Syllabus

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Purpose and Nature of Course: Economics 211/Physics 201 acquaints students with various aspects of innovation — its raison d’être, major characteristics, pursuit, and desired outcomes — and entrepreneurship. The course focuses largely on projects pursued by student teams (three students per team) who conceive and conduct ambitious endeavors that illuminate the challenges of innovation. Economics 211/Physics 201 comprises two lectures per week and a third class meeting devoted to projects, presentations, and debate among project teams and members of the class. Mr. Gary Vaughan plays an important role in the course; he is an entrepreneur and educator with broad expertise and experience in business. He and other resource persons experienced in innovation and entrepreneurship will offer special guidance to particular project groups. Selected readings from books, articles and case studies are discussed in class, and visiting experts provide lectures regarding special areas of interest.

Definition of Innovation: Innovation in this course is defined as the creation, development, and/or application of new ideas or approaches to products, processes, and/or practices which usually have antecedents and usually bring value to society. The course recognizes various types of innovation: incremental, directional, intersectional, disruptive, proprietary, social, national policy, technological, and management. In some cases, the innovative changes are sufficient to generate paradigm shifts that force realignments of entire fields and/or the obsolescence of previous approaches. Some experts believe that innovation is more likely to occur at intersections between contrasting fields. In this case, an innovator’s ability to contribute to interdisciplinary activities is useful, and hence a liberal education that emphasizes breadth offers a promising underpinning for innovative activities. Prior experience, skills, and/or expertise can be very important in the pursuit of innovative projects in this course.

Impetus for Course: Economics 211/Physics 201 responds in part to several US and global developments, the first being various reports which assert that the American workforce must be better attuned to the pursuit of innovation if the US is to maintain a competitive position in the rapidly expanding global economy. Since the prevailing trend of technological growth and outsourcing is likely to persist, the sustaining of innovative leadership by the US is important if the jobs that disappeared in the recent recession are to be replaced. And secondly, addressing and solving innumerable global problems concerning energy, food, global warming, pollution control, water availability, equitable levels of consumption, and public health will require a broad range of innovation. This course attempts to bring the attention and energy of Lawrence students to the pursuit of innovation to prepare them to help address these challenges in a wide range of careers.

Prerequisites: Most students in this course have upper class standing, thereby ensuring that they bring substantial exposure to at least one discipline and/or relevant extra-curricular activity. This
prerequisite enhances the prospect for students to undertake, as members of a team, a carefully chosen and ambitious innovative project in an expeditious manner.

**Projects:** Projects in this course focus on new, innovative objects or activities that hold potential for rapid development and entrepreneurial realization. These projects need not be brought to full realization, but substantial progress toward at least partial realization is expected. Project teams should make considerable use of Mr. Vaughan’s entrepreneurial expertise and experience in regular meetings outside of class. To consider at least ten or more possible projects before narrowing the field to one, students should spend 15-20 hours casting a broad net in search of and fleshing-out bold, imaginative, compelling, and yet realistic projects. Here are a few examples that are suggestive of possible projects:

1. Develop a new product such as a piece of IKEA-like furniture, a new type of backpack gear, a piece of apparel, or a knowledge-based system based upon a distinctive algorithm.

2. Employ a “reversing the assumptions” approach or “reverse engineering” to develop a novel enterprise, cuisine, or health food such as the Scandinavian restaurant described in Johansson’s *The Medici Effect*.

3. Develop a wireless consumer product such as a personal ID system, remote key-entry system, or iPhone application that would run on a “touch” iPod.

4. Conduct a random intersection exercise (TRI) whereby one group of individuals explains five concepts from discipline X and another group five concepts from discipline Y.

**Funding Projects:** Each student team has $150 for acquiring materials, performing market research, or other project expenses. Teams are to seek verbal or written approval for these expenses from Messrs. Brandenberger, Galambos, or Vaughan. Funding beyond $150 may be approved for well-conceived and well-executed projects.

**Project Fair:** The last two days of the course are devoted to a Project Fair where each team delivers a final project presentation that serves as a product pitch. Presentations will be judged by a panel consisting of Messrs. Brandenberger, Galambos, Vaughan, and business leaders and entrepreneurs. Up to two teams will be awarded substantial grants (up to $3500) for implementation of their projects over the winter and spring.

**Expectations and Grades:** This course is quite demanding in terms of student time (about 15 hours per week) and student preparedness to participate aggressively and meaningfully (not just off-the-cuff, superficial contributions) in classroom discussion. Hence the course requires conscientious preparation for every class period, significant daily contributions to classroom discussion, and many hours spent on group projects. Your instructors advise you against taking this course merely to satisfy the “speaking intensive” requirement. Project teams in this course maintain a single, shared notebook that thoroughly documents on a daily basis the execution of the group project; each member of the team must contribute his/her fair share to the maintaining of the notebook in a neat and comprehensive fashion. Grades in this course are determined as follows: Midterm exam (15%); final exam (15%); productive meetings with Messrs. Brandenberger, Galambos, and Vaughan (10%); classroom participation (15%); individual contributions to projects (20%); individual contributions to project notebooks (10%); practice
presentation (5%); final presentation (10%). [In the case of the project and notebook, each student is evaluated separately based upon his/her apparent contributions.]

**Reading and Speaking:** Assigned readings in this course must be completed before class so that all students are prepared to contribute discussion and interaction. Since this course is “speaking intensive” and aims to incubate innovators among its survivors, uninhibited engagements in classroom activities are expected of all students on a daily basis. If a student is not prepared to embrace the various objectives and behavioral expectations of this course, then enrolling in this course is probably a mistake. Correct and sophisticated use of English, well-phrased and well-delivered, is a basic expectation in this course. Sloppy language reflects sloppy thinking, and the instructors will seek evidence of powerful thinking and compelling language. As an example of this requirement, gratuitous use of the word “like” is proscribed in this course.

**Characteristics of Innovators:** Successful innovators tend to exhibit certain character traits thought to be conducive to innovation: this course focuses on the following: confident, ambitious, insightful, cooperative, competitive, articulate, bold, productive, creative/imaginative, risk-taking, skilled, and promotional. The instructors urge students to cultivate these traits.

**Various Definitions and Attitudes Regarding Innovation:**

Adam Galambos and John Brandenberger (LU). “Innovation involves the creation, development, and/or application of new ideas or approaches to various products, processes, and/or practices, most of which have antecedents and bring value to society.”

Janet Rae-Dupree (Science writer). “Innovation is a slow process of accretion, building small insight upon interesting fact upon tried-and-true process. Just as a oyster wraps layer upon layer of nacre atop an offending piece of sand, ultimately yielding a pearl, innovation percolates within hard work over time.”

Thomas A. Edison. “Innovation can be pursued with a new idea and a pile of junk.”

Julia Douthwaite (Professor of French, University of Notre Dame). “The term innovation is anchored in revolutionary politics: before 1789, the words innovator and to innovate in French were usually associated with danger and heresy. The link to heresy later faded, but the struggle between innovation and preserving the status quo continues to this day.”

Tom Kelley (General Manager of IDEO and author of The Art of Innovation). “Innovators are proactive and energetic — they inspire, create, build on new ideas, experiment, and transform the entire culture of organizations. To succeed at innovation, people need new insights, viewpoints, and roles. IDEO’s approach to innovation is part golf swing, part secret recipe, and not very formulaic. It’s a blend of methodologies, practices, culture, and infrastructure.”

Tom Baer (LU ’74, Executive Director of the Stanford Photonics Research Center, President of the Optical Society of America, and founder of Arcturus). “Innovation is the process of converting scientific theory and experiment into commercial products of benefit to society.”

Dean Kamen (President of DEKA Research and Development, inventor of the Segway and iBOT Mobility System). “Innovation is rare; it occurs only when some idea or technology is so profoundly better than what existed before that people are willing to change.”

*The Economist* (a British weekly). “Innovation is now recognized as the single most important ingredient in any modern economy.”
David Skorton (President, Cornell University). “The key ingredient for innovation is the curiosity of the individual. If someone is curious and has the tools to sate his/her curiosity by asking questions and trying to find answers, that’s where most innovation comes from.”

Cheryl Perkins (Founder of Innovationedge, a Fox Valley consulting company). “Innovation comes from novus meaning new; it is about creating and delivering new and more effective products and services . . . Innovation elevates your lifestyle, infiltrates your shopping experiences, hastens the way you communicate with co-workers. The driver of innovation is discovery and design. A true innovation affects people by changing their habits through filling unmet needs . . . Above all, innovation creates value to society.”

Peter F. Drucker (Expert on innovation and author of Innovation and Entrepreneurship). “Successful innovators do not wait until ‘the Muse kisses them’ and gives them a ‘bright idea.’ They simply go to work. They do not look for the ‘biggie,’ the innovation that will ‘revolutionize the industry,’ or ‘make one rich overnight.’

Recent Speech: In a recent half-hour address to the National Academy of Science President Obama used the word innovation ten times. Apparently he agrees that innovation is important. Here are his passages that employed the “i” word:

1. “A half century ago, the US made a commitment to lead the world in scientific and technological innovation — to invest in education, research, and engineering. Since then our investments have steadily declined as a share of GDP and other countries are pulling ahead. . . . We are setting a goal to devote more than 3% of our GDP to R&D. We will invest in basic and applied research, create new incentives for private innovation, promote breakthroughs in energy and medicine, and improve education in math and science.”

2. “We are proposing a major commitment to basic science and applied research, from the labs of renowned universities to the proving grounds of innovative companies. . . . In no area will innovation be more important than in the development of new technologies to produce, use, and save energy.”

3. “To lead in the global economy and to ensure that our businesses can grow and innovate, we must address the shortcomings of our health care system. . . . I will charge PCAST with advising me about national strategies to nurture and sustain a culture of scientific innovation.”

4. “We also need to work with our friends around the world. Science, technology, and innovation proceed more rapidly when insights, costs, and risks are shared. . . There are states doing innovative work . . . [to make] . . . science, technology, engineering and mathematics education a top priority so as to develop the necessary workforce skills for the 21st century.”

5. “We will support fellowships, interdisciplinary graduate programs, and partnerships between academic institutions and innovative companies to meet future challenges. . . . Scientific innovation offers a chance [for greater] prosperity. It forces us to reckon with the truth, which fills us with awe . . . Science cannot supplant ethics, values, principles, or faith, but it informs them and helps put our values, morals, and faith to work – to feed a child, to heal the sick, and to be good stewards of the earth.”
Sources:
The Innovator’s Dilemma, by Clayton M. Christensen, Collins, 2002.
Is America Falling Off the Flat Earth?, Norman R. Augustine, National Academies Press, 2008.
Invention by Design by Henry Petroski, Published by Harvard University Press, 1996.

Case Studies:

Articles:
How to Kill Creativity, by T. M. Amabile, HBR Breakthrough Thinking, HBS Press, 1999.
Disruptive Innovation for Social Change, by Clayton Christensen et al., HBR December 2006.

The Economics of Science and Technology, David Audretsch et al., Journal of Technology Transfer, 27, 155–203, 2002.