



האוניברסיטה העברית בירושלים  
THE HEBREW UNIVERSITY OF JERUSALEM

Rothberg International School  
Department of Summer Courses  
and Special Programs

ביה"ס לתלמידים מחו"ל ע"ש רוטברג  
המחלקה לקורסי קיץ  
ותוכניות מיוחדות



## **Breakthrough Technologies: Shaping the Future (SPEC203)**

*Course Instructor: MSc. Erez Livne*

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July 03 – 27, 2016

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

45 Academic Hours, 3 Academic Credits

*Note: The opening session will take place on Thursday July9 at Rothberg International School Classroom (RIS) 301 between 14:00-20:15hrs. 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.*

### **Abstract**

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

- 65% - Weekly assignments
- 25% - Final Assignment
- Bonus 15% - Presentation

### **Weekly assignment:**

An short online survey will be available throughout the course (<http://goo.gl/forms/UTrlvtQp2YnMIPW52>). Students are required to answer questions, describe their reflections of what they have learnt and offer general feedback after each of the days of the course (dates: 5.7, 10.7, 12.7, 17.7, 19.7, 24.7, 26.7). The online survey will be available for submissions until two weeks after the last class (9.8), yet students are encouraged to submit the surveys during the week of the relevant class.

### **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.

Note:

- The topic for each paper must be approved by the course instructor, Erez Livneh ([erezliv@gmail.com](mailto:erezliv@gmail.com))
- Students are required to submit a 5-page paper which includes its references.
- Undergraduate students can prepare the final assignment in groups of up to 3 members. **The paper must be submitted no later than two week after the last class (18.8).**
- Graduate students submit individually a 15-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**

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**

### ***2. Agriculture & Food***

#### Topics (among others)

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

#### Bibliography

- A Report on Genetically Engineered Crops; Rader; Revised 2008.  
[http://members.tripod.com/c\\_rader0/gemod.htm](http://members.tripod.com/c_rader0/gemod.htm)

### ***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**

## **4. Transportation**

### Topics (among others)

Autonomous cars, peak oil, electric vehicles

### Bibliography

- Let the Robot Drive: the Autonomous Car of the Future Is Here; Vanderbilt; Wired, 2012.  
[http://www.wired.com/magazine/2012/01/ff\\_autonomoucars/](http://www.wired.com/magazine/2012/01/ff_autonomoucars/)
- The Economics of Traffic Congestion; Arnott, Small; American Scientist, 1994.  
<http://www.econ.ucsb.edu/~tedb/Courses/Ec1F07/traffic.pdf>

## **5. Materials & Production**

### Topics (among others)

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

### Bibliography

- It will be Awesome if They Don't Screw it Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology; Weinberg, 2010. <http://publicknowledge.org/it-will-be-awesome-if-they-dont-screw-it-up>
- Weinberg, Michael (2010), "It will be Awesome if They Don't Screw it Up: 3D Printing, Intellectual Property, and the Fight Over the Next Great Disruptive Technology", *Public Knowledge*.  
<http://publicknowledge.org/it-will-be-awesome-if-they-dont-screw-it-up>
- Murphy, Erin B. & Wudl, Fred (2010), "The world of smart healable materials", *Progress in Polymer Science*, vol. 35, p. 223-251. **E-Journal** (<http://dx.doi.org/10.1016/j.progpolymsci.2009.10.006>)

## 6. *Bio-medical Engineering*

### Topics (among others)

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

### Bibliography

- Hessel, Andrew, Goodman, Marc & Kotler, Steven (2012), "Hacking the President's DNA", *The Atlantic*.  
<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. [EJOURNAL \(http://dx.doi.org/10.1016/j.tins.2006.07.004\)](http://dx.doi.org/10.1016/j.tins.2006.07.004)

## 7. *Security*

### Topics (among others)

Airport security, future of military, military technologies

### Bibliography

- Bogue, Robert (2009), "Exoskeletons and robotic prosthetics: a review of recent developments", *Industrial Robot: An International Journal*, vol. 36, p. 421 - 427.  
[EJOURNAL \(http://dx.doi.org/10.1108/01439910910980141\)](http://dx.doi.org/10.1108/01439910910980141)

## 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 expertise”, *Singularity Hub*. <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*. <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*. <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](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](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. Trancendence.**

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.**

Artificial 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://www.youtube.com/watch?v=ttX4H4WkrJM>

## **9. Uncanny valley - short movie 9 min**

Virtual reality, future psychopathology, future wars, wisdom of the crowds

<https://www.youtube.com/watch?v=UXX0TRtg5Vk>