

Information sheet for the course Ceramic Materials

University: <i>Alexander Dubček University of Trenčín</i>	
Faculty: <i>Faculty of Industrial Technologies in Púchov</i>	
Course unit code: <i>MI-I-P-15</i>	Course unit title: <i>Ceramic Materials</i>
Type of course unit: <i>compulsory</i>	
Planned types, learning activities and teaching methods: <i>Lecture: 2 hours weekly/26 hours per semester of study; face to face</i> <i>Seminar: 1 hours weekly/13 hours per semester of study; face to face</i> <i>Laboratory tutorial: 3 hours weekly/39 hours per semester of study; face to face</i>	
Number of credits: <i>6</i>	
Recommended semester: <i>3rd semester in the 2nd year full-time</i> <i>5th semester in the 3rd year part-time</i>	
Degree of study: <i>the 2nd degree of study (Engineer's degree)</i>	
Course prerequisites: <i>none</i>	
Assessment methods: <i>Elaborating of project from the area of ceramic materials and its presentation on seminar;</i> <i>Passing of laboratory tutorial from course, elaborating and handover of protocols;</i> <i>Passing of written examination focused on knowledge obtained during semester;</i> <i>Successful defense of project, passing of laboratory tutorial and handover of protocols and acquirement 50 % of points in minimum from written examination are conditions for obtaining of credits.</i>	
Learning outcomes of the course unit: <i>Student has knowledge from the issue of ceramics materials, student knows and understands relationship between properties of ceramic materials, their structure and chemical composition. Student has knowledge about the types of ceramic materials, about raw materials needed to produce them, and about technological processes of forming, heat treatment and finalization of products. During the laboratory tutorial, students will obtain knowledge and manual skills in the area of forming, drying and firing of ceramics products. Students have knowledge and practical experiences in the area of determination of structure and basic properties of ceramic materials.</i>	
Course contents: <i>1. Definition of ceramics. Properties of ceramic materials – advantages, limitations. Types of ceramics – classical ceramics, construction ceramics. Oxide ceramics (Al₂O₃, ZrO₂), non-oxide ceramics (SiC, Si₃N₄, BN, MoSi₂)</i> <i>2. Application of construction ceramic materials – abrasion resistant components, hybrid ceramic engine, abrasive materials, cutting tools, bearings, bioceramic materials, electrotechnical devices, heat exchangers, coatings, military and cosmic applications, high-tech ceramics.</i> <i>3. Raw materials needed to ceramics production – classification: by origin, by function in ceramic mixture.</i> <i>4. Plastic raw materials – types of clay raw materials and their properties, plasticity, application options. Clay minerals – structure, types of clay minerals.</i> <i>5. Non-plastic raw materials – classification. Opening materials (groggs) – types, function in ceramic mixture. Fillers – types, function in ceramic mixture. Fluxes – types (K spars, Na spars, Ca spars), function in ceramic mixture.</i> <i>6. Treatment of raw materials. Floating of kaolin. Grinding of ceramic mixture – mills, mode of grinding, principle of grinding, wet grinding, dry grinding, grinding of very fine powders.</i> <i>7. Drainage of ceramic suspension. Filter pressing. Spray drying. Production of the most</i>	

important synthetic raw material needed to production of ceramics (Al_2O_3 , TiO_2 , ZrO_2 , SiC , Si_3N_4 , transformed reinforced ceramics)

8. Forming of ceramic products – forming methods of advanced ceramics. Methods of dry forming – pressing – types, procedure, shapes of products. Methods of wet forming – casting from suspension – procedures, shapes of products. Methods of plastic forming – plasticization (fillers), procedure, device. High-pressure injection – procedure, shapes of products and types of products. Hot pressing. Hot isostatic pressing. Forming of ceramic mass turning on the potter's wheel.
9. Thermal treatment of ceramic products – processes, devices. Ovens – types of ovens. Furnaces – types of furnaces (by construction, by ways of operation and by source of energy) Chamber furnace – construction, principle of work. Tunnel furnace – construction, principle of work. Principle of work of periodically and continuously operating device.
10. Drying – definition of drying, humidity and humidity ratio, ways of binding of humidity in ceramic material. Bigot curve – retraction, critical humidity, sensitivity coefficient of material to drying.
11. Firing ceramics – definition of firing process, ways of firing, phases of firing process, conditions of firing process. Processes in ceramic material during the firing: dehydroxidation of clay minerals; Burnout of organic substances – reactions during burnout of organic substances, influence of Fe compounds on combustion of organic substances, influence of calcium carbonate. Formation of new crystalline phases in body – formation of mullite, cristobalite. Melting of spars – melting of Na-spar and K-spar individually, in mixture and with addition of quartz. Reactions in solid phase – kinetics of homogeneous and heterogeneous reactions. Sintering – processes during sintering, stages of sintering.
12. Surface treatment of ceramic products. Glazing – functions of glazes, types of glazes, properties and classification of glazes, colored glazes, preparation of glazes. Engobing – properties and utilization of engobing.

Recommended of required reading:

1. Hanykýř V., Kutzendorfer J.: *Technologie keramiky*, Vega s.r.o. 2000, ISBN 80-900960-6-3
2. J.Hlaváč: *Základy technológie silikátov*, SNTL, Praha, 1987.
3. J. Majling a kol.: *Technológia špeciálnych anorganických materiálov*, STU, Bratislava.
4. Z.Pospíšil a kol.: *Jemná keramika*, SNTL/Alfa Banská Bystrica.
5. V.Hanykýř, J. Kutzendorfer: *Technologie keramiky, vyd. I., VEGA, s.r.o., 2000.*

Language: Slovak

Remarks:

Evaluation history:

Number of evaluated students: 37

A	B	C	D	E	FX
16.22	10.81	37.84	8.11	27.03	0.0

Lecturers: prof. Ing. Darina Ondrušová, PhD.

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Supervisor: prof. Ing. Darina Ondrušová, PhD.