Rothberg International School

בית הספר לתלמידים מחו"ל ע"ש רוטברג

THE HEBREW UNIVERSITY OF JERUSALEM

האוניברסיטה העברית בירושלים

Breakthrough Technologies: Shaping the Future (48788)

Course Instructor: Dr. Elishai Ezra Tsur

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July 02 – 24, 2019

Sunday: 8:00hrs - 20:00hrs and Tuesday: 8:00hrs - 18:00hrs*

45 Academic Hours, 3 Academic Credits

* Class hours will vary according to field trips and course activities.

This course can be taken as a single course or as a component of the 6-credit program **InnovNation***, which is comprised of the following two courses: "Start Ups and Innovation: The Israeli Model" and "Breakthrough Technologies: Shaping the Future". Since these two courses are designed to complement each other we strongly recommend participants to enroll in both courses.*

Course Description

This course analyzes how breakthrough developments in fields such as 3D printing, neuroscience, bionics, robotics, nano-tech, biomed, genetics, cyber-computing, artificial intelligence, clean-tech, and autonomous transportation may impact our lives, industries and society in the next five to fifteen years. Throughout the course, participants will meet experts from different disruptive technologies and gain exposure to some of the latest breakthroughs developed in Israel. With the insight gained, students will be better prepared to face and seize the opportunities and challenges arising from the emergence of these exponentially growing technologies.

Site Visits and Meetings

Through a wide array of guest lectures and behind-the-scenes visits to cutting-edge research institutes and high tech companies in Israel's entrepreneurial ecosystem and high tech industry, participants will meet face-to-face with:

● Groundbreaking Scientists and Thinkers

● Researchers from innovative Labs and Institutes

- Executives from disruptive Hi-Tech Companies
- Prominent Industry and Technology Experts
- R&D staff from Leading Multinational Firm

Due to the busy and dynamic schedules of the companies and guest speakers that collaborate with this initiative, meetings and visits are subject to change and will be finalized on a later date. As a reference only, participants may refer to last year's itinerary for the InnovNation program.

Course and Study Visits Outline

Throughout the course, participants will learn about the impact of technology on human evolution and the general status of emerging and future technologies, latest developments, leading innovators and companies in the following industrial fields:

1. Technology & Human Evolution
2. Agriculture & Food
3. Water & Energy
4. Transportation
5. Materials & Production
6. Medicine and Healthcare
7. Security
8. Internet & Artificial Intelligence

Application Requirements

This course is open to undergraduate and graduate students who have completed at least one year of study in the areas of Business, NPO Management, Economics, Natural & Applied Sciences, Engineering, and Entrepreneurship. Professionals and Entrepreneurs are also welcome to apply.

Assignments and Grading

Participants who do not require academic credits will be exempt from these requirements and will be able to obtain an active participation certificate.

- 10% - Class attendance and participation
- 70% - Final Assignment
- 20% - Presentation

Final assignment:

The course provides a broad review of current cutting-edge technologies and progressing trends. Students will prepare a report about any one of the breakthrough technologies or its derivatives studied during the

course. In the report, students will analyze the selected technology, its possible effects on the industry and society, and the opportunities and threats posed by the technology in the next decade.

The paper has to incorporate data from 5-8 academic papers / industrial reports or evaluation.

Note: The topic for each paper and main references (3-5) must be approved by the course instructor, Dr. Elishai Ezra Tsur (elishai85@gmail.com)

● Undergraduate students can prepare the final assignment in groups of up to 3 members, delivering 10-page paper (including references). **The paper must be submitted no later than two week after the last class (**August 10).

● Graduate students submit individually a 15-20-page paper within 2 months following course completion.

It is mandatory for all students to attend classes, guest lectures, field trips, etc. Failure to attend classes will result in a student being denied the right to partake in the final assignment and receive a final grade in the course. Students who have a justified reason to miss class (illness, mourning, etc.) must communicate with their instructors and the Department of Summer Courses and Special Programs, and complete the material that they miss. Students who miss class due to illness must obtain a signed and stamped sick note from a treating physician and submit it to the Department of Summer Courses and Special Programs immediately following their return to class. Failure to do so will result in an unexcused absence. The Department reserves the right to refer the issue to an Academic Committee. In some cases, the Academic Committee may decide, in light of the requirements of the course, that it is not possible to make up the missing course work.

Plagiarism will not be accepted and will lead to disqualification of the paper.

Recommended Bibliography

READING LIST

The order and topics of the lectures may vary according to the background and area of expertise of speakers and companies that will take part in the program.

1. Technology & Human Evolution

Topics

Ethical, legal & regulatory aspects of future technologies, technology & society, technological evolution, exponential technologies

Bibliography

● Kurzweil, Ray (2006), *The Singularity is Near*, New York: Penguin. **Overseas Library 612.82 K96**

● Harari, Yuval N. (2014), *Sapiens: A Brief History of Humankind*, London: Vintage Books. **Overseas Library 909 H254**

● Harari, Yuval N. (2016), *Homo Deus: A Brief History of Tomorrow* (2016), New York : Harper. **Overseas Library 909 H254**

2. *Agriculture & Food*

Topics (among others)

Genetic engineering of plants, synthetic meat, robotic farms, prevention of aging and decay

Bibliography

● George Acquaah (2012) *Principles of Plant Genetics and Breeding*, Wiley. **E-book**

3. *Water & Energy*

Topics (among others)

Smart cities, solar energy, green tech, green energy

Bibliography

● Diamandis, Peter H. (2012), *Abundance: the future is better than you think,* New York: Free Press. **Overseas Library 303.48 D537**

● Peter H. Raven, David M. Hassenzahl, Mary Catherine Hager, Nancy Y. Gift, Linda R. Berg (2015), *Environment*, Wiley **Overseas Library 574.5 R253**

4. *Transportation*

Topics (among others)

Autonomous cars, peak oil, electric vehicles

Bibliography

● Vivek Wadhwa (2017). *The Driver in the Driverless Car: How Our Technology Choices Will Create the Future*, Berrett-Koehler Publishers **Overseas Library 303.48 W122**

5. *Materials & Production*

Topics (among others)

Rapid prototyping (Objet, Shapeways, Cubify, etc.), C&C manufacturing, nano-materials and smart materials

Bibliography

● Chris Anderson (2014), *Makers: The New Industrial Revolution,* Crown Business **Overseas Library 338.04 A544**

6. *Bio-medical Engineering*

Topics (among others)

Tissue engineering, stem cells, medical robotics, tele-medicine, designer babies, brain-machine interfaces, genetic engineering

Bibliography

● Francis S Collins (2011), *The Language of Life: DNA and the Revolution in Personalized Medicine*, Harper **E-BOOK**

● Hessel, Andrew, Goodman, Marc & Kotler, Steven (2012), "Hacking the President's DNA", *The Atlantic*. **Free access**: http://www.theatlantic.com/magazine/archive/2012/11/hacking-the-presidents-dna/309147/

● Lebedev, Mikhail A. & Nicolelis, Miguel A.L. (2006), "Brain–machine interfaces: past, present and future", *Trends in Neurosciences*, vol. 29, p. 536-546. **E-journal**

7. *Security*

Topics (among others)

Airport security, future of military, military technologies

Bibliography

● Marc Goodman (2015), *Future Crimes: Everything Is Connected, Everyone Is Vulnerable and What We Can Do About It*, Doubleday **Overseas Library 364.1 G653**

8. *Internet & AI*

Topics (among others)

Privacy, bots & AI, narrative science, IBM's Watson

Bibliography

● Saemnz, Aaron (2011), "From Jeopardy! to insurance – IBM's Watson AI hired by Wellpoint for medical exertise", *Singularity Hub*. **Free access**: http://singularityhub.com/2011/09/20/from-jeopardy-to-insurance-ibms-watson-ai-hired-by-wellpoint-for-medical-expertise/

● Nowak, Peter (2012), "Silicon sirens: The naughty bots out to seduce you", *New Scientist*. **Free access**: http://www.newscientist.com/article/mg21428705.900-silicon-sirens-the-naughty-bots-out-to-seduce-you.html

● George, Alison (2006), "Living online: The end of privacy?", *New Scientist*. **Free access**: http://www.newscientist.com/article/mg19125691.700-living-online-the-end-of-privacy.html

Thought provoking SciFi movies recommendations:

1. GATTACA
Full genome screening for everyone and genetic prejudice.
The birth of two brothers:
https://www.youtube.com/watch?v=eRpQMW77T_o

2. Sight - a short Israeli SciFi movie (7min).
Futuristic date and Augmented reality.
https://www.youtube.com/watch?v=lK_cdkpazjI

3. Robocop 2014.
Autonomous war robots and man-machine interface.
Occupation of Tehran scene:
https://www.youtube.com/watch?v=aXUMP9cP5G8

4. Transcendence.
Over popularized, yet, some nice demonstrations of Artificial general intelligence (AGI) and Nano-robotics tissue regeneration.
Ecological prospects of nanobots scene:
https://www.youtube.com/watch?v=VCTen3-B8GU

5. Ex-Machina.
Excellent thriller about Artificial General Intelligence, Robotics and Ethics.
Human rights to non-human intelligence:
https://www.youtube.com/watch?v=8gVY6pC4F54

6. AI.
Artificiall General Intelligence (AGI), Robotics, Bioism (the discrimination and racism of artificial life by biological life).
Pool scene:
https://www.youtube.com/watch?v=pTAmOvTVnm0

7. The lawnmower man.
Virtual reality.
Virtual sex scene:
https://www.youtube.com/watch?v=sYkgWJzJ6fE

8. Big Hero 6.
Swarm robotics, Medical robots.
Microbots swarm:
https://youtu.be/ep2-W1X65KI

9. Uncanny valley - short movie 9 min
Virtual reality, future psychopathology, future wars, wisdom of the crowds
https://www.youtube.com/watch?v=UXX0TRtg5Vk