Physical Basis of Life is a one-semester, cross-disciplinary Special Topic course to be offered alternately at undergraduate and graduate levels to students majoring in physics, chemistry, biology, biomedical sciences and more. The purpose of the course is to take a closer look at the molecular and physical basis of life processes and to explain biological phenomena, such as protein biosynthesis, folding, signal transduction, excitability, based on fundamental concepts of physics. The main components of the course are the origin of life in cosmos, formation of atoms, molecules, biomolecules and the first organisms, and the role of physical factors, such as ionic currents and electric potentials, polar and hydrophobic interactions, in high-level organization and function of complex biomolecular assemblies. The students will thus sharpen their skills of analytical thinking and explaining seemingly intricate life processes in relatively simple terms. Introductory chemistry and physics will be required to succeed in this higher level course. Let’s delve into the realm of atomic and molecular aspects of life and uncover the inner workings of the miraculous processes that support life.

SYLLABUS
Instructor: Dr. Suren A. Tatulian, statulia@ucf.edu

Office Hours: Tue/Thu 3:00-4:00 pm

CLASS TIME AND LOCATION:

CLASS TIME: Tue/Thu 4:30-5:45 pm

LOCATION: BA1 0110

PREREQUISITIES:

CHM2046 (Chemistry Fundamentals II)

PLUS:

EITHER: PHY2049 (College Physics II for Scientists and Engineers, with calculus)

OR: PHY2054 (College Physics II, with algebra)

COURSE DESCRIPTION:

*Physical Basis of Life* is a one-semester Special Topic course offered to the undergraduate students majoring in natural and biomedical sciences. The course is deemed suitable for juniors and seniors. The purpose of the course is to provide the students with a solid framework of knowledge of the molecular and physical basis of life processes. Emphasis is placed on understanding the major principles of the origin of life on earth and in the universe, the physical-chemical processes that support the transition from non-living to living matter, the physical interpretation of “biological interactions”, the major biochemical reactions that support life, and an overall physical interpretation of life processes. The amount of math will be kept at a minimum and will mainly involve algebra and trigonometry. Calculus, i.e., calculations involving differentials and integrals, when needed, will be elementary.

COURSE OBJECTIVE:

By taking this course, the students are expected to grasp the main concepts and mechanisms of life processes at molecular and atomic levels. This course will thus help the students develop higher level learning and thinking skills. The students with a fundamental physics and chemistry background will acquire essential knowledge of molecular biology, physical chemistry, and
biochemistry, which may be essential in pursuing a career in the fields of biological physics, biochemistry, molecular biology, and various branches of life sciences.

TEXTBOOK:

*ORIGINS OF LIFE ON THE EARTH AND IN THE COSMOS*


THE FOLLOWING TOPICS WILL BE COVERED:

1. Theories of Origin of Life; Pros and Cons of Spontaneous Generation
2. What is Life from a Physicist’s Point of View?
3. From Chemical Elements to Molecules and Biomolecules
4. Physical versus Chemical Interactions: Covalent and Non-covalent Bonding
5. Mutations, Information, Entropy, and Molecular Evolution
7. Basic Biochemical Reactions are Based on Electron and Proton Transfer Processes; Nucleophiles and Electrophiles, Oxidation and Reduction
8. Applicability of Thermodynamics to Life Processes; the Second Law Broken?
9. The Role of the Enzymes in Life Processes
10. Structure and Function of Major Biomolecules: Nucleic Acids, Proteins, Carbohydrates, Lipids
11. The Genetic Code; Its Biological Role and Physical Interpretation
12. Importance of Hydrogen Bonding in Biological Structure and Function (Molecular Recognition in Replication and Transcription, Secondary Structure of Proteins, etc.)
13. Importance of the Hydrophobic Effect in Biological Structure and Function
14. Structure and Function of Biomembranes
15. Protein Folding Supports Specific Biological Functions
16. From Biomolecules to the Cell
17. Physical Interactions versus Biological Interactions. (Can “Biological Interactions” Be Interpreted in Pure Physical Terms?)
18. Major Metabolic Pathways

EXAMS and QUIZZES:

Five quizzes will be given during the semester. Each quiz will constitute 4% of the final grade. Two mid-term exams will be given. The grades of each mid-term exam will constitute 20% of the final grade. A comprehensive final exam will be given at the end of the semester; it will include the entire material covered during the semester and will determine 40% of the final grade. All exams may be written, multiple choice, or a combination of the two. For each exam, student must have a number two (2) pencil and a scientific calculator. No internet-active devices will be allowed during the exams and quizzes. The student ID number must be recorded in the proper location of the scantron and the exam.

MISSED WORK POLICY:
Making up missed work will only be permitted if the work had been missed because of University-sanctioned activities and bona fide medical or family reasons. Authentic justifying documentation must be presented (in advance for University-sanctioned activities). At the discretion of the instructor, the make-up may take any reasonable and appropriate form including, but not limited to, the following: a replacement exam, replacing the missed work with the same score as a later exam, replacing the missed work with the quiz average.

**GRADES:**

As stated above, each of the two mid-term exams will count 0.2, all five quizzes together will count 0.2, and the final exam 0.4 fraction of the overall final grade. All exams will be closed book and closed notes. The maximum possible total number of points earned, i.e. the sum of the exams and quizzes, will be 100 points, plus extra points if extra credits are offered and earned. The chart below indicates the correspondence between the grade percentile and letter grades.

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<tr>
<th>Percentage</th>
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<td>90%-100%</td>
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<td>Below 60%</td>
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**ATTENDANCE:**

Class attendance is very important since a) by missing a class you may miss a quiz or a mid-term exam that may be equivalent to a failed quiz or exam, unless the absence is appropriately justified and excused (see above), and b) all exam questions will be drawn from the class lectures and discussions.

The syllabus may be subjected to modification if necessity of such modification arises during the semester.