**BIOE 479 / 598 / 598 NIO - Cancer Nanotechnology**

**Spring 2024**

**In-Person Classroom: Everitt 1306**

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Synchronous Zoom:

Join Zoom Meeting

https://illinois.zoom.us/j/3051298224?pwd=UVpVQlV5cEdmWDh1alJ0RlVLL3EvQT09

Meeting ID: 305 129 8224

Password: 233003

**Description:**

This is an in-depth elective course for undergraduate and graduate students who are interested in learning nanoscience, nanotechnology, and their applications in cancer biology and clinical oncology. The basic rationale is that nanometer-sized particles have functional and structural properties that are not available from either discrete molecules or bulk materials. Recent advances have developed semiconductor quantum dots (QDs) with size-tunable optical properties, iron oxide nanocrystals with superparamagnetic domains, plasmonic nanoparticles for electromagnetic field enhancement (e.g., surface-enhanced Raman scattering or SERS), polymeric nanostructures for drug encapsulation and release, and lipid nanoparticles for mRNA delivery and cancer immunotherapy. The topics to be discussed are of considerable interest across a broad range of research areas in engineering and medicine. This course will serve the immediate needs of graduate and undergraduate students in bioengineering, as well as students from other departments such as chemistry, materials, and electrical and computer engineering.

**Objectives**:

The objectives of this course are to familiarize students with a number of key topics including: (1) cancer biology and clinical oncology, (2) nanoscience fundamentals, (3) nanoengineering and nanotechnology, (4) major classes of nanoparticles and nanostructures, (5) cancer nanomedicine, and (6) nanoparticle mRNA vaccines, cancer immunotherapy, and biopharmaceuticals.

**Organization:**

1. **Basic Lectures**:  background and fundamentals: in-person lectures, synchronous Zoom lectures, and recorded lectures/videos for asynchronous viewing.
2. **Invited Lectures**: Zoom or in-person lectures delivered by guest speakers (scientists/engineers, clinicians/oncologists, and industrial/regulatory experts).
3. **Project Reports:** small-group or individual projects for in-depth studies of nanotechnology and nanomedicine for cancer applications, including nanoparticle vaccines for cancer and infectious diseases.

**Detailed Course Outline:**

Part 1 - Introduction to Cancer Biology and Clinical Oncology.

Part 2 - Nanoscience Fundamentals.

Part 3 - Nanotechnology Fundamentals.

Part 4 - Cancer Nanomedicine - Fundamentals.

Part 5 - Cancer Nanomedicine - Applications.

Part 6 - Frontiers and Emerging Topics: lipid nanoparticles, mRNA vaccines, nano-immunotherapy, cell-based therapies, and biopharmaceuticals.

**Hours and Credits**: Two Lectures (1.5 hours each) per Week (Tue and Thu), 3-4 Credits.

**Classroom Location**: Everitt Room 1306

**Time:** 5:00 – 6:20 pm, Tue and Thu.

**Office Hour**: Everitt Room 2116, by individual appointment (Zoom or in-person)

**Course Materials:**

1. **Recommended Textbooks (not required)**: (1) **Biology of Cancer** (Robert Weinberg, 2nd Edition). (2) **Nano-oncology: Engineering Nanomaterials for Cancer Therapy and Diagnosis (**Gil Gonçalves and Gerard Tobias, 2018). (3)[**Nanomedicine in Cancer** (Lajos Balogh, 2017).](https://www.amazon.com/Nanomedicine-Cancer-Lajos-P-Balogh-ebook/dp/B0759TYPGR/ref%3Dsr_1_15?ie=UTF8&qid=1544254836&sr=8-15&keywords=cancer+nanomedicine)
2. **Reading and Viewing Assignments** – Historical accounts, review articles, and other special items of interests.
3. **Lecture Notes and Handouts** – In-class and electronic distribution.

**Online Learning Platforms:**

1. **Zoom –** for synchronous and pre-recorded lectures.
2. **Course Website on Canvas –** All course materials will be made available on this website, including announcements, weekly updates, lecture videos, lecture notes, homework, etc).
3. **Gradescope –** for submission of homework assignments, written exams, project reports, etc.

**Attendance:** In-person or synchronous online attendance is encouraged, but not required.

**COVID-19 Cautions:** Follow university and BIOE department policies.

**Grading**: Homework and related assignments (20%), project reports (20%), mid-term quiz (20%), final written exam (40%).

**Final Grades**: Based on total scores, not curved.