Course Outline

1) General

SCHOOL	SCIENCE		
DEPARTMENT	CHEMISTRY		
DEGREE	MASTER		
COURSE CODE	**18B8**	**SEMESTER**	**2**
COURSE TITLE	Magnetic and Optical materials for storing information		

INDEPENDENT TEACHING ACTIVITIES in the case that the credits are awarded to separate parts of the course e.g. Lectures, Laboratory Exercises, etc. If the credits are awarded uniformly for the entire course, enter the weekly teaching hours and total credits	**TEACHING HOURS PER WEEK**	**CREDITS**
Lectures	7	10
Add lines if necessary. The teaching organization and methods used are described in detail in (d).		

COURSE TYPE *general background, special background, general knowledge specialization, skill development*	Special background, skill development
PREREQUISITE COURSES:	No
COURSE AND EXAM LANGUAGE:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS ?	If needed yes
COURSE WEBSITE (URL)	**https://eclass.uoa.gr/courses/CHEM252/**

(1) LEARNING OUTCOMES

LEARNING OUTCOMES

The learning outcomes, specific knowledge, skills and abilities of an appropriate level that the students will acquire after the successful completion of the course are described.

Consult Appendix A

• Description of the Level of Learning Outcomes for each course of study according to the Qualifications Framework of the European Higher Education Area

• Descriptive Indicators for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Annex B

• Comprehensive Guide to writing Learning Outcomes

The aim of the course is to disseminate knowledge about the theory and methods used in the storage of information using magnetic and optical materials.

More specifically, in the context of this course, students are taught:

- Molecular Magnetic and Optical Materials as information storage media. Basic principles and phenomena of molecular magnetism.
- Paramagnetism - Diamagnetism.
- Zeeman Effect, the Van Vleck equation.
- Ferromagnetic - anti-ferromagnetic interactions between metal centers.
- Zero-field splitting and quantum tunneling of the magnetization.
- New trends in molecular magnetism: high spin complexes and single molecule magnets.
- Introduction to nonlinear optics,
- frequency mixing, optical properties of crystalline materials,
- nonlinear optical properties of crystals,
- third order linear processes,
- dispersion and optical pulses,
- non-linear pulse optical systems.

Knowledge

- Knowledge and understanding of the basic principles and phenomena of molecular magnetism.
- Knowledge and understanding of magnetic interactions between paramagnetic metal centers.
- Knowledge and understanding of various phenomena such as the Zeeman effect, zero field splitting, quantum tunneling of the magnetization.
- Knowledge of modern trends in molecular magnetism.
- Knowledge and understanding of the basic principles and phenomena of non-linear optical properties.

Skills

- Skills in solving the Van Vleck equation.
- Skills in determining the activation energy for the magnetization reversal in single molecule magnets.

- Skills in determining energy differences between microstates caused by zero-field splitting.
- Skills in bibliographic research, writing and public presentation of a scientific paper.
- Skills in predicting the frequencies generated during a non-linear optical process.
- Skills in solving nonlinear wave equations in simple problems.
- Skills in explaining the origin of spatial and temporal solitons.

Abilities

- Ability to apply the knowledge gained by the students in dealing with problems related to magnetic and optical materials.
- Ability to interpret magnetic data and relate them to the structures of the studied compounds.
- Ability to conduct literature research, write and present a scientific paper to the public.
- Ability to improve nonlinearity with phase matching.
- Ability to calculate the upper power limit allowed in a glass optical fiber due to the existence of the effect of optical non-linearity.

General Skills

Taking into account the general skills that the graduate must have acquired (as stated in the Diploma Appendix and listed below) which of the following is/are the course aimed at?.

Reearch, analysis and synthesis of data and information, using the necessary technologies
Adaptation to new situations
Decision making
Independent work
Teamwork
Working in an international environment
Working in an interdisciplinary environment
Generating new research ideas
Project planning and management
Respect for diversity and multiculturalism
Respect for the environment
Demonstrating social, professional and ethical responsibility and sensitivity to gender issues
Exercise criticism and self-criticism
Promotion of free, creative and inductive thinking
Other…….

The course aims at equipping students with the following general skills:

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Autonomous work.
- Group work.
- Ability to apply knowledge to problem solving.
- Generation of new research ideas.
- Work in an interdisciplinary environment.
- Promotion of free, creative and inductive thinking.
- Decision making.

(2) COURSE CONTENT

Molecular Magnetic and Optical Materials as information storage media. Basic principles and phenomena of molecular magnetism. Paramagnetism - Diamagnetism. Zeeman Effect, the Van

Vleck equation. Ferromagnetic - anti-ferromagnetic interactions between metal centers. Zero-field splitting and quantum tunneling of the magnetization. New trends in molecular magnetism: high spin complexes and single molecule magnets. Introduction to nonlinear optics, frequency mixing, optical properties of crystalline materials, nonlinear optical properties of crystals, third order linear processes, dispersion and optical pulses, non-linear pulse optical systems.

(3) TEACHING AND LEARNING METHODS – EVALUATION

LECTURES' DELIVERY *In person, distance, etc..*	In person
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGIES *Use of I.C. T. in Lectures, Laboratory Exercises, Communication with students*	In Teaching: • Presentations with multimedia content (power point) In Communication with students: • Support the learning process through the e-class electronic platform (announcements, information, messages, documents, user groups, etc.). • Email.
TEACHING ORGANIZATION *The teaching style and methods are described in detail.* *Lectures, Seminars, Laboratory Exercises, Field Exercises, Literature Study & Analysis, Tutorial, Internship (Placement), Clinical Exercises, Art Workshop, Interactive Teaching, Educational Visits, Study Preparation (Project), PaperWriting Assignments, Artistic Creation, etc. etc.* *The student's study hours for each learning activity as well as unguided study hours according to ECTS principles are listed*	
STUDENT EVALUATION *Description of the evaluation process* *Assessment Language, Assessment Methods, Formative or Deductive, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Report / Report, Oral Examination, Public Presentation, Laboratory Work, Clinical Patient Examination, Artistic Interpretation, Other / Others* *Explicitly defined evaluation criteria are mentioned, and if and where they are accessible by students.*	The evaluation of the course takes place in Greek and includes: • written exam that includes multiple choice questions, short development of theoretical issues, judgment, as well as problem solving. • evaluation of the bibliographic work, evaluation of the presentation of the bibliographic work.

Activity	*Semester workload*
Lectures	91
Unguided study	70
Paper writing	70
Study preparation	19
total	250

(4) RECOMMENDED BIBLIOGRAPHY

- Mabbs and Machin 'Magnetism and transition metal complexes', 1973
- Kahn 'Molecular magnetism', 1993
- Carlin 'Magnetochemistry', 1986
- Ribas 'Coordination chemistry', 2008
- Gatteschi, Sessoli and Villain 'Molecular nanomagnets', 2006
- Miller and Drillon (Eds) 'Magnetism: Molecules to materials' Vol I-V, 2001-2005
- Robert W. Boyd, Nonlinear Optics (3rd edition), Elsevier Academic Press (2007)
- NPTEL "Nonlinear Optics Course" (2015); available at the following link: https://nptel.ac.in/courses/115101008