ETY913 - Bioceramics

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY913	**SEMESTER**	9
COURSE TITLE	Bioceramics		

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 aim of this course is to understand the selection and application of ceramic materials (including glass and glass-ceramics) in biomedicine in the light of the history and the research of leading researchers in their discovery and development, as well as their prospects in relation to implants and other categories of materials in current clinical practice. Emphasis is given on the way for categorizing the bioceramics, according to the way they react with the tissues, the characteristics of each class of bioceramics and the ways of laboratory determination of these characteristics, the clinical applications of various materials in the light of classical applications but also the most modern (and future) trends in bioceramics. These trends include the consideration of biological origin as well as the biomimetic materials and functions.

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

The course has been placed in the Curriculum in the 9th semester. Thus, after its teaching and successful attendance, the students are absolutely, in terms of the necessary theoretical background, capable and prepared (in the perspective of their professional rehabilitation as Materials Engineers), to work in any laboratory or industry in the world and address all possible technical and technological challenges that may arise in both the research laboratory and the industry, either in the bioceramics 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 itself of the course, but mainly with the use of data from other courses in the same year and from previous ones, but also to be excellently prepared to do the same in the practice of his profession, as a Materials Engineer, and regarding the ability in *Assessment*, the student must be able (i.e., expected to be able) to make evaluative judgments about this knowledge, in the sense of comparison, drawing conclusions, judging their evaluation and support, 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 to design new bioceramic material compositions with the desired properties. Their quality control as produced by the biomaterials industry and marketed and applied in a variety of biomedical applications are a particularly attractive prospect (and acquired skill) for the graduates of the Department as they match the particular characteristics of the Greek Economy, such as that of biomaterials, which provide the guarantees to be the future of the country's development in the near future. Thus, with regard to *Understanding*, the student must be able (i.e., expected to be able) to distinguish, explain, evaluate and conclude the value and importance of the above knowledge as essential to the Science and Technique of Bioceramics, and with regard to the *Application*, the student is (that is, he 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 in biomaterials research.

The teaching of the course, with questions and discussion, as well as with the assignments, along with the evaluation of the students are done in such a way as to satisfy all the above learning outcomes, one to one and also 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 the 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 and laboratory exercises as a demonstration. The course content is concentrated in the following sections:

1. Introduction – terms: Biomaterials, biocompatibility, implants and transplants
2. Biologically derived materials: biological hydroxypatite (from bone and teeth), aragonite (shells and corals), other materials
3. Biomineralization (physical biocomposites)
4. Bioceramics: advantages disadvantages, categories
5. Bioinert ceramics: Biochemistry and applications
6. Porous bioceramics: production and applications
7. Surface active bioceramics (bulk, coatings, porous, scaffolds of tissue engineering)
8. Bioactivity (testing) and clinical applications
9. Resorbable bioceramics (bulk, coating, tissue engineering scaffolds): Applications
10. Tumor treatment with ceramics
11. Hyperthermia
12. Ceramics membranes
13. Targeting and guidance by electromagnetic field
14. Drug delivery systems
15. Hydrogels
16. Machineable bioceramics
17. Composites (coating, cermets)
18. Biomemetic ceramic and composites
19. Ceramics in tissue engineering
20. Qualification of novel ceramics in biomedicine – certification (ASTM, ISO)
21. Personal prototyping and tissue engineering
22. Bioethics
23. International standards and quality control
24. Special issues and future perspectives (tissue engineering, radiotherapy, biomemetics, biocatalysis)

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face in the classroom (literature survey by eminent journals is included, 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, literature survey	26
Exercises in the Lab as demonstration experiments	13
Unattended study of the student for literature survey	16
Unattended stud 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:

Books

– Ph. Pomonis, K. Beltsios, M. Karakasidis, University Notes, University Press, Ioannina (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

– Biomaterials
– Acta Biomaterialia
– Bone
– Journal of Materials Science: Materials in Medicine
– Journal of Biomedical Materials Research (A) & (B)