TECHNION INTERNATIONAL
Israel Institute of Technology

Technion Israel Institute of Technology

Technion International

Winter Semester 2019/20

Course Syllabi

Table of Contents

Please note:

- Technion reserve the right to make changes in the academic program throughout the year.
- The final and official syllabus of each course will be given by the lecture at the beginning of the semester. The number of credits, lecture hours and recitation will not change.

Physics

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 Schrodinger equation in 1D
   – The Quantum particle in a well
   – Tunneling through a potential energy barrier
   – Scanning Tunneling Microscopes
   – The simple Harmonic Oscillator
   – The 3D Schrodinger equation, a particle in a 3D box, degeneration
3. **Atomic Physics**
   – The Hydrogen atom: Schrodinger 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: 4

Mathematics

Differential and Integral Calculus 2M – 104022

Function of Several Variables, Basic Differential Calculus of Such Functions. Multiple Integrals, Line Integrals, Surface Integrals, Vector Calculus. Vectors in R2 and R3. Scalar Product, Vector Product and Mixed Product. Additional Topics in Differential Calculus: Taylor'S Formula, Local and Global Extrema, Implicit Functions, Transformations in Rn.

Contact Hours per Week

Lecture: 4 hours

Recitation: 2 Hours

Credit points: 5

Statistics - 014003

Course Subjects

Data processing, introduction to sets and probability. Sample space, events, counting sample points, combinatorical conditional and total probability, independence, Bayes' theorem, one and higher dimensional random variables, probability distributions, expectation and higher moments, Chebyshev's inequality, known discrete and continuous distributions, regression, sampling, estimation of parameters, testing hypotheses, decision under uncertainty, basic concepts in simulation.

Contact Hours per Week

Lecture: 2 hours

Recitation: 2 Hours

Credit points: 3

Ordinary Differential Equations - 104131

Lecture Topics

- Introduction, examples, models and classification [B&D, Sections 1.1, 1.2].
- First order differential equations. Linear equations, separable equations, solution by substitution and other tricks, exact equations and integrating factors. Direction field, orthogonal curves. [B&D, Sections 2.1, 2.2, 2.3, 2.5, 2.6]
- The existence an uniqueness theorem [B&D, 2.8].
- Second order and higher order linear equations. Fundamental solutions of homogeneous equations, linear independence, the Wronskian, Abel's formula, reduction of order. Homogeneous equations with constant coefficients. Euler equations.
- Inhomogeneous linear equations. The method of undetermined coefficients, variation of parameters. [B&D, Chapters 3 and 4, Euler equation in Chapter 5]
- Systems of linear equations. Homogeneous systems with constant coefficients. Nonhomogeneous systems and variation of parameters. Linear systems in the phase plane [B&D, 7.4 – 7.9, 9.1]
- Series solutions. Solution of differential equations near an ordinary point
- Section numbers are taken from editions 7 – 9. In older editions some numbers are different.

Textbook

Elementary Differential Equations by Boyce and DiPrima, 9th edition

Contact Hours per Week

Lecture: 2 hours

Recitation: 1 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 per Week

Lecture: 2 hours

Recitation: 2 hours

Credit points: 3

Linear Systems M 034032:

Course Objectives:

1. Mathematical models of dynamic systems.
2. First order systems.
3. State space representation- state variables, realizations, linearization.
4. State space solution – functions of matrices, general solution, convolution.
5. Sample-data systems.
6. Stability.
7. Laplace and Z transforms.
8. Transfer functions.
9. Modal analysis – introduction to vibration

Grading:

Homework: 10% of the final grade (elective)
Project: 10% of the final grade (mandatory)
Midterm: 20% of the final grade (elective)
Final exam: 90% of the final grade.

- Midterm and finals will be held with closed material except for non-graphic calculator and a formula sheet that you can add personal notes on the other side. Detailed instructions will be given towards those exams.
- All the final grade rules apply only if the final exam's grade is at least 45. If it is less than 45 than the final grade will be the lower between the two: the weighted average and 50.
- The weighting and all other rules are the same for the first and second finals.

Contact hours per week:

Lecture: 3 hours

Recitation: 2 hours

Credit points: 4

Chemical Engineering

Chemical Engineering lab 2 – 054400

Lecture Topics:

To implement the principles of chemical engineering in practice in the lab.

The lab is conducted in fixed groups of three students.

Safety: First, this is an experimental lab. Always exercise mature judgment and keep yourselves and your classmates safe.

Required clothing: Closed shoes (no Mary Janes, etc.), long pants, lab coat, and safety goggles. It is the student's responsibility to wear protective clothing throughout the lab.

A student who deviates from these safety rules will not be allowed to continue the course this year.

The safety rules, as provided by the course supervisor and detailed on the course site, must be followed. All students must pass the Safety in Chemistry Labs quiz, and submit the printed and signed authorization screen during the introductory lecture. A student who commits a first safety offense will be removed from the lab and receive a grade of zero for that lab. A second safety offense will result in a grade of zero for the course.

Course requirements: Active participation in six labs over the course of the semester.

Each lab requires:

1. Independent study of the presentation/video, located on the course site, in preparation for the lab. The student is to arrive to the lab already familiar with the details of the experimental system and having met all the requirements for the preliminary preparation for the experiment, if there are any. If the student wants to see the experimental system and discuss it with the instructor, s/he can arrange a meeting in advance (at least 48 hours before the meeting) with the relevant tutor.

2. Attendance on the lab day starting at 8:30, unless arranged otherwise with the instructor. **Arrival on time is a course requirement. Therefore, after tardiness of 10 minutes or more, participation in that lab will not be allowed.** A written 20-minute quiz will be given at the beginning of each meeting.

3. Presence at the second meeting, where group members are required to present the lab results to the instructor using a PowerPoint presentation. Other course staff may be present during the presentation. The presentation will be sent ten days after the lab, on Thursday, by 18:00. Deferrals will not be permitted. Any exceptional request should be addressed to the head tutor, with each day of delay leading to a deduction of 5 points from the final lab score. The presentation will be presented within three weeks of the lab's completion. Students are responsible for scheduling a date with the instructor.

In addition to the presentation itself, the group will send the instructor the raw results and calculation examples. Technion – Israel Institute of Technology Department of Chemical Engineering.

Each student must participate in the presentation equally. Division of roles is up to the group. Example: (A) The planner – responsible for the scientific background and determining the experiment's objectives; (B) The experimenter – responsible for presenting the experiment's details and procedure; (C) The analyst – responsible for analyzing the results and conclusions as well as the strategy for scale-up and industry application.

Grade:

• 20%: Quiz score.
• 50%: Presentation score. A score for all members of the group on performance and the presentation. General knowledge of the lab and presentation (all parts). It is important to be able to answer the instructor's questions throughout and at the end of the presentation.
• 30%: Tutor's evaluation. Based on questions during lab time, work performance, order, and cleanliness during lab work.
• Leaving the work space and equipment disorganized and dirty, and intentional damaging and inappropriate behavior with the equipment will result in a 40-point reduction from the lab score.

All course information, including lab procedures, can be found on Moodle. Please pay attention to the allocation of labs and presentations.

Presentation and appendix requirements

• **Introduction**: scientific background, experimental objectives, equations, and relevant variables (units, orders of magnitude).
• **Illustartion and description of the system**: flow directions, the course of execution. (Not a photograph of the system).
• **Raw results**: headings and units in graphs and tables, areas of deviation and error.
• **Discussion and analysis**: reliability of the results, comparison with other work, error analysis, discussion of compliance or deviation from theory and other work, discussion of individual deviations.
• **Conclusions and recommendations:** changes and improvements to equipment and the experiment procedure, and analysis of results.
• **Connection to industry and scale-up**: objective, strategy, and appropriate formulas.
• **Literature sources**: a note in the body of the report and a list at the end of the presentation. Proper, standard citation.
• **Appendices**: calculation examples, examples of deviation and error calculations, raw data.
• **Presentation duration**: 20 minutes. Students are required to present the presentation within the allotted time frame. Failure to meet the time limit will result in a deduction from the score.

Contact Hours per Week

Lab: 3 hours

Credit points: 2.5

Polymers 2 – 054351

Thermodynamics of Polymer Solutions. Methods of Molecular Weight Determination. Rheology of Polymeric Solutions and Melts. Physical Properties of Polymers in the Solid State. Amorphous and Crystalline Structures. Rubber Elasticity. Fabrication Methods of Thermoplastics.

Contact Hours per Week

Lecture: 2 hours

Recitation: 1 hour

Credit points: 2.5

Integrated Chemical Process Design - 054416

Course Objectives:

This course integrates all of the engineering knowledge acquired over the last six semesters of study. On completing the course, a successful student will be able to:

- carry out a detailed simulation of a chemical process, including its optimization, using UNISIM and interpret the results.
- be able to carry out an economic assessment of a chemical process.
- carry out the synthesis of a train of separation units.
- carry out the synthesis of a heat exchanger network (HEN) for a chemical process such that the maximum energy is recovered and/or the minimum number of exchangers is used.
- be able to read and prepare a Piping and Instrumentation Diagram (P&ID).
- suggest reasonable process control configurations using qualitative methods.
- carry out a HAZOP and HAZAN analysis on a process P&ID be able to analyze an accident in terms of ethical reasoning.

Flipped Course Format:

"Flipping" means doing the lectures at home: 054416 is the first 100% "flipped" course to be taught at the Technion. The course is structured so that each week, you are expected to spend 2-3 hours preparing an On-line Lesson at home, and then to attend a 2 hour Class Meeting in which course materials learned at home will be discussed and demonstrated, followed by a 3 hour Active Tutorial in which you will solve classwork problems with your project team mates.

You will get credit for self-study! In this "flipped" course, each week's home assignment is to do the On-line Lesson in preparation for the materials to be studied in the next week. Each student that spends enough time doing this before the deadline (by 12:00 noon, on the day of the Class Meeting) will be given credit for each week (with the maximum credit being 10 points). Credit is given for mastery of the quiz questions - you are allowed to retry questions that you got wrong, with the best grade you obtain after retries counting.The On-line Lessons are organized as a series of 5-10 minute video clips (occasionally they will run longer, and for those, Prof. Lewin apologizes in advance), each followed by a quiz question. Depending on the materials, this should take you between 2-3 hours of self-study each week. The first lecture of the course will be given conventionally as you will not have time to prepare for it in advance. The flipping starts in the first week of the course.

What will happen in the 2-hour Class Meetings? Since you will have prepared by watching the on-line lecture in advance and completed the quiz questions, Prof. Lewin will have a good idea which parts of the materials gave you the most problems. This will allow him to focus on addressing your problems in the 2-hour class, as well as giving examples, and working with you on the solution of typical problems associated with the week's lectures.

Since you are doing the lectures at home, why is the Class Meeting needed? To get credit for doing the lectures at home, you have to complete them ahead of the Class Meeting. Thus, by participating, you will have mastered the on-line material ahead of the class meeting. This will allow the Class Meetings to focus of working on example problems together, in preparation for the Active Tutorials, when you guys will be working independently on the Classwork.

What will happen in the 3-hour Active Tutorials? The classwork exercises (what used to be called "homework" before this course became a flipped one) are designed to help you understand the material taught in the course. You will not be submitting your solutions to the classroom exercises - sample solutions will be posted at the beginning of the following week. The exercise sessions in this course invest most of their time to allow for you to work on your classwork together with your project team members. Like the Class Meetings, your participation in them is not mandatory, but strongly recommended.

What's so great about Active Tutorials? The class exercises for this course have been as Active Tutorials for several years. To see what Active Tutorials look like, check outthis clip. Our experience is that this format increases the performance of students who participate, and has lead to a marked improvement in grades of the final exam.

Grade**:**

Flipping Credit – 10%

Design Project – 30%

Final Exam – 60%

Contact Hours per Week
Lecture: 3 hours

Recitation: 2 hours

Credit points: 4

Introduction to Materials Engineering - 314533

Course Objectives:

Atomic Bonds, Crystallography, Defects, Mechanical Properties: Strain-Stress Curves, Mechanical Properties: Factors that affect strain-stress curves, Fracture, Fatigue and Creep Exam, Phase Diagram (Solid Solution+ Eutectic Diagram), Phase Diagram (Eutectoid Diagram + Iron-Carbon Diagram), TTT Diagrams, Corrosion, Ceramics.

Ethics

The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition.

In addition, the specific ethics guidelines for this course are:

(1) No mobile phones are allowed during class

(2) No web surfing is allowed during class

Report any violations you witness to the instructor.

Contact Hours per Week
Lecture: 2 hours

Recitation: 1 hours

Lab: 1 hours

Credit points: 3.5

Introduction to Process Dynamics and Control - 054314

Course Objectives:

This course provides the tools for developing dynamic process models (focusing only on lumped parameter systems), and the use of these models to develop process control systems (focusing mainly on single input - single output [SISO] control systems). On completing the course successfully, you will:

- Be able to formulate a lumped parameter model describing the process dynamics.
- Be able to generate an approximate linear model of the process in its standard forms, either from fundamental models or using an empirical fitted to plant data.
- Be able to design a control system for the process that meets desired performance criteria.
- Be able to use MATLAB and SIMULINK for the design and testing of control strategies.

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Project Assignments and Grading

As part of the on-line assignments, each student will be required to prepare SIMULINK models, run them in MATLAB and use the results to answer questions. There will be 4-5 of these assignments during the semester.

Miluim and other unfortunate occurrences: Students called to reserve duty should contact Prof. Lewin as soon as possible on receipt of the call-up papers. Students on miluim are strongly recommended to try the classwork they have missed in their own time. Please seek help either with one of the assistants of the course or Prof. Lewin to make up for lost classes. A student who misses either the final exam (or the retake exam) because of army duty is eligible for a special retake exam. If you need a special exam, please see Prof. Lewin.

Grade:

Flipping Credit – 15%

Final Exam – 85%

Contact Hours per Week
Lecture: 2 hours

Recitation: 2 hours

Credit points: 3

TECHNION INTERNATIONAL
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Civil Engineering

Water and wastewater Treatment Laboratory – 014305

Course description and objectives:
The goal of the course is to teach basic techniques of laboratory tests of water and wastewater treatment engineering-related issues. The lab exercises simulate water and wastewater treatment processes. The laboratory work includes several selected tests and experiments of chemical, physical and physico-chemical methods which related to water quality control processes, water sources, and treatment processes of water, wastewater and sludges (biosolids).

Learning achievements:
By successful graduation students will master basic techniques of laboratory tests related to water, wastewater and treatment of both, and gain practical experience (in laboratory scale) of several treatment processes of water and wastewater.

Necessary equipment:
Each student should bring along at least:

• Laboratory notebook (hard cover) with student name on it. EVERYTHING you do in the lab should be written in the notebook (we reserve the right to go over your notebooks).

• Attach the lab safety instructions to the first page of the notebook.

• Pen, pencil, eraser, small ruler, and calculator.

• Permanent marker

• Safety equipment (will be provided)

Student evaluation and grade composition:
1. Attendance is mandatory (lectures, lab, quizzes) 1.1 Absence from lab or quiz –justified reason (e.g. IDF reserve service) and authorized by course professor. New date for supplementary lab or quiz must be set immediately .

1.2 Unjustified absence – Zero (0) grade would be given for lab/quiz.

1.3 You have to be on time – Being late more than 10 minutes – Attendance to the lab will not be permitted and 0 will be given on the quiz and on the lab report.

2. Quizzes – At the beginning of each lab session, a short quiz will be given (closed notebooks, 10 minutes) on the subjects that will be studied in the lab (up to 10 quizzes).

3. Reports – reports should be submitted up to two weeks from completion of the lab.

• Report should be submitted in pairs.

• Submission should follow the given instructions.

• Report should be submitted through the Moodle.

• Points will be deducted for late submissions (2 points per day)

4. Grade composition

Laboratory reports 70%

Quizzes 30% - n-1 best grades will be considered (n – number of quizzes)

Laboratory subjects and time frame:

Lesson No.	Subject	Reports
1	**Lecture**: Introduction; presentation of the course and requirements; flocculation; requirements from lab reports; safety instructions	-
2	**Lecture**: flocculant sedimentation, COD, BOD **Lab**: Coagulation–Flocculation of surface water.	1
3	**Lab**: Coagulation – Flocculation of wastewater, COD and BOD determination and meaning.	2
4	**Lab**: Sedimentation after flocculation; summary of labs 2-4	3
5	**Lecture:** Adsorption, chlorination, gas transfer **No lab**	-
6	**Lab**: Adsorption – batch isotherms	4
7	**Lab:** Chlorination	5
8	**Lab**: Gas transfer	6
9	**Lecture**: Oxygen uptake by biomass, sludge characterisation, nitrification-denitrification **No Lab**	-
-	**No lesson**	-
10	**Lab**: Oxygen uptake rate by biomass	7
11	**Lab**: Sludge characterization	-
12	**Lab**: Nitrification – denitrification	8

Contact Hours per Week

Lecture: 2 hours

Lab: 2 hours

Credit points: 2.5

Design of Water and Wastewater System - 014325

Prerequisites

(Hydraulics 014205 and Water and Wastewater Treatment 014322 and Engineering Economics 014603)

Incorporated Courses: Design Principles of Water Supply Syst. 014208

Water Supply and Wastewater Collection 014323

Course Subjects

Principles of design and operation of water supply systems and wastewater collection. Calculation of water supply networks and wastewater collection systems. Goal, structure and preparation of an engineering project. Objectives of general planning, data collection and processing for design. Techno-economic evaluation and comparison of design alternatives. Topics in water and wastewater systems design. Project of general planning of water treatment and supply system.

Contact Hours per Week:

Lecture: 3 hours

Recitation: 1 Hours

Credit points: 4

Mechanization in Construction - 014609

Course Goal:

To provide a basis for the efficient planning of construction equipment array and integrating construction equipment and construction methods in engineering projects.

Course Objectives:

- The procedure of project construction – the link between the two courses; Acquaintance with building construction projects.
- Overview on formworks, industrialized and conventional, formwork types, combined solutions.
- The world of construction equipment, classification of construction equipment.
- Selection, erection and operation of tower cranes.
- Selection of construction equipment: decision factors, employment planning, cycle time.
- Cost estimation of construction equipment, alternatives for equipment selection in projects.
- Combinations of construction major equipment – cranes, formworks, concrete pumps.
- Construction safety with an emphasis on tower crane safety

Lectures:

Every meeting will take three academic hours (Monday 13:30 to 16:30). There will be no separate exercise lessons; exercises will be integrated in lecture meetings. Participation in lectures is compulsory. Attendance and participating in classes will be accounted for. Unexcused absence will result in grade penalty.

Field tour: One or two field tours TBD.

Exercises: During the course the students will submit three exercises, part of which will be made in threesomes. Exercises will be Submitted in print, including texts and figures. Appropriate submission will be considered in grading. Please insist on timely submission.

Literature:

1. Peurifoy, R. L., Schexnayder, C. J., and Shapira A. (2006). Construction Planning, Equipment, and Methods, 7th Ed., McGraw-Hill. (Main textbook, the students will be directed to specific chapters.)
2. Shapira, A., (2008) "Equipment for Concrete Buildings Construction", Ch. 10 in E. G. Nawy, Editor, Concrete Construction Engineering Handbook, 2nd Ed., CRC Press

Student evaluation:

The final grade will consist of: home exercises 25%; final exam 70%; participating in lectures and field tour 5%. The final exam grade has to be at least 55; otherwise it will determine the course grade (in this case other ingredients of evaluation will not be taken into account).

Course planned schedule:

Meeting no.	Main topics
1	Introduction, the procedure of building construction, building construction projects
2	Formwork for concrete 1
3	Formwork for concrete 2
4	Introduction to the world of construction equipment, equipment for concrete (production, transporting, finishing), site layout planning
5	Pumps and hoists
6	Cranes 1: introduction, tower cranes
7	Cranes 2: mobile cranes, introduction to crane operation planning
8	Field tour 1
9	Equipment selection: factors, considerations, cost estimation
10	Equipment selection: generating alternatives, project array planning
11	Safety: construction safety, tower crane safety
12	Field tour 2 (Sunday!)
13	Concluding session

Contact Hours per Week
Lecture: 2 hours

Recitation: 1 hours

Credit points: 2.5

Hydraulic Engineering – 014942

Course Objectives:

- Water supply system – general design of storage and supply.
- Water sources, hydrology, max. discharge, flow volumes, storage volume.
- Water balance
- Hydraulics of pipelines
- Water canals, diversions structures, overflow structure.
- Engineering survey, lab tests.
- Dam stabilization, reservoir layout.
- Earth works.
- Inlet and outlet structures. Freeboard, pump stations, hydraulic curves.
- Water breaker structure.
- Infiltration, seeling, piping.
- Pumps, operating point of pump and.
- Pipelines and accessories. Local and longitudinal pressure losses
- Properties of pipelines and pipeline placing
- longitudinal pipeline design
- Water hammer
- Economic engineering.

Literature:

1. "Design of Small Dams ", U.S. Department of Interior, Bureau of Reclamation .
2. "Earth and Earth Rock Dams: Engineering Problems Of Design", J.L. Sherard .
3. USBR 13 - Bureau of Reclamation Technical Service Center Design Standards No. 13
4. civil engineering hydraulics", R.E. Featherstone and c.Nalluri.

Grade:

Attendance in lectures – obligatory

Attendance in exercise – obligatory

Homework – 25%

Final project – 75%

Attendance in all meetings and exercises is obligatory. The exercises and the project should be handed in on time.

Contact Hours per Week

Lecture: 2 hours

Recitation: 1 hours

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

Week	Lectures	Tutorial
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.	#1 CPM inMsProject (1%)
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.	#2 Initial estimate Excel (1%)
3	Manage bills of quantities and tenders, using a standard price list for the building industry	#3 Detailed estimating (2%) Candy 2.0
4	**Scheduling projects using CPM** Principles of the method, its advantages and its limitations; technological and organizational relationships; examination of alternatives.	#4 Scheduling constraints and resourcesVICO Control (2%)
5	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).	#5 Scheduling using line of balances VICO Control (2%)
6	**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**	#6 General contractor calculations (2%) Candy 2.0
7	**Budget planning, cash and cost flows** Principles of planning and control of project budgets; Computerized budget management; layout according to the schedule budget	Preparation for the midterm exam
8	Budget, cost flows, cash flows (Continued): Preparation of flows of costs, expenses, income and cash;	Preparation for the midterm exam
9	Basic terms in production management: cycle time, throughput, work in progress; setup time, learning curve, waste	#7 Planning of construction budget Candy 2.0 (2%)
10	Production management: Last Planner System (LPS)	#8 Schedule of modular projects

		Candy 2.0 VICO Office (3%)
11	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	
12	Technological and organizational considerations, scheduling the execution of projects consisting of several modular buildings; a detailed demonstration of various alternatives and discussion of problems, advantages and disadvantages; impact of industrialization of construction; techniques for scheduling alternatives.	
13	**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.	
14	Design management, Information management in construction projects, the DSM method.	

Contact hours per week:

Lecture: 2 hours

Recitation: 2 hours

Credit points: 3

Strength of Materials 1 – 014104

Course Objectives

This course builds on the principles of statics mastered in the course "Introduction to Engineering Mechanics" and will introduce the students to the fundamentals of Mechanics of Materials. This subject covers basic concepts of solid mechanics and mechanical behavior of materials, including stress-strain relationships, beam bending, stress transformation and stability of columns. Structural behavior will be analyzed, along with the material and geometric contributions to the behavior of structures.

Lecture topics

1. Introduction to course; Mechanical property definitions for Young's Moduli, yields stress, ultimate stress, etc; Hooke's Law; Stress, strain and deformation: Axial loadin
2. Statically indeterminate problems – axial loading Thin walled pressure vessels
3. Torsion of circular shafts
4. Torsion of general bars
5. Bending stresses
6. Deflections of beams
7. Deflections of beams: conjugate beam
8. Statically indeterminate beams
9. Shear stresses in beams
10. Shear stresses Shear centre for different cross-sections
11. Buckling of columns
12. Transformation of stresses Principal stresses
13. Mohr's circle Transformation of strains

Prerequisites

014103 – Introduction to Engineering Mechanics

Textbooks

E. P. Popov, Engineering Mechanics of Solids, 2nd edition, Prentice-Hall R. C. Hibbeler, Statics and Mechanics of Materials, 2nd edition,

Prentice Hall. F. P. Beer and E. R. Johnston, Mechanics of Materials, McGraw Hill.

Contact Hours per Week

Lecture: 3 hours

Recitation: 2 Hours

Credit points: 4

Hydraulics – 014205

Lecture topics

1. Dimensional Analysis, Introduction
2. Similarity & Models
3. Dimensional Analysis of Different Problems
4. Steady & Uniform Flow, Elements of Channel Design
5. Energy Conservation, Transitions
6. Transitions (finish)
7. Hydraulic Jump, Control Sections
8. Gradually Varied Flow, Hydraulic Profiles
9. Laminar & Turbulent Flows
10. Flow in Pipeline
11. Pipeline Calculations
12. Pipeline Systems & Networks

Prerequisite

014211 – Fluid Mechanics

Reading Requirements

- "Hydraulics", by Professor Hillel Rubin. Available on the course's site on Moodle.
- "Hydraulics Laboratory Book", by: Professor Poreh. Available on the course's site on Moodle.

Contact Hours per Week

Lecture: 2 hours

Recitation: 1 Hours

Lab: 1 Hours

Credit points: 3

Introduction to Hydrological Engineering - 014212

Lecture topics

- Introduction. Balance equation.
- The watershed area and its characteristics
- Rainfall.Statistics and extreme values.
- IDF Curves (Intensity-Duration-Frequency).Rainfall Hyetographs. Design storm.
- Infiltration.The Horton Model. The SCS Method. Index Φ
- Unit Hydrograph.
- The S Curve. Hydrograph separation. The rational equation.
- Reservoir and river routing.
- Groundwater. Introduction, classification of aquifers. Darcy's law.
- Dupuy's assumptions. Flow in an aquifer.
- Wells hydraulics and permanent flow.

Conclusion.

Reading:

1. Bras R. L., 1990, "Hydrology: An Introduction to Hydrologic Science", Addison – Wesley Publishing Co. Inc.

2. Viessman, W, "Introduction to Hydrology", Upper Saddle River, N.J, Pearson.

3. Shaw E. M., 1983, "Hydrology in Practice", Published by Van Nostrand Reinhold (UK) Co. Ltd.

4. Chow V. T., 1964, "Handbook of Applied Hydrology", McGraw-Hill Inc.

5. Chow V. T., Maidment D. R., and Mays L., 1988, "Applied Hydrology", McGraw-Hill Inc.

6. Maidment D. R. (Editor), 1993, "Handbook of Hydrology", McGraw-Hill Inc.

7. Bear J., 1979, "Hydraulics of Groundwater", McGraw-Hill Inc.

Contact Hours per Week

Lecture: 2 hours

Recitation: 1 Hours

Credit points: 3

Project II - Environmental Eng. – 014301

Planning of a Project in Environmental Engineering. Self Study of An Engineering Problem. General Plannig and Comparison of Different Solutions. Design of One Alternative Including a Technical Report and Relevant Drawings.

Contact Hours per Week

Lecture: 2 hours

Credit points: 2.5

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Engineering Geology - 014405

Course Objectives

The course is divided roughly into two parts:

The first part contains topics relating to geological materials, which form rocks of different types, identifying rocks and important engineering properties of different rocks and minerals.

The second part contains different topics from general and engineering geology, with an emphasis on geological tools within engineering fields. The exercises will include practical labs on the subjects of identifying minerals, identification and classification of rocks, and understanding geological maps.

Prerequisite

014104 – Strength of Materials 1

Lecture topics

1. Introduction, architecture of the earth.
2. Minerals, what is a mineral, mineral groups, identifying minerals, rock forming minerals
3. Rocks, introduction to the Rock Cycle. Igneous rocks, intrusive, extrusive, volcanoes.
4. Sedimentary Rocks. Sedimentary processes, erosion, transport, deposition, lithification. Clastic sedimentary rocks versus chemical sedimentary rocks. Identifying sedimentary rocks. Important properties of sedimentary rocks in Israel.
5. Metamorphic Rocks. Causes and effects. Texture changes, changes in component mineralogy.
6. Plate tectonics. Concept of continental drift, evidence. Effects, spreading rates. Ocean geomorphology.

   7 & 8. Structural geology. Correlation, faulting, folding, stresses conditions, introduction to strike dip and geological maps.

9. Engineering seismology, seismic waves qualitative site effect, liquefaction.
10. Geological time. Relative time, fossils. Absolute time.
11. Sinkholes along the Dead Sea. Why are they forming, where are they forming
12. Slope stability, mass wasting.

Contact Hours per Week

Lecture: 2 hours

Recitation: 1 Hours

Credit points: 2

Concrete Structures 1 – 014153

Review of Concrete and Reinforcing Steel Properties. Limit State Analysis. Service Limit State: Introduction to Calculation of Deflection: Cracking Moment, Review of Methods (Equivalent Moment of Interia, Equivalent Curvature). Ultimate Limit Design of Cross-Sections Under Bebding Moment Without/ with Axial Force. One Way Solid Slabs. Curtailment of Longitudinal Reinforcement. Bond and Anchorage. Shear in Reinforced Concrete Beams. Redistribution of Moments.

Contact Hours per Week

Lecture: 3 hours

Recitation: 1 Hours

Credit points: 3.5

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:

Water quality for various uses, potable water quality regulations. Principles of water treatment processes. Separation of non-dissolved solids: sedimentation, filtration, flocculation. Gas transfer, disinfection. Separation of dissolved solids. Municipal wastewater characterization, regulations for effluent quality. Wastewater treatment processes: pretreatment, primary sedimentation, biological treatment. Sludge treatment. Effluent reuse.

Contact hours per week:

Lecture: 2 hours

Recitation: 1 hour

Credit points: 2.5

Mechanical Engineering

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 per Week

Lecture: 1 hour

Lab: 2 hours

Credit points: 2.5

Advanced Engineering Design 1 – 036041

Systematic Conceptual Design Techniques of a New Product, Including Analysis of New Needs. Customer Value Management, House of Quality, Abstractization and Functional Analysis. Intuitive and Discursive Techniques for Concept Generation, Synthesis to Full Solutions by Concurrent Engineering Techniques, Design for Manufacturing, Value Engineering and Quality Engineering.

Contact Hours per Week

Lecture: 2 hours

Recitation: 1 hour

Lab: 1 hour

Credit points: 3

Control Theory – 035188

System Theory: Modeling , Matrix Polynomial Description, Controllability, Observability, Minimal Realization, Stability. Feedback (Siso): Block Diagram Algebra, Closed Loop Stability and Causality, Steady State Performance, Sensitivity and Robustness. Design: Design Criteria, Lead-Lag, Design Algorithms. Industrial Controllers: Pid, Dead-Time Compensators, Cascade and Feedforward, Non-Minimum Phase Systems, Internal Model Control. Feedback (Mimo): State Feedback, Observers, Pole Placement. Non-Linear Systems: Nl Elements, System Representation, Describing Function, Popov and Circle Criteria, Phase Plane, Lyapunov Methods.

Contact Hours per Week

Lecture: 3 hours

Recitation: 1 hour

Credit points: 3.5

Research Project in Mechanical Eng. 1 – 034355

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 per Week

Lab: 2 hours

Credit points: 3

Introduction to the Theory of Elasticity – 035043

Displacement Vector. Displacement Gradient Tensor. Transformation of Tensors. Strain and Stress Tensors. Differential Equations of Equilibrium. External Load Boundary Conditions. Strain Energy and Work of External Forces. Constitutive Equations. Compatibility Conditions. Analytical and Numerical Solutions of Selected Problems in the Theory of Elasticity.

Contact Hours per Week

Lecture: 3 hours

Credit points: 3

Mechanics of Microsystems – 035041

Introduction to Micro-Electro-Mechanical Systems (Mems). Elastostatics Theory: Field Equations. Dielectrics. Elastostatic Energy. Mems Statics: Electromechanical Beams and Plates. Residual Stresses. Piezoelectrics. Thermoelectric Elasticity Theory: Boundary-Value Problems. Exact and Numerical Solutions. Thermal Effects in Microsystems: Thermal Mismatch in Layered Structures. Solutions of Coupled Electro-Thermomechanical Problems. Dynamics and Vibration of Electromechanical Systems. Electric Driving Forces. Damping Mechanisms and Measures in Microsystems. Nonlinearity, Stability and Linearization.

Contact Hours per Week

Lecture: 3 hours

Recitation: 1 hour

Credit points: 3.5

Mechanical Engineering Design 1 – 034015

Introduction: Stages of the Design Process and Requirements from Machine Elements. Review of Components. Fundamental Criteria of Failure in Static and Fatique Loads. Joints: Screws, Seals, Riveting, Pins Etc. Welded Joints.

Contact Hours per Week

Lecture: 2 hours

Recitation: 2 hours

Credit points: 3

Introduction to Materials Eng. M1 – 314533

Course Objectives:

This course provides a basic knowledge in materials science and engineering. The main objectives are to acknowledge the atomic bonding and structure of engineering materials and its linkage to the mechanical and physical properties.

Class Schedule and Sequence of Lectures:

Lecture 1: Introduction + Atomic Bonds + Crystallography
Lecture 2: Defects + Diffusion in Solids
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: TBA
Lecture 7: Binary Phase Diagram (Solid Solution+ Eutectic Diagram)
Lecture 8: Phase Diagram (Eutectoid Diagram + Iron-Carbon Diagram)
Lecture 9: TTT Diagrams
Lecture 10: Aging of Aluminum Alloys
Lecture 11: Corrosion
Lecture 12: Polymers
Exam, Part 2: TBA
Exam, Part 1+2, TBA

Literature:

W.P. Callister, Jr., "Materials Science and Engineering – An Introduction", 9th Edition, John Wiley & Sons, Inc.

Evaluation and Requirements:

a) Tutorials: the student should attend all tutorials, and submit at least 11 exercises from the homework booklet (submission within 1 week from the tutorial, in paper or via Moodle). **Not submitting the exercises on time will cause a reduction of 1 point per exercise in the final mark.**
b) Laboratories: 6 experiments will take place at the Dantziger Labs. The student should attend all the experiments.
c) Final exam: will be divided into two independent parts. The first part will be in the middle of the semester and the second part will be at the end. Term B will be given for both parts at the same day during the second exam period.

Grading:

Exams – 35% X 2 = 70%
Laboratories – 20%
Homework – 10%

Contact Hours per Week

Lecture: 2 hours

Recitation: 2 hours

Lab: 1 hour

Credit points: 3.

Solid Mechanics 1 – 034028

Course Objectives:

Topic	Week	Textbook (chapter)
Force systems: vectors, forces and moments, resultants	1-2	M(1) ,M(2)
Equilibrium: free body diagram	2-3	M(3)
Equilibrium in Trusses	4	M(4)
Equilibrium in frames and machines	5	M(4) ,M(5)
Friction	5	M(6)
Virtual work	6	M(7)
Distributed forces, Centers of mass	7-8	M(5)
Beams: forces and moments	8-9	M(5)
Stress – strain, Hooke's low (uniaxial)	9	P(1) , P(2)
Static indeterminate problems, thermal strains (uniaxial)	9-10	P(13)
Displacements and strains in simple trusses	11	Altus
Torsion	12-13	P(4)

Literature:

1. Meriam J.L., Kraige L.G., 1987, Engineering Mechanics, vol 1: "Statics", Wiley **(M)**
2. Popov E.P., 1990, "Engineering Mechanics of solids, Prentice Hall **(P)**
3. Altus E., On Springs and Matrices, International Journal of Mechanical Engineering Education 31(3) 2003. (see course website), **(A)**
4. Shames .H., “Engineering Mechanics ", Vol. 1 ; 1966 ; Prentice Hall

Grading:

Weekly homework (HW): 10%

Students are required to individually submit 12 weekly electronic homework sheets that will be published in the course's website. HW grade will be calculated based on the average of all submitted sheets, excluding the two lowest grades.

Midterm (MT): 20% (optional, no term B)

Final exam (FE): 70% (or 90% pending midterm grade)

Final course grade is calculated as follows:

$Final\ grade = 0.1 * HW + \max\ [\ (0.2 * MT + 0.7 * FE), (0.9 * FE)]$

- A minimal final exam grade of 50 is required for including midterm in the final course grade.

Contact Hours per Week

Lecture: 3 hours

Lab: 2 hour

Credit points: 4

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. • Drawing instruments. • How we see the world. • Central projection, parallel projection, orthographic projection. • Standard drawing formats and scales.	Geometrical constructions in plane. Monge's method, projections of 3D bodies on three projection planes.
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).
3	Defining a plane. Special planes. Points and particular lines in the plane. Perpendicular on plane. The traces of a plane.	The common tangent of two circles. Relationships between point and plane. Perpendicular on plane. Constructing a line segment of given length.
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. Dimensioning 2.	Development of pyramid.
6	Axonometric projection. The law of scales. Dimetric and trimetric projections. Recommendations for isometric projections.	Isometric views. Using a caliper for measurement. Basic dimensioning.
7	The cylinder – projections, sections, development. The influence of dimensioning on tolerances	Development of cylinder.
8	The helix – definitions, projections, equation, development, slope angle. **Midterm examination**	Resulting dimensions and alternative dimensions in linear chains.
9	The cone – projections, sections, development.	The development of the cone. Detail drawings, assemblies.
10	Screws, bolts and nuts. Tolerances of form.	Screws. Geometric tolerances 1: form and orientation.
11	Drawing gears. Surface roughness.	Geometric tolerances 2: positioning.
12	The sphere – projection, sections. Conclusion on developable surfaces.	Geometric tolerances 3: analysis in assemblies.

13	Assembly drawing – contents. Course conclusions, synthesis, comments on the continuation of learning.	Review.

Grading.

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

Credit points: 3

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

Manufacturing Processes – 034030

Course Objectives:

The course gives the student basic understanding of the following subjects:

- Acquaintance with various manufacturing processes starting with selection and ordering materials to final product manufacturing.
- Exposure to techno-economic considerations and production in a competitive environment.
- Planning manufacturing operations and acceptance testing. Preparing a sheet for carrying out specific technological actions (taught in the course) and constructing a routing chart that includes a list of all operations performed during production.

After studying Introduction to Manufacturing Processes, the student should be able to:

	Learning Objective
1	Know classification of main production processes.
2	Know of the main technological production processes studied in the course.
3	Know the basic principles of planning the technological processes studied in the course and their connection to material properties.
4	Know to relate a certain defect of a product to a certain improperly done manufacturing operation.
5	Select the most appropriate technological process for production for a certain product.
6	Know the methods of quality control.
7	Compose a correct list of operations required for manufacturing of a certain product according to the required technological steps.

Course Structure:

The course is composed of frontal lectures and recitations. A few homework assignments will be given during the course, these assignments are not mandatory.

Course Contents:

1. Introduction.
2. Casting processes.
3. Forming and shaping processes.
4. Machining processes.
5. Joining and cutting processes.
6. Surface technology.
7. Advanced processes.
8. Dimensioning and tolerancing, geometric tolerancing.
9. Quality assurance and acceptance tests.

10. Process planning.

Literature:

Textbook:

Kalpakjian & Schmid, Manufacturing Engineering and Technology, 6th ed., Prentice-Hall, 2010.

Grading:

Homework assignments – 15%

Lab – 10%

Final exam – 75%

The final exam grade should be 55 or higher in order to the student to pass the course, a final exam grade lower than 55 will become the course grade.

Contact hours per week:

Lecture: 2 hours

Recitation: 1 hour

Lab: 3 hours

Credit points: 3.5

Fluid Mechanics 1 – 034013

Course description:

Fluid flows are everywhere! From the stars and planets, to the air we breathe, to the oceans, to the engines that power our lives, and the blood that pumps through our bodies. This course will explore and quantify the mechanics of fluid flows. Buckle your seat belts as we may experience some unexpected turbulence! Fluid mechanics involves the study of the kinematics and dynamics of fluid (liquids and gases) flows. Fluid flows are described by quantities such as the velocity vector, density, pressure, path lines, streamlines, and vorticity vector. The governing equations of fluid mechanics are derived from the principles of mass, momentum (F = ma for a fluid), and energy conservation (the 1st-law of thermodynamics). Measurements of fluid flows reveal complex flow patterns and force distributions. Analysis of practical flow devices and associated forces is facilitated by applying the integral form of the governing equations to finite control volumes. The differential forms of the governing equations enable more detailed local flow analyses, either analytically in certain cases or more generally numerically. We will learn all this and more in this class.

Course Objectives:

Below is a list of some high level and also specific learning objectives for this class:
• Develop the ability to identify and classify the various types of flows one may encounter.
• Develop (from first principles) the integral and differential forms of the governing equations of fluid dynamics.
• Apply the integral form of the equations to perform a control volume analysis of physical systems.
• Apply the differential forms of the equations to solve them for simple canonical flows.
• Appreciate both experimental and numerical approaches to studying fluid flows.
• Enhance systematic problem solving skills and analysis skills.
The main goal of this class is to get you excited about learning more fluid dynamics!

Schedule:

Week	Topic
1	Introduction to course Introduction to fluid dynamics Basic concepts of fluid dynamics
2	Pressure Hydrostatics
3	Integral equations Integral equations (integral form)
4	Problem solving
5	Differential equations
6	Problem solving
7	Internal flows
8	Internal flows
9	Internal flows
10	Internal flows
11	Potential flow/CFD
12	Compressible flow
13	Problem solving Review

Textbooks:

All the reading and homework assignments, as well as most of the lecture material, will be selected from the following textbook:

• White, F. M., Fluid Mechanics, 8th Edition, McGraw-Hill, 2016 (”W”)

There should be a number of copies available on reserve at the Mechanical Engineering library on the first floor of the Dan Kahn Building.

Other excellent recommended textbooks include:

• Pritchard, P., Fox and McDonald’s Introduction to Fluid Mechanics. 9th Edition, Wiley, 2015 (”PFM”)

• Cengel, Y. & Cimballa, J., Fluid Mechanics: Fundamentals and Applications 4th Edition, McGraw-Hill. 2017 (”CC”)

• Kundu, P., Cohen, I. M., & Dowling, D. R. Fluid Mechanics. Academic Press. 6th Edition, 2015 (”KCD”).

Grading:

Homework – 20%
Midterm – 40%
Final exam – 40%

Despite being a smaller percentage of your grade, you are highly encouraged to do the homework in a diligent and timely fashion. It will be the most effective way for you to learn the material and prepare and perform well on the exams.

Homework will be due at the beginning of the tutorial session corresponding to the scheduled due date of the assignment and should be turned in to the teaching assistant at the time. The graded assignments will be returned to you ideally in the tutorial session corresponding to the scheduled assignment date of the subsequent homework.

Contact hours per week:

Lecture: 3 hours

Recitation: 2 hours

Credit points: 4

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Dynamics - 034010

Description

This course provides an introduction to modeling and analysis of dynamic systems, with a focus on the motion of particles, systems of particles, and rigid bodies under the action of forces and moments. Core topics include kinematics of a particle, particle dynamics, particle systems and dynamics of rigid bodies. It will meet weekly for 4 hours of lectures and 2 hours of recitations.

Time and frequency domain solutions to first and second order equations of motion are discussed.

Prerequisites

Courses in: Physics 1 (114051), Ordinary Differential Equations (104131), Calculus (104022) and Solid Mechanics (034028) or equivalent.

Textbook

Miles Rubin, and Eliezer Altus, "Dynamics," Faculty of Mechanical Engineering, Technion-I.T.T., 2003 (Available online at: http://w2.technion.ac.il/~meeng/adb_admin/uploads/Studies/Disc_Update/2011-12/034010-2012.pdf)

Additional References

Meriam, James L. & Kraige, L. G., "Engineering Mechanics: Dynamics., Vol. 2.," 6th Ed., Hoboken, N.J.: Wiley, 2010

Course Topics

- Kinematics of a particle: geometry of motion at different coordinates, angular velocities, moving coordinates, relative speeds and accelerations, and kinematics of rigid bodies).
- Particle dynamics: motion equations, vibrations, work-energy concepts and conservation laws).
- Particle systems: (formulation of balance laws, impulse and momentum, mechanical power and kinetic energy, and impact of two particles)
- Dynamics of rigid bodies: inertia tensor, planar motion, impulse and momentum, a system of rigid bodies, gyroscopic effects and Euler's laws of motion.

Contact Hours per Week

Lecture: 4 hours

Recitation: 2 Hours

Credit points: 5

Biotechnology and Food Engineering

Nutrition – 064603

Appetite and Satiety, Control of Food Consumption. Body Composition, Estimation Methods and Their Physiological-Nutritional Importance. Digestion and Absorption. Proteins, Metabolism, Essential Amino Acids. Nutritional Value of Proteins. Evaluation Methods. Carbohydrates in Nutrition: Hormonal Control of Blood Glucose. Lipid Metabolism. Cholesterol and Lipoproteins. Essential Fatty Acids. Energetics, Physiology and the Interrelationships Between the Energy, Protein, Lipid and Carbohydrates Requirements. Direct and Indirect Calorimetry. Minerals and Vitamins in Nutrition.

Contact Hours per Week

Lecture: 2 hours.

Recitation: 2 hours.

Credit points: 3

Biotechnology Engineering – 064509

Composition of Microorganisms Growth Media, Theory and Practice of Continuous Culture. Agitatio, Mass Transfer and Scale-Up in Fermentation Systems. Methods of Large Scale Fermentations: Organic Feedstoks, Organic Acids, Amino Acids and Antibiotics. Enzymatic Reactors, Cell Culture Biotechnology.

Contact Hours per Week

Lecture: 3 hours.

Recitation: 1 Hour.

Credit points: 3.5

Bioprocess and Food Process Lab – 064239

Technological and Engineering Aspects in Food Anf Biological Products Processing. Lab Exercises in Heat and Mass Transfer, Sterilization and Pasteurization, Heat Exchangers, Diffusion, Drying, Concentration, Microwave Heating. Separation and Concentration by Membranes, Filtration and Centrifugation. Analytical Methods for Monitoring of Processes, Rheology of Liquids and Semi-Solids, Enzymatic Method and Sensors.

Contact Hours per Week

Lecture: 1 hour.

Lab: 5 hours

Credit points: 2.5

Packaging of Food, Drugs and Biological Products – 066217

The Objective of the Course Is to Give An Overview of the Basic Scientific and Technical Concepts of Food Packaging. Topics: Functions and Requirements of Food Packaging. Terminology and Materials Used. Basic Concepts in Polymers and Plastics with An Emphasis on Structure, Properties, Manufacture and Characteriztion. Mass Transfer in Plastic Packaging Materials: Diffusion, Permeability and Migration. Additional Topics Environmental and Legal Issues of Food Packaging and Active and Intelligent Packaging Trends.

Contact Hours per Week

Lecture: 2 hours.

Recitation: 1 Hour.

Lab: 1 hour

Credit points: 3

Plant Design – 064119

Decision-Making Process Towards Plant Erection. Pre-Project and Process Design: Process and Engineering Flow-Diagram. Development of Equipment Specifications. (Obtaining and Analyzing of Bids). Plant Layout. Design of Utility and Process Pipelines.

Contact Hours per Week

Lecture: 1 hour.

Recitation: 2 hours.

Credit points: 2

Synthetic Biology – 066526

The Synthetic Biology Course Wil Involve Both Theoretial and Labwork Whose Goal Will Be to Design, Model and Assemble a Synthetic Biological Circuit. the First Part of the Course Will Be Dedicated to Learn the Necessary Tools in Order to Design, Build, Simulate and Analyze Genetic Circuits. the Second Part of the Course Will Be Lab. the Students Will Learn Advanced Cloning Techniques, Such as Gibson Assembly, Golden Gate Assembly and Plate Reader Analysis. Finally, the Students Will Submit a Final Project Which Will Address Current Challenges with Synthetic Biology Gene Circuits. Dedicated to

Contact Hours per Week

Lecture: 2 hours.

Recitation: 1 Hour.

Lab: 4 hours

Credit points: 3

Biotechnology Enterprise - 066525

Research Commercialization in Pharma Industry and Biotech Start-Up Companies. Generic Drugs, Regulations (Ind, Nda, Anda and Dmf Preparation for Fda), Quality System (Gmp, Cgmp, Glp, Gcp), Patents and Intellectural Property, Technology Transfer, the Company, Market, Marketing and Manufacturing.

Contact Hours per Week

Lecture: 2 hours.

Recitation: 1 Hour.

Credit points: 2.5

Other

General Chemistry Laboratory - 125013

Course Goals and Content

Safety instructions, measurements and accuracy, combustion reactions, concentration determination by titration, determination of hydration water in copper sulfate. Chemical equilibrium and Le-Chatelier principle. Determination of zinc equivalent (ideal gas laws). Atomic absorption and emission spectrum, elements in flame, absorption law, phase diagrams, measuring the enthalpy of vaporization, ion exchangers, acid and bases, elution curves. Note: the lab is given once in 2 weeks.

Contact Hours per Week

Lab: 3 Hours

Credit points: 0.5

Physical Chemistry Lab – 124601

Course Objectives:

The main purpose of the laboratory is to enable students to independently experience the operation of measuring systems in order to perform experiments in physical chemistry. In this way, the student's own experience serves to teach him/her about the quantitative relationship between theoretical laws and principles to experimental measurements and results; and about the correlation between simplistic models and the real world.

Lecture topics:

1. Punctual arrival at the lab.
2. Handing in the Preparatory Report to the lab instructor.
3. Quiz (usually written).
4. Opening discussion.
5. Obtaining permission from the instructor to start the experiment.
6. Performing the experiment.
7. Writing down results (on lab Results Sheets only!)
8. Final discussion (optional).
9. Finish lab, obtain instructor's signature on Results Sheet.

Grade:

Quiz – 35%

Performance in lab - 40%

Reports – 25%

Each report must contain the original Results Sheets, signed by the instructor, and the Preparatory Report. The instructor will provide guidelines for the final report and may add specific demands to each report. These will factor into the final report grade, as well. For the first two reports, students will be given a chance to improve and correct the report in order to raise its grade, according to conditions presented in the opening discussion.

Some of the experiments will be analyzed at the lab and the report will be handed in during the lab.

Contact Hours per Week:
Lab: 5 hours

Credit points: 2.5

Engineering Economics – 014603

Course Objectives:

- The economic value of time.
- Interest formulas.
- Comparing alternatives (NPV, AE, NFV).
- Comparing alternatives (IRR, AIRR, IROR).
- Depreciation and economic life of assets and equipment.
- Feasibility of replacing the equipment.
- Effect of taxation on comparing alternatives.
- Effect of inflation on comparing alternatives

Grade:

- During the exercises Homework will be given (Obligation submitting homework). The Homework & exercises attendance are 10% of the grade.
- Mid-term Exam - 20% ("Magen")
- Final Exam - 70% (minimum 55 in order to pass the course).
- The mid-term exam and the final exam will be with closed material.
- Equation pages will be given with the exams.

Contact Hours per Week:
Lecture: 2 hours

Recitation: 1 hours

Credit points: 2.5