ETY901 - Ceramics-Special Topics

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY901	**SEMESTER**	9
COURSE TITLE	Ceramics-Special Topics		
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		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:	-		
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 knowledge acquired by the students in this course concerns the understanding of the whole range of application of ceramic materials, that is the traditional applications, up to the most advanced one, where the general classical view of ceramics does not apply. They include refractories, good mechanical properties and high chemical stability in adverse conditions of salinity and alkalinity; also other properties, such as storage of energy materials (eg hydrogen), superconductivity, permeability, optical effect on electromagnetic excitation, electrical excitation under mechanical stress, etc.. Moreover, ceramic materials, although being known as brittle materials, can be welded to obtain difficult shapes or to be joined with other materials, e.g. other ceramics or metals, steels and metal alloys, to produce composite materials

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

The learning objective of this course is to integrate the knowledge acquired in courses of the

previous semesters (Ceramic Materials, Glasses, and Materials Laboratory II, as well as Composite Materials and Clays and Nano-materials), and in particular the methodology of producing ceramic materials, glass and glass-ceramics, in porous and solid forms, in macro-, micro- and nano-scale, and in one, two and three dimensions. The students (in the perspective of their professional rehabilitation as Materials Engineers), after successfully completing this course, are fully capable of working in any workshop or ceramic industry in the world and facing all possible technical and technological challenges that can be presented both in the research laboratory and in the industry, or in the ceramic production line, or in the 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 itself of the course, but mainly with the use of data from other courses in the same year and from previous ones (not exclusively related to ceramic materials), but also to be excellently prepared to do the same in his Diploma Thesis if required, as well as later in the practice of his profession, as a Materials Engineer, and with regard to the ability in *Assessment*, the student must be able (i.e., expected to be capable) to rational judgments regarding this knowledge, in the sense of comparing, 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 with the desired properties as well as in the quality control of ceramic materials produced by the industry and marketed and applied in many applications. On the other hand, they are a particularly attractive perspective (and an acquired skill) for the graduates of the Department as they match the particular characteristics of the Greek Economy, not only as its aspect related to traditional ceramics, which is certainly a cornerstone of a country's industry but also of Europe and internationally, but also that of advanced 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 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 the student is expected to be able to do when he / she successfully completes this course, and also to know the knowledge that he / she 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…*
	…….

- Working independently
- Team work
- Production of new research ideas

- Criticism and self-criticism
- Production of free, creative and inductive thinking

(3) SYLLABUS

The course includes theoretical lessons (demonstration experiments in the Lab are also included). The course content is concentrated in the following sections:

1. Introduction: Ceramics, glasses, glass-ceramics, traditional and advanced production methods of them.
2. Traditional ceramics, porcelains
3. Composites with ceramic matrix
4. Composites reinforced with ceramics
5. Ceramic fibers and whiskers
6. Connective (building) materials (cement and gypsum)
7. PZT ceramics
8. LEDs
9. SOFCs
10. Hydrogen storage ceramics
11. Superconductive ceramics
12. Nano-structured ceramics
13. Joining techniques
14. Advanced ceramics: Oxides, carbides, nitridates, borates
15. Construction of special structures: sol-gel, nanostructures, sintering, plasma-spray, dip-coating, sputtering, welding
16. Bulk ceramics and thin films, coating, ceramic foams
17. Application of advanced ceramics
18. Structural ceramics: hard materials, cutting tools, coatings
19. Biomaterials
20. Corrosion (coatings, mechanical stress and thermal shock resistance)
21. Electrochemical applications and catalysis (SOFC, hydrogen storage, zeolites, mesoporous)
22. Photosensitive and photicatalysis
23. Superconductors, PZT and elctormagnetic ceramics

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face in the classroom (literature survey from eminent journals, is included, which takes place under the direct supervision of the professor who teaches the course)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
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*	

Activity	*Semester workload*
Lectures, literatures survey	26
Experiment in the Lab, as demonstration	13
Unattended study of the student for literature survey	16
Unattended study of the student for preparation for the final exams	20

	Course total	75
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.*	LANGUAGE OF EVALUATION: Greek METHOD OF EVALUATION: Final exams	

(5) ATTACHED BIBLIOGRAPHY

-Suggested bibliography:

- K. Beltsios, M. Karakasidis, University Notes, University Press, Ioannina (in Greek).
- Ch. P. Ftikos, Ceramics Science and Engineering, 960-254-648-4 (ISBN 25887), University press of the NTUA (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