Statement of rationale:

(Include a list of the area certification criteria (former called GE objectives) and GE Student Learning Outcomes (if applicable). These certification criteria and GE SLOs are listed in the GE Committee Combined document. After each certification criterion and GE SLO, list several course activities (lectures, readings, assignments, etc.) that address it. If it is not completely obvious, explain how the activities relate to the certification criterion or outcome. Please attach a copy of the syllabus which has been annotated to identify the corresponding activities. Electronic annotations are required. Please use the *comment* feature in Word to annotate electronic copies.)

The course should meet two GE requirements: (1) quantitative reasoning and (2) life science.

1: Quantitative reasoning

Certification Criteria

Students will be able to

1. make use of mathematical (including statistical) models for physical or social systems; -and/or- compute and interpret numeric data, summative statistics and/or graphical representations;

Instructional activities:

- *lectures. We will learn how to model atoms in proteins as point masses and their interactions using force fields. We will learn how to perform protein geometry calculations and protein dynamics analysis, and how to use protein structure and the results of protein dynamics analysis to interpret protein function.*

Assessment:

- *homework assignments and the final project. One of the homework assignments (see attached), for example, will be about reading and processing PDB (short for protein data bank) files. A PDB file stores the coordinates of all the atoms in a protein. Students will write a computer program that can read the coordinates from a PDB file, and then perform numerical calculations and geometric manipulations on the protein structure.*

2. reflect on the strengths and weaknesses of particular quantitative models or methods as tools in the natural and social sciences;

Instructional Activities:

- *Lectures. We will discuss the strengths and weaknesses of:*
    - *Various sequence matching methods,*
    - *Various structural matching methods,*
    - *Various machine learning models.*
    - *Various models for studying protein dynamics,*
    - *Etc.*

Assessment:

- *homework assignments*

3. be able to interpret, reflect on, and use quantitative models and data in public, vocational, and/or private decision making.

Instructional Activities:

- *Lectures on drug design and vaccine development, the mechanism behind; on understanding the biological basis of drug side effects, etc.*

Assessment:

- *The final project presentation*

Student Learning Outcome (assessed as part of Quantitative Reasoning ILO):
Students will apply relevant scientific, mathematical and logical methods to analyze and solve problems effectively and be able to utilize the results appropriately when making decisions.

Instructional Activities:

- *Lectures. We will learn how to apply computer algorithms to solve some biological problems effectively. Form hypotheses, test them, and make decisions.*

Assessment:

- *homework assignments. Most of the homework assignments involve mathematical methods and modeling (see attached homework examples).*

2 Life Science:

Certification Criteria

Students will be able to

1. describe the investigative approaches of the life sciences;

Instructional Activities:

- *This course will take a computational and bioinformatics-based approach to study and understand life sciences, specifically, the structure, dynamics, and function of proteins and protein complexes.*

Assessment:

- *Reading assignments and homework assignments*

2. list, describe and explain processes in living systems as appropriate to the course’s subject domain;

Instructional Activities:

- *Lectures. Gene transcription and translation, protein sequences, protein folding, protein function, drugs, etc.*
- *the textbook adopted, Proteins in Action, was selected as* ***2018 PROSE award for best new textbook in the biological and life sciences.*** **(**I personally know all three authors. One of the authors, Robert Jernigan, was my postdoctoral advisor).

Assessment:

- *Reading assignments*

3. describe and explain diversity and variability in living organisms as appropriate to the subject of the course;

Instructional Activities:

- *Lectures*
    - *Protein fold classification, the different classes and folds of proteins.*
    - *The various molecular machines in the cell*
    - *Etc.*

Assessment:

- *homework assignments*

4. identify and describe controversies, positions and approaches to the interdisciplinary and theological implications of the life sciences.

Instructional Activities:

- *Lectures. I was trained in both physics and computer science and did my doctoral and postdoctoral work in protein folding and computational biology. My background prepares me well to take an interdisciplinary approach to life sciences. Students will be exposed to various experimental (such as X-ray crystallography) and computational approaches (such as molecular dynamics simulations) taken to study life sciences.*
- *In-class discussion. Regarding theological implication, the course will examine the complexity of life and ask the question, what is life? In 1944, the physicist Erwin Schrödinger, the founder of modern quantum mechanics, published a short book that changed the course of modern biology "What is Life?" he asked in his title. Could the events inside a living organism be explained solely by physics and chemistry? We will discuss this topic during the first couple of weeks.*

Assessment:

- *Reading assignments*

Student Learning Outcome

Students will generalize how the scientific method can be used to investigate the physical and living world.

Instructional Activities:

- *Lectures. Students will be exposed to many computational methods that are used in investigating the living systems. Some of these methods are developed in other disciplines such as computer science (such as machine learning, dynamic programming), physics or engineering (such as molecular dynamics simulations), mathematics (protein geometry, Voronoi diagrams, alpha shapes), etc.*

Assessment:

- *Student will use computational methods to model and analyze the sequence, structure, and/or functional mechanisms of proteins and protein complexes.*