ETE705 - Technology of Ceramics and Glasses

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETE705	**SEMESTER**	7
COURSE TITLE	Technology of Ceramics and Glasses		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures and laboratory exercises	3	3
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	Specialized general knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	-

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

- **Learning outcomes:**

The aim of this course is to introduce students to the special category of glass and glass-ceramic materials in conjunction with the ceramic materials. Students learn that the materials of the former two categories have a distinct development over the centuries and significant and distinct differences from ceramic materials, which are directly related to both structure and technology and their characterization. Understanding the essential differences for a Materials Engineer is the ultimate and essential learning goal of the course. The analysis of the course subject, as presented in detail in another section, aims precisely at this goal. Particular emphasis is given to the relationship of the structure of these materials with their properties. Also, the teaching of the technology of ceramics, glass and glass-ceramic materials aims at learning all the experimental methods of producing and control of these materials as they are applied all over the world and aim at a wide range of applications. The interest of the course is focused on all the basic categories of ceramics, glass and glass-ceramic materials, both in terms of composition, and in terms of their form, e.g. powders, porous and solid materials, and in terms of their final

application.

- **Skills** (ie problem solving, transferring existing knowledge and acquired skills to new situations):

The course is in the 7th semester of the Curriculum. It was done so that students are fully competent and scientifically prepared to attend it, in terms of the necessary theoretical background, (i.e. the course of Ceramics in the 5th semester, and laboratory experience, in the 6th semester). Moreover, those who will successfully attend it in this semester will be able to proceed to a deeper understanding of the elective courses of the fifth year (Special Issues of Ceramics Materials and Bioceramics). From the perspective of their future professional rehabilitation as Materials Engineers, the students, after the successful attendance of this course, in combination with their successful attendance and practice in all the aforementioned courses, will be absolutely capable of working in any laboratory or ceramics, glass and glass ceramics industry of the world and to face all possible technical and technological challenges that may arise both in the research laboratory and in the industry, either on the production line or in quality control. Thus, regarding the ability of *Analysis*, the student must be able (that is, expected to be able) to distinguish the distinct components of the knowledge acquired from this course and to fully understand their organizational structure as taught in the course. Regarding the ability of *Synthesis*, the student must be able (that is, expected to be able) to create, compose, organize but also to propose and revise this knowledge, not only the knowledge of this course, but mainly by using data from other courses in the same year and from previous ones (and not only those related to ceramic materials), but also to be excellently prepared to do the same in the following years but also in practical exercises in the forthcoming years, and with regard to the ability in *Assessment*, the student must be able (i.e., expected to be able) to make assessment judgments regarding knowledge, in the sense of comparison, drawing conclusions, judging, evaluating and supporting them, especially in the practice of his profession, as a Materials Engineer, when it will require the use of this knowledge.

- **Competences** (ie combination of understanding and application):

The above are absolutely necessary (in terms of skills) for a Materials Engineer for the design of new compositions of ceramic materials, glass and glass-ceramics, with the desired properties as well as in the quality control of these materials produced in industry and marketed and applied in a number of applications. On the other hand, they are a very attractive perspective (and acquired skill) for the graduates of the Department as they match the special characteristics of the Greek Economy, such as traditional ceramics, which is the cornerstone of industry of a country and Europe, and internationally, but also advanced ceramics, glass and glass-ceramics, which should be the future of the country's development in the near future. Thus, with regard to *Understanding*, the student must be able (that is, expected to be able) to distinguish, explain, evaluate and conclude the value and importance of the above knowledge as necessary to the Science and Technique of Ceramics as a key component of the Materials Engineering subject, and with regard to *Application*, the student is (that is, must be) able to use the knowledge both in the strict context of this course and in the context of the challenges he will face in practicing the profession of Materials Engineer, in industry or research.

The teaching of the course with questions and discussion as well as with the assignments of the students, in conjunction with the evaluation of the students are done in such a way as to satisfy all the above learning outcomes, one by one and in a completely distinct way, that is, what exactly is expected that the student will be able to do when he successfully completes this course, and also to know the knowledge that he will acquire.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*

Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision-making
- Working independently
- Team work
- Working in an interdisciplinary environment
- Production of new research ideas
- Criticism and self-criticism
- Production of free, creative and inductive thinking

(3) SYLLABUS

The course includes theoretical lessons and laboratory exercises. The course content is concentrated in the following sections:

1. Definitions of glasses and glass-ceramics
2. History of these materials.
3. Structure of glasses
4. Crystallization of glasses
5. Design of compositions
6. Raw materials
7. Production methods
8. Glass transition point
9. Sol-gel method
10. Categories of glasses
11. Technology of glasses: kilns, production, annealing and special treatments
12. Technology of glass-production and glass-ceramics - industry
13. Physical properties
14. Thermal properties glasses
15. Mechanical properties
16. Determination of glass structure
17. Molecular dynamics
18. Chemical durability
19. Electrical properties
20. Optical properties of glasses
21. Silicate glasses
22. Phosphate glasses
23. Borate glasses
24. Glass-ceramics: Development
25. Low thermal expansion glasses and glass-ceramics
26. Glass windows, optical filters, smart glasses
27. Refractory glasses – pyrex
28. High mechanical stress glasses and controlled fracture toughness
29. Glass fibers – optical fibers
30. Glasses and glass-ceramics in energy technologies
31. Glasses and glass-ceramics in biomedicine
32. Coatings
33. Ceramic foams
34. Recycling
35. Special topics
36. Joining techniques
37. Optical fibers: introduction, signal transmission, production, faults, configurations

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY Face-to-face, Distance learning, etc.</td><td>Face to face in the classroom (it includes the literature survey, with the supervision of the professor who teaches the course)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td></td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (literature survey, included) and project presentation by the students in the classroom</td><td>26</td></tr>
<tr><td>Laboratory exercises, as demonstration</td><td>13</td></tr>
<tr><td>Unattended study (literature survey, needed to prepare the project presentation)</td><td>36</td></tr>
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<tr><td>Course total</td><td>75</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>LANGUAGE OF EVALUATION: Greek

METHOD OF EVALUATION:

Public presentation of a project (level of presentation: scientific conference – the content of the project is strictly based on eminent scientific journals) at 2 stages:
(1) Introductory presentation
(2) Presentation as an original research project</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

-Suggested bibliography:

- Books:
  M. Karakasidis, Notes on Ceramics, University Press, University of Ioannina (in Greek)
  Ch. Ftikos, Ceramics Science and Engineering, NTUA Press (in Greek)
  S. Agathopoulos, Notes (in Greek)

-Related scientific journals:

There is an extended bibliography, available to the students of this course by the professor who teaches this course as well the University Library, from many books and Journals, such

as :
Journal of the European Ceramic Society
Journal of the American Ceramic Society
Ceramics International