mode, grinding principle, wet grinding, dry grinding, grinding of very fine powders.
Drainage of ceramic suspensions - Kalolising. Spray drying.
Production of the most important synthetic raw materials for the production of ceramics (Al_2O_3, TiO_2, ZrO_2, SiC, Si_3N_4, transformation-strengthened ceramics)
Shaping of ceramic products - shaping methods of advanced ceramics. Dry methods
shaping - pressing - types, procedure, shapes of products. Hot pressing, isostatic pressing, CIP, HIP.
Wet forming methods - casting from suspension - procedure, forms ex. Methods of plastic shaping - plasticization (fillers), procedure, equipment.
High-pressure injection molding - process, product shapes and product types.
Forming ceramic mass by spinning on a circle.
Heat treatment of ceramic products - processes, equipment. Dryers - types of dryers.
Furnaces - types of furnaces (according to construction, method of operation and energy source). Chamber furnaces - construction, working principle. Tunnel furnaces - construction, working principle.
The principle of work of periodically and continuously working equipment.
Drying - definition of drying, humidity and humidity ratio, methods of binding moisture in ceramic material.
Bigot's curve - shrinkage, critical moisture, coefficient of material's sensitivity to drying.
Ceramic firing - definition of the firing process, firing methods, phases
of the firing process, conditions of the firing process.
Processes in ceramic material during firing: Dehydroxidation of clay minerals; Combustion of organic substances - reactions during the combustion of organic substances, the influence of Fe compounds on the combustion of org. substances, influence of calcium carbonate.
The formation of new crystalline phases in the shard - the formation of mullite, cristobalite.
Smelting of feldspars - melting of Na-feldspar and K-feldspar separately, in a mixture and with the addition of quartz. Reactions in the solid phase – kinetics of homogeneous and heterogeneous reactions.
Sintering - processes during sintering, stages of sintering.
Surface treatment of ceramic products.
Glazing - functions of glazes, types of glazes, properties and division of glazes, colored glazes, preparation of glazes.
Engobing - characteristics and use of engobs.

Recommended of required reading:

HANYKÝŘ, V., KUTZENDORFER, J.: Technologie keramiky, Vega s.r.o. 2000. ISBN 80-900960-6-3.
HLAVÁČ, J.: Základy technológie silikátov,SNTL, Praha, 1987.
MAJLING, J. a kol.: Technológia špeciálnych anorganických materiálov, STU, Bratislava, 2007.
POSPÍŠIL, Z. a kol.: Jemná keramika, SNTL/Alfa Banská Bystrica, 2000.
BOCH, P., NIEPCE, J-C: Ceramic Materials: Processes, Properties and Applications. Wiley Online Library, 2007. Print ISBN:9781905209231 Online ISBN:9780470612415, DOI:10.1002/9780470612415.
https://onlinelibrary.wiley.com/doi/book/10.1002/9780470612415
E-learning TnUAD.

Language:
English

Remarks:
Compulsory course / Profile course

Evaluation history: 0
Total number of graded students:

A	B	C	D	E	FX
0.0	0.0	0.0	0.0	0.0	0.0

Lecturers: prof. Ing. Darina Ondrušová, PhD., Ing. Iveta Papučová, PhD., doc. Ing. Katarína Moricová, PhD.

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