

Technion Israel Institute of Technology

Technion International

Spring Semester 2020/21

Course Syllabi

Table of Contents

Chemical Engineering	3
Soil Chemistry – 014956	3
Membrane Process Lab – 056379	3
Ecological Engineering in Daily Lives – 054376	3
Catalysis on Surfaces – 056398	ļ
Fundamentals of Bionanotechnology – 648011	5
Biotechnology and Food Engineering	7
Biotechnology Lab - 064508	7
Advanced Technologies – 064209	7
Fundamentals of Bionanotechnology - 648011	7
Mathematics	3
Int. to Probability and Statistics – 094481	3
Differential and Integral Calculus 1 – 104003)
Linear Algebra – 104019	L
Partial differential equations – 10422812	2
Differential and Integral Calculus 1M 10401813	3
Algebra 1/Extended - 104016	5
Civil Engineering16	5
Planning and Control of Construction Projects – 01461716	5
Project I - Construction management – 01460118	3
Air pollution - 016302	3
Human Resource Management in Construction - 01461319)
Construction Methods - 01461019)
Introduction to financial management - 01461520)
Earthmoving Equipment & Systems - 015017)
Introduction to Engineering Mechanics – 01410322	L
Introduction to Materials Engineering – 31453522)
Geomechanics - 01440922	2
Water resources systems engineering – 01620323	3
Mechanical Engineering24	ļ
Introduction to Robotics – 035001	ļ

Design for Manufacturing Project – 034371	24
Theory of Vibration – 034011	25
Introduction to Mechatronics – 034022	26
Introduction to Financial Management – 014615	27
Advanced Control Lab – 034406	28
Kinematics Dynamics & Control of Robots – 036026	28
Finite Elements For Engineering Analysis – 035022	28
Research Project in Mechanical Eng. 2 – 034381	29
Experimental Methods Laboratory – 034039	29
Int. to Experimental Methods – 034044	29
Solid Mechanics 2 – 034029	
Introduction to Engineering Drawing - 034042	31
Heat Transfer – 034041	
Introduction to Control – 034040	34
Introduction to Control – 034040 Humanities	34 36
Introduction to Control – 034040 Humanities Issues in Contemporary Israeli Society – 324879	34
Introduction to Control – 034040 Humanities Issues in Contemporary Israeli Society – 324879 Archaeology of Israel - 324880	
Introduction to Control – 034040 Humanities Issues in Contemporary Israeli Society – 324879 Archaeology of Israel - 324880 Politics of Identities: A Multicultural Perspective on Israeli Society - 324282	
 Introduction to Control – 034040 Humanities Issues in Contemporary Israeli Society – 324879 Archaeology of Israel - 324880 Politics of Identities: A Multicultural Perspective on Israeli Society - 324282 Terrorism, Jihad and State Response - 324299. 	
Introduction to Control – 034040 Humanities Issues in Contemporary Israeli Society – 324879 Archaeology of Israel - 324880 Politics of Identities: A Multicultural Perspective on Israeli Society - 324282 Terrorism, Jihad and State Response - 324299 Other	
Introduction to Control – 034040 Humanities Issues in Contemporary Israeli Society – 324879 Archaeology of Israel - 324880 Politics of Identities: A Multicultural Perspective on Israeli Society - 324282 Terrorism, Jihad and State Response - 324299 Other Thermodynamics – 034035	
Introduction to Control – 034040 Humanities Issues in Contemporary Israeli Society – 324879 Archaeology of Israel - 324880 Politics of Identities: A Multicultural Perspective on Israeli Society - 324282 Terrorism, Jihad and State Response - 324299 Other Thermodynamics – 034035. System Analysis – 014004	
Introduction to Control – 034040 Humanities Issues in Contemporary Israeli Society – 324879 Archaeology of Israel - 324880 Politics of Identities: A Multicultural Perspective on Israeli Society - 324282 Terrorism, Jihad and State Response - 324299 Other Thermodynamics – 034035 System Analysis – 014004 Introduction to Computer Language C – 234126	
Introduction to Control – 034040 Humanities Issues in Contemporary Israeli Society – 324879 Archaeology of Israel - 324880 Politics of Identities: A Multicultural Perspective on Israeli Society - 324282 Terrorism, Jihad and State Response - 324299 Other Thermodynamics – 034035 System Analysis – 014004 Introduction to Computer Language C – 234126 Physics 2 – 114052	
Introduction to Control – 034040 Humanities Issues in Contemporary Israeli Society – 324879 Archaeology of Israel - 324880 Politics of Identities: A Multicultural Perspective on Israeli Society - 324282 Terrorism, Jihad and State Response - 324299 Other Thermodynamics – 034035 System Analysis – 014004 Introduction to Computer Language C – 234126 Physics 2 – 114052 Water Chemistry – 014327	

Chemical Engineering

Soil Chemistry - 014956

Soil Texture, Clay Minerals, Formation and Classification of Soil, Double Layer, Ion Exchange and Ion Adsorption, Flocculation- Dispersion, Calcareous, Saline and Acid Soils, Soil Organic Matter, Nitrogen Cycle, Plant Nutrition, Agricultural Activity and Environmental Pollution.

Contact hours:

Lecture: 2 hours Lab: 2 hours Credit points: 2.5

Membrane Process Lab – 056379

The Purpose of This Laboratory Is to Train the Students in Membranes Separation Processes, Including Reverse Osmosis, Ultrafiltration, Nanofiltration, Microfiltration, Gas Separation and Pervaporation.

Contact hours: Lab: 4 hours Credit points: 2

Ecological Engineering in Daily Lives – 054376

Utilization of Engineering Knowledge in Daily Life, with Focus on the Principles of Ecological Devices Encountered in the Home Environment. Introduction of Ecological Devices Encountered in Daily Lives, and Their Engineering Principles. Among the Introduced Devices: Desert Coolers, Solar Cookers, Geothermal Cooling, Photovoltaic Panels, Natural Construction Materials.

Contact hours: Lecture: 2 hours

Catalysis on Surfaces – 056398

Role of the Catalytic Surface, Reactivity of Surfaces, Absorption/ Desorption on Surfaces, Catalyst Porous Structure, Electronic Metal Support Interactions, Lewis- Bronsted Acid- Base Heterogeneous Catalysts, Synthesis and Charechterization of Heterogeneous Catalysts, Heterogeneously Catalyzed Reactions Pertaining to the Synthesis of Alternative Fuels.

Learning Outcomes

At the End of the Course the Student Will Be Able to:

1. Understand the Role of the Catalytic Surface.

2. Understand the Functionality and How to Compute Parameters Relevant to the Catalyst Physical and Chemical Parameters.

- 3. Know the Effect of the Catalyst Electronic and Surface Properties on Catalytic Perfomance.
- 4. Explore Catlyst Synthesis and Charechterization Methods.
- 5. Correlate Catalytic Properties and Reactions Relavant to Alternative Fuels.

Contact hours:

Lecture: 2 hours Credit points: 2

<u> Plant Design M – 054410</u>

Course Objectives:

Students enrolled in this course will participate in the development of a process package, as an "employee" in an imaginary company, assigned to a section group. The course will simulate the main tasks of such an engineer, who will be given the opportunity to demonstrate management and leadership skills. The end result of the course will be a complete process package, developed by teamwork between the student-engineers of each company.

Course Policies:

Workshops:

Most lectures have an associated workshop in which students will get an opportunity to solve homework while getting support from the course staff.

Homework:

The homework exercises are designed to help you understand the material taught in the course. It will be very difficult for you to keep up with the course if you do not solve them yourself. The homework exercises can be downloaded from the Assignments Page. Homework exercises will be assigned every week and solutions provided on the web site on the following week. No credit is given for homework.

Proficiency Exam:

The proficiency exam will test your capability of using the materials learned in the course. This exam will be closed-book.

Grading:

The course grading is distributed according the following table. Please note that to pass the course, you must get a passing grade (55 % and above) in the Proficiency Exam. Students who do not the exam will be graded according to these items alone.

Component	Percentage of Grade
Proficiency Exam	30 %
Individual Performace	10 %
Final Project	60 %
Total Grade	100 %

Contact hours:

Lecture: 2 hours Recitation: 2 hours Credit points: 3.5

Fundamentals of Bionanotechnology – 648011

Nanobiotechnology is an arm of nanotechnology that studies and makes use of the advantages of nanomaterials at the interface with biological systems. There are numerous potential applications, e.g. in medicine (drug delivery, tissue engineering), in bio-nanosensors (using cells, or biological components, like antibodies, nucleic acids etc.) as part of sensitive nano sensors.

In this course, following an introduction to cell biology, and several examples of the various applications of bionanotechnology, we will focus on one important application in nanomedicine. We will study why nanotechnology grants major advantages over conventional treatment approaches, for treating different diseases, including cancer.

Course Objectives:

- The course will describe various types of nanoparticles, including liposomes lipid based vesicles.
- This course will deal with the fundamental aspects of constructing medicinal nanoparticles: from the molecular building blocks to the formation of drug carriers.
- The thermodynamic basis and practical approaches for fabricating nanoparticles will be studied.
- The course will deal with approaches for loading and delivering drugs and genes to disease sites using nanotechnology.
- Approaches for targeting drugs to specific organs and to diseased tissues will be described.
- The application of nanobiotechnology, and specifically, nanomedicine, will be studied.

Course requirements:

1) Weekly - upload a one-page summary of the materials learned online during this week. In addition, the students will be asked to participate in the course forums.

2) Once per semester - upload a filmed summary (up to15 minutes) that deals with the learning materials taught during one week of the course.

3) Once per semester - upload a filmed project (at least 20 minutes) that deals with a specific topic/product/research area within the broader field of NanoBioTechnology. The project should touch the science at base of this topic and the practical applications of the topic for daily life.

Grading:

The course grade consists of these components:

30% – Weekly – Mandatory weekly online reading/online course, and a writing assignment to summarize the read materials in one paragraph in the class Moodle. As well as an online class quiz after the Tirgul is placed online – to verify the materials were clear to the students.

30% – Once a semester – A filmed Tirgul the student will convey to his/her fellow students on one of the home assignments.

40% – Final Project – an online project presentation with sound and visuals on a topic of choice within the field of BioNanoTechnology. A peer review system will be applied in which each group will also evaluate a peer group by raising 5 questions that seem unanswered in the presentation.

5% - Bonus – Addition of novel contents (such as interesting papers, outstanding online lectures or unique presentations) to the course material will grant a bonus to the final grade.

Contact hours:

Lecture: 3 hours Recitation: 1 hour Credit points: 3.5

Biotechnology and Food Engineering

Biotechnology Lab - 064508

Description:

Growth of E. Coli on Two Sugars, Regulation of Aspartokinase in E. Coli, Macromolecular Composition as a Function of Growth Media. Mutagenesis and Screening for Auxotrophs Via Transposons. Transformation of Plasmid Dna in Bacilli. Operation of Fermentors.

Contact hours:

Lecture: 2 hours Lab: 4 hours Credit points: 3.5

Advanced Technologies – 064209

Description:

Advanced Aspects of Engineering and Technology in Biological Systems: Microbial and Enzyme Inactivation, Advanced Measurement Characterization Techniques, Advanced Preservation Technologies (Ohmic Heating, High Hydrostatic Pressure, Pef, Shock-Waves), Supercritical Fluid Extraction, Membranes, Control, Process Development. Lab Exercises Include Microwave Heating, Water- Product Relations, Ohmic Heating, Shock Waves, and Membrans. Students Perform a Product Development and Process-Planning Project.

Contact hours:

Lecture: 2 hours Recitation: 2 hours Lab: 4 hours Credit points: 5

Fundamentals of Bionanotechnology - 648011

Description:

Introduction to Bionanotechnology and Overview of Nanobiomaterials: Biomolecules, Cell Structure and Function, Effect of Nanolength Scale on Properties and Self-Assembly. Preparation and Characterization Techniques of Bionanostructures: Surface Patterning and Functionalization. Soft Lithography. Principles and Applications of Bionanotechnology: Nanomedicine Diagnostics and Imaging, Engineering Multifunctional Drug Nanodelivery Platforms, Toxicity of Nanomaterials, Fundamentals of Bionanoelectronics, Bionanosensors, Lab- on- a- Chip Devices, Biotemplating, Biocompatible Inorganic Devices, Protein- Based Nanostructures: Bacterial and Mammalian Nanomotors, Nano Printing of Dna, Rna and Proteins. Nanotechnology in Tissue Engineering.

Contact hours:

Lecture: 3 hours Recitation: 1 hour Credit points: 3.5

Mathematics

Int. to Probability and Statistics – 094481

Description:

This course will present an introduction to the basic principles and vocabulary of probability and statistics. The first part of the course is an introduction to probability, including models commonly used in engineering. The second part of the course covers statistical methods for data analysis and the tools of statistical inference: drawing conclusions about a process or population from a sample.

Literature:

All the relevant material will be provided in the lectures and tutorials. Lecture slides and tutorial material are on the Moodle and should be downloaded by the students. Three supplementary books that include more than required are:

Freedman D., Pisani R. and Purves R. Statistics, Norton, New-York, 1998, 3rd edition.

Walpole R.E. and Myers R.H. Probability and Statistics for Engineers and Scientists, MacMillan, 1998.

Devore J.L. Probability and Statistics for Engineering and Sciences, 1991.

Course Objectives

- Probability model, conditional probability, Bayes' Law, independence.
- Discrete random variables: probability and distribution functions, mean and variance.
- Special discrete random variables: binomial, geometric, Poisson, hypergeometric, uniform.
- Joint random variables: bivariate distributions, covariance, independence.
- Continuous random variables: density and distribution functions, mean and variance.
- Special continuous random variables: exponential, uniform.
- Normal distribution and central limit theorem, including normal approximation of binomial distribution.
- Statistical inference, sampling distributions, point estimation methods and properties.
- Point estimates and confidence intervals for mean, standard deviation and proportion.
- Hypothesis testing: type I and type II errors, significance, pvalue, power, meaning of "reject"/"don't reject", sensitivity to sample size.
- Comparing means and variances of two independent populations, comparing means for paired data.
- Tests for goodness of fit and for association.
- Simple linear regression: definition of model, R2, sums of squares, confidence curves

Course Expectations & Grading:

A homework assignment will be given each week. All homework must be submitted; it can be prepared in pairs. Each week one randomly selected question will be graded. The overall homework grades will be based on the best 10 of 12 weekly homework grades. The final examination will be open-book and open-note and will require

a hand calculator (no laptops allowed). The examinations will cover only the material presented in the lectures and tutorials. The final grade will be calculated as follows:

20% homework grade

80% final examination grade

It is essential to keep up by doing the homework, as current concepts and methods taught will be based on previously taught material.

Contact hours:

Lecture: 3 hours Recitation: 2 hours Credit points: 4

Differential and Integral Calculus 1 – 104003

The real numbers as a complete ordered field, infinite sequences of real numbers, real valued functions of a single real variable: limits and continuity, continuity on a closed interval, monotonic functions, inverse functions, differentiability and the fundamental theorem of differential calculus, Taylor's theorem, L'Hopital's rule, curve tracing, elementary, functions, methods of integration, definite integrals, integrable functions, fundamental theorems of integral calculus, improper integrals. Sequences and numerical infinite series, power series.

Description:

- Sequences
- Functions Limits and Continuity
- Derivatives
- The Basic Theorems of the Differential Calculus
- Indefinite Integrals
- Definite Integrals and the Fundamental Theorem of Calculus
- Improper Integrals
- Series and Power Series

Contact hours

Lecture: 4 hours Recitation: 2 hours

Process Analysis Using Numerical Methods – 054374

Description:

The course objective is to provide students with the knowledge and experience to apply numerical methods efficiently to the solution of engineering problems. Given a problem to be solved, the student should be able to select the appropriate numerical algorithm to use, implement it, and interpret the obtained numerical approximation. As part of the course the students will be using *C* or *Matlab* intensively to test the methods taught on practical examples. Basic Numerical analysis is based on Linear Algebra, Taylor series, and solving algorithms using a computer according with the sketch below. This course is then heavily based on your previous courses in Linear Algebra, *C* or *Matlab*, and Ordinary Differential Equations.

The topics covered in the course are:

- 1. Basic concepts in numerical analysis
- 2. Solution of linear algebraic equations
- 3. Solution of nonlinear algebraic equations and basic optimization
- 4. Polynomial interpolations
- 5. Finite difference approximations
- 6. Integration
- 7. Solution of differential equations

Books (available in library):

- Elementary Numerical Analysis by Conte and De Boor
- Numerical Methods for Engineers and Scientists by Hoffmann
- Numerical Methods for Engineers by Chapra and Canale

Course grading:

Exam

In the exam we measure your ability to (a) implement the numerical methods you have learnt using a pen and a paper, (b) use the principle of numerical analysis you have learnt to suggest methods for solving non-conventional problems, and (c) implement numerical analysis using C or Matlab

Homework

• The homework exercises are designed to help you understand the material taught in the course. It will be very difficult for you to keep up with the course if you do not solve them yourself on time.

- Homework exercises can be downloaded from the Assignments Page.
- Submission of homework
- o Homework will include both paper based work and Matlab/C codes.

o Paper-based work must be hand written and is to be handed during the tutorials.

o Submission of Matlab/C Codes: Please see the corresponding data sheet on the webpage of the course.

o Grading Homework:

• Paper-based work: You are allowed to do mistakes; grades will be given solely for answering the questions and not for how close you are to the

right answer. You will be graded according with the number of homework questions answered relative to the number of questions given. We expect a reasonable effort invested in each question.

• Codes: You will be given 50% of the grade for submitting a code. The additional 50% will be given if your code gives the right answer.

Course Grading: 90% final exam + 10% homework Passing the course requires passing the exam. There will be no Midterm Exam.

Contact hours

Lecture: 2 hours Recitation: 2 hours Credit points: 3

<u>Linear Algebra – 104019</u>

Course Objectives

The goal of the course is to provide tools and methods of Linear Algebra. These include theoretical discussions and practical implementation of the methods Homework will be assigned from MathNet, the problem collection on Moodle and questions sent by email to the course list.

Description

- Sequences
- Functions Limits and Continuity
- Derivatives
- The Basic Theorems of the Differential Calculus
- Indefinite Integrals
- Definite Integrals and the Fundamental Theorem of Calculus
- Improper Integrals
- Series and Power Series

Contact hours

Lecture: 4 hours Recitation: 2 hours Credit points: 4.5

Partial differential equations – 104228

Lecture Topics

- General discussion of PDE and associated conditions
- first order equations
- the Cauchy problem and the method of characteristics
- existence and uniqueness theorem
- second order PDE classification and canonical form
- well posedness
- one-dimensional wave equation
- D'Alembert method
- Sturm- Liouville problems and separation of variables
- heat and wave equations on different domains with Dirichlet and Neumann boundary conditions
- Laplace and Poisson equations
- the energy method
- the maximum principle and properties of harmonic functions

Homework:

Open HW exercises will be published every week - these are what we call "magen" grades, meaning they are not obligatory.

If you choose to submit the HW and your average HW grade is higher than your final exam grade, then it will be weighted as 20% of your final grade. In this case the grade will be calculated in the following way:

Final grade = 0.2*HW grade + 0.8*Exam grade

In case your average HW grade will be lower than your exam, your final grade will consist 100% of your exam grade.

Recommended books:

• Y. Pinchover & J. Rubinstein, An Introduction to Partial Differential Equations, Cambridge University Press, 2005.

- W.E. Boyce & R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems.
- E.C. Young, Partial Differential Equations, Allyn and Bacon.
- H.P. Weinberger, A First Course in Partial Differential Equations, Blaisdell, 1965.
- P.W. Berg & S.L. McGregor, Elementary Partial Differential Equations, Holden Day, 1966.
- A. Pinkus & S. Zafrany, Fourier Series and Integral Transforms, Cambridge University Press, 1997.

Contact Hours

Lecture: 2 hours

Recitation: 2 hour

Differential and Integral Calculus 1M 104018

Lecture Topics

1. Introduction

- notation and basic notions: sets of numbers

(natural, integers, real, rationales), intervals, absolute value, basic

rules of inequalities, triangle inequality, the function [x] (integer part of x).

 $|x| \!\! < \!\! M < \!\! = \!\! = \!\!\! - M < x < M.$

- functions: domain, range, image, graph, onto (surjection),

one to one (injection), monotone function, bounded function.

- operations on functions including composition and inverse functions.

- notions of: definition, axiom, theorem, negation of statements, disproof, proof.

2. Limit of functions

- definition of a limit, punctured neighborhood, basic theorems, arithmetic of limits.

- one sided neighborhood, one sided limits, basic theorems.
- limit at infinity, infinite limits.
- sandwich theorem, "pizza" theorem
- trigonometric functions, $\lim \sin x / x$.

- bounded sets and functions, sup, inf, min, max, axiom of supremum,

monotone bounded functions.

3. sequences

- definition of limit, basic theorems, arithmetic of limits.
- sandwich rule, q^n , $n^{1/n}$, $a^{1/n}$.
- monotone sequences, bounded sequences, recursively defined sequences.
- $(1+1/n)^n$ monotone and bounded, e.
- subsequence, partial limits.
- Heine's theorem

4. continuous functions

- definitions
- arithmetic rules, composition, inverse functions.
- discontinuities.
- mean-value theorem
- Weierstrass theorem
- 5. the derivative
- definition + geometric meaning + in physics.
- derivatives of elementary functions
- one sided derivatives, differentiability ==> continuity
- arithmetic rules
- chain rule, log x, inverse function
- higher order derivatives
- 6. more on derivatives
- extremal points, Fermat's theorem

- theorems of Roll, Lagrange, Cauchy.
- derivatives of monotone functions
- min/max via the second derivative
- Lhopital's theorem
- convexity, inflexion point, drawing graphs of functions
- 7. Order of magnitude
- order of magnitude
- linear approximation
- taylor's polynomial
- 8. Integral
- indefinite integrals: integration by parts, substitution, partial fractions.
- definite integral, Riemann sum, geometric meaning, arithmetic rules.
- fundamental theorem + applications to definite integrals
- arc length, volume of rotational bodies (about the x-axis and y-axis)
- 9. generalized integrals
- integral of bounded function on a ray, integral of unbounded function on interval.
- comparison theorems
- absolute convergence
- 10. series
- definition through partial sums, geometric and telescopic series
- necessary conditions for convergence.
- comparison theorems
- root and ratio test
- integral test
- series with alternating signs. Leibniz theorem
- absolute convergence
- 11. power series
- definition, radius of convergence, domain of convergence,
- root and ratio method of finding the radius
- integration and derivation of power series
- Taylor series

Contact hours

Lecture: 4 hours

Recitation: 2 hours

Algebra 1/Extended - 104016

Lecture Topics

- 1. Polynomials, Complex numbers and Fields.
- 2. Matrices: Terminology and special matrices, algebraic operations on matrices.
- 3. Systems of linear equations, Gaussian elimination, rank of a matrix.
- 4. Vector spaces and subspaces.
- 5. Linear combinations, linear span, linear dependence/independence.
- 6. Basis and dimension, including row and column spaces and coordinate vectors.
- 7. Invertible matrices, definition and properties.
- 8. Determinants, definitions and properties.
- 9. Linear transformations, kernel, image, dimension theorem, matrix with respect to a basis.
- 10. Matrix similarity and change of basis.
- 11. Eigenvalues and diagonalization.

Contact hours

Lecture: 4 hours

Recitation: 2 hours

Civil Engineering

Planning and Control of Construction Projects – 014617

Aims of the course:

Deepening central issues of Construction Management: Comparing alternative designs and construction plans, methods of contracting, design management and information flows, client's design cost estimation, preparation of master plan schedules, tendering procedures, contractor cost calculations and bid preparation, budgeting, planning and scheduling of construction, production management, project controls. The goal is to understand and gain experience in these tasks, including achievement of a basic level of proficiency in appropriate software.

Teaching Methods:

In addition to the theoretical material, there will be class discussions and exercises– guided homeworks and selflearning. The last homework assignment will be worth 8% of the HW grade. It is a cumulative assignment where you work on it each week and turn it in at the end of the semester. In addition, guest lectures will be given by leaders in the field of information management in construction. All materials will be included in the exam.

Homework Assignments:

During the semester there will be seven home assignments. The weight of the home assignments in the final grade is 15%. The weight of each assignment is listed below in the course program. Before every tutorial you should download the home assignment from the course website. The TA will explain how to start the task and you will continue independently. You are required to submit all assignments by the published deadlines, as exercises and solutions may be discussed in the lectures. Late submission will not be accepted. The assignments must be submitted only using the Moodle system. During the tutorials, relevant software and tools will be presented and practiced for the topics discussed in the lectures. All homework assignments may be submitted in pairs or individually.

<u>Final project</u>

The final project combines the use of all the tools learned during the course in a construction planning project. The weight of the project in the final grade is 15%. Every student must submit their own individual project. Submission of the project is required to complete the course.

Final exam and calculation of the final grade

The weight of the final exam in the final grade is 70%.

- The minimum score required in the final exam in order to pass the course is 55%.
- If and only if the exam score is at least 65%, and the homework grade is higher than the exam score, then the homework grade will be taken into account in calculation of the final grade (the final project will be considered in any case). If not, the weight of the final exam will be 85%.

Bibliography:

Location-Based Management for Construction – Planning, Scheduling and Control, R. Kenley and O. Seppanen, Spon Press, London and New York, 2010.

Paulson, B. C., Computer Applications in Construction, McGraw-Hill, 1995. Hendrickson, C., Project Management for Construction, Department of Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, PA I52I3 Copyright C. Hendrickson 1998 http://www.ce.cmu.edu/pmbook/

Course schedule:

Week	Lecture		
1	Introduction - Detailed construction process and project management objectives. Contracting methods . The multiple roles of construction managers at different levels and with different types of employers. Course aims and rules.		
2	Design management: Information management in construction projects. Sharing information through an Extranet. Cost estimates at different accuracy levels; An initial estimate; estimating using parameters; detailed estimates. Measuring of quantities, methods of measurement, preparation of a bill of quantities.		
3	Manage bills of quantities and tenders, using a standard price list for the building industry		
4	Scheduling projects using CPM Principles, advantages and its limitations; technological and organizational relationships; examination of alternatives. Advantages of computers in CPM solution and comparing alternative plans.		
5	Examine alternatives to execution using Building Information Modeling (4D). Principles of planning and scheduling of location based projects Specialization; continuity; independence; Responsibility; equal TAKT time. Implementation of principles in modular and non-modular projects.		
6			
7			
8	Detailed cost calculation Direct costs, indirect costs, overheads; methods of distributing overheads; editing computer calculations; examination of alternative methods of distributing overheads. Comparison of bids		
9	Budget planning, cash and cost flows Principles of planning and control of project budgets; Computerized budget management; layout according to the schedule budget		
10	Budget, cost flows, cash flows (continued): Preparation of flows of costs, expenses, income and cash		
11	Basic terms in production management : cycle time, throughput, work in progress; setup time, learning curve, waste.		
13	Production management: Last Planner System (LPS)		
12	Schedule control, budget and cash flow Control Schedule; control cash flows. Understanding the control results; cash flow. Submitting interim accounts and calculations of price increases.		

Contact hours

Lecture: 2 hours

Recitation: 2 hours

Project I - Construction management – 014601

The Project Is a Guided Assignment Which the Student Carries Out to Solve a Real Life Problem in the Field of Construction Management. There Are Three Project Options: a. Construction Planning of a Building Project, Which Includes a Selection of the Construction Method and Equipment on the Basic of the Analysis of Alternatives, and Preparation of Site Layout, of Schedule and Budget for Construction. B. Development of a Construction Venture, Which Includes Market Study, Development of Investment Alternatives, Preparation of Cash Flow for Each of Them, Selection of the Most Attractive One and a Sensitivity Analysis. C. Application of Automation to a Construction Task, Which Includes the Selection of the Task, Application Planning, Development of Software Or Hardware and a Feasibility Analysis.

Contact hours Recitation: 2 hours

Credit points: 2.5

Air pollution - 016302

Lecture Topics

Primary air pollutants – sources and effects. Physical and chemical properties of aerosols. Secondary pollutants, photochemical reactions, formation and removal of gasses and particles. Global air pollution, meteorology of air pollution. Evaluation and monitoring of ambient air: air pollution control – administrative and technological aspects.

Contact hours

Lecture: 2 hours

Recitation: 1 hours

Credit points: 2.5

Management and Engineering of Traffic – 014733

Human, Vehicle and Road as Factors Traffic. Traffic Flow Characteristics. Traffic Data Measurements. Traffic Flow Models and Shock Wave Theory. Operational Assessment, Delay and Capacity of Unsignalized and Signalized Intersections. Traffic Light Design for Isolated Intersections, Coordinated Signalized Intersections and Green Waves, and Public Transportation Priority.

<u>Contact Hours</u> Lecture: 3 hours Recitation: 2 hours Lab: 1 hour

Human Resource Management in Construction - 014613

Course Objectives

a- To enhance the students' understanding of their future managerial role, with emphasis on the management of the human resources and with a multi-cultural perspective.

b- To learn about theories and practical tools applied when working with and/or managing human resources inside and outside of the construction industry.

Course Content

The course focuses on two main knowledge areas: a- soft aspects of management: primary HRM activities, motivation, change management, communications, teamwork; and b- the construction industry: its characteristics and various players; the players' roles, functions and interactions in the delivery of construction projects.

Contact Hours

Lecture: 2 hours Recitation: 1 hour Credit points: 2.5

Construction Methods - 014610

Lecture Topics:

<u>Methods of piling and foundations for infrastructure works</u>. Earth and rock drilling application and equipment, percussive, rotary and CFA technology. Basics of Bentonite and Slurry technology.

<u>Construction methods for retaining walls</u>, application and principles of built. Gravity walls, cantilevered, sheet piling, anchoring soil, earth nailing. Reinforced Earth construction methods. Applying Geosynthetics for soil stabilization.

<u>Principles of rock drilling and blasting for civil engineering and quarries.</u> Percussive vs. rotary drifters and down the hole. Explosives type and applications. Controlled blasting.

Trenching methods, equipment and trench supporting systems

Earthmoving methods, equipment and management for infrastructure and civil engineering projects. Soil and rock properties which affects earthmoving (based on 014409); earthmoving machine design, machine-job applicability and performance; rock ripping and dozing; earth loading methods; earth hauling and conveying equipment; computerized truck dispatch and GPS earthmoving applications; optimizing system and job layout selection by manual and computerized techniques. Included in the course are also the studies and student's personal practicing of the most updated computer programs (Runge – Talpac, FPC etc.) for earthmoving optimization in construction projects.

<u>Soil and rock stabilization methods</u>. Clayey layers consolidation by compaction and Vertical Drainage Methods.

<u>Equipment economics</u> and earthmoving cost analysis (based on 014603); Principles of construction sites safety management and work regulations.

Contact hours

Lecture: 2 hours

Recitation: 1 hour

Credit points: 2.5

Introduction to financial management - 014615

General Course Description

The course will impart basic and advanced concepts in financial accounting and management, such that the student will be able to understand and analyze a financial report, especially in areas related to real estate.

Weekly Lecture Topics

- 1. General introduction and accounting principles.
- 2. Principles of accounting records and different depreciation methods.
- 3. Types of business and economic models.
- 4. Structure of a financial report, balance and profit & loss reports.
- 5. Counting, taxation and funding in real estate.
- 6. Cash flows.
- 7. Analysis of financial reports, cost of capital, financial stability and leverage.
- 8. Worthwhileness of investments given risks and lifecycle costs.
- 9. Different topics.

Prerequisites

014603 – Engineering Economics 014606 – Introduction to Construction Management

Contact Hours

Lecture: 2 hours

Recitation: 1 hour

Credit points: 2.5

Earthmoving Equipment & Systems - 015017

Course Objectives

Development of equipment and methods in earthmoving as a factor in civil engineering, agricultural and mining projects. Properties of moved soil and rock. Power and forces for excavating and earth hauling. Machine components and their performance: diesel engines, power-trains, tracks and tires. Equipment

application and production: rippers, excavators and shovels. Levelling equipment. Principles of soil compaction, selection of rollers. Mass-haul diagrams and their interpretation. Machine loading and handling analysis in equipment operation and earth-works. Safety in earthmoving.

Contact hours

Lecture: 2 hours

Recitation: 1 hours

Credit points: 2.5

Introduction to Engineering Mechanics – 014103

Weekly Lecture Topics

- 1. Introduction to Mechanics
- 2. The rigid body
- 3. Vector formulation of force and moment
- 4. Equivalent systems and the simplest equivalent system
- 5. Equilibrium of a particle and equilibrium of a rigid body
- 6. Point loads and distributed loads
- 7. Centers of area, mass and gravity; second moment of the area (moment of inertia)
- 8. Introduction to structures
- 9. Equilibrium of multi-body structure; Frames
- 10. Planar and space trusses
- 11. Beams and frames -2-D and 3-D formulation
- 12. Differential and integral relationships for beams with distributed loads
- 13. Generalization of formulation for a planar frame and arch
- 14. Cables

Prerequisites

114051 - Physics 1

Contact Hours

Lecture: 3 hours

Recitation: 2 hours

Introduction to Materials Engineering – 314535

Course Objectives

Provide basic knowledge of materials microstructure, mechanical and physical properties and the linkage between them.

Class Schedule and Sequence of Instruction

- Lecture 1: introduction + atomic bonds + crystallography
- Lecture 2: crystallography + defects
- Lecture 3: mechanical properties: strain-stress curves
- Lecture 4: mechanical properties: factors that affect strain-stress curves
- Lecture 5: Fracture
- Lecture 6: fatigue and creep Exam part 1:Dec 18th
- Lecture 7: phase diagram (solid solution)
- Lecture 8: phase diagram (eutectic diagram)
- Lecture 9: phase diagram (eutectoid diagram)
- Lecture 10: phase diagram (Iron-Carbon diagram)
- Lecture 11: TTT diagrams Winter break
- Lecture 12: Polymers
- Lecture 13: corrosion
- Lecture 14: material selection

Contact Hours per Week

Lecture: 2 hours Recitation: 1 hour Credit points: 2.5

Geomechanics - 014409

Course Objectives

The course is an integration of strength of materials and building materials, analytical description of empirical observation. The idea of the course is to transfer the rules of soil response/behavior into analytical form. The course is divided roughly into three parts: (i) Indicative properties of soils, classification of soils, flow in saturated soils, effectives stress. (ii) Stress distribution below foundations, compressibility of soils, consolidation theory, determination of settlements. (iii) Strength of soils.

Prerequisite

014104 - Strength of Materials 1, 014405 - Engineering Geology, 014211 - Fluid Mechanics

Book.

R.F. CRAIG: "SOIL MECHANICS, Publishers UK Van Nostrand Reinhold: Copies of the book can be found in the library.

Week by Week

- 1. Introduction, elementary cube, volume-weight relationships.
- 2. Unified sol classification system, indicative properties.
- 3. Permeability, flow in saturated soils, flow nets.
- 4. Effective stresses, liquefaction, piping.
- 5. Stress distributions, immediate settlements
- 6 & 7. Soil compressibility, consolidation settlements.
- 8 & 9. Consolidation theory, analytical solutions, numerical solutions.
- 10 & 11. Strength of sands, Direct shear testing.
- 12 & 13. Strength of Clays, Triaxial testing.

Contact hours

Lecture: 3 hours

Recitation: 1 hours

Lab: 1

Credit points: 4

Water resources systems engineering – 016203 Lecture Topics

- Mathematical models of water resources systems
- Selection of models for optimization and simulation
- Model structures
- Objective functions
- Formulation of optimization and simulation models
- Methods of solution
- Examples, including: development of surface water, aquifer management, design and operation of distribution systems

Contact Hours

Lecture: 2 hours

Recitation: 1 Hour

Mechanical Engineering

Introduction to Robotics – 035001

Introduction, rigid body transformations; Rotation matrices and transformations, direct kinematics, inverse kinematics, Serial robot's Jacobian; Singular configurations; Static forces in serial robots; kinematic considerations in robot's design; trajectory planning in joint space and task space; Parallel robots; Dynamics of serial robots; Sensors for robotics.

Literature:

- 1. Lynch and Frank, "Modern Robotics," Cambridge, 2017 (pdf available).
- 2. Spong, "Robot Dynamics and Control", Wiley, 2005. Updated book: "Robot Modeling and Control", Wiley, 2006.
- 3. Tsai, "Robot Analysis Mechanics of Serial and Parallel Manipulators", Wiley, 1999.

Contact hours

Lecture: 2 hours

Recitation: 1 hours

Credit points: 2.5

Design for Manufacturing Project – 034371

Design of An Engineering Project, Based on Elements That Are Being Taught in "Engineering Design 1". Tutoring Will Be Enlarged on: Tolerancing, Materials, Processes and Fixtures. the Project Will Include: Concept Selection, Embodiment Design Including Analysis and Structure Optimization and Detailed Design in Computerized Drawings. the Design Will Include All the Required Data for Manufacturing.

Contact hours

Lecture: 1 hour

Theory of Vibration – 034011

An important part of modern engineering is the analysis and prediction of the dynamical behavior of physical systems. An omnipresent type of dynamic behavior is vibratory motion in which the system oscillates about a certain equilibrium position. This course on the theory of vibration is concerned with the oscillation of both rigid-body and continuous dynamical systems and includes derivation of their equations of motion (via both Newtonian and Lagrangian approaches), their solution (analytically and numerically) and analysis (frequency response, loss of stability and periodicity). Examples include those of classical mechanical systems (robotics, fluid-structure interaction, control) and current applications (micro- and nano- electromechanical systems). The objectives of this course include development and application of modern elements of vibration analysis for complex engineering systems.

Topics:

- classification of dynamical systems, Newtonian modeling, stability of equilibrium.
- orbital stability, periodicity, harmonic balance, Poincare' maps.
- Lagrangian modeling: energies, non-conservative generalized forces, holonomic constrains.
- free undamped vibrations, integrability, beats.
- free damped vibration, equivalent damping, backbone curves.
- flutter, self-excited vibration, friction induced vibration.
- forced harmonic vibration, primary and parametric resonances.
- multi-body vibrations, internal resonances.
- continuous systems: string, rod, beam.
- free vibration of continuous systems: viscoelastic damping.
- forced vibration of continuous systems: Galerkins method, reduced order modeling.
- dynamic buckling and internal resonances.
- hybrid rigid-body and continuous systems, applications.

Literature:

Meirovitch, L., 1986, Elements of Vibration Analysis. (M 86).
Meirovitch, L., 1997, Principles and Techniques of Vibration. (M 97).
Selected scientific/technical papers and handouts (Matlab, Maple).
Additional references
* Review of Dynamics:
Greenwood, D.T., Principles of Dynamics, 1988.
O' Reilly, O.M., Engineering Dynamics: A Primer, 2000.
* The History of Vibration:
Rayleigh, J.W.S., The Theory of Sound, 1877 (Dover 1945).
Timoshenko, S., Vibration Problems in Engineering, 1928 (1959).
Den Hartog, J.P., Mechanical Vibrations, 1934 (Dover 1985).
* Advanced reading:
Moon, F.C., Chaotic and Fractal Dynamics, 1992.

Selected papers and handouts on 'analytical dynamics' and 'nonlinear vibration'.

Contact hours:

Lecture: 2 hours Recitation: 1 hours Credit points: 2.5

Introduction to Mechatronics – 034022

Description

This course provides an introduction to analysis and design principles of electronic circuits, with emphasis and examples from the emerging field of mechatronics. Topics include basic and semiconductor components, basic principles of electrical circuit analysis, circuit response to analog/digital excitation, analog system and circuits based on action amplifiers, digital electronics, gates (logic circuits) and circuits based on logic gates, memory components, and microprocessors and microcontrollers.

Prerequisites

Courses in: Physics 2 (114075 or 114052), and Linear Systems (034032) or equivalent.

Course Topics

- Review of electrical components and circuit elements.
- Analysis of DC circuits.
- Transient response analysis.
- Frequency response analysis.
- Analog electronics (diode and transistor amplifiers).
- Digital electronics (logic gates, De Morgan's laws, and circuit systems).

Contact Hours per Week

Lecture: 2 hours. Recitation: 1 Hour. Credit points: 2.5

Introduction to Financial Management – 014615

The course is aiming to acknowledge the financial and managerial accounting principles, and introduction to the reading, analysis, relevance, importance and understanding of the various financial statements. The lecturer will be available for each student for consulting- upon request. The course, practice and final exam will be held in 13 meetings, on Thursdays 11:30-14:30, beginning March 22rd, 2018. Practice and exercises will be held by the lecturer, in between and after lectures, within the course hours. Home assignments and reading will be given-to be done within 7-14 days of assignment.

Course topics:

Meeting	Торіс		
1	Acquaintanceship, course objectives and requirements, intro to the accounting		
	principles, intro to the financial statements		
2	The accounting equation, accounting basics, the balance sheet statement, the income		
	statement, the registration and entry accounting principles		
3	Revenue recognition, measuring business income and expenses, the matching principle,		
	the accrual and cash basis reporting principles		
4	Financial accounting inventories- reporting and management		
5	Assets: evaluation and records, amortization systems		
6	Liabilities, loans, provisions and reserves in accounting		
7	The Cash Flows statement		
8	The different forms of businesses and entities, legal issues regarding accounting, the		
	basics of labor laws		
9	The owner's equity, report on changes in equity, dividends		
10	Accounting cost and pricing basics in the Civil, Contractor and Engineering companies		
11	The various taxes: company income tax, personal income tax, dividend tax, basics of		
	international tax conventions		
12	Companies' evaluation and pricing systems, business plans, investment assessment,		
	budget management, a glance at the consolidated financial statements of holding		
	companies Financial statement analysis, financial ratios, additional & various subjects		
	and summary of the course		
13	Final exam		

Literature:

Stickney-Weil - "Financial Accounting: an Introduction to Concepts, Methods and Uses"

Grading:

80% is the final exam10% the home assignments10% attendance.

Contact hours

Lecture: 2 hours

Recitation: 1 hours

Advanced Control Lab – 034406

Demonstration of Principles Studied in the Courses "Control Theory" and "Industrial Automation."

Contact hours

Lab: 4 hours

Credit points: 2.5

Kinematics Dynamics & Control of Robots – 036026

Forward and Inverse Kinematic Equations, Jacobian, Singularity, Lagrange Equations, Symbolic Simulation, Motion and State Equations. Perfect Global Linearization, Robustness, Linear Control, Min-Max and Adaptive Control, Tracking.

Contact hours

Lecture: 2 hours

Recitation: 1 hours

Credit points: 2.5

Finite Elements For Engineering Analysis – 035022

Principles of Finite Elements Methods (Including a Brief Review of Other Popular Numerical Methods) for the Solution of One- Dimensional Boundary Value Problems. Critical Evaluation of the Choice of the Physical Model and Its Mathematical Formulation (Dimension of the Problem, Material Behavior, and Boundary Conditions). Reliability of the Numerical Solution. Knowlegeable Use of Professional Codes for the Design of Mechanical Projects in Solid Mechanics and Heat Transfer.

Contact hours

Lecture: 2 hours Recitation: 2 hours Credit points: 3

Research Project in Mechanical Eng. 2 – 034381

The Final Research Project. (Supervised by Faculty Members Only) Definition of the Research Goal and Overview of the Different Methodologies to Tackle the Defined Research Goal. Description of the Experimental, Theoretical and Numerical Solutions or Combinations of Them, Oral Presentation and Written Report of Results and Conclusions.

Contact hours

Lab: 2 hours

Credit points: 3

Experimental Methods Laboratory – 034039

Temperature Measurement, Strain and Stress Measurements, Measurement of Force and Torque, Pressure Measurement, Velocity and Flow Rate Measurement, Displacement, Size, Force and Power Measurement.

Contact hours

Lab: 4 hours

Credit points: 1.5

Int. to Experimental Methods – 034044

Basic Concepts: Accuracy, Repeatability, Sensitivity, Measurement Error, Hysteresis. Review of First and Second Order Systems, Response Function. Static and Dynamic Measurements. Data Acquisition and Processing. Experimental System Design. Statistical Measurement Theory. Techniques for Temperature Measurement, Strain and Stress Measurements. Measurement of Force and Torque, Pressure Measurement, Velocity and Flow Rate Measurement, Displacement, Size, Force, Power Measurement. Technical Writing.

Contact hours

Lecture: 2 hours

Recitation: 1 hours

Solid Mechanics 2 – 034029

Lecture Subjects

- Stresses
- Strains4
- Stress-Strain relations
- Failure criteria, pressure vessels
- Bending of beams, Moment of Inertia
- Shear stresses in beams
- Elastic deformation in bending
- Energy methods
- Column buckling

Books and studying material

- 1. Lecture copies
- 2. Extended Lecture notes
- 3. Questions from past exams
- 4. Popov E.P., 1978, "Mechanics of Materials", SI Version, Prentice Hall
- 5. Shames. H., "Mechanics of Deformable Solids", Prentice Hall
- 6. Parnes R, "Solid Mechanics in Engineering", J. Wiley & Sons, 2001
- 7. Course Video (in Hebrew)
- e. Grades

Exercises – weekly without submission, based on problems given in previous exams. Final answers included.

Midterm Exam -30 %, voluntary, can only improve grade, two hours long. Midterm is considered only if the grade of the final-exam is higher than 50.

Final Exam – 70%, three hours long. Two equivalent tests (term A and B), only the last exam-grade counts.

Contact Hours per Week

Lecture: 3 hours

Recitation: 2 hour

Introduction to Engineering Drawing - 034042

Lecture Subjects:

1) Introduction to engineering drawing as the language of mechanical engineering.

2) To teach how to draw simple mechanical elements and to enable the engineer to sketch manually and with the help of instruments.

3) To enable the reading of mechanical drawings.

4) To provide a theoretical basis for computer-aided draughting.

The course covers selected, basic subjects of *descriptive geometry* and *engineering drawing*. The aim of descriptive geometry is the two-dimensional description of three-dimensional objects in a way that enables the recovery of form and dimensions. The engineering drawing inherits this aim and adds the requirement that the drawing shall enable the production of the drawn object with satisfying precision and in accordance with relevant standards and regulations. The engineering drawing is a language and, as each language, has a dictionary, a grammar and styles.

The dictionary and the grammar are defined by standards. The State of Israel has its own standards based on the international ISO standards. The style of drawing depends on personal experience and abilities.

Week	Lecture	Exercise
1	About this course.	Geometrical constructions in
	 Drawing instruments. 	plane.
	• How we see the world.	Monge's method, projections of
	 Central projection, parallel projection, 	3D bodies on three projection
	orthographic projection.	planes.
	 Standard drawing formats and scales. 	
2	Monge's projections on two planes. The point in	Points in space. Completing a 3rd
	four quadrants. –First angle view. Third angle	projection based on two given
	view. This course uses the first-angle view.	projections. True length of line
	The projections of the straight line. Parallel lines,	segment (TS).
	lines parallel to projection planes, intersecting	
	lines. When is necessary a third projection. True	
	length.	
3	Defining a plane. Special planes. Points and	The common tangent of two
	particular lines in the plane. Perpendicular on	circles. Relationships between
	plane. The traces of a plane.	point and plane. Perpendicular
		on plane. Constructing a line
		segment of given length.
4	Ine cube – projections, sections and	Relationships between lines and
	development.	planes, and between planes.
	Introduction to dimensioning	Cube development.
5	The pyramid – projections, sections,	Development of pyramid.
	development.	
	Dimensioning 2.	

6	Axonometric projection. The law of scales.	Isometric views.	
	Dimetric and trimetric projections.	Using a caliper for measurement.	
	Recommendations for isometric projections.	Basic dimensioning.	
7	The cylinder – projections, sections,	Development of cylinder.	
	development.		
	The influence of dimensioning on tolerances		
8	The helix – definitions, projections, equation,	Resulting dimensions and	
	development, slope angle.	alternative dimensions in linear	
	Midterm examination	chains.	
9	The cone – projections, sections, development.	The development of the cone.	
		Detail drawings, assemblies.	
10	Screws, bolts and nuts.	Screws.	
	Tolerances of form.	Geometric tolerances 1: form	
		and orientation.	
11	Drawing gears.	Geometric tolerances 2:	
	Surface roughness.	positioning.	
12	The sphere – projection, sections.	Geometric tolerances 3: analysis	
	Conclusion on developable surfaces.	in assemblies.	
13	Assembly drawing – contents.	Review.	
	Course conclusions, synthesis, comments on the		
	continuation of learning.		

The components of grades.

With midterm examination and if the midterm grade is higher than that of the final-exam grade: 60% exam + 10% midterm + 30% homework.

Without midterm examination, or if the midterm grade is lower than the final-exam grade: 70% exam + 30% homework.

Contact Hours per Week

Lecture: 2 hours

Recitation: 2 hour

Heat Transfer – 034041

Description:

The course is an introductory exposition to engineering heat transfer. It is part of the engineering curriculum of students in disciplines such as, mechanical, aerospace, chemical biomedical and material engineering. Concepts of control volume analysis, conservation laws of mass, momentum and energy, conduction, laminar and turbulent, convection and radiation will be developed and applied. The problems and examples will include theory and applications drawn from a wide range of engineering problems.

Prerequisites:

- Thermodynamics 1 (034035 or equivalent).
- Fluid Mechanics (034013 or equivalent)..

Course Objectives:

(1) Students will learn theory and applications of engineering heat transfer.

(2) Students will be expected to be able to formulate and solve problems of engineering heat transfer.

WEEK	COURSE TOPICS		
1	Introductory Material, Modes of Heat Transfer, Control Volume Analysis, Conduction – Fourier's law		
2	1D Steady State Conduction, Conduction with Thermal Energy Generation		
3	Heat Transfer from Extended Surface, Fin Equation, Fin Performance		
4	Solutions of 2D and 3D Steady State Conduction problems		
5	Transient Conduction, Lumped Capacitance Method, Spatial Effects		
б	Convection, Boundary layer, Laminar and Turbulent, Similarity, Reynolds Analogy		
7	Convection, Flow over Flat Plate, Empirical Methods		
8	Convection, External Flows, Flow over Cylinder, Sphere, Flow across banks of Tubes, Midterm Quiz		
9	Convection in Internal Flows, Laminar Flow in Circular Tubes, Empirical Correlations		
10	Natural (Free) Convection		
11	Heat Exchangers		
12	Radiation, Black Body, Absorption, Reflection, Transmission		
13	Radiation Exchange Between Surfaces		

Contact Hours per Week

Lecture: 3 hours

Recitation: 2 hours

Introduction to Control – 034040

Course Objectives

- Comprehension of the notions of feedback control
- In depth analysis of stability, performance and robustness of control systems
- Synthesis of control laws in the frequency and time domains for fundamental engineering problems Lecture Topics
 - 1. Introduction, feedback and closed-loop
 - 2. Modeling and control of DC motor
 - 3. Deviation variables and linearization
 - 4. Internal stability of closed loop
 - 5. Steady state performance
 - 6. Dynamic Performance
 - 7. Industrial controllers
 - 8. Root Locus -principles and design
 - 9. Frequency response and Nyquist Criterion
 - 10. Dead Times (Delays)
 - 11. Signals and systems in frequency domain
 - 12. Performance requirements in frequency domain
 - 13. Stability margins
 - 14. Design of leadlLag controllers
 - 15. Realizations and tunings of PID controllers
 - 16. Feedforward control
 - 17. Finale: what you haven't studied in this course

Prerequisites

034032 - Linear Systems

Contact Hours per Week

Lecture: 2 Hours

Recitation: 2 Hour

Hybrid Dynamics in Mechanical Systems – 036087

Description:

Analysis of Mechanical and Robotic Systems with Multiple Unilateral Frictional Contacts. Contact Kinematics and Contact Forces, Coulomb'S Friction Model, Statics-Graphical Methods, Formulating Dynamics with Constraints Under Different Contact Modes. Painleve'S Paradox and Dynamic Jamming, Impact Models, Zeno Phenomenon Dynamically Walking Robot Models, Stability of Orbits in Hybrid Systems, Poincare Maps. of:

1. Analysis of Planar Problems in Statics with Multiple Unilateral Frictional Contacts by Methods and by Solving Alinear Programming.

2. Formulating Equations of Motion for a Mechanical System with Contact Constraints.

3. Formulating Conditions for Occurrence of Painleve'S Paradox in a System with a Single Frictional Contact.4. Formulating Impact Laws for a Single Contact with and Without Friction in a System of Rigid Bodies.5.Formulating Equations of Motion of a Mecanical Systems with Intermittent Contacts as a Hybrid System. 6.Conducting Numerical Sinulations of Mecanical Systems with Intermittent Contact.

7. Finding Periodic Solutions of a Hybrid Dynamical System and Their Stability Using Poincare Map.

Contact Hours per Week

Lecture: 3 hours

Recitation: 2 hours

Humanities

Issues in Contemporary Israeli Society – 324879

Introduction:

This course seeks to unravel the complexity of the Israeli political, social, and cultural aspects and provide tools for understanding the uniqueness of Israeli society and peoples. Students will read and discuss issues such as religion and democracy; ethnicity and nationalism; cultural diversity; gender, media and popular culture. The course introduces Israel's contemporary society through a holistic approach using lectures, films, and discussions.

Topic 1: Pre-State and early stages of nation building

Lesson 1 (13.7): Introduction to the course, Overview of Zionism, Modern history of Eretz Israel/Palestine

Lesson 2 (17.7): The Holocaust and its impact on Israel

Topic 2: The Israeli-Palestinian conflict

Lesson 3 (20.7): The Arab-Palestinian minority in Israel

Lesson 4 (24.7): Military and society relations

Lesson 5 (27.7): Peace and Wars

Topic 3: Religion, ethnicity, and gender

Lesson 6 (31.7): Religious Secular Divide - part 1

Lesson 7 (3.8): Religious Secular Divide – part 2

Lesson 8 (7.8): Ethnicity divide

Lesson 9: Gender, gender and its relation to religion and ethnicity, Israel as a 'femilism' society

Lesson 10: Education in Israel- guest speaker

Lesson 11: Open space discussion

Lesson 12: Conclusions: Is there an Israeli culture?

Contact Hours per Week

Lecture: 2 Hours Credit points: 2

Archaeology of Israel - 324880

First Week *Class 1* - What is archeology? What does it prove and what significance does it have? Do "Creation" and "Evolution" clash? The first million years or so.

Second Week Tour in the Hecht Archeological Museum

Third Week *Class 2* - The Ancient Eastern Mediterranean – Using archeology and written texts we will piece together the cultures and histories of those peoples who lived in this region from the Bronze Age until the advent of the Greek conquest of Alexander the Great.

Third Week – Field Study - Pre-historic human existence took place in the Carmel Mountain range hundreds of thousands of years ago as was discovered at the *Nahal Me'arot Archeological Dig*. According to archeologists how did we become the human beings that we are today and what do we know of this deep human past?

Fourth Week *Class 3* - The clash between the Hebrew Scriptures and Biblical Archeology. Archeology is presented as a tool to verify or negate the Biblical text leading to issues of belief vs. "rational" study. Were the Israelites really hill dwelling Canaanites or was there truly an Exodus from Egypt? Was there a Davidic and Solomonic Empire?

Fifth Week – *Class 4* - Rome Defeats Greece and Builds an Empire – The story of the rise and domination of Rome from the defeat of Carthage and its destruction to the conquest of Greece and the eastern Mediterranean. Focus will be on the era from Julius Caesar to Octavian (Augustus). Focus on Herod in the Holy Land.

Sixth Week – *Class 5* - The Development of Christianity – The Greco-Roman World conquered Judea and destroyed the Temple in Jerusalem in 70 CE. The resulting universalist religion grew from a small persecuted sect originally made up of Jews who believed Jesus to be the Messiah. What brought about the development of the Byzantine Empire and eventual Christianization of the Western World?

Seventh Week - Class 6 - The Rise of Islam and the Muslim Arab invasion of the Holy Land resulting in the defeat of the Christian Byzantines in the 630s. Zoroastrian Persia captured and Christendom defeated in North

Seventh Week - *Field Study* - An outing to *Tzippori* to survey the archeological remains and testament to the pluralistic relations between Rome, the Byzantines and the dwindling Jewish community of the Galilee. In particular, we will investigate the mosaic motifs, both geometric designs and those depicting the Greco-Roman gods of yesteryear including the world famous "Nile Mosaic" and "Mona Lisa of Galilee".

Final Exam – (Date to be announced)

Contact Hours per Week

Lecture: 2 Hours

Politics of Identities: A Multicultural Perspective on Israeli Society - 324282

Introduction:

"Alcohol from Russia, Moroccan food, an Ashkenazi violin with a drop of Tinanai Nai ..." These words from one of the most popular songs in Israel today only partially express the complexity of Israeli society. Although it has been established as a Jewish state, demographic and cultural processes are reshaping the face of the Israeli society. Today, it is possible to speak of four "tribes": secular, national-religious, ultra-Orthodox and Arab living side by side. These demographic changes raise important issues regarding contemporary Israeli identity: What is Israeli culture? Is there room for a dominant Israeli culture? Is and how much space should be given to a wide variety of languages and cultures? In order to shed light on these issues, the course will deal with the various ways in which these issues are expressed in everyday life in Israel. The course will focus on three main topics: politics, family and education, and popular culture, with each subject being examined from four points of view of the various tribes.

Topic 1: Multi-culturalism in Israel

Lesson 1: Introduction to Israel's "new order" – part 1: Secular Jews, religious (dati'im) and ultra-orthodox (Haredi).

Lesson 2: Introduction to Israel's "new order" – part 2: Arab citizens of Israel: demographic characteristics, economy and education.

Topic 2: Politics in the Israeli context

Lesson 3: Israel's political institutions: The Knesset, the Government and the Party System.

Lesson 4: Between 'left' and 'right': Understanding the development and ideologies of Israel's two major political parties.

Lesson 5: Haredim (Ultra-Orthodox), Religious Zionists political parties and the Rabbinate.

Lesson 6: Arab Citizens of Israel: Everyday life and political representations.

Topic 3: Family, gender and education

Lessons 7: Femininity and masculinity in Israeli society: cross-cultural/religious perspective

Lesson 8: Motherhood as a national mission and children as a national asset

Lesson 9: Educational tracks in Israel: state-secular, state-religious, independent religious and Arab.

Topic 4: Popular culture

Lesson 11: Popular culture and the four tribes: poetry, literature and music

Lesson 12: Is there a main stream popular culture in Israel today?

Lesson 13: Final exam/presentations

<u>Contact Hours per Week</u> Lecture: 2 Hours Credit points: 2

Terrorism, Jihad and State Response - 324299

Class 1 – Defining Terrorism Discussion – What is Terrorism? Guerilla Warfare? Differences? Objectives and Actions Bruce Hoffman, Inside Terrorism, Chapter 1, "Defining Terrorism" Drop Box Folder or to be sent Boaz Ganor – "Defining Terrorism: Is One Man's Terrorist Another Man's Freedom Fighter?" https://www.ict.org.il/.../Defining-Terrorism-Is-One-Mans-Terrorist-Another-Mans-Freedom 4th Geneva Convention, under Preamble and Part 1, General Provisions Articles 1-12 http://www.un.org/en/genocideprevention/documents/atrocity-crimes/Doc.33 GC-IV-EN.pdf

Class 2– Background History – The Origins of Terrorism

From the French Revolution thru Russian anarchists and the Far Left

Terrorism or guerilla warfare? Examples: Cyprus, Palestine Mandate (Jewish revolt against the British) and the Algerian case

Traditional Stages in Revolution: Does Terrorism play a part? Do we differentiate?

Handout – Stages in Revolution (Yisrael Ne'eman)

BBC - Who Were the Baader-Meinhof Gang?

news.bbc.co.uk/2/hi/europe/6314559.stm

Hoffman, Chapter 2 "The Post-Colonial Era"

Class 3 – Strategy and Terrorism

Goals, Targets, Methods Hoffman, Inside Terrorism, Chapter 6, "The Modern Terrorist Mindset" The Ultimate Sacrifice? A Glimpse for the Moment – Does it Succeed? Robert Pape, The Strategic Logic of Suicide Terrorism www.columbia.edu/itc/...7/Strategic%20Logic%20of%20Suicide%20Missions.pdf

Class 4 - Religious Terrorism

Analyzing Religious Terror Hoffman, Terrorism, Chapter 4 "Religion and Terrorism" Mark Juergensmeyer, "The Logic of Religious Violence," in David Rapoport, Inside Terrorist Organizations, pp. 172-193 The Logic of Suicide Terrorism – Rand Corporation www.rand.org/content/dam/rand/pubs/reprints/2005/RAND_RP1187.pdf

Class 5 – Terror Organizations in the Arab-Israel Conflict

The secular PLO/Fatah and internationalization - 1970s

The Black Hand (early Palestinian Muslim Brotherhood) prior to 1948

Hamas and Hezbollah - Factoring in Islam? Revolt against secular Arab nationalism?

Sheikh Izz ad-Din al-Qassam - MidEastWeb

www.mideastweb.org/Middle-East-Encyclopedia/sheikh_izz_ad-din_al-qassam.htm

Naim Qassem Hizbollah: The Story from Within - Vision and Goals, pp. 55-66.

Barry Rubin, Revolution Until Victory, Chapters 1 – 3, pp. 1-65.

Shai Lachman, Arab Rebellion and Terrorism in Palestine 1929-39.

Class 6 - Dilemmas in Response

Military and Non-Military

Download PDF - "Combating Terrorism Center at West Point"

https://ctc.usma.edu/posts/the-salafi-jihad-as-a-religious-ideology

Daniel Pipes, "God and Mammon: Does Poverty Cause Militant Islam?"

National Interest, Winter 2001-2002

http://www.danielpipes.org/104/god-and-mammon-does-poverty-cause-militant-islam

How should the world respond to terrorism - The Atlantic

https://www.theatlantic.com/international/archive/2016/04/world...terrorism/476337/ President Trump is responding to terrorism the way demagogues and ... https://www.washingtonpost.com/.../president-trump-is-responding-to-terrorism-the-way...

Class 7 - Terrorism as Theater and Communication/

Ethical Issues in Fighting Terrorism Hoffman, Terrorism, Chapter 5 "Terrorism, the Media and Public Opinion" Brendon I. Koerner <u>Why ISIS Is Winning the Social Media War | WIRED</u> <u>https://www.wired.com/2016/03/isis-winning-social-media-war-heres-beat/</u> ISIS Media <u>http://heavy.com/tag/isis/</u> (Specific and most recent video clips TBA) Michael Walzer, "Excusing Terror" <u>http://prospect.org/article/excusing-terror</u>

Class 8 - Islamist Foundational Concepts in the 21st Century

Koran – Chapters 8 and 9 (often referred to as the "Jihadi" Chapters) (Each verse in this link is accompanied by the Arabic)

https://quran.com/8

https://quran.com/9

The Quran's Verses of Violence - Religion of Peace -

http://www.thereligionofpeace.com/pages/quran/violence.aspx

The Way of Jihad : Complete Text by Hassan Al Banna

actmemphis.org/MB-The-Way-of_Jihad-by-al-Banan.pdf

Abdullah Azzam Join the Caravan

https://ebooks.worldofislam.info/ebooks/Jihad/Join%20the%20Caravan.pdf

OR Abdullah Azzam Join the Caravan

https://archive.org/stream/JoinTheCaravan/JoinTheCaravan_djvu.txt

Can Terror be Understood – Laurent Murawiec

http://www.cambridgeblog.org/2008/10/can-terror-be-understood/

Osama bin Laden's Fatwa 1996

https://is.muni.cz/el/1423/jaro2010/MVZ203/OBL___AQ__Fatwa_1996.pdf

Osama bin Laden - World Islamic Front Statement Urging War Against Jews and Crusaders http://fas.org/irp/world/para/docs/980223-fatwa.htm

Terrorism and Jihad: Perspectives - Philipp Holtmann

http://www.terrorismanalysts.com/pt/index.php/pot/article/view/352/html

Class 9 - Theological Motivations: Hybrid Islamic Organizations (Sunni) The Muslim Brotherhood and Hamas The "Dawa" (Calling) and Jihad *The Hamas Covenant* - <u>The Avalon Project : Hamas Covenant 1988</u> avalon.law.yale.edu/20th_century/hamas.asp Yisrael Ne'eman, Hamas Jihad, Chapter 2, "Arab Islamist Ideologues – Jihad Past and Present" Khaled Hroub, Hamas Political Thought and Practice, Chapter 1,"How it All Began," pp. 11 – 41. <u>Hamas Islamic Resistance - A Document of General Principles and Policies</u> hamas.ps/en/post/678/a-document-of-general-principles-and-policies

Class 10 - Theological Motivations: Hybrid Islamic Organizations (Shia) Iran, Khomeinism and Hezbollah Amir Taheri, Holy Terror, pp. 225 – 240. Naim Qassem, Hezbollah: The Story from Within pp. 67 – 123. Syria's Path to Islamic Terror https://www.meforum.org/articles/2009/syria-s-path-to-islamist-terror

Class 11 - Film "Unthinkable" and the Islamic State (ISIS/ISIL)

Film Unthinkable – Discussion https://www.youtube.com/watch?v=j_8B3HCe3p8 Wikipedia – Islamic State of Iraq and the Levant https://en.wikipedia.org/wiki/Islamic_State_of_Iraq_and_the_Levant#Supporters Islamic State Group – Full History BBC http://www.bbc.com/news/world-middle-east-35695648 The Islamic State's (ISIS, ISIL) Magazine - Clarion Project www.clarionproject.org/.../islamic-state-isis-isil-propaganda-magazine-da... Psychological damage to victims The Psychological Effects of Witnessing Terrorism | Geopolitical Monitor https://www.geopoliticalmonitor.com/the-psychological-effects-of-witnessing-terrorism/

Class 12 - State Terror vs. Islamic Terror (Syria)

and Assessing Future Threats/Seeking Solutions

Syria's financial support for Jihad

https://www.meforum.org/articles/2010/syria-s-financial-support-for-jihad

Starving bombing civilians in the guise of "fighting terrorism"

https://www.aljazeera.com/.../starving-bombing-civilians-fighting-terrorism-18051708...

Taking all the wrong steps in Syria, Iraq and the fight against terrorism

https://www.csis.org/.../taking-all-wrong-steps-syria-iraq-and-fight-against-terrorism

Assad has learned that chemical attacks are a tactic that works

https://www.chathamhouse.org/.../assad-has-learned-chemical-attacks-are-tactic-works

Assad regime barrel bombs relief web

https://reliefweb.int/.../syrian.../assad-regime-has-dropped-nearly-70000-barrel-bombs

Class 13 - ISIS/ISIL – Terror State being forced underground?

Future Solutions? Military and otherwise? WMDs?

Islamic State (ISIS) - Council on Foreign Relations

http://www.cfr.org/iraq/islamic-state/p14811

Terrorism is an Understandable Response to the West's Wars in the Middle East. Philip Weiss

http://mondoweiss.net/2015/12/terrorism-understandable-response/

The Islamic State and WMD - Stephen Hummel

https://www.ctc.usma.edu/posts/the-islamic-state-and-wmd-assessing-the-future-threat

Yisrael Ne'eman - Hamas Jihad, Chapter 9 "Conflict Resolution in the Shadow of Islamic Abrogation".

Contact Hours per Week

Lecture: 2 Hours Credit points: 2

Other

Thermodynamics – 034035

Description

The course is designed as an introductory exposition to engineering thermodynamics. It is typically part of the engineering curriculum of students in disciplines such as mechanical, aerospace, chemical, biomedical and material engineering. It will meet weekly for 3 hours of lectures and 2 hours of recitations.

The course covers concepts including heat, work and energy. The first and second laws of thermodynamics are introduced for systems and control volumes. Engineering applications include power and refrigeration cycles. The course is augmented by a wide range of engineering problems and examples.

Prerequisites

104003 - Calculus 1 or equivalent.

Textbook

Required: A. Shavit and C. Gutfinger, "Thermodynamics – From Concepts to Applications", 2nd Edition, 649 pp., CRC Press, Division of Taylor & Francis, 2009. http://isbndb.com/d/book/thermodynamics_a86.html

Course Objectives

- Students will learn theory and applications of engineering thermodynamics.
- Students will be expected to formulate and solve problems of engineering thermodynamics.

Course Topics

Chapter in book	r Course Topics	
1, 2	Introduction, basic definitions, equilibrium	1
3	Work, First Law, energy, heat, Zeroth Law, temperature	2
4	State Principle, simple systems, pure substance, steam tables	3
5	Ideal gas	4
6	Control volume	5
7	Heat Engines, efficiency, reversibility, Thermodynamic temperature	6
8	Clausius Inequality, Entropy. Midterm Quiz: May 13, 2018	7
8	Entropy relations and diagrams,	8
9	Second Law applications	9
11	Steam work cycles – power stations	10
11	Gas work cycles – gas turbine	11

Chapter in book	Course Topics	Week
11	Refrigeration cycles – refrigerators and air conditioners	12
	Course summary and review.	13

Contact Hours per Week

Lecture: 3 Hours

Recitation: 2 Hour

Credit points: 4

System Analysis – 014004

Course overview

To get to know the field also known as "Operations research": the use of analytical/quantitative models for decision making. Problem formulation and solution methods will be covered. The first half of the course is devoted to the definition of optimization problems and solution approaches, in particular Linear Programming (LP) that is an important tool to solve optimization problems: problem formulation, the simplex method, the dual problem, sensitivity analysis, the use of computer programs to solve LP, the interpretation of the solution, and problems of special structure.

The second half of the course is devoted to additional topics: Dynamic Programming, the formulation of dynamic programming problems and their solution, the recursive equation; introduction to Integer Programming; Decision Making under uncertainty.

Prerequisites

014003 - Statistics

014603 - Engineering Economics

234112 - Programming C

Contact Hours per Week

Lecture: 2 hours

Recitation: 2 hours

Introduction to Computer Language C – 234126

Course Description / Objectives

Computer structure overview. Algorithmic approach to problem solving. Basic programming abilities and concepts including procedural programming (methods, parameters, return values), basic abilities of writing, executing and debugging programs in the C language. Computational efficiency of algorithms.

Week	Lecture Topics	Recitation Topics
1	Introduction to Programming	Introduction to code blocks environment
2	Identifiers, Constants	I/O
3	Types, operators	Types, type conversion
4	Logical expressions, conditional statements	Types and operators
5	Loops	Condition statements
6	Arrays	Loops, arrays
7	Functions, scope of variables	Functions
8	Pointers	Scope of variables
9	Pointers and arrays	Pointers as parameters
10	Search in arrays	Search in arrays
11	Sorting	Sorting
12	Recursion	Recursion
13	Recursion	Recursion

Contact Hours per Week

Lecture: 2 hours Recitation: 2 Hours Lab: 2 Hours Credit points: 4

<u>Physics 2 – 114052</u>

Course Objectives and Targets

1. Introduction to electrostatic and magnetostatic phenomena.

2. Developing basic understanding of electric DC and AC circuits and also electric appliances, such as transformers, and engines.

3. Introduction to mechanical and electromagnetic waves and wave phenomena, such as interference and diffraction.

Weekly Lecture Topics

1. The electric charge (discrete and continuous) and Coulomb's law. Superposition. Polarization and charging by induction. The electric field. Vector field representations. Motion of a charged particle in an electric field

2. Electric flux and Gauss' law. Electrostatic potential energy, and the electric potential. Calculation of the electric field from the potential

3. Equipotential surfaces. Fields around and inside conductors. Electrostatic shielding. Leiden jar. High-Voltage breakdown, Lighting and Sparks

4. Capacitance and capacitors. Electric energy density. Dielectrics

5. Currents, resistivity and Ohm's law. Batteries, electromotive force, electric circuits, Kirchhoff's laws, RC circuit. Power. High voltage power lines

6. Magnetic field, Lorentz force, torques, electric motors (DC)

7. Motion of a charged particle in a magnetic field: cyclotron and mass spectrometer

8. Ampere's law. Bio-Savart law. Gauss' law for magnetic field

9. Faraday's law of induction and non-conservative fields. Eddy currents and magnetic breaking. Inductance. Self-inductance. RL circuit

10. Transformer and magnetic energy density. RLC circuit, AC current. Synchronous and induction motors

11. Magnetic materials. Dia-, Para- and Ferromagnetism. Displacement current, and Maxwell equations. Part 2: Waves

12. Derivation and analysis of the wave equation. Amplitude, velocity, polarization, periodic waves – frequency/period and wavelength/wavenumber

13. EM waves: Poynting vector, Doppler effect. Wave adding, beats, standing wave

14. Interference, Young's experiment, Newton rings, Huygens' principle. Diffraction grating, resolution. Single-slit diffraction, double-slit diffraction. Snell's law, total reflection

Prerequisite

114051 - Physics 1

Contact hours

Lecture: 3 Hours Recitation: 1 Hour Credit points: 4

Water Chemistry – 014327

Course schedule:

	Lastura tonia	Tutorial	I ab tania
<u>1</u>	Introduction to aqueous phase reactions	Introduction: unit conversion + HW #1	Introduction to lab work
<u>2</u>	Introduction to acids and bases	Influence of ionic strength and temperature on equilibrium + HW #2	Lab 1: general water characterization (Cl-, EC, TSS)
<u>3</u>	Equivalent solutions, equivalent points, mono- di- and tri-protic weak acids	Quiz + Graphic representation of weak acid systems	
<u>4</u>	Definition and mathematical development of the terms alkalinity and acidity	Graphic representation of weak acid systems + HW #3	Lab 2: colorimetry + preparations to COD + BOD
<u>5</u>	Water characterization; potentiometric titrations, buffer capacity, Alk lab measurement; Gran's method	Quiz + Alkalinity and acidity – monoprotic systems	Lab 3: colorimetry + completion of COD + BOD
<u>6</u>	Acid-base water mixing problems	Alkalinity and acidity + HW #4	
<u>7</u>	Changing water characteristics via chemical dosing.	Quiz + Mixing streams	Lab 4: demonstration of IC, GC, ICP
<u>8</u>	Henry's law	Mixing streams (continued) + HW #5	
<u>9</u>	Solid phase – aqueous phase equilibrium	Quiz + Henry's law	Lab 5: acid-base characterization of water and wastewater
<u>10</u>	Water softening	Solid phase equilibrium + HW #6	Lab 6: water stabilization. Solid dissolution

<u>11</u>	Water stabilization	Quiz + Water softening and	
12	Paday reactions Disinfaction	Water softening and	Lah 7: summarizing
12	Redox feactions Distinection	stabilization	Lab 7. summarizing
		stabilization	lau
<u>13</u>	Solving questions from previous	Quiz + Water softening and	
	year exams	solving questions	

Remarks:

1. Homework submitted two weeks after receipt. You must submit in two copies, a physical one to the TA and a scanned work uploaded to the moodle.

2. An in-class, 10 min short quiz on homework questions subjects- Every two weeks (6 quizzes).

3. The final grade for civil engineering group comprises 65% exam, 15% average quiz grade, 20% average lab reports. A minimum grade of 55 is required in the final exam.

4. The final grade for chemical engineering group comprises 75% exam, 25% average quiz grade.

5. A minimum grade of 55 is required in the final exam.

6. Final exam term A- 12/7/2018, term B- 2/8/2018.

Recommended literature:

1. Stumm, James, Morgan Werner (1996) Aquatic Chemistry: an introduction emphasizing chemical equilibria in natural waters.

2. Sawyer, McCarthy and Parkin (1994) Chemistry for Environmental Engineering.

3. Lahav and Birnhack, course notes in English (at the Civil Eng. library).

Contact hours

Lecture: 2 Hours Recitation: 1 Hour Lab: 3 Hours Credit points: 3.5

Selected Topics in Management: The Lean Startup - 096808

Course Objectives

This course is very different - it's not theoretical, it does not focus on writing papers or business plans, nor on patents creation. It's about creating actual startups and moving fast using the most up to date entrepreneurship methodology: The Lean Startup. The Lean Startup is focusing on finding early customers and users ("early adopters"), before investing a lot of money, time and efforts on building and marketing a solution. The concept avoids Business Plans as the first step in creating a new venture and prefers fast "validation" with customers over focusing on full product development, investors and pre-mature scale up. It uses a series of MVPs (Minimal Viable Products), which are targeted at getting feedback and learning from early adopters. The Lean Startup is being used widely not only in the "classic" startups' scene, but also in enterprises, non-profits, governmental agencies and other organizations which want to launch a new service or product under extreme uncertainty. The startup idea to be developed during the course can be anything you want. It doesn't have to be based on research. It can be a physical product, or a virtual service. It can be a for-profit business startup (preferably) or a nonprofit one. And if you don't have an idea - that's fine, no worries. You will be able to join others, or find an initial idea at the beginning of the course, with the help of the lecturer and other students. One of the first steps in the course will be creating teams, to work on your startups. A team is made of two students that will work together to develop an startup idea. Each of the students having ideas will pitch the ideas very briefly in front of the class. Then we will form the teams. We'll learn the Lean Startup methodology and work accordingly on the ideas:

- 1. Define the most important assumptions of your startup, using tools focusing on customer understanding and on business model definition like The Lean Canvas.
- 2. Validate the riskiest assumptions, focusing on finding early adopters and validating their needs, problems, and the gap in the market.
- 3. Create a "low fidelity MVP" (Minimal Viable Product) to illustrate your solution for potential customers and users. It can be a landing page, a video clip, a power point demo presentation, some wireframes or a physical model of a hardware device.
- 4. Define you "high fidelity MVP", the actual product or service to start with, focusing on maximizing learning from users and customers.

Course Scope

The course will focus on:

- Familiarize the student with the Lean Startup concept and methodology
- Familiarize the student with The Lean Canvas and other customer focused tools for defining a startup model in an efficient yet detailed enough way. The course will deep dive into customer's problems and needs analysis.
- Familiarize the student with concept and some tools for developing MVPs (Minimal Viable Products).
- Provide the student with the tools needed to review alternative models for the startup and separate short term view from longer term vision.
- Provide the student with a tool needed to review progress level in a startup, based on the Lean Startup concept.
- Experiencing real-life situations where you work with other co-founders on your startup.
- Familiarize the student with the way to articulate a clear value proposition, which is an important ingredient to get customers.
- Improve presentation and pitching skills.

Teaching Methods

• The class will include a mix of lectures, workshops, working in teams and mentorship sessions.

- Learning by doing will be used as a primary teaching method. Students will gain hands-on experience through the initiation of a scalable venture.
- Students will have the opportunity to present their venture at the class and get feedback.

Course Content & Requirements:

Team assembly and Idea selection -

Students are asked to form a team of 2 members around a specific startup idea.

The idea must be for a scalable startup (not a small business), but is not limited in any other way.

The suggested ideas will be contributed by the students or, if needed, by the course lecturer.

Changing the idea within the course first sessions is permitted, as per the Lean Startup concept Pivots are part of the entrepreneurship cycle.

Course Assignments -

I. In-class Presentations:

The teams will be asked to prepare and present the following:

- An elevator pitch (no presentation is needed).
- A presentation focusing on the first elements of the Lean Canvas Customers and Problems (or "gap in the market").
- A presentation on the next two Canvas elements, Solution (including MVP) and Value Proposition.
- A full canvas review.

The teams will be getting questions and feedback by the other teams' members and the course lecturer, in an open conversation. The presentations/pitch will be presented in class by the team members (each team member will be required to present part of the presentations).

II. Final Presentation:

The final team presentation will be held during the last session of the course. Every team member will actively participate the final presentation. The end of course presentation will be based on the on-going class presentations as prepared by each team, and include a full Lean Canvas model presentation, a detailed presentation of the MVP, the customer pitch and validation points.

Course Plan

Session 1. Course introduction: objectives, processes & expectations. The Lean Startup Intro lecture. Short pitches, forming teams.

Session 2. A lecture on Job-To-Be-Done and some Design Thinking tools for startups. In-class exercises. Start working on your own startup.

Session 3. A lecture on the problem - gap in the market analysis, and on customers – personas and early adopters. In-Class exercises. Working on your startup, implementing the concepts learned. Session 4. A lecture on Business Models, Business Model Canvas and Lean Canvas. Progress reports (All teams), focusing on customer and problem assumptions definitions. In-Class exercises (long term and short-term canvases, competitor's canvas) and working on your startups.

Session 5. A lecture on Validation. Progress reports (All teams). Mentoring and working on your startup. Problem validation readiness (All teams) Exercising problem validation with a campus related startup idea.

Session 6. A lecture on Value Proposition. Working to create your value proposition. Creating a landing page for your startup. Mentoring and working on your startup.

Session 7. A lecture on MVPs, Solution Validation and Pivots Mentoring and working on your startup. Progress reports and presentations (All teams)

Session 8. Pitching - the lean startup way. Mentoring and working on your startup, focusing on defining and creating MVPs. Continue with validation exercises.

Session 9.

A lecture on startup metrics and on Lean Startup in the enterprise.

A lecture on Decentralized Autonomous Organizations, "reinventing organizations" and entrepreneurship. Working on creating the Final Presentation and preparation for the quiz.

Session 10. Short Quiz. Final Project presentations by all teams.

* Some adjustments may be possible.

Student Assessment

We expect eah student will attend all the class meetings and invest time either in team work during the entire period of the course.

The final grade will be based on the following elements*:

Final team presentation:	50%
Validation Progress within the course:	35%
Quiz:	15%

Recommended Readings:

Ries Eric, "The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses", Crown Publishing, 2011.

Steve Blank, Bob Dorf, "The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company", K&S Ranch, 2012.

Contact hours

Lecture: 3 Hours