Technion Israel Institute of Technology

Technion International

Winter Semester 2020/21

Course Syllabi

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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

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

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

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

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

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

Mechanical Engineering

Electric Actuators - 034034

Description

This course will include an introduction to the basic theory and applications of motors and generators. The design and application of electric drives used in the starting and control of electric machines will be introduced. Applicable industry standards will be introduced as well. This course will review parts of an electric drive, electric machine, and system application considerations. We will review the theory of operation of magnetic circuits, transformers, and electromagnetic devices. Topics on DC motors: principle of operation, circuit compensation, dynamic behavior, driver electronics, stepper motors: principle of operation, dynamic behavior, driver electronics. Topics on AC motors: Creating a rotating field, inductive motors (3 phase). Position and speed control of DC and AC motors.

Literature:

1. A. E. Fitzgerald, Charles Kingsley, Jr., Stephen D. Umans. Electric machinery, McGraw-Hill series in electrical engineering. Power and energy, McGraw-Hill.
2. Theodore Wildi. Electrical machines, drives, and power system. Prentice Hall.
3. Stephen J. Chapman, Electric machinery fundamentals, McGraw-Hill.
4. Bhag S. Guru, Huseyin R. Hiziroglu, Electric machinery and transformers, The Oxford series in electrical and computer engineering, Oxford University Press.

Course Objectives

The students acquire the operation knowledge of the different electric drives of application. They will be capable what the differences of control drive pneumatic-, hydraulic-, asynchronous-, synchronous-, stepping-, servo motors drive. They will be able to recognize the given application, the aspects of selecting of a suitable drive. They will be capable to integrate, to switch on and to test-run the electric drives.

Course Topics

- Alternating current circuit
- Three phase systems
- Concepts and Laws of Magnetism
- Transformers
- Forces in magnetic circuits
- DC motors
- Induction engines

Contact Hours per Week

Lecture: 2 hours

Recitation: 1 Hours

Credit points: 2.5

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

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

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 hours

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.	Geometrical constructions in plane.

	• Central projection, parallel projection, orthographic projection. • Standard drawing formats and scales.	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.	Review.

	Course conclusions, synthesis, comments on the continuation of learning.	

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: 2.5

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

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

Humanities

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

The complexity of the Israeli society has various manifestations. Although it has been established as a Jewish state, demographic and cultural processes are changing and shaping the face of the Israeli society. Today, it is possible to speak of four "groups": secular, national-religious, ultra-Orthodox and Arabs living side by side. These demographic changes raise important issues regarding contemporary Israeli identity: What is Israeli culture? Is there room for a dominant Israeli culture? Is and how much space should be given to a wide variety of languages and cultures? The course will focus on three main topics: politics, family and education, and popular culture, with each subject being examined from four points of view of the various tribes.

Contact Hours per Week

Lecture: 2 hours.

Credit points: 2

History of the Middle-East – 324463

Survey the Power of Religion and Secular Nationalism in the Middle East, Their Development and Clash Within Different National Entities and Across State Boundaries. in Particular Secular Arab Nationalism and Islamic Fundamentalism Are Locked in Combat and Jewish Nationalism (Zionism) Remains in a Conflictual Relationship with Much of Arab/Islamic Society.

Contact Hours per Week

Lecture: 2 hours.

Credit points: 2

Issues in Contemporary Israeli Society – 324879

Course description:

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.

Requirements:

Students are expected to:

1) Come prepared to classes and participate in the discussions.

2) Participate in the course on-line discussion.

3) Present your group project.

4) Formulate a group project.

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

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

Lesson 2: The Holocaust and its impact on Israel

In-class viewing of the film "Operation Thunderbolt" Link:
https://www.youtube.com/watch?v=W3LTfZ1CZ1g&spfreload=10

Topic 2: The Israeli - Palestinian conflict

Lesson 3: The Arab-Palestinian minority in Israel

Lesson 4: Military and society relations

In-class viewing of the film Waltz with Basir (2008)

Lesson 5: Peace and Wars

Topic 3: Religion, ethnicity, and gender

Lesson 6: Religious Secular Divide – part 1

In-class viewing of the film "Haredi: The Ultra-Orthodox Community in Israel" (2008-2009)

https://www.youtube.com/watch?v=FGJg1lHPPZw: Link

Lesson 7: Religious Secular Divide – part 2

Lesson 8: Ethnicity divide

In-class viewing of the film "Late Wedding"

Lesson 9: Gender and family

Topic 4: Education, innovation and creativity

Lesson 10: Education in Israel- cross-cultural perspective

Lesson 11: Is there an 'Israeli DNA'?

Lesson 12: Is there an Israeli culture?

Lesson 13: Open Space discussion.

Contact Hours per Week

Lecture: 2 hours.

Credit points: 2

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

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