San Francisco State University
Department of Mathematics
Spring 2008 Course Syllabus

MATH 414 section 1
MATH 714 section 1
Analyzing DNA Topology with Mathematical and Computational Methods (3 units)

Instructor: Mariel Vazquez
Office TH 928; Phone 338-2071; e-mail: mariel@sfsu.edu
Website: http://math.sfsu.edu/mariel/Math414_Spring08/index.html
Lectures: T-TH 14:10-15:25, room TH211
Office Hours: TH 15:30-16:30 or by appointment

1.- MATH 414.01/714.01: Topology of DNA

i.- Prerequisites:

Grade of C or better in MATH 228 (Calculus III) and
Grade of C or better in MATH 325 (Linear Algebra) **or instructor's consent**

ii.- Textbook: DNA Topology by Andrew D. Bates, Anthony Maxwell. Publisher Oxford University Press. Other reading materials will be provided throughout the course.

iii.- Bulletin Description: Students from mathematics, computer science and biology will be introduced to mathematical and computational techniques used to analyze DNA structure. Strong interaction between math and biology is emphasized. (MATH 414 and MATH 714 are paired courses. Students who have completed MATH 714 may not take MATH 414 for credit.)

iv.- Description:

We will start by describing the atomic structure of the DNA molecule and by presenting mathematical and computational methods that allow us to find structures with minimal energy (such as minimization algorithms and molecular dynamics). We will continue by introducing the concept of DNA supercoiling. We will present White's formula and its computer implementations. Next we will study random knotting of DNA. We will conclude the course by analyzing the effects of enzymes in the topology of DNA.

v.- Course Goals:

Upon successful completion all students will be proficient in the following topics:

a. DNA structure: Ability to explain the molecule of DNA and the different atomic interactions;
b. Experimental knot identification: Interpret gel electrophoresis experiments to describe different topological forms of DNA;
c. Quantitative knot identification: Describe different topological forms of DNA mathematically and computationally;

d. Algorithms: Implement and reproduce the sequence of steps of minimization, molecular dynamics and Monte Carlo algorithms (e.g. Verlet, Crank Shaft);
e. DNA geometry: Ability to define twist, link and writhe as Gauss integrals, give their geometrical interpretation, and state White's theorem;
f. Knot theory: Ability to define knots, links, Reidemeister moves, polygonal knots, tangles;
g. DNA-protein interaction: Summarize various protein-DNA interactions;
h. Tangle method: Explaining tangle analysis of site-specific recombination;

Undergraduate and graduate students will be evaluated differently as follows:

Math 414: [Research and writing] Undergraduate students will be evaluated on their ability to reformulate a DNA topology problem, revise relevant literature, design a research strategy, and infer a possible outcome, as well as on the ability to present the above in a research paper or a project proposal.

Math 714: [Research] Graduate students will be evaluated on their ability to reformulate a DNA topology problem, revise relevant literature, design a research strategy, **solve a sub-problem** and infer a possible outcome, as well as on the ability to present the above in a research paper or a grant proposal. Graduate students will be expected to undertake collaborative research and mentoring.

GRADES AND TEST POLICIES:

i.- Exams and Grading

Grading will be based on homework (20% of the grade), two midterms (40% of the final grade), final project (40% of the final grade)
Homework: There will be weekly assignments
Midterm: There will be two midterms
Final Project: Group project with presentation in class and written report (to be turned in individually).

Students will be evaluated on their ability to devise, **organize and present complete solutions** to problems. Solutions need to be presented in a **neat and organized way**; cryptic answers or untidy assignments **will not be graded**. **Complete answers** to all problems are required; **a correct answer with no reasoning or with wrong reasoning will result in partial or no credit**
The grade distribution is as follows: A (90%-100%), B (80%-89%), C (70%-79%), D (60%-69%), F (0%-59%).

ii.- Calculators: Not allowed

iii.- CR/NCR Grading

Most Mathematics classes allow CR/NCR grading, but many majors—including Mathematics—do not count CR/NCR grades towards the major. Mathematics majors should not take their Mathematics classes CR/NCR. All other majors should check with their academic advisors before deciding to take a Mathematics class CR/NCR.

If--after checking with your advisor--you want to apply for CR/NCR grading, you must log onto the web site www.sfsu.edu/student and sign up for CR/NCR grading before the **deadline** (see below-**Important dates**). Your instructor will not pass out a CR/NCR sheet in class.

iv.- Incompletes

The Incomplete grade (I) is assigned only to students doing satisfactory work until the last few weeks of a course, when events beyond the students' control prevented them from completing the course. If this happens to you, discuss with your instructor the possibility of taking an Incomplete rather than withdrawing from a class that you cannot finish.

Incompletes must be made up within twelve months of the date they are assigned. Your instructor will tell you how to make up your incomplete. **Do not enroll in the same course again.** You can only take a course once.

v.- Late and Retroactive Withdrawals

Petitions for withdrawal from a class after the **April 24th** deadline, either before the end of the semester (late withdrawal) or after the semester ends (retroactive withdrawal) must be justified by events that occurred after the withdrawal deadline. In general, only petitions for withdrawal from all courses will be approved. Late withdrawal from your math course alone is usually not approved.

vi.- Policy on make-up exams and late assignments:

No make up exams. If you know you will be missing a quiz/exam, please arrange to take the quiz/exam early. If you miss an exam AND you have an excused absence (medical excuse), your Final Exam grade will determine your midterm exam grade. This replacement policy applies only to missing one exam.

vii.- Exam re-grades

If you wish to have an **exam answer re-graded**, you must attach a written statement explaining how your answer deserves a higher score and submit the note along with the exam to the instructor within one week of receipt of your graded exam. The re-grade procedure will result in an **increase, decrease, or no change in the grade**

3.- CLASS POLICIES

Attendance:

While I do not require attendance it is to your advantage to come to class as attending lectures is the best way to learn the material. From the SFSU bulletin:

"Students are expected to attend classes regularly because classroom work is one of the necessary and important means of learning and of attaining the educational objectives of the institution." Regular attendance is suggested and encouraged. Please note that **class BEGINS at 14:10 pm and ENDS at 15:25 pm**. If a student misses a class, it is the student's responsibility to obtain lecture notes and find out about any missed announcements from fellow class members.

Attendance is REQUIRED on exam days.

NO LATE ARRIVALS OR EARLY DEPARTURES. IF YOU NEED TO LEAVE THE CLASS EARLY LET ME KNOW IN ADVANCE. REPEATED FAULTS MAY AFFECT YOUR FINAL GRADE

4.- IMPORTANT DATES

Here is a short version of the University calendar for Spring, 2008. **Note that the Mathematics Department strictly enforces the deadlines for CR/NCR grading and withdrawals.**

February 8 or 20	Last day for add permits- Last day for late permits
February 20	Last day to drop classes online
March 19	Last day to select CR/NCR grading
March 24-28	Spring Break
April 24	Last day to withdraw from a course
May 15	Last day of instruction
May 17-23	Final exams
June 2	Grades due from instructors

5.- REASONABLE ACCOMODATIONS

i.- Students with Disabilities

Students with disabilities needing reasonable accommodations must bring an official written request to their instructor from the Disability Programs and Resource Center (Student Services Building, Room 110, (415) 338-1041, drc@sfsu.edu). The DPRC is available to facilitate the reasonable accommodations process.

ii.- Religious Holidays

Reasonable accommodations will be made for you to observe religious holidays when such observances require you to be absent from class activities. It is your responsibility to inform the instructor during the first two weeks of class, in writing, about such holidays.

6.- CHANGES IN SYLLABUS

The syllabus is subject to change upon agreement between students and instructor. If you are absent from class, it is your responsibility to check on announcements made while you were absent.