Syllabus of Bionanotechnology

Graduate Course (56: 115:527) on:

Bionanotechnology: Discovery, Assembly, Function, and Application

Time: 6 pm – 8:50 pm, Thursday

Location: FA-219

Instructor: Jinglin Fu, Ph.D.; Associate Professor, Department of Chemistry, Center for Computational and Integrative Biology.

Contact: jinglin.fu@rutgers.edu, 856-225-6612

Office Hour: 11:20 – 12:20 pm, Monday free period

Office Hour WebEx link:

https://rutgers.webex.com/rutgers/j.php?MTID=mbece64b3c28f1771033cdfd971447027

Office: Joint Health Science Center, Room 120.

Course Description Bionanotechnology is an emerging field that applies the fundamentals of nanotechnology to solving relevant biological and chemical problems and refining new methods and tools for medicine and energy. Nanotechnology refers to the revolutionary technology that manipulates matter with matter with at least one dimension sized from 1 to 100 nanometers. Molecular structures exhibit unique properties at this scale where the quantum phenomenon starts to play an important role as compared to bulk materials. Bionanotechnology describes the overlapping multidisciplinary activities that evolves photonics, chemistry, biology, biophysics, nano-medicine, and engineering converge. The course will expose students on topics of generating new materials from naturally occurring biological materials, generating new materials using biological components or processes, the design and synthesis of de novo biologically-based materials, and the design and fabrication of bio-inspired and biomimetic materials and devices.
The course will be offered as in-person class, no hybrid nor virtual participation.

Learning Goals: Through literature studies and class discussion, students will learn the essential and emerging topics of: (1) the fundamentals of nanotechnology; (2) DNA nanotechnology and application for functional device platforms; (3) Peptide and protein nanotechnology; (4) biologically-based materials from virus and bacteria; (5) De novo design and synthesis of bio-inspired and bio-mimetic materials; (6) Super-resolution imaging of biomolecular nanostructures. (7) Computational design tools for bionanotechnology

Course Materials: The course will introduce most advanced studies in the fields of bionanotechnology. They are journal articles, designed softwares and lecture notes. Announcement, syllabus, quiz and lecture PPTs will be posted on the Canvas.
Some useful computation tools:
NUPACK: http://www.nupack.org/
Cadnano: https://cadnano.org/
TIAMAT: http://yanlab.asu.edu/Resources.html

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Some books related to Bionanotechnology:
Structural DNA Nanotechnology *by Nadrian C. Seeman*

Assessments and Grading:

	Students Grade
Class participation/discussion	10 %
Pre-lecture quiz	10 %
Projects/homework	30 %
Presentation	25 %
Short term paper	25 %

Class participation/discussion is evaluated by: How prepared you are for the lecture (e.g. quiz), are you attend the lecture on time, get involved in the discussion and ask question.

Pre-lecture quizzes are used to help students to review and prepare the contents that are going to be discussed in the coming week. Quiz question will be posted on the sakai 48 hours prior the lecture. Students are required to complete the quizzes questions and submit it on Canvas prior to every **Thursday** lecture. **Fail to submit the quiz on time will result in the loss of points.**

Projects are computational design of DNA/protein structures. They will be on class or take home. Labtop will be needed for class projects.

Presentations are required by every student. Each student will present at least once during the semester. The instructor will assign the topic and article to students. The PPT slides must be uploaded onto the assignment of Canvas. The presentation should be ~ 20 mins, followed by 10-min questions and discussions.

Short term paper is required for graduate/undergraduate students. Each student needs to select a recent science/technology progress related to bionanotechnology, and write a reading review/comment on it. **The term paper is around 3-5 page long (~ 1000 - 1500 words), 12-font size, and single space. Minimum 5 references must be cited.** The short term paper should include a title, a short abstract (less than 50 words), maintext and figures. Important! **Missing or incomplete submission of term paper** will result in a "Fail" or "IN" grade, no matter what is your overall grade.

An example term paper can be found at:

Jinglin Fu & Hao Yan "Controlled drug release by a nanorobot", Nature Biotechnology 2012, 30, 407–408. https://www.nature.com/articles/nbt.2206

"DNA self-assembly scaled up" https://www.nature.com/articles/d41586-017-07690-y

Academic Integrity: You cannot copy verbatim from any source, including other individuals in the quiz and homework. Any infractions to this rule are considered as academic plagiarism. It will be reported to the graduate school and result immediate failure of the class.

Absences from class: If student has an emergency that prevent him or her from taking the exam, Dr. Fu must be notified **48-hour in advance**. Valid excuses include medical emergency

(physician's approval of absence), family funeral, and other compelling circumstances. Proofs must be submitted to the instructor for validating the excuse**. Moe than two unexcused absences will result in a "Fail" of the course.**

COVID-19 related policy:

1. Face mask is mandatory for all the time in the classroom.
2. For all COVID-19 related sickness and quarantine, students need to report to the Deans' student office for the accommodation. https://deanofstudents.camden.rutgers.edu/
   In addition, students also need to inform the lecture instructor.

Tentative Schedule of Topics, Material Covered and Exams:

Date	Lecture Topic
9/2	Course Intro, Nanotechnology
9/9	DNA Nanotechnology
9/16	DNA Selfassembly: Student Presentation
9/23	DNA-scaffolded biomaterials: Student Presentation
9/30	Computation Design 1: NUPACK
10/7	Cancelled
10/14	Computation Design 2: Cadnano
10/21	Computation Design 3: Pymol
10/28	Peptide Nanotechnology/Student Presentation
11/4	Protein Nanotechnology/ Student Presentation
11/11	Virus/Bacteria material/ Student Presentation
11/18	Nanorobots/Student Presentation
12/2	Nanomedicine/ Student Presentation
12/9	Super-resolved imaging / Student Presentation
	Final Exam