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EUROPEAN UNIVERSITY FOR CUSTOMISED EDUCATION

STUDY GUIDE

Physical chemistry of biological systems and biointerfaces. Principles of Biological Physical-Chemistry (Module 1).

Organised by

[Università di Catania]

1. IDENTIFYING DATA.

· **Course Name.**	*Physical chemistry of biological systems and biointerfaces. Principles of Biological Chemistry Physical (Module 1). (1015752)*
· **Coordinating University.**	*Università di Catania*
· **Partner Universities Involved.**	---
· **Course Field(s).**	*Biophysical chemistry, Chemistry, biophysics, Biology*
· **Related Study Programme.**	*Master in Chemical Sciences (Msc in Chemistry LM-54)*
· **ISCED Code.**	*0442 Chemistry*
· **SDG.**	*SDG Goal 4: Inclusive and equitable quality education* *SDG Goal 7: Affordable and clean energy* *SDG Goal 9: Industry, innovation and infrastructure*
· **Study Level.**	*The course is part of Master in Chemical Sciences (Msc in Chemistry LM-54) program*

· **Number of ECTS credits allocated.**	*6*
· **Mode of Delivery.**	*Online (intended for EUNICE)*
· **Language of Instruction.**	*English*
· **Course Dates.**	*from 01/10/2024 to 18/01/2025*
· **Schedule of the course.**	*first semester*
· **Key Words.**	*Cell membrane, model membrane, phospholipid, lyotropic liquid crystal, amino acid, protein, folding, thermodynamics, kinetic, molecular dynamics, spectroscopy, structure, amyloidogenic proteins protein-membrane interaction, liquid water structure.*
· **Catchy Phrase.**	*Living organisms are lyotropic liquid crystal.*

· **Prerequisites and co-requisites.**	*Elements of thermodynamics – Elements of statistical thermodynamics – Elements of descriptive kinetics – Elements of quantum mechanics - elements spectroscopy – Elements of biochemistry.*
· **Number of EUNICE students that can attend the Course.**	*unrestricted number*
· **Course inscription procedure(s).**	*EUNICE website*

2. CONTACT DETAILS.

· **Department.**	*Dipartimento di Scienze Chimiche, Università di Catania*
· **Name of Lecturer.**	*Carmelo La Rosa*
· **E-mail.**	*carmelo.larosa@unict.it; clarosa@unict.it.*
· **Other Lecturers.**	-----

3. COURSE CONTENT.

1.Recalls of:
thermodynamics; chemical equilibrium and Gibbs free energy; descriptive chemical kinetics and kinetic models; structure of liquid water; Anisotropy of nematic, smectic, cholesteric and lyotropic liquid crystals.
2. Spectroscopy
Fluorescence, circular dichroism, X-ray, SS-NMR of deuterium and phosphorus 31,
3. Calorimetry
Differential scanning calorimetry and isothermal calorimetry.
4. Molecular dynamics
Force Field and popular software. Data analysis.
5. Biological membranes
Phospholipid in water, model membranes and their structures. Bilayer and its phase transition. Order and disorder. Dynamics.
5. Proteins
Amino acid and polypeptides. Folding reaction. Amyloidogenic proteins and their aggregation and pore formation. Molecular model of Alzheimer, Parkinson and Type 2 diabetes diseases.

4. LEARNING OUTCOMES.

The objective of the course is to provide the student with how to apply Chemistry-Physics and its experimental and theoretical techniques to systems of biological interest with emphasis on bilogical membranes and amyloidogenic proteins. In addition, the course will show what modern methodologies are available for the development of selective and disease-specific drugs such as Alzheimer's disease, Parkinson's disease, and type 2 diabetes.
Knowledge and understanding.
The purpose of the course is to further the applications of theoretical and experimental techniques proper to chemistry-physics to biology.
Applying knowledge and understanding
During the course, an attempt will be made to develop in the student a critical ability in the critical analysis from experimental data and their superimposition with currently existing theoretical i models. All these concepts will be applied to the development of effective drugs.
Communication skills.
Ability to discuss about advanced theory of amyloidogenic proteins and their interaction with model membrane, both in Italian and in English.
Learning skills.

The learning skills that are usually developed in the student is critical reading of scientific articles and analyzing data reported therein.

5. OBJECTIVES.

The course aims at providing the following objectives:
- to apply fundamental laws of Physical-Chemistry *to understood quantitative biology;*
- to apply the knowledge of nuclear physics concepts within stellar evolution and nucleosynthesis of the elements in the cosmos;
- to apply fundamental laws for deriving physical quantities of interest in nuclear physics, such as binding energy and q-value;
- to apply the acquired skills for evaluating astrophysically relevant energy ranges in nuclear astrophysics, cross sections and reactions rates for nuclear reactions;
- to apply basic knowledges for the application of indirect methods in experimental nuclear astrophysics

6. COURSE ORGANISATION.

UNITS

1.	*Nuclear processes involved in stellar evolution*
2.	*Nucleosynthesis in the Cosmos*
3.	*Nuclear structure and binding energy*
4.	*Nuclear reactions: q-value, cross sections and reactions rates*
5.	*Difficulties in experimental nuclear astrophysics: indirect methods*

LEARNING RESOURCES AND TOOLS.

Lectures will be delivered by using slides prepared by the teacher.

PLANNED LEARNING ACTIVITIES AND TEACHING METHODS.

Learning activities are in the form of lectures on the different topics. Seminars could be also delivered.

7. ASSESSMENT METHODS, CRITERIA AND PERIOD.

At the end of the course, an oral exam is foreseen.

OBSERVATIONS.

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8. BIBLIOGRAPHY AND TEACHING MATERIALS.

1. Nuclear Physics of Stars, C. Iliadis, Wiley
2. Cauldrons in the Cosmos, C. Rolfs, The Univ. Of Chicago Press
3. Nuclear and Particle Physics, W.S.C. Williams, Clarendon Press
4. Introductory Nuclear Physics, K. S. Krane, Wiley & Sons. Inc.