Cancer Biology and Biotechnology (Biol 4015, 7015 & ISyE 8813A) Fall, 2011

Course description: The purpose of this course is to introduce students (graduate and upper level undergraduate), faculty, post-doctoral fellows and others to the major concepts of cancer biology as well as to state-of-the-art technologies that are being applied to the understanding of cancer and cancer risk, the early detection of tumors, cancer treatment, and monitoring of treatment efficacy (and recurrence). Although these topics will be covered in depth, the lectures will be geared to a multidisciplinary audience encompassing both basic scientists and engineers.

Instructor(s): Al Merrill, Biology (al.merrill@biology.gatech.edu)
Eva Lee, Industrial and Systems Engineering, Director, Center for Operations Research in Medicine and HealthCare (evakylee@isye.gatech.edu)
with faculty from the Colleges of Sciences and Engineering at Georgia Tech as well as special invited lecturers.
Teaching assistant: Andrew Huang, e-mail: biol4015TA@gmail.com

Time and location: Thursdays, Classroom: 5:05 to 7:55 pm; room L1205 ES&T
(sometimes 7:05 to 7:55 pm will be dedicated to small group meetings)

Optional textbook: No textbook covers all the information in this course, but if you want a general overview of cancer biology, two relatively recent (and good) books on cancer biology are: *Principles of Cancer Biology* by Lewis J. Kleinsmith, Pearson/Benjamin Cummings Pub. (2005) and *Biology of Cancer* by Robert A. Weinberg, Garland Science (2006). These are on reserve in the library. All of the information that you will be required to know will be presented in class or assigned research papers

The course will refer often to the recent document prepared by Georgia Tech entitled "Innovations in Cancer Biology, Detection and Treatment" which can be downloaded from T-Square or the web site:
http://gtresearchnews.gatech.edu/wp-content/uploads/2011/06/Georgia-Tech-CancerPublication-2011.pdf

Grading:

Exams	50%
Mid-term exam (30%) Final exam (20%)	
In-class participation	10%
For the graduate students, this will be written critiques of the projects in progress; for undergraduate students, this will be awarded for attendance at all of the in-class project discussions, but without a requirement to critique them.	
Team research project	40%
(Festival presentation, 10%; Written report, 30%)	

Final grades will be assigned by the scale: 90% and greater (A); 80-89% (B); 70-79% (C); 60-69% (D) Less than 60% (F)

Course format: Classes will be comprised of introductory lecture(s), discussion of research literature, and team projects.

Course Schedule

Date (lect #)	Topic	Instructor(s) (Affiliation)
Aug. 25 (1)	Overview of cancer and carcinogenesis (Chap 1-6)*	A. Merrill (GT Biol)
	Discussion of research project	
Sept. 1 (2)	Molecular biology of cancer and an overview of techniques for analysis (misc chapters; Innovations in Cancer Biology, Detection & Treatment)	A. Merrill (GT Biol)
	Discussion of research project choices	
Sept. 8 (3)	Computational methods in cancer informatics, early intervention, diagnosis, and treatment	E. K. Lee (GT ISyE)
	Discussion of research project choices	A. Merrill (GT Biol)
Sept. 15 (4)	Basic and clinical aspects of a prototypic cancer:	
	Prostate cancer (Chap. 11)	O. Kucuk (EUSM)
	Discussion of research projects	A. Merrill (GT Biol)
Sept. 22 (5)	Biosensors	W. D. Hunt (GT ECE)
	Discussion of research projects	A. Merrill (GT Biol)
Sept. 29 (6)	Cancer genetics and epigenetics	P. Vertino (EUSM)
	Discussion of research projects	
Oct. 6 (7)	Cancer detection & treatment in the era of systems biology	M. D. Wang (GT/EUSM BME)
	Discussion of research projects	
Oct. 13 (8)	Basic and clinical aspects of a prototypic cancer:	
	ovarian cancer (Chap. 11)	J. McDonald (GT Biol)
	Discussion of research projects	A. Merrill (GT Biol)
Oct. 20 (9)	Discussion of research projects	A. Merrill (GT Biol)
	Nanotechnologies	G. Bao (GT/EUSM BME)
Oct. 27 (10)	Mid-term exam	A. Merrill (GT Biol)
	Other cancers—similarities, differences, and factors in selection of detection/treatment methods (Survey; appendix A)	E. K. Lee (GT ISyE) & A. Merrill (Biol)
	Discussion of research projects	A. Merrill (GT Biol)
Nov. 3 (11)	Preparations for Poster fair	A. Merrill (GT Biol)
Nov. 10 (12)	Students critique each other in preparation for Poster fair	A. Huang (GT Biol)
Nov. 17 (13)	**Georgia Tech Festival of Research Ideas in Cancer Biology and Technology**	
	Poster set-up (4 pm) and display: 5 to 7 pm	
Nov. 24	**Thanksgiving break**	
Dec. 1 (14)	Follow-up of project reports/poster fair (Project scoring)	A. Merrill (GT Biol)
Dec. 8 (15)	This is what it all means….putting it into action	B. Todd (GT Mgt)
Dec. 15, 5 pm	**Final exam**	

*The numbers in parentheses give the related chapters from *Principles of Cancer Biology* by Lewis J. Kleinsmith in case the student feels outside reading is needed.

Team research project

The goal of this portion of the course is to give you a chance to work on a challenging problem in the area of cancer biology and technology. During the first week of class, the instructors will provide a list of problems in cancer and you will select which interest you most and form a group to work with it. The teams should have at least 4 and no more than 6 members. The number of possible themes has been limited so several teams will work on the same cancer research problem, but their approaches must be different.

As these groups are being formed, you will probably want to identify a time/place where all of the members can meet outside of class. There will be some opportunities to meet during the third hour of class, but you will probably need to have additional meetings, and we have found that it is best to identify the time at the beginning rather than discover none exist later in the semester.

You will give periodic updates on your progress during class so your classmates can learn about the topic and your plans, and they (and the instructors) can make suggestions for improving it. Graduate students will be assigned to give you a written critique of each stage of the project to help you progress more quickly to a high quality, final proposal. At the end of the semester (see course schedule) each team will present an oral report or poster in a Festival of Research Ideas in Cancer Biology and Technology, followed by a written report in the form of an NIH grant application. It is strongly suggested that your final proposal incorporate any relevant comments/suggestions that have been raised during the Festival.

After the group has been formed, pick a team coordinator, who will chair meetings and be the instructor's contact person for updates on progress, etc. Also select a recorder, who will be responsible for recording attendance, and will keep notes on who volunteers to be responsible for various tasks during the semester. Give Dr. Merrill a list of the group members with e-mail addresses of the coordinator and recorder, and the time and place where the group will meet weekly. The meeting can take place during the third hour of class (7 to 8 pm, Thursdays) or at a time more convenient to all the members of the group. It should be on campus, and preferably during usual "work hours" (8 am to 6 pm) so the TA or Dr. Merrill can drop in on your meetings, if necessary.

After you have organized the group, explore several potential solutions, then evaluate each with respect to its: a) likelihood to solve the problem in various manifestations (for example, if it is a tumor detection device, what is the likelihood of false positives and false negatives); b) how you would develop and test its efficacy; and c) developmental feasibility (e.g., is it a minor change in an established method or a novel concept that requires a lot of research and development?). Then, select the strategy that you are going to pursue and summarize how you arrived at this choice and strategy in a brief Powerpoint slide show (with 3-5 slides) and present it to the class during one of the designated in-class periods. After incorporating suggestions from the instructor/class, summarize the plan in a one-page document with a bibliography with at least 3-5 key references and e-mail this to Dr. Merrill as an attachment.

During the rest of the semester, flesh out your R&D plan with experiments, timelines, milestones, and alternative strategies for steps where you envision encountering difficulties. Summarize these in a longer Powerpoint slide show and a more in-depth text document with an appropriate bibliography. Be prepared to give updates on your progress duing the in-class periods designated for this purpose.

For each of the in-class progress reports described above, a panel of graduate students taking the course will be assigned to (each) prepare a short, written critique of the subject with comments about the basic concept, the experimental objectives that you have selected, your experimental plan, etc. These comments are provided for your use as judged appropriate, and you are welcome to discuss them with the students who prepare them and/or the TA and Dr. Merrill if you do not know whether and how to deal with the points raised.

You will present your (essentially) final report at a event called the Georgia Tech Festival of Research Ideas in Cancer Biology and Technology, which will be held in the atrium of the Petit Institute of Bioengineering and Biosciense from 4 to 7 PM on November 17. This will be publicized to the entire Georgia Tech, and some Emory, cancer research community, essentially as follows:

> Goal: The purpose of this event is to provide an open and stimulating forum for exploration of new ideas for basic and translational research in cancer biology and technology. Ideas for new research projects and data from ongoing research at Georgia Tech and the Winship Cancer Center at Emory University will be presented on posters in the Atrium of the Petit Institute for Bioengineering and Biosciences. Student presentations: Designated presentations have been prepared by students in the combined graduate/advanced undergraduate course in Cancer Biology and Technology at Georgia Tech ((BIOL4015 & 7015 and ISyE 8813A), who develop research proposals based on needs that have been brought to their attention by cancer researchers at Georgia Tech and Emory. Their posters and oral presentations are works-in-progress as they formulate their plans, therefore, attendees are encouraged to assist them by discussing the need that they are addressing, their choice of an approach, the technological feasibility, and other facets that might strengthen the plan and aid their understanding of cancer and cancer research.

Any useful suggestions/comments that you receive should be used to revise your experimental plan. On December 1, each group will have 5 min to sell their plan to the entire class, which will vote on which projects are the most exciting and likely to be successful.

The written report (due the last day of class) must be prepared in the format of an NIH grant applications (R01, R03 or R21, whichever seems to apply best to your project (see: http://grants.nih.gov/grants/funding/funding_program.htm). The forms can be downloaded from http://grants.nih.gov/grants/funding/phs398/phs398.html. As you will note, the main body of these grants is approximately 10 pages in length (double spaced), and for this course, you may limit the bibliography to approximately 20 to 25 research articles from peer-reviewed journals (more may be used if you wish). It should be divided into the same sections as described for a standard research proposal. If the work will involve samples from human subjects or experimental animals, a section should be added that addresses the major issues that are involved in such research (see http://www.osp.gatech.edu/research-policies/ for information about human investigations, IRB, and animal research, IACUC).

This report is due the last day of class, but you may turn it in earlier, which is sometimes beneficial if you have made any major mistake in format that might affect the grade (I will return a draft that has this problem to you for revision if you submit it at least a week before the final due date). This applies only to formatting errors and does not apply to the quality/content of the proposal, which I will only grade once.

All members of a project group will receive the same grade for the report (worth 25% of your final grade) **plus an individual grade (worth 5%) for a one-page synopsis that <u>each member</u> of the group needs to write and submit separately**. This individual synopsis should give a one paragraph summary of the project (in the words of that person, not cut-and-pasted from the group report) and a one paragraph summary of what that individual contributed to the project over the entire semester.

If there is any difficulty with respect to a member of the group who is not fulfilling their share of the responsibilities for the team project, contact Dr. Merrill as soon as possible. Conversely, if anyone decides they are not comfortable in a group, they should change within the first few weeks.* At the end of the semester, you will need to declare what has been your role in the final reports (at the Festival and the written report), so it is in the best interest of everyone if non-participation by any member of the team is identified and solved as soon as possible.

*In exceptional circumstances, it might be possible for a student to prepare a report alone.

Additional information (required by Georgia Tech):

All students are required to adhere to the Georgia Tech Academic Honor Code (www.honor.gatech.edu). This includes, but is not limited to, the following issues that pertain to the oral and written critiques, quizes, and exams for this class:

1. Plagiarism is not allowed. Plagiarizing is defined by Webster's as "to steal and pass off (the ideas or words of another) as one's own; use (another's production) without crediting the source."

In simpler terms: When you use any phases, sentences, etc. verbatim from another source, they must be identified by quotation marks and citation of the source. In scientific writing, it is generally preferable to rephrase information from other sources and cite the source rather than use the same text, even when you offset the text with quotation marks. When you show diagrams, models and other materials that are not your own, the sources must also be identified.

These rules apply both to published information and information that you might receive from another student, website, previous class report, etc.

Plagiarizing will be dealt with according to the GT Academic Honor Code.

2. Students are encouraged to collaborate in some aspects of the preparation of oral and written critiques, such as the early stages where you are achieving an understanding of the assigned papers; however, the final critiques must be written by each student alone.

For team oral presentations, students may collaborate in all aspects of the work, indeed, it is expected that all will contribute equally to the final product and that they will share the single grade that is awarded for the ppt presentation. Students may use copyrighted figures, etc. from publications in the ppt presentation (if appropriate citations are given) because the ppt will only be posted on the access restricted WebCt website. However, if the team uses multiple copies of any copyrighted items (such as the pdf file of a copyrighted article), each student must download their own copy from the Georgia Tech library website rather than for one student to distribute the pdf.

In the event the assigned paper has been used by a previous class, students are not allowed to use any of the ppt slides in whole or part that were prepared by the other class.

3. Unless specifically identified as group work; quizzes, tests, take–home-tests, homework, etc. are to be completed alone.

4. For Quizzes/Tests: Cheating off of another person's test or quiz is unethical and unacceptable. Cheating off of anyone else's work is a direct violation of the GT Academic Honor Code, and will be dealt with accordingly.

5. Because the exams for this course change every semester, students may use old tests as study tools.

For any questions involving these or any other Academic Honor Code issues, please consult the professors, teaching assistant, or www.honor.gatech.edu.