Course Approval Form

For approval of new courses and deletions or modifications to an existing course.

registrar.gmu.edu/facultystaff/curriculum

Action Requested:

- [X] Create new course
- [ ] Delete existing course
- [ ] Modify existing course (check all that apply)
  - [ ] Title
  - [ ] Credits
  - [ ] Repeat Status
  - [ ] Grade Type
  - [ ] Prereq/coreq
  - [ ] Schedule Type
  - [ ] Restrictions
  - [ ] Other: ______

Course Level:

- [ ] Undergraduate
- [X] Graduate

College/School: College of Science
Department: School of Systems Biology
Submitted by: Dmitri Klimov
Ext: 3-8395
Email: dklimov@gmu.edu

Subject Code: BINF **Number:** 641
(Do not list multiple codes or numbers. Each course proposal must have a separate form.)

Effective Term:
- [ ] Fall
- [x] Spring
- [ ] Summer

Year 2014

Title:

Current	Biomolecular Modeling
Banner (30 characters max including spaces)	Biomolecular Modeling
New	

Credits: (check one)
- 3 Fixed ______ or ______
- [ ] Variable ______ to ______

Repeat Status: (check one)
- [X] Not Repeatable (NR)
- [ ] Repeatable within degree (RD)
- [ ] Repeatable within term (RT)

Maximum credits allowed: 3

Grade Mode: (check one)
- [X] Regular (A, B, C, etc.)
- [ ] Satisfactory/No Credit
- [ ] Special (A, B C, etc. +IP)

Schedule Type Code(s): (check all that apply)
- [X] Lecture (LEC)
- [ ] Lab (LAB)
- [ ] Recitation (RCT)
- [ ] Internship (INT)
- [ ] Independent Study (IND)
- [ ] Seminar (SEM)
- [ ] Studio (STU)

Prerequisite(s):	Corequisite(s):
Students are expected to be familiar with basic concepts of physics, calculus, and biology on undergraduate level. Access to PC with internet connection is required.	none

Instructional Mode:
- [ ] 100% face-to-face
- [ ] Hybrid: ≤ 50% electronically delivered
- [x] 100% electronically delivered

Special Instructions: (list restrictions for major/college/degree/prereq to be enforced by Banner)

none

Are there equivalent course(s)?
- [ ] Yes
- [X] No

If yes, please list ______

Catalog Copy for NEW Courses Only (Consult University Catalog for models)

Description (No more than 60 words, use verb phrases and present tense)	**Notes** (List additional information for the course)
Introduction to basic principles and practice of computational biomolecular modeling. Students learn the elements of physical chemistry and molecular biology, which constitute the foundation of molecular modeling. Practical application of biomolecular software and development of related skills are emphasized through online lectures, homework, and course project.	

Indicate number of contact hours: Hours of Lecture or Seminar per week: 3 Hours of Lab or Studio: ______

When Offered: (check all that apply) [x] Fall [x] Summer [x] Spring

Approval Signatures

Department Approval ______ Date ______ College/School Approval ______ Date ______

If this course includes subject matter currently dealt with by any other units, the originating department must circulate this proposal for review by those units and obtain the necessary signatures prior to submission. Failure to do so will delay action on this proposal.

Unit Name	Unit Approval Name	Unit Approver's Signature	Date

For Graduate Courses Only

Graduate Council Member ______ Provost Office ______ Graduate Council Approval Date ______

For Registrar Office's Use Only: Banner______________________________Catalog________________________________

revised 11/8/11

Course Proposal Submitted to the Curriculum Committee of the College of Science

1. COURSE NUMBER AND TITLE: BINF641 Biomolecular modeling

Course Prerequisites: Students must be familiar with the basic concepts of physics, calculus, and biology on undergraduate level. Access to PC with internet connection is required.

Catalog Description: Introduction to basic principles and practice of computational biomolecular modeling. Students will learn the elements of physical chemistry and molecular biology, which together constitute the foundation of molecular modeling. Practical application of biomolecular software and development of related skills are emphasized through lectures, homework, and course project. The course is delivered entirely online via recorded lectures and meetings.

2. COURSE JUSTIFICATION:

Course Objectives: This course is designed for the students with the background in biology, chemistry, or computer science and who are interested in learning biomolecular modeling. The goal of the course is to introduce the principles of biomolecular modeling and develop practical skills using existing modeling software.

Course Necessity: Biomolecular modeling is a standard tool used in modern molecular biology, which allows one to address diverse problems from protein and RNA folding to biomolecular interactions in cellular environment and membrane transport. This approach is unique in its ability to provide detailed atomistic description of biomolecular systems, which complements experiments. The course will train students in this novel field and develop necessary practical skills. It is expected that completion of this course will improve employment prospects of the students on the job market.

Course Relationship to Existing Programs: This course will be included in the online versions of Bioinformatics and Computational Biology Graduate Certificate and MS in Bioinformatics and Computational Biology. These online programs are currently being developed.

Course Relationship to Existing Courses: At the present time GMU does not offer similar courses. The proposed course has partial (about 30%) overlap with existing graduate course BINF740 Introduction to Biophysics. However, the proposed course is entirely focused on the principles of biomolecular modeling with the emphasis on developing practical skills in software application. In contrast, BINF740 does not address practical use of software and it covers all fields of biophysics well beyond biomolecular aspects. The level of presentation in BINF740 is more advanced, because this course is required for PhD Program in Bioinformatics and Computational Biology. In addition, the curriculum of BINF641 is specifically designed for online asynchronous delivery, whereas BINF740 is a “traditional” classroom course.

3. APPROVAL HISTORY: none

4. SCHEDULING AND PROPOSED INSTRUCTORS:

Semester of Initial Offering: Spring 2014

Proposed Instructors: Dmitri Klimov

5. TENTATIVE SYLLABUS: See attached

Syllabus for the proposed new online course BINF641

BINF641: *Biomolecular Modeling*

Instructor: Dmitri Klimov

Course objective: This course is designed for the students with the background in biology, chemistry, or computer science and who are interested in learning biomolecular modeling. The goal of the course is to introduce the principles of biomolecular modeling and develop practical skills using existing modeling software.

Course description: The course consists of two parts. The first part starts with the introduction of fundamental concepts of physical chemistry, which are commonly used in the description of biological systems. Molecular interactions, from covalent bonding to electrostatic and van-der-Waals interactions, are discussed. The course shows how these interactions are combined to produce a complex array of biomolecular structures found in DNA, RNA, proteins, and lipid cellular membranes. The molecular mechanisms of protein folding are discussed in detail. The unfolding of proteins implicated in a variety of biological functions is also introduced. The consequences of protein aggregation are explored and linked to a new class of diseases. Cellular defensive mechanisms against protein misfolding and aggregation, including chaperone systems, are presented.

The second part of the course describes the basic principles in biomolecular modeling, such as molecular mechanics. Practical implementation of biomolecular modeling, including the application of relevant simulation and visualization software, is emphasized. Several case studies illustrating the use of biomolecular modeling are discussed, including ligand binding and protein interactions with cellular membranes. As a final exam the students complete the course project on biomolecular modeling.

***Prerequisites*:** Students are expected to be familiar with basic concepts of physics, calculus, and biology on undergraduate level. Access to PC with internet connection is required.

***Grading basis*:** Students will be graded on the basis of homework (50%) and final exam (50%).

Course materials:

1. Rodney Cotterill "Biophysics: An introduction"
2. Online lecture notes

Instructor: Dmitri Klimov
Occoquan Building, Room 328C, Prince William Campus
703-993-8395
dklimov@gmu.edu
Office hours: 2-3pm Monday or by appointment

Academic Honesty Policy: Students are expected to follow the Honor Code. Academic dishonesty will not be tolerated in this class. Exams, projects, and homework must reflect individual work. If you have difficulty with the assignments, discuss it with the instructor.

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Resources at 703/993-2474. All academic accommodations must be arranged through that office.

<u>Tentative course schedule:</u>

Lecture 1

Elements of thermodynamics and statistical mechanics.

Lecture 2

Reaction kinetics and transport processes. Connecting thermodynamics and kinetics.

Lecture 3

Biomolecular interactions.

Lecture 4

Biomolecular structure: DNA, RNA, polypeptides.

Lecture 5

Biomolecular structure: Lipid membranes.

Lecture 6

Protein folding

Lecture 7

Mechanical unfolding of proteins as biological function

Lecture 8

Protein aggregation

Lecture 9

Preventing protein misfolding and aggregation

Lecture 10

Proteins in cells: Molecular crowding

Lecture 11

Principles of biomolecular modeling

Lecture 12

Biomolecular modeling in practice: Using software applications

Lecture 13

Course project on biomolecular modeling

Lecture 14

Biomolecular modeling as a research tool: (i) ligand binding to proteins, (ii) protein interactions with cellular membranes