Course Syllabus

ENGINEERING 1931J - Section S01, CRN 17096

'SOCIAL IMPACT OF EMERGING TECHNOLOGIES – THE ROLE OF SCIENTISTS/ENGINEERS"

Tentative (Hybrid) Course Syllabus (Fall 2020)

Time/Place: Thu 4-6:30pm; Room: TBD; Web Site: Canvas

Instructor: Arto Nurmikko

Office: 233 Barus&Holley **Office Hours**: by appointment and TBA **Phone**: 401-863-2869

Email: arto_nurmikko@brown.edu (mailto:arto_nurmikko@brown.edu)

Teaching Assistant: Sarah_Cavanagh@brown.edu (mailto:Sarah_Cavanagh@brown.edu)

Administrative Assistant: Agnes Madriega, B&H 2N, Agnes_Madriega@brown.edu (mailto:Agnes_Madriega@brown.edu)

A. Course Rationale:

In this course we will examine nature of engineering, physical and life sciences, economics, politics and their role in today's ever changing, technology-driven, highly interconnected world. What will be our role as global citizen-technologists in the decades to come and how does one prepare for this? Based on at least freshman level physical science education, the students will be expected to develop basic working knowledge of selected contemporary technologies that help identify and forecast future prospects such as future disruptions that may shape societies locally and globally.

Of particular emphasis in the course is the importance of ethical and social responsibilities which a technologist must not only be aware of but should play a role in shaping research and development and provide contributions to policymaking and corporate leadership. Put another way, how do we create future technologies which offer

true benefits to mankind – yet anticipate their potential social costs and vulnerabilities which arise, say, from workforce automation or wholesale dependence on the Internet**.** Will we give up brains as our last private space? Who will control the

ecosystem of data and technology that influence our decisions and what accountability mechanisms will be available? Where might nanotechnologies make their breakthrough? In short, where will the roads past inform us of the technology roadmap of the 21st century?

B. Course Objectives:

1. To develop an understanding of issues and contemporary social balance raised by the accelerating pace of developments of new
2. To develop and practice critical skills relevant to the analysis of the pros and cons of prospective new technologies (e.g., conceptual clarification, argument analysis, assessment of positions).
3. To develop and practice skills relevant to conducting research and writing on issues concerning technology, science and
4. To develop and practice skills relevant to preparing and delivering public

C. Course Requirements:

1. Attendance and participation (incl. weekly discussion board) 25%
2. Group research project (presentation and report) 35%
3. One 15-20 page final research paper 40%

Course Structure: The course will be organized into lectures (including guest lecturers) grouped into several critical technology sectors. These major sectors are: 1) electronic communication and the internet; 2) healthcare and human enhancement; 3) energy and environment; (4) transportation from l0cal to global scale; (5) relationship between civilian and military technology

Students will be asked to create case studies in small groups where an emerging technology is presented as an opportunity to advance frontiers of scientific innovation while assessing their possible societal impact, by design or possible unintended.

Students are guided to preparatory reading assignments requiring basic physical sciences and mathematics knowledge to develop these case specific studies (oral classroom and written presentations). Case studies could be found within areas associated e.g with development of autonomous transportation systems, tailoring personalized and global health though genomics and medical devices, and their relationship to an electronically integrated world. We ask questions about unintended consequences of technological innovations from yesterday to today to tomorrow, both good and less so.

Course Reading Material: Scientific papers/journal articles, policy papers, and extracts from books and related materials will be assigned on weekly basis. For each week, the reading materials will be posted in advance on the course bulletin board. *It is*

important that students read this material before class and be prepared to participate in active discussion, both for asking questions and offering views.

TENTATIVE CLASS SCHEDULE AND ASSIGNMENTS (may be modified):

9/10 *INTRODUCTION TO THE COURSE*; Overview of the Contents; "World as a 21st Century as a Global, Interactive Network"

MAJOR TOPIC 1: COMMUNICATION AND COMPUTING TECHNOLOGIES

9/17 Telecommunication technologies and infrastructure (from Telegraph to Optical Fibers; from Wireless Networks to the Internet of Things)

9/24 Computing, Machine Learning, and Artificial Intelligence (definition of "Human Mind" in 2050?)

10/1 Computing around us: from Video Games to Non-Fungible Tokens

MAJOR TOPIC 2: BIOTECH - HEALTHCARE AND HUMAN ENHANCEMENT

10/8 Medical diagnostics (Imaging, Genome Sequencing, Global Access)

10/15 Brain- Machine Interfaces (Assistive medical devices/prosthesis)

10/22 Genetic Tools (Modification Human Genes vs Animals and Plants)

MAJOR TOPIC 3: ENERGY SOURCES, CONSUMPTION, AND ENVIRONMENTAL IMPACT

10/29 Energy Production and Demand: Carbon, Fossil Fuels, Nuclear Power (Fusion?), Renewable Sources and Clean Energy (does such exist?). The relationship between energy consumption, energy production, and the economics of supply and demand.

11/5 Renewable Energy Sources - Prospects for Solar Energy Technologies; Global Resources for Critical Materials for Energy Generation and Technology at Large; Extraterrestial resources?

11/12 The Sustainable Earth: Energy, Resources and Environmental Costs - for a planet of 10 billion people.

MAJOR TOPIC 4: TRANSPORTATION TECHNOLOGY AND NETWORKS

11/19 Ground-based (Auto, Rail, Other; Public Vs. Private); Airborne (UAVs)

11/26 THU NOV 28 - THANKSGIVING

TOPIC 5: MILITARY TECHNOLOGIES: THE OTHER SIDE OF THE SAME COIN?

12/3 The Push-and-Pull of Technologies across the Military and Civilian Sectors. Societal benefit and impact of advanced military capabilities?

12/10 GROUP PRESENTATIONS: on chosen assigned topics (teams of ~3 students);

12/XX FINAL RESEARCH PAPER DUE (Date TBD)

GENERAL GUIDELINES

1. The format of the course will be that of a seminar in which participants are expected to attend and come prepared for all classes. Classes will involve (a) discussion of assigned readings and associated study questions and (b) group presentations on selected topics (TBD)

2. For each of weeks 2-11 of the course (~9/10-12/3), you are expected to post to the Canvas Discussion Board at least one comment/question concerning the reading assignments for that week (specific guidelines TBD). The comments and the questions should be well crafted (e.g., provide background for the question; discuss significance of the) In addition, you are encouraged to make a response to one or more comments/questions posted by others. Both the original comments/questions and the responses should be viewed as opportunities for an extended on-line discussion and as part of your preparation for class

3. In the first phase of the semester, research groups will be formed on the basis of preference for working on some topical area related to the course. During the semester, groups will be expected to formulate a specific question in their chosen area, to research the question, to prepare and present a 20 minute Powerpoint presentation to the class. As needed, I will consult with each group to help clarify the question, to assist in developing research strategies etc. A prospectus for the group project should be submitted by 11/19.

4. A final 15-20 page research paper will be due by 12/11. The paper should address one of the topics discussed in the course and it should focus on a specific question that draws out a controversy related to that topic. In the paper, you will be expected to: clarify the question, articulate your position, formulate an argument for your position, identify important objections to your argument, formulate your replies to the objections, and discuss the significance of the question and your response to it. Evaluation of the papers will be based on (a) organization, focus, and clarity of your writing, and (b) quality of the arguments provided in support of your A prospectus and an outline for your paper is encouraged to be shared with the instructor by 11/19 (email is fine).

5. The course web site (on Canvas) contains a number of resources for each of the topics we will discuss in the course. These will include: links to electronic reserves (OCRA) for assigned readings links to other assigned or optional readings; supplementary documents; and links to relevant web sites on the internet. In addition to the weekly postings, we will also make use of the Discussion Board on the web site for the purpose of extending discussions outside of class as well as for providing individuals (or groups) with an opportunity to try out ideas and arguments related to their group presentation or the individual research

Course Summary:

Date	Details	Due
Sat Oct 3, 2020	STUDY MATERIAL + DISCUSSION TOPICS AND FOR CLASS MEETING #4 (Oct 1:) COMPUTING and ARTIFICIAL INTELLIGENCE (https://canvas.brown.edu/courses/1082686/assignments/7790497)	due by 11:59pm
Sat Oct 10, 2020	STUDY MATERIAL + DISCUSSION TOPICS AND FOR CLASS MEETING #5 (Oct 8): MEDICAL DEVICE TECHNOLOGIES (https://canvas.brown.edu/courses/1082686/assignments/7791381)	due by 11:59pm
	STUDY MATERIAL + DISCUSSION TOPICS FOR CLASS MEETING #2 (September 17): Telecommunication/ Internet (https://canvas.brown.edu/courses/1082686/assignments/7788569)	due by 11:59pm
	STUDY MATERIAL + DISCUSSION TOPICS FOR CLASS MEETING #3 (September 24): Big Data ... and Pandemics (https://canvas.brown.edu/courses/1082686/assignments/7789606)	due by 11:59pm

Date	Details	Due
	STUDY MATERIAL FOR CLASS#1 - POLL OF IMPACTFUL TECHNOLOGIES (https://canvas.brown.edu/courses/1082686/assignments/7786362)	due by 11:59pm
Tue Oct 20, 2020	STUDY MATERIAL + DISCUSSION TOPICS AND FOR CLASS MEETING #6: BRAIN-MACHINE INTERFACES (https://canvas.brown.edu/courses/1082686/assignments/7792176)	due by 11:59pm
Tue Oct 27, 2020	STUDY MATERIAL + DISCUSSION TOPICS AND FOR CLASS MEETING #7: INVENTIONS THAT CHANGED THE WORLD (https://canvas.brown.edu/courses/1082686/assignments/7792883)	due by 11:59pm
Tue Nov 3, 2020	STUDY MATERIAL + DISCUSSION TOPICS AND FOR CLASS MEETING #8: GENETIC ENGINEERING (https://canvas.brown.edu/courses/1082686/assignments/7793856)	due by 11:59pm
Tue Nov 10, 2020	STUDY MATERIAL + DISCUSSION TOPICS FOR CLASS MEETING #9 : Global Energy Drivers: Consumption and Production (Nonrenewable) (https://canvas.brown.edu/courses/1082686/assignments/7794695)	due by 11:59pm
Tue Nov 17, 2020	STUDY MATERIAL + DISCUSSION TOPICS AND FOR CLASS MEETING #10: A SUSTAINABLE PLANET EARTH ? (https://canvas.brown.edu/courses/1082686/assignments/7795297)	due by 11:59pm
Tue Nov 24, 2020	STUDY MATERIAL + DISCUSSION TOPICS AND FOR CLASS MEETING #11: RENEWABLE ENERGY SOURCES/TECHNOLOGIES (https://canvas.brown.edu/courses/1082686/assignments/7796091)	due by 11:59pm
Tue Dec 8, 2020	STUDY MATERIAL + DISCUSSION TOPICS AND FOR CLASS MEETING #12: DUAL USE OF TECHNOLOGY (https://canvas.brown.edu/courses/1082686/assignments/7797306)	due by 11:59pm
Thu Dec 10, 2020	Group Presentation (https://canvas.brown.edu/courses/1082686/assignments/7798076)	due by 11:59pm
Fri Dec 11, 2020	Final Paper (https://canvas.brown.edu/courses/1082686/assignments/7798077)	due by 11:59pm