Technion Israel Institute of Technology

Technion International

Spring Semester 2018/19

Course Syllabi
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<td>054330</td>
<td>38</td>
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</tbody>
</table>
Physics

Physics 2 – 114052

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

**Prerequisite**

114051 – Physics 1

**Contact Hours per Week**

Lecture: 3 Hours
Recitation: 1 Hour
Credit points: 4
Physics 3 - 114054
Course subjects:

1. **Photons, electrons, and particle waves**
   - Blackbody radiation
   - The Photoelectric Effect
   - The Compton Effect
   - Atomic spectrum
   - Rutherford’s Scattering and the discovery of the nucleus
   - Bohr’s model for the Hydrogen Atom
   - The statistical interoperation of waves
   - De Broglie wavelength, Davisson-Gremer experiment, Bragg diffraction

2. **Quantum Mechanics**
   - Electrons interference
   - The Uncertainty Principle
   - Wave function
   - The Schrödinger equation in 1D
   - The Quantum particle in a well
   - Tunneling through a potential energy barrier
   - Scanning Tunneling Microscopes
   - The simple Harmonic Oscillator
   - The 3D Schrödinger equation, a particle in a 3D box, degeneration

3. **Atomic Physics**
   - The Hydrogen atom: Schrödinger equation, energy levels, wave function, quantum numbers
   - Spin, Stern & Gerlach experiment, angular momentum, magnetic moment
   - Pauli Exclusion principle and the Periodic table
   - x-rays, shielding (Moseley)
   - Lasers

4. **Solid State**
   - Bonding in Solids
   - Band theory of solids, Conductors, Insulators
   - Fermi Free-Electron theory of metals
   - Semiconductors, doping
   - Semiconductor devices: diodes, LED, Transistors.
   - Superconductivity

5. **Nuclear Physics**
   - The structure of Nuclei
   - Nuclear energy
   - Nuclear models
   - Radioactivity
   - The decay processes
   - Nuclear reactions
   - Nuclear Fission
   - Nuclear reactor
   - Nuclear fusion

6. **Elementary particles and Cosmology**
   - Positrons and anti-particles
   - Mesons
   - Classification of particles
   - Conservation laws
   - Quark model
   Cosmology
Books

– Serway, Beichner: Physics for scientists and engineers, 5th edition or
– Serway, Jewett: Physics for scientists and engineers, 6th or 7th editions

Comments: Some of the material is presented as problems for the students at the end of each chapter in these books.

Most of the material is covered in the more detailed book:

“Modern Physics” by P.A. Tipler

Contact Hours per Week

Lecture: 3 hours.

Recitation: 1 Hour.

Credit points: 3.5
Chemistry

Physical Chemistry 1B – 124503

Course overview
The kinetic theory of gases. Thermodynamics: the first law and thermochemistry, the second law and entropy, free energy and chemical equilibria, multicomponent systems, the chemical potential, solutions and colligative properties. Electrochemistry: properties of ions and aqueous solutions, electromotive forces and electrochemical cells, colloidal systems, electro kinetic phenomena. Biological applications.

Contact hours
Lecture: 3 Hours
Recitation: 2 Hour
Credit points: 2.5
Mathematics

**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

Credit points: 5
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
  - Homework will include both paper based work and Matlab/C codes.
  - Paper-based work must be hand written and is to be handed during the tutorials.
  - Submission of Matlab/C Codes: Please see the corresponding data sheet on the webpage of the course.
- 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

**Linear Algebra – 104019**

**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
Numerical Analysis M - 034033

Course Description:
This introductory course in numerical analysis introduces students to the basic methodology, and techniques for numerical solution of engineering problems. Topics covered include: roots of nonlinear equations, the solution of systems of linear algebraic equations (direct and iterative techniques), numerical interpolation, differentiation and integration methods, numerical solutions of ordinary differential equations (IVP and BVP).

Course materials

Tentative Course Outline and Schedule:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction: Modeling, Computers, Programming/Software, and Error Analysis</td>
</tr>
<tr>
<td>2</td>
<td>Roots of Non-Linear Equations: Bracketing Methods</td>
</tr>
<tr>
<td>3</td>
<td>Roots of Non-Linear Equations: Open Methods</td>
</tr>
<tr>
<td>4</td>
<td>System of Linear Algebraic Equations: LU Factorization</td>
</tr>
<tr>
<td>5</td>
<td>System of Linear Algebraic Equations: Iterative Methods</td>
</tr>
<tr>
<td>6</td>
<td>System of Linear Algebraic Equations: Iterative Methods Polynomial Interpolation</td>
</tr>
<tr>
<td>7</td>
<td>MIDTERM</td>
</tr>
<tr>
<td>8</td>
<td>Polynomial Interpolation</td>
</tr>
<tr>
<td>9</td>
<td>Numerical Differentiation and Integration Methods</td>
</tr>
<tr>
<td>10</td>
<td>Numerical Differentiation and Integration Methods</td>
</tr>
<tr>
<td>11</td>
<td>Numerical Solution of Ordinary Differential Equations [IVP]</td>
</tr>
<tr>
<td>12</td>
<td>Numerical Solution of Ordinary Differential Equations [IVP]</td>
</tr>
<tr>
<td>13</td>
<td>Numerical Solution of Ordinary Differential Equations [IVP]: Adaptive Methods and Stiff Systems</td>
</tr>
<tr>
<td>14</td>
<td>Numerical Solution of Ordinary Differential Equations [BVP]</td>
</tr>
<tr>
<td></td>
<td>FINAL EXAM</td>
</tr>
</tbody>
</table>

Grading Plan
Coursework will be weighted as follows:
Midterm Exam: 20%
Final Exam*: 65%
Homework: 15%
*The student must pass the final exam with a passing grade or higher; otherwise, the student fails the course*

**Contact Hours**
Lecture: 2 hours  
Recitation: 2 hours  
Credit points: 3

**Introduction to Numerical Analysis – 014006**

**Course Objectives**
The course aims to provide tools and methods of linear algebra. Emphasis is given to topics that will be useful in other disciplines. The course includes theoretical discussions (i.e. theorems) and practical implementations of the methods. Many of the theorems will be stated without proofs.

**Lecture Topics**

1. Introduction. Taylor series, partial derivatives.  
2. Description of various errors: rounding errors truncating errors  
3. Systems of linear equations  
4. Finding roots of algebraic equations  
5. Nonlinear systems of equations  
6. Optimization of functions without constraints  
7. Interpolation  
8. Curve fitting: least squares approximation, regression  
9. Numerical integration  
10. Numerical derivation  
11. Solution of ordinary differential equations

**Prerequisites**

104002 – Calculus 2  
234112 – Programming C  
104131 – Ordinary Differential Equations (may be taken in parallel)

**Contact Hours**
Lecture: 2 hours  
Recitation: 2 hours  
Credit points: 3
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:

- E.C. Young, Partial Differential Equations, Allyn and Bacon.

Contact Hours

Lecture: 2 hours
Recitation: 2 hour
Credit points: 3
Civil Engineering

**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 hour
- Credit points: 2.5

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
**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
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.
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
Water and wastewater treatment – 014322

Prerequisites:

054131 – Int. to Chemical and Biochemical Eng. and/or 124114 – Principles of Chemistry
054131 – Int. to Chemical and Biochemical Eng. and/or 124120 – Principles of Chemistry
124503 – Physical Chemistry 1b and/or 125011 – General Chemistry + Lab

Course Description:


Contact hours per week:

Lecture: 2 hours
Recitation: 1 hour
Credit points: 2.5
**Planning and Control of Construction Projects – 014617**

**Course Objectives**

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.

**Course Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Lectures</th>
<th>Tutorial</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>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.</td>
<td>#1 CPM inMsProject (1%)</td>
</tr>
<tr>
<td>2</td>
<td><strong>Design management</strong>: Information management in construction projects. Sharing information through an Extranet. <strong>Cost estimates</strong> at different accuracy levels; an initial estimate; estimating using parameters; detailed estimates. Measuring of quantities, methods of measurement, preparation of a bill of quantities.</td>
<td>#2 Initial estimate Excel (1%)</td>
</tr>
<tr>
<td>3</td>
<td>Manage bills of quantities and tenders, using a standard price list for the building industry</td>
<td>#3 Detailed estimating (2%) Candy 2.0</td>
</tr>
<tr>
<td>4</td>
<td><strong>Scheduling projects using CPM</strong> Principles of the method, its advantages and its limitations; technological and organizational relationships; examination of alternatives.</td>
<td>#4 Scheduling constraints and resources VICO Control (2%)</td>
</tr>
<tr>
<td>5</td>
<td>Advantages of computers in CPM solution and comparing alternative plans. Updating a network of projects: Adding and removing tasks; update start dates and the estimated duration of their execution Examine alternatives to execution using Building Information Modeling (4D).</td>
<td>#5 Scheduling using line of balances VICO Control (2%)</td>
</tr>
<tr>
<td>6</td>
<td><strong>Detailed cost calculation</strong> Direct costs, indirect costs, overheads; methods of distributing overheads; editing computer calculations; examination of alternative methods of distributing overheads. <strong>Comparison of bids</strong></td>
<td>#6 General contractor calculations (2%) Candy 2.0</td>
</tr>
<tr>
<td>7</td>
<td><strong>Budget planning, cash and cost flows</strong> Principles of planning and control of project budgets; Computerized budget management; layout according to the schedule budget</td>
<td>Preparation for the midterm exam</td>
</tr>
<tr>
<td>8</td>
<td>Budget, cost flows, cash flows (Continued): Preparation of flows of costs, expenses, income and cash;</td>
<td>Preparation for the midterm exam</td>
</tr>
<tr>
<td>9</td>
<td>Basic terms in production management: cycle time, throughput, work in progress; setup time, learning curve, waste</td>
<td>#7 Planning of construction budget Candy 2.0 (2%)</td>
</tr>
<tr>
<td>10</td>
<td>Production management: Last Planner System (LPS)</td>
<td>#8 Schedule of modular projects</td>
</tr>
<tr>
<td>Contact Hours</td>
<td></td>
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<tr>
<td>----------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lecture: 2 hours</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recitation: 2 hours</td>
<td></td>
<td></td>
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<tr>
<td>Credit points: 3</td>
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</tr>
</tbody>
</table>

### Introduction to transportation planning – 014702

#### Course overview

Basic Principles and Data for Transportation Planning Aggregate and Disaggregate Models for Travel Behavior and Travel Demand, Minimum Path and Traffic Assignment, Analyzing Transportation Networks, and Transport Project Evaluation.

#### Contact hours

- Lecture: 3 Hours
- Recitation: 2 Hours
- Lab: 1 Hour
- Credit points: 4.5
Statics of Structures 1 – 014108

Lecture Topics

1. Diagrams of internal forces and influence lines in statically determinate structures.
2. Betti’s theorem and calculations of elastic deflections.
3. Flexibility (force) method.
4. Stiffness (displacement) method.
5. Influence lines in statically indeterminate structures.

Prerequisite

014104 – Strength of Materials 1

Contact Hours

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

Fundamentals of Fluid Mechanics – 014214


Lecture: 3 Hours
Recitation: 2 Hours
Credit points: 4
**Graphical Engineering Information – 014008**

**Course Objectives**

- Develop understanding and capability in representation and communication of engineering information in order to establish civil engineering projects.
- Develop skills in:
  1. Spatial vision
  2. Reading sets of building drawings
  3. Drawing projections/sections/details/quantity lists/specifications
  4. Compiling a computerized building information model
  5. Communication of building concepts using sketches and basic drafting
- Lead a computerized building model or civil engineering project
- 3D computerized parametric modeling and production of reports (drawings, bills of quantities, etc.)

**Weekly Lecture Topics**

<table>
<thead>
<tr>
<th>Module</th>
<th>Lectures</th>
<th>Content</th>
<th>Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
<td>Course objectives, Historical background of representation of engineering concepts, Communication principles, Sketch examples and information samples</td>
<td>#1</td>
</tr>
<tr>
<td>I Space and its representation in Engineering Graphical Language</td>
<td>2-4</td>
<td>Preparation and reading of projections/sections/details, Developing skills in representing engineering ideas using hand drawn sketches, scale and graphical language, preparation of hand drawn isometric views</td>
<td>#2-#4</td>
</tr>
<tr>
<td>II Building and Environment modeling, plans and quantities</td>
<td>5-11</td>
<td>Reading plans and recognizing components of building structures, introduction to building information modeling (BIM), Drafting language – reading skills of engineering drawings, Computerized graphics, Computerized parametric 3D modeling, Graphical engineering information in mapping engineering and geo-information, Boolean solid modeling, advanced modeling – mechanical, electrical and water systems in buildings</td>
<td>#5-#11</td>
</tr>
<tr>
<td>III Summary</td>
<td>12</td>
<td>Developments in the field, Advice for continued independent study</td>
<td></td>
</tr>
</tbody>
</table>

In addition to the theoretical content, discussions and class exercises will occur during the classes. Guest lectures will take place by leading figures in the field of information management in the construction industry. All of the lecture content will be included in the final exam.

**Contact Hours per Week**

Lecture: 2 hours
Recitation: 2 hours
Credit points: 3
**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
Credit points: 4
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
Mechanical Engineering

Solid Mechanics 2 – 034029

Lecture Subjects
- Stresses
- Strains
- 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
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
Credit points: 4
Computer Based Engineering Drawing – 034043

Course objective
In the course we will learn to model physical items via computer aided design in Siemens NX.

Grade composition
H.W. – 30%
Class assignments and work – 20%
Project – 50%
• Required participation of minimum 8 classes throughout the semester.

H.W.
7 HomeWorks will be assigned throughout the semester. The submission is in pairs via email.

Class works
• The course consists of individual work with the help of interactive guides. The guides are located in the following folders: Essential activities
• Intermediate activities
• Drafting activities

Contact Hours per Week
Lecture: 2 hours
Lab: 2 hour
Credit points: 3
**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.

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture</th>
<th>Exercise</th>
</tr>
</thead>
</table>
| 1    | - About this course.  
- Drawing instruments.  
- How we see the world.  
- Central projection, parallel projection, orthographic projection.  
| 2    | Monge’s projections on two planes. The point in four quadrants. – First angle view. Third angle view. This course uses the first-angle view. The projections of the straight line. Parallel lines, lines parallel to projection planes, intersecting lines. When is necessary a third projection. True length. | Points in space. Completing a 3rd projection based on two given projections. True length of line segment (TS). |
| 4    | The cube – projections, sections and development.  
Introduction to dimensioning | Relationships between lines and planes, and between planes. Cube development. |
| 5    | The pyramid – projections, sections, development.  
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>7</td>
<td>The cylinder – projections, sections, development. The influence of dimensioning on tolerances</td>
<td>Development of cylinder.</td>
</tr>
<tr>
<td>8</td>
<td>The helix – definitions, projections, equation, development, slope angle. <strong>Midterm examination</strong></td>
<td>Resulting dimensions and alternative dimensions in linear chains.</td>
</tr>
<tr>
<td>9</td>
<td>The cone – projections, sections, development.</td>
<td>The development of the cone. Detail drawings, assemblies.</td>
</tr>
<tr>
<td>13</td>
<td>Assembly drawing – contents. Course conclusions, synthesis, comments on the continuation of learning.</td>
<td>Review.</td>
</tr>
</tbody>
</table>

**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 hours
Credit points: 3
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.

<table>
<thead>
<tr>
<th>WEEK</th>
<th>COURSE TOPICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introductory Material, Modes of Heat Transfer, Control Volume Analysis, Conduction – Fourier’s law</td>
</tr>
<tr>
<td>2</td>
<td>1D Steady State Conduction, Conduction with Thermal Energy Generation</td>
</tr>
<tr>
<td>3</td>
<td>Heat Transfer from Extended Surface, Fin Equation, Fin Performance</td>
</tr>
<tr>
<td>4</td>
<td>Solutions of 2D and 3D Steady State Conduction problems</td>
</tr>
<tr>
<td>5</td>
<td>Transient Conduction, Lumped Capacitance Method, Spatial Effects</td>
</tr>
<tr>
<td>6</td>
<td>Convection, Boundary layer, Laminar and Turbulent, Similarity, Reynolds Analogy</td>
</tr>
<tr>
<td>7</td>
<td>Convection, Flow over Flat Plate, Empirical Methods</td>
</tr>
<tr>
<td>8</td>
<td>Convection, External Flows, Flow over Cylinder, Sphere, Flow across banks of Tubes, Midterm Quiz</td>
</tr>
<tr>
<td>9</td>
<td>Convection in Internal Flows, Laminar Flow in Circular Tubes, Empirical Correlations</td>
</tr>
<tr>
<td>10</td>
<td>Natural (Free) Convection</td>
</tr>
<tr>
<td>11</td>
<td>Heat Exchangers</td>
</tr>
<tr>
<td>12</td>
<td>Radiation, Black Body, Absorption, Reflection, Transmission</td>
</tr>
<tr>
<td>13</td>
<td>Radiation Exchange Between Surfaces</td>
</tr>
</tbody>
</table>

Contact Hours per Week
Lecture: 3 hours
Recitation: 2 hour
Credit points: 4
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 leadLag 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
Credit points: 3
**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 circuits based on 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: 3
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 archaeology? 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 archaeologists 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

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**


**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**

<table>
<thead>
<tr>
<th>Chapter in book</th>
<th>Course Topics</th>
<th>Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>Introduction, basic definitions, equilibrium</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Work, First Law, energy, heat, Zeroth Law, temperature</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>State Principle, simple systems, pure substance, steam tables</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Ideal gas</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Control volume</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Heat Engines, efficiency, reversibility, Thermodynamic temperature</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Clausius Inequality, Entropy. <strong>Midterm Quiz:</strong> May 13, 2018</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>Entropy relations and diagrams,</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Second Law applications</td>
<td>9</td>
</tr>
<tr>
<td>11</td>
<td>Steam work cycles – power stations</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Gas work cycles – gas turbine</td>
<td>11</td>
</tr>
<tr>
<td>Chapter in book</td>
<td><strong>Course Topics</strong></td>
<td>Week</td>
</tr>
<tr>
<td>-----------------</td>
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</tr>
<tr>
<td>11</td>
<td>Refrigeration cycles – refrigerators and air conditioners</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Course summary and review.</td>
<td>13</td>
</tr>
</tbody>
</table>

**Contact Hours per Week**

Lecture: 3 Hours  
Recitation: 2 Hour  
Credit points: 4
**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.

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

**Contact Hours per Week**

Lecture: 2 hours  
Recitation: 2 Hours  
Lab: 2 Hours  
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
Credit points: 3
### Separation Processes 2 - 054305

**Course description:** Separation processes 2 course includes classic separation processes as well as modern techniques, such as biochemical and protein separations. The topics that will be studied in this course include: absorption and stripping, distillation, chromatography, extraction, humidification and drying, precipitation and crystallization, and electro-separations. The course will introduce core concepts, such as thermodynamic driving forces for the separation, staged and continuous-contact equipment, transfer units, process design and physicochemical principles of separations.

**Course Structure:**

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
</tr>
<tr>
<td>1-3</td>
<td>Absorption and Stripping</td>
</tr>
<tr>
<td>4-6</td>
<td>Distillation</td>
</tr>
<tr>
<td>7-8</td>
<td>Adsorption and Chromatography</td>
</tr>
<tr>
<td>9-10</td>
<td>Extraction</td>
</tr>
<tr>
<td>11-12</td>
<td>Precipitation and Crystallization</td>
</tr>
<tr>
<td>12-13</td>
<td>Humidification and Drying</td>
</tr>
<tr>
<td>13</td>
<td>Electro-separations</td>
</tr>
</tbody>
</table>

**Course prerequisites:** Separation Processes 1, Principles of Chemical Engineering 1 and 2

**Grading:** HW - 10% Final exam: 90%

**Course textbooks**

1. W.L. McCabe, J.C. Smith, P. Harriott, Unit Operations in Chemical Engineering, McGrow-Hill, 7th edition, 2004 (or earlier editions)


**Contact hours**

Lecture: 3 Hours
Recitation: 1 Hour
Credit points: 3.5
Principles of Reaction Engineering – 054409

Lecture Topics
1. Review of Ideal Reactors: CSTR, PFR, design equations and optimizations.
2. Reactors systems and recirculation.
3. Design and optimization for several reactions.
4. Thermal effects, multiple solutions and stability.
5. Deviations from ideal behavior and their characterizations.
6. Reactions and heat and mass transfer in heterogeneous catalysis.

Textbooks:
C.G. Hill, An introduction to chemical engineering kinetics and reactor design, Wiley, 1977
Other books:
O. Levenspiel, Chemical reaction engineering, 3RD edition, Wiley, 1999

Grading: 10% HW, 45% Midterm, 45% Final Exam

Contact hours
Lecture: 2 Hours
Recitation: 1 Hour
Credit points: 2.5
Chemical Process Simulation Lab – 054330

Course Objectives

To provide students with the knowledge and experience to use a process simulator effectively for the analysis and synthesis of process flow diagrams.

The topics covered are:
1. Getting started with UNISIM.
2. Solving material and energy balances for recycle processes.
3. Selection the appropriate thermodynamic package.
4. Modelling heat exchangers using UNISIM.
5. Modelling PFRs using UNISIM.
6. Modelling CSTRs using UNISIM.
7. Modelling separation devices using UNISIM: from flash to distillation.

Note that topics 1-4 cover material for which you have already learned the theory, while topics 5-7 support courses that you are learning this semester. You are expected to progress through the course material at your own pace, using multimedia instruction modules in a pre-arranged order. At the end of each lesson, you will be able required to pass a computerized quiz. If you pass the test, you can continue to the next lesson.

Course Policy and Grading

Exercises.
The course has been designed so that you make the best use of your time in the exercise sessions. Most of the instruction on the usage of UNISIM, and a large part of the course-work will be carried out during these sessions. Attendance of these sessions is compulsory - 5% of your course credit is for attendance, and you must attend at least 10 sessions to get this credit (factored into the grades of students who pass the exam).

Quizzes and assignments.
Most exercise sessions end with a quiz, which is intended to check that you have adsorbed and understood the material in the exercise. Some of the questions may change from one attempt to another, and your quiz score is the highest score attained over all attempts. Your quiz scores will constitute 20% of the course grade (factored into the the grades of students who pass the exam). Each quiz equal 1%, each assignment equal 4.33%

Homework.
There will be no homework set, but you are expected to complete the tasks associated with each exercise before the next one.

Final Exam.
Your knowledge of UNISIM will be tested in a final exam (closed-book), with the score you obtain in the exam being 75% of the course grade (assuming you pass the exam - for students who fail the exam, the course grade is the exam grade).

Contact hours
Recitation: 2 Hour
Credit points: 1