Course Syllabus
NAN 747
Single-Molecule Biophysics

COURSE NUMBER: NAN 747

COURSE TITLE: Single-Molecule Biophysics

CREDITS: 3:3

PREREQUISITES/COREQUISITES: Graduate student in nanoscience or permission of instructor

FOR WHOM PLANNED: This is an elective course for students enrolled in the Nanoscience Ph.D. or Professional Masters program, and may be taken as an optional course for graduate students from other programs.

INSTRUCTOR INFORMATION:

Instructor: Adam Hall
Office: 208J Joint School of Nanoscience and Nanoengineering
Phone: 336.285.2859
E-mail: adam.hall@uncg.edu
Office Hours: By appointment

CATALOG DESCRIPTION: Experimental methodologies and theoretical underpinnings of single-molecule biophysics research, with a focus on the role of such studies in nanoscience. Topics include widely-used preparations, techniques, and models for interpreting results.

STUDENT LEARNING OUTCOMES (SLOs): Upon successful completion of this course students will:

1) Describe fluorescence techniques, including molecular tracking, live cell imaging, and FRET
2) Explain molecular detection with nanopores
3) Compare manipulation techniques including optical tweezers, magnetic tweezers, and AFM
4) Evaluate the capabilities and limitations of the current state of the art in single-molecule biophysics
5) Synthesize the most pertinent concepts in a particular research theme

TEACHING METHODS AND ASSIGNMENTS FOR ACHIEVING LEARNING OUTCOMES:
The majority of the material in the course will be presented in a lecture format driven by class discussion about the content of assigned readings. The primary source of information for these discussions will be the primary text and supplementary journal

articles (see *e.g.* References section of the syllabus). A particular emphasis will be placed on technology-driven research approaches and their applications to problems in biophysics. At the beginning of each class period, an overview of the topic at hand will be given followed by an increasingly detailed analysis of the approaches used and conclusions drawn.

Student learning will be evaluated evenly through a number of means. The class will be driven largely through Socratic discussions (SLO 1-3), making class participation extremely important (20%). Throughout the semester, two reports will be assigned (20% each) in which the student will detail the most important points of an assigned topic (chapter or paper) that we were unable to discuss in class (SLO 4). These reports will demonstrate the ability of the individual student to read technical details and distill them to their most important points in the manner that is accomplished in class (SLO 5). In lieu of a final exam, students will write a 10-15 pg. paper (25%) on an approved topic in the format of a scholarly review article (SLO 5). This review will focus on a particular biophysical question and discuss the most important ways in which that question has been addressed through the methods of single-molecule biophysics. This report will be accompanied by a conference-style oral presentation on the same topic (15%), to demonstrate acquired knowledge of the subject (SLO 5).

EVALUATION AND GRADING:

Student learning will be evaluated with class participation, two written assignments, a final written review article and a presentation.

Content		**Grading Scale**:	
Report 1	**20%**	A	94-100
Report 2	**20%**	A-	90-93
Review Paper	**25%**	B+	87-89
Presentation	**15%**	B	84-86
Class participation	**20%**	B-	80-83
		C+	75-79
		C	70-74
		F	<70

REQUIRED TEXTS/READINGS/REFERENCES:

Textbook:
The required text for this class is:

Handbook of Single-Molecule Biophysics, Peter Hinterdorfer and Antoine van Oijen (Eds.); 1st Edition (2009), ISBN: 978-0-387-76496-2

The content of this book is available *electronically* (PDF format) through UNCG access at the following address:

http://link.springer.com/book/10.1007/978-0-387-76497-9/page/1

A link to this page will appear on the class website. Additional articles will be provided on the class website. These will include:

- Journal articles that are cited by the primary text and can be used for context
- Current scholarly articles that update/improve understanding of subject (if applicable)

CLASS WEBSITE: The website for the class will provide links to articles, list homework assignments, etc. The website can be found on the instructor's lab site at:

http://jsnn-halllab.uncg.edu/teaching

TOPICAL OUTLINE/CALENDAR:

Week 1, 2: Molecular imaging and tracking with fluorescence

Week 3, 4: Forrester Energy Resonance Transfer and correlation microscopy

Week 5, 6: Molecular imaging *in vivo* and sub-diffraction imaging

Week 7, 8: Molecular detection and analysis with nanopores and nanochannels

Week 9, 10: Single-molecule manipulation with optical and magnetic tweezers

Week 11, 12: Single-molecule manipulation, imaging, and force spectroscopy with AFM

Week 13, 14: Student Presentations

ACADEMIC INTEGRITY POLICY: Each student is required to sign the Academic Integrity Policy on all assignments and tests in this course. A complete description of the Academic Integrity Policy can be found in the UNCG *Graduate Bulletin* or at http://sa.uncg.edu/handbook/academic-integrity-policy/

ATTENDANCE POLICY: Class attendance is expected. The discussion-based format will be used in part to ensure student preparedness. If a student misses a class meeting for any reason, he/she is still responsible for all of the material covered.

DISABILITY SERVICES: UNCG strives to comply fully with the Americans with Disabilities Act (ADA). If you have any kind of learning of physical disability, please contact the UNCG Office of Disability Services. You must register/petition them first. They will contact the instructor after approval.

FINAL EXAMINATION: No final exam will be given for this course.

ADDITIONAL REQUIREMENTS: None