Subject group “Basic Natural Sciences”

Mathematics I

Code: MK3MAT1A8RX17-EN

ECTS Credit Points: 8

Evaluation: mid-semester grade

Year, Semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 4+4

Topics:

The basic notions of linear algebra, differentiation and integration for real functions; some applications in physics.

Literature:

Compulsory:

- Thomas’ Calculus, Addison Wesley (11th edition, 2005), ISBN: 0-321-24335-8
- S. Minton, Calculus Concept and Connections, McGraw Hill (2006), ISBN: 0-07111200-6

Schedule

1st week Registration week

2nd week:

Lecture: *Real numbers*

Axiom system.Boundary, inf, sup, min, max. Dedekind-complete, real line. Distance, neighbourhood, interior point, accumulation point. Intervals. The sets $\mathbb{R}$, $\mathbb{R}^2$, $\mathbb{R}^3$ and their geometric interpretations. Natural numbers, integer numbers, rational numbers. *Coordinate systems* Polar

3rd week:

Lecture: *Sequences of real numbers and their limit.* The notion of real sequences. Limits and operations. Some important sequences and their properties. Monotone and bounded sequences.

Practice: *Vector geomety, vector algebra.* The algebra of vectors in 2 and 3 dimensions: operations, coordinate systems. The algebraic definition of the

coordinate system. Spherical- and Cylindrical coordinate systems. **Practice:** Operations of sets, Boole algebra. Logic values, logic operations, logic functions.Cartesian product, 2-tuple, n-tuple.Cardinality. Illustrations of sets on the plane and in the space.	cross product. Geometric interpretations of the scalar product and the cross product. The mixed product.
4th week: **Lecture:** *Series of real and complex numbers.* Partial sums and convergence. Absolute convergence Geometric series, criteria of convergence. (Comparison test, ratio test, root test). **Practice:** Applications: Mechanical work, moment of a force with respect to a point, moment of a force with respect to an axis.	**5th week:** **Lecture:** *Series of real functions.* The notion of series of real functions, the convergence domain, the radius of the convergence.Power series. Power series of some elementary functions. **Practice:** *Vector geomety, vector algebra.* Unit vector in the direction of a vector, projections. Geometric applications: lines and planes in the space. The area of a triangle, the volume of a tetrahedron. The distance between a point and a line, or between a point and a plane.
6th week: **Lecture:** *Approximations of real functions.* Lagrange interpolation.Linear regression. **Practice:** *The set of thee complex numbers.* Complex plane, rectangular form, trigonometric form, exponential form, operations. Application: complex impedance	**7th week:** **Lecture:** Summary, sample test **Practice:** *Sequences of real numbers.* Limits and operations. Monotone and bounded sequences, convergence and relations among them.
8th week: 1st drawing week Test 1	
9th week: **Lecture:** *Matrices.* The arithmetic of matrices, determinants and their properties: operations, the notions of symmetrical matrix, skew-symmetrical matrix, determinant, the inverse matrix. **Practice:** *Matrices.* Operations, determinants and inverses with adjoint matrices	**10th week:** **Lecture:** *Vector spaces.* The notion of linear (or vector) space, linear combinations of vectors, linearly dependent and independent systems, basis, dimension, coordinates.Ranks of vector systems, ranks of matrices **Practice:** *Vector spaces.* Linearly independent and dependent systems, bases.Ranks of vector systems, ranks of matrices

11th week:

Lecture: *Systems of linear equations:* Gauss elimination (addition method) and Cramer's rule. Applications: Calculations for direct current using Kirchhoff's current and voltage laws.

Practice: *Systems of linear equations:* Gauss elimination (addition method) and Cramer's rule.

12th week:

Lecture: *Systems of linear equations:* by the inverse of the coefficient matrix

Practice: *Systems of linear equations:* by the inverse of the coefficient matrix

13th week:

Lecture: *Linear functions.* The notion of the linear function, the matrices of linear functions.Eigenvalues, eigenvectors.

Practice: *Linear functions.* Determinations of matrices of linear transformations.Determinations of eigenvalues, eigenvectors.

14th week:

Lecture: *Linear functions.* Bases transformations

Practice: *Linear functions.* Bases transformations

15th week: 2nd drawing week Test

Requirements

A, for a signature:

Participation at practice, according to Rules and Regulations of University of Debrecen. The correct solution of homework and submission before deadline. Solving assorted tasks.

B, for a grade:

All the tests must be written during the semester. Evaluation is according to the Rules and Regulations of University of Debrecen.

Mathematics II

Code: MK3MAT2A6RX17-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 1st year, 2nd semester

Its prerequisite(s): Mathematics I

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+4

Topics:

Differentiation and integration of multivariable and vector-valued functions, differential equations.

Literature:

Compulsory:

- Thomas' Calculus, Addison Wesley (11th edition, 2005), ISBN 0-321-24335-8
- S. Minton, Calculus Concept and Connections, McGraw Hill (2006), ISBN 0-07111200-6
- M. D. Greenberg, Fundamentals of engineering analysis, Cambridge University Press, ISBN 978-0-521-80526-1

Schedule

1st week Registration week	
2nd week: **Lecture:** Metric, topology, sequences in $\mathbb{R}^n$. Linear functions. **Practice:** Limits of vectorsequences. Limits and continuity of multivariable functions. Linear functions. Notions of differential equations, classification of differential equations, initial value problem.	**3rd week:** **Lecture:** Parametric curves I. Notions of differentiation, linear approximation. Frenet-Serret frame. Some examples in physics **Practice:** Differentiation, linear approximation, tangent line. Applications: velocity, acceleration. Problems leading to differential equations. (Newton's second law, RLC, examples in economics).
4th week: **Lecture:** Parametric curves II. Curvature, torsion. Evolute, evolvent, conic sections. **Practice:** Curvature, torsion. Determinations of conic sections in parametric form. Differential equations which can be integrated on direct way. Separable differential equations.	**5th week:** **Lecture:** Differentiable functions of type $\mathbb{R}^n \to \mathbb{R}^m$. **Practice:** Derivatives of functions of type $\mathbb{R}^n \to \mathbb{R}^m$. First order linear differential equations (homogeneous and inhomogeneous, method of variation).
6th week: **Lecture:** Parametric surfaces. Tangent plane, linear approximation. Surfaces of revolution, ruled surfaces. **Practice:** Surfaces of revolution: ellipsoid and paraboloid in parametric form.	**7th week:** **Lecture:** Scalar field, gradient. Young's theorem. Directional derivative. **Practice:** The domains of functions of type $\mathbb{R}^2 \to \mathbb{R}$. Directional derivative and

Derivatives of functions of type $\mathbb{R}^2 \to \mathbb{R}^3$.The equation of the tangent plane. Determination of solutions of inhomogeneous first order linear differential equations

gradient. Higher order linear differential equations, Wronski determinant.

8th week: 1st drawing week Test 1,2

9th week:

Lecture: Local and global extrema.

Practice: Local extremas of functions of type.

$$\mathbb{R}^2 \to \mathbb{R} \quad , \mathbb{R}^3 \to \mathbb{R}$$

10th week:

Lecture: Vector fields. Derivatives. Divergence and curl. Potential function.

Practice: Determination of global extremas on boundary closed sets. Solution of linear homogeneous differential equations of order two having constant coefficients.

11th week:

Lecture: The notion of double and triple integrals on 2 and 3 dimensional intervals. The extensions of the integrals.

Practice: Vector fields. Derivatives. Divergence and curl. Potential function. Method of undetermined coefficients.

12th week:

Lecture: Integrals over general regions. *Applications: second moment of area, mass, center of gravity*

Practice: Double and triple integrals on 2 and 3 dimensional intervals. Special second order differential equations.

13th week:

Lecture: The arc length of curves, surface area. Line and surface integrals. The theorems of Gauss and Stokes, Green's formulae. Applications in physics.

Practice: Integrals over general regions. Applications: second moment of area, mass, center of gravity. The theorems of Gauss and Stokes, Green's formulae. Applications in physics. The Laplace transform and its applications.

14th week:

Lecture: Mahtematical softwares

Practice: The arc length of curves, surface area. Line and surface integrals. Slope fields, numerical methods. (Euler, Runge-Kutta).

15th week: 2nd drawing week Test 3, 4

Requirements

A, for a signature:

Participation at practice, according to Rules and Regulations of University of Debrecen. The correct solution of homework and submission before deadline. Solving assorted tasks.

B, for a grade:

All the tests must be written during the semester. Evaluation is according to the Rules and Regulations of University of Debrecen.

Mathematics Comprehensive Exam

Code: MK3MATSA00RX17-EN

ECTS Credit Points: 0

Evaluation: exam

Year, Semester: 1th year, 2nd semester

Its prerequisite(s): Mathematics I, Mathematics II at the same time

Further courses are built on it: Yes/No

Subjects of the comprehensive exam: Mathematics I and II

Statics and Strength of Materials

Code: MK3STSZG04XX17-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 1th year, 1th semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Introduction to engineering mechanics. Newton's laws of motion. Force, moment, and couples. Statics of a particle. Statics of rigid body. Planar force systems. Statics of planar structures. Internal force systems of rigid bodies. Loading of beams (cantilevers, freely supported beams, fraction lined beams). Determination of stress resultant diagrams (normal force, shear force and bending moment diagrams). Statically determined beam structures (hinged-bar systems, compound beams, truss systems). Fundamentals of Strength of Materials. Physical interpretation of strain terms. State of deformation. State of stresses. Constitutive equation (Hooke's law). Simple loadings (tension, compression, bending, torsion, shear). Sizing methods. Mohr's circle. Combined loadings (tension and bending, inclined bending, excentrical tension, tension and torsion, bending and torsion). An introduction to the finite element method.

Literature:

Compulsory:

- Russel C. Hibbeler (2006): Engineering Mechanics – Statics and Dynamics, Prentice Hall, 2006. ISBN-13 9780132215091

- Ladislav Cerny (1981): Elementary Statics and Strength of Materials, McGraw-Hill, ISBN 0070103399, 9780070103399
- László Kocsis (1988): Brief Account of the Lectures of Mechanics, Strength of Materials, BME
- Ferdinand P. Beer, E. Russel Johnston, Jr., John T. DeWolf (2006): University of Connecticut Mechanics of Materials, 4th Edition, © 2006, ISBN-13 9780073107950

Recommended:

- Stephen Timoshenko (1955): Strength of Materials: Elementary Theory and Problems, Van Nostrand
- Jacob Pieter Den Hartog (1961): Strength of Materials, Courier Dover Publications, ISBN 0486607550, 9780486607559

Schedule

1st week Registration week	
2nd week: **Lecture:** Mathematical preliminaries (vector-, matrixalgebra). Introduction to engineering mechanics. Statics of a particle **Practice:** Calculation the resultant of 2 and 3 dimensional force systems acting on particles.	3rd week: **Lecture:** Statics of rigid bodies. Moments. Equilibrium state of a rigid body. Planar force systems. **Practice:** Calculation of moments. Examples for equilibrium state of rigid bodies and for planar force systems.
4th week: **Lecture:** Statics of planar structures. Supports and reaction forces. **Practice:** Practical examples for the determination of the reaction forces of statically determined structures.	5th week: **Lecture:** Internal force systems of rigid bodies. Loading of beams. **Practice:** Practical examples for the determination of the normal force, shear force and bending moment functions of beams.
6th week: **Lecture:** Determination of stress resultant diagrams of beams. **Practice:** Practical examples for the determination of the normal force, shear force and bending moment diagrams of beams.	7th week: **Lecture:** Statically determined beam structures. **Practice:** Analysis of hinged-bar systems and truss systems. **1st test.**
8th week: 1st drawing week	
9th week:	10th week:

Lecture: Fundamentals of Strength of Materials. Displacement-, strain- and stress field. Constitutive equation (Hooke's law).

Practice: Practical examples for strain and stress calculations.

Lecture: Simple loadings I: tension, compression and bending of prismatic beams. Fundamentals of sizing and control.

Practice: Practical examples for tension, compression and bending.

11th week:

Lecture: Simple loadings II: torsion of prismatic beams with circular and ring cross sections. Mohr's circle. Shear.

Practice: Practical examples for torsion and shear.

12th week:

Lecture: Combined loadings I: tension and bending, inclined bending, excentrical tension.

Practice: Practical examples for combined loadings.

13th week:

Lecture: Combined loadings II: tension and torsion, bending and torsion. Sizing methods.

Practice: Practical examples for combined loadings.

14th week:

Lecture: The finite element method.

Practice: Case studies for numerical calculation of engineering structures. **2nd test.**

15th week: 2nd drawing week

Requirements

A, for a signature:

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice** is compulsory. Students must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Students can't make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, being discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments to the course with them to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two tests: the 1st test in the 7th week and the 2nd test in the 14th week. Students have to sit for the tests.

B, for a grade:

The course ends in a **mid-semester grade** based on the test results.

The minimum requirement for both mid-term and end-term tests is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

Score=Grade

0-39 = fail (1); 40-52 = pass (2); 52-63 = satisfactory (3); 64-71 = good (4); 72-80 = excellent (5)

If the score of the sum of the two tests is below 40, the student once can take a retake test of the whole semester material.

Engineering Physics

Code: MK3MFIZA04RX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Geometrical optics, kinematics and dynamics of particles, concept of mechanical work, kinetic and potential energy, electrostatics, electric fields around conductors, transport processes, steady-state transport of electric charge, steady-state heat transfer (conduction, convection and radiation)

Literature:

Compulsory:

- Alvin Halpern: 3,000 Solved Problems in Physics, SCHAUM'S SOLVED PROBLEM SERIES (2011), ISBN-13: 978-0071763462
- Jerry S. Faughn, Raymond A. Serway, Chris Vuille, Charles A. Bennett: Serway's College Physics, Published 2005 by Brooks Cole Print, ISBN 0-534-99723-6

Schedule

1st week Registration week	
2nd week: **Lecture:** Geometrical (ray) optics. Concept of geometrical optics, law of reflection and refraction (Snell's law), Brewster's angle, Optics of prisms and lenses, imaging properties and magnification, aberrations, compound lenses.	**3rd week:** **Lecture:** Kinematics of a particle I. Description of the motion by scalar quantities: Scalar position, velocity and acceleration. Example: uniform and uniformly varying motion

Practice: Solving problems for the reflection and refraction of light beams and for the imaging of lenses and compound lenses.

Practice: Solving problems for uniform and uniformly varying motions.

4th week:

Lecture: Kinematics of a particle II. Description of the motion by vector quantities: Position vector, vector velocity and acceleration.

Example: throwing problems, circular motion.

Practice: Solving throwing and circular motion problems.

5th week:

Lecture: Kinetics of a particles I. Inertial frame of reference, Newton's Laws, force formulas. Application of Newton's Laws in static and dynamic problems.

Practice: Application of Newton's laws in kinetic problems.

6th week:

Lecture: Kinetics of a particles II. Concept of work and kinetic energy, work-energy theorem. Application of work-energy theorem in dynamic problems.

Practice: Application of Newton's laws and the work energy theorem in kinetic problems.

7th week:

Lecture: Electrostatics I. Electric field strength and flux, Gauss's law for electricity (Maxwell's first equation), potential energy in electric fields.

Practice: Calculation of the electric field strength and its flux in the electrostatic fields of different charge arrangements.

8th week: 1st drawing week Test 1

9th week:

Lecture: Electrostatics II. Electric voltage and potential, capacitance, capacitance of planar, cylindrical and spherical capacitors, the energy of capacitors, capacitor circuits.

Practice: Calculating the capacitance and stored energy of different types of capacitors and capacitor connections.

10th week:

Lecture: Transport processes

Concept of physical system, current intensity and source strength, extensive and intensive physical properties, conduction and convection current. Equation of balance and steady-state conduction. Thermal conductivity and conductive resistance. Conductive resistance circuits.

Practice: Application of the equation of balance and steady-state conduction in different physical problems.

11th week:

Lecture: Steady state transport of electric charge (Direct electric current). Electric current intensity, electrical conductivity and resistance, Ohm's law, electric work and power, characteristics of DC sources,

12th week:

Lecture: Steady-state heat transfer I - Thermal conduction. Concept of heat current and thermal conduction, equation of steady-state thermal conduction, thermal conductivity and resistance, steady

Kirchhoff's circuit laws, solution of DC circuits **Practice:** Solution of DC circuits	state temperature distribution in a one dimensional wall of thermal conductivity **Practice:** Solving thermal conduction problems
13th week: **Lecture:** Steady-state heat transfer II - Thermal convection. Concept of thermal convection and heat transfer, equation of steady-state heat transfer, heat transfer coefficient and resistance, overall heat transfer coefficient and resistance **Practice:** Calculating the steady state temperature distribution in a one dimensional wall of thermal conductivity.	**14th week:** **Lecture:** Steady-state heat transfer III - Thermal radiation. Thermal radiation characteristics, concept of black body radiation, fundamental laws of thermal radiation (Planck distribution, Wien displacement law, Stefan-Boltzmann and Kirchhoff's law), gray body radiation **Practice:** Solving thermal radiation problems.
15th week: 2nd drawing week Test 2	

Requirements

A, for a signature:

Participation at lectures is compulsory. Students must attend lectures and may not miss more than three of them during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at lectures will be recorded by the lecturer. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed lectures must be made up for at a later date, being discussed with the tutor.

Students have to write two midterm tests during the semester. The first (40 points max) in the 8th, the second (40 points max) in the 14th week. At the end of the semester everybody will get a seminar grade on the basis of the table below:

0-39 = Fail (1); 40-50 = Close fail (2); 51-60 = Improvement needed (3); 61-70 = Very good (4); 71-80 = Excellent (5)

If somebody fails then he has to write both tests in the 1st week of the exam period again. If the result is 40 points (50%) or better, then he can take an exam. If somebody has to repeat his midterm tests then his seminar grade can't be better than (2).

There will be homework from week to week. Only students who have handed in all their homework at the time of the midterm test will be allowed to write it. The problems in the midterm tests will be selected from the homework assignments.

B, for a grade:

Everybody will get an exam grade for their exam. The final grade will be the average of the seminar and exam grade. If it is for example (3.5) then the lecturer decides if it is (3) or (4).

Dynamics and Vibrations

Code: MK3MREZG04XX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st year, 2nd semester

Its prerequisite(s): Engineering Physics, Mathematics I

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Motion of a particle:

position, velocity and acceleration and the mathematical relations between them, description of the motion of the particle in Cartesian coordinate system and Frenet-frame, Newton's laws and differential equation of the motion of the particle, theorems of kinetics, force fields, kinetic, potential and mechanical energy, constrained motion along a two or three dimensional curve

Motion of a rigid body:

description of the translational, rotational and general plane motion of a rigid body, concept and determination of the instantaneous centre of zero velocity and acceleration, rolling motion without slipping, description of the plane motion of a rigid body in a time interval, centre of mass, momentum and angular momentum, moment of inertia and its calculation, mechanical work, Newton's laws and theorem of kinetics for rigid bodies, rotating and swinging of the body about an axis, rolling without slipping

Vibrations:

Description and classification of vibratory motions and vibrating systems. Basic definitions and properties of vibratory motion. Investigation of the elements of vibrating systems: masses and inertial elements, flexible and damping elements. Investigation of the dynamic models. Two ways for the generation of motion equations: the D'Alembert's principle and the Lagrange equations of motion. Investigation and properties of the free vibrations of single DOF undamped and damped systems. Solution of the homogenous motion equation. Investigation and properties of the forced vibrations of single DOF undamped and damped systems. Basic types of forced vibrating systems. Multiple DOF systems: introduction, basic properties, natural frequencies and modes, modal transform and decoupling.

Literature:

Compulsory:

- Russel C. Hibbeler: Engineering Mechanics – Statics and Dynamics, Prentice Hall, 2006. ISBN-13 9780132215091

- Jerry Ginsberg: Engineering Dynamics, 3rd edition, Cambridge University Press, 2007. ISBN-13: 978-0521883030
- Lakshmana C. Rao, J. Lakshminarasimhan, Raju Sethuraman, Srinivasan M. Sivakumar: Engineering Mechanics: Statics and Dynamics, PHI Learning Pvt. Ltd., 2004. ISBN 8120321898, 9788120321892
- Meirovitch, Leonard: Fundamentals of Vibration, McGraw-Hill Publishing Company, 2000. ISBN 0071181741

Recommended:

- Ferdinand P. Beer, E. Russell Johnston, Jr.: University of Connecticut, Mechanics for Engineers: Statics and Dynamics (Package), 4th Edition, ©1987, ISBN-13 9780070045842
- Joseph F. Shelley: 700 solved problems in vector mechanics for engineers, Volume II: Dynamics. (SCHAUM'S SOLVED PROBLEM SERIES), McGraw-Hill, 1990. ISBN 0-07-056687-9

Schedule

1st week Registration week

2nd week:

Lecture: Kinematics of a particle

Scalar and vector position, velocity and acceleration and the mathematical relations between them. Description of the motion in Cartesian coordinate system and Frenet-frame. Special motion types: Motion with constant acceleration, circular motion.

Practice: Particle kinematics problems

3rd week:

Lecture: Kinetics of a particle I

Newton's laws and differential equation of the motion of the particle. Theorems of kinetics (impulse-momentum, work-energy and angular impulse-angular momentum theorems). Mechanical Power. Force fields (homogeneous, central and conservative). Kinetic, potential and mechanical energy.

Practice: Particle kinetics problems

4th week:

Lecture: Kinetics of a particle II

Formulas for work and potential energy in homogeneous and central force fields. Motion of the particle in gravitational and elastic spring force fields. Constrained motion along a two or three dimensional curve.

Practice: Particle kinetics problems II

5th week:

Lecture: Kinematics of a rigid body I

Basic concepts (rigid body and disc, planar, translational, rotational and general plane motion). Connections between the velocity and acceleration of the different points of a rigid body undergoing translational, rotational and general plane motion. Instantaneous centre of zero velocity and acceleration and procedure for the determination of them with calculation and construction.

Practice: Rigid body kinematics problems

6th week:

Lecture: Kinematics of a rigid body II

Rolling motion without slipping. Description of the plane motion of a rigid body in a time interval. Pole curves.

Practice: Rigid body kinematics problems

7th week:

Lecture: Kinetics of a rigid body I

Basic concepts: centre of mass, momentum and angular momentum, moment of inertia and its calculation, parallel axis theorem, mechanical work.

Practice: Rigid body kinetics problems

8th week: 1st drawing week

9th week:

Lecture: Kinetics of a rigid body II

Newton's laws and theorem of kinetics for rigid bodies (impulse-momentum, angular impulse-angular momentum and work-energy theorems). Special motion types: Rotating and swinging about an axis, rolling without slipping.

Practice: Rigid body kinetics problems

10th week:

Lecture:

Description and classification of vibratory motions and vibrating systems. Basic definitions and properties of vibratory motion. Investigation of the elements of vibrating systems: masses and inertial elements, flexible and damping elements.

Practice: Reduction of masses. Replacement of rigid bodies by lumped masses. Reduction of springs and damping elements.

11th week:

Lecture: Investigation of the dynamic models. Two ways for the generation of motion equations: the D'Alembert's principle and the Lagrange equations of motion.

Practice: Generating the equations of motion for single- and multiple degrees of freedom (DOF) systems.

12th week:

Lecture: Investigation and properties of the free vibrations of single DOF undamped and damped systems. Solution of the homogenous motion equation.

Practice: Calculation problems related to the free vibrations of single DOF undamped and damped systems.

13th week:

Lecture: Investigation and properties of the forced vibrations of single DOF undamped and damped systems. Basic types of forced vibrating systems.

Practice: Calculation examples of several kinds of forced vibrations in case of single DOF undamped and damped systems.

14th week:

Lecture: Multiple DOF systems: introduction, basic properties, natural frequencies and modes, modal transform and decoupling.

Practice: Calculation problems related to the free and forced vibrations of multiple DOF undamped and damped systems.

15th week: 2nd drawing week

Requirements

A, for a signature:

Participation at lectures and seminars is compulsory. Students must attend lectures and seminars and may not miss more than three of them during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at lectures and seminars will be recorded by the lecturer. Being late is equivalent with an absence. In case of further absences, a medical certification needs to be presented. Missed lectures must be made up for at a later date, being discussed with the tutor.

Students have to write two midterm tests during the semester. The first (40 points max) in the 8th, the second (40 points max) in the 14th week. At the end of the semester everybody will get a seminar grade on the basis of the table below:

0-39 = Fail (1); 40-50 = Close fail (2); 51-60 = Improvement needed (3); 61-70 = Very good (4); 71-80 = Excellent (5)

If somebody fails then he has to write both tests in the 1st week of the exam period again. If the result is 40 points (50%) or better, then he can take an exam. If somebody has to repeat his midterm tests then his seminar grade can't be better than (2).

There will be homework from week to week. Only students who have handed in all their homework at the time of the midterm test will be allowed to write it. The problems in the midterm tests will be selected from the homework assignments.

B, for a grade:

Everybody will get an exam grade for their exam. The final grade will be the average of the seminar and exam grade. If it is for example (3.5) then the lecturer decides if it is (3) or (4).

Thermodynamics and Fluid Mechanics I

Code: MK3THE1R06HX17-EN

ECTS Credit Points: 6

Evaluation: exam

Year, Semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses are built on it: <u>Yes</u>/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Definitions and Fundamental Ideas of Thermodynamics. Changing the State of a System with Heat and Work. Zeroth Law of Thermodynamics. The isotherm, isochor, isobar, adiabatic and polytrophic process. The First Law of Thermodynamics: Conservation of

Energy. Corollaries of the First Law. Generalized Representation of Thermodynamic Cycles. The Carnot Cycle. Entropy. The second law of Thermodynamics. Reversibility and Irreversibility in Natural Processes. Technical work. Enthalpy. Exergy. Mixtures: Partial pressure, Dalton's laws. Gas mixtures. Gas mixtures. Real gases. Steam. Humid air. T-s diagram. Energy cycles.

Heat transfer. Basic forms of heat transfer. Fundamental equations. General differential equation of heat conduction. Steady state and transient conduction. Thermal resistance. Conduction (plane walls, cylindrical walls, spherical walls). Convection: concepts and basic relations, boundary layers, similarity concept. Free convection, forced convection (the Reynolds, Grasshof, Prandtl, Nusselt numbers).

Literature:

Compulsory:

- Lakatos Á. Basics of Heat Transfer and Fluid Mechanics. 2014, Terc Kft.
- Robert Balmer (2006) Thermo-dynamics, Jaico Publishing House, ISBN: 817224262X, 868 pages
- James R. Ogden (1998) Thermodynamics Problem Solver, Research and Education Association, ISBN: 0878915559, 1104 pages.
- Warren M. Rohsenow, James P. Hartnett, Young I. Cho (1998), Handbook of Heat Transfer, McGraw-Hill New York, ISBN: 0070535558 / 9780070535558, 1344 pages.

Schedule

1st week Registration week

2nd week:

Lecture: Definitions and Fundamental Ideas of Thermodynamics. Changing the State of a System with Heat and Work. Zeroth Law of Thermodynamics

Practice: Solving problems in the theme of the lecture

3rd week:

Lecture: The isotherm, isochor, isobar, adiabatic and polytrophic process. The First Law of Thermodynamics: Conservation of Energy

Practice: Solving problems in the theme of the lecture

4th week:

Lecture: Corollaries of the First Law. Generalized Representation of Thermodynamic Cycles.

Practice: Solving problems in the theme of the lecture

5th week:

Lecture: The Carnot Cycle. Entropy. The second law of Thermodynamics.

Practice: Solving problems in the theme of the lecture

6th week: **Lecture:** Reversibility and and Irreversibility in Natural Processes. Technical work. Enthalpy. Exergy. **Practice:** Solving problems in the theme of the lecture	**7th week:** **Lecture:** Mixtures: Partial pressure, Dalton's laws. Gas mixtures. Gas mixtures. Real gases. **Practice:** Solving problems in the theme of the lecture
8th week: 1st drawing week	
9th week: **Lecture:** Steam. Humid air. T-s diagram. **Practice:** Solving problems in the theme of the lecture	**10th week:** **Lecture:** Energy cycles. Carnot's Cycle, Joule' s cycle. **Practice:** Solving problems in the theme of the lecture
11th week: **Lecture:** Heat transfer. Basic forms of heat transfer **Practice:** Solving problems in the theme of the lecture threaded joints in section and on view.	**12th week:** **Lecture**: Fundamental equations. General differential equation of heat conduction. Steady state and transient conduction. **Practice:** Solving problems in the theme of the lecture
13th week: **Lecture:** Thermal resistance. Conduction (plane walls, cylindrical walls, spherical walls). Convection: concepts and basic relations, boundary layers, similarity concept. **Practice:** Solving problems in the theme of the lecture	**14th week:** **Lecture:** Free convection, forced convection (the Reynolds, Grasshof, Prandtl, Nusselt numbers). **Practice:** Solving problems in the theme of the lecture
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the lectures is recommended, but not compulsory.

Participation at practice is compulsory. Student must attend the practices and my not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student can't make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments for the course with them to each practice. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class.

During the semester there are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for grade:

The course ends with exam grade. Based on the average of the test results x 0.3 + the exam grade from the theory x 076 the mid-semester grade is calculated as an average of them:

The minimum requirement for the mid-term, end-term tests and for the exam is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

Score / Grade

0-50 = fail (1); 51-60 = pass (2); 61-74 = satisfactory (3); 75-89 = good (4); 90-100 = excellent (5);

Thermodynamics and Fluid Mechanics II

Code: MK3THE2R04HX17-EN

ECTS Credit Points: 4

Evaluation: exam

Year, Semester: 1st year, 2nd semester

Its prerequisite(s): Thermodynamics and Fluid Mechanics I

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Introduce concepts, principles, laws, observations, and models of fluids at rest and in motion. Provide basis for understanding fluid behavior and for engineering design and control of fluid systems. Develop competence with mass, energy and momentum balances for determining resultant interactions of flows and engineered and natural systems. Develop basis for correlating experimental data, designing tests, and using scale models of fluid flows. Learn nature of rotation, circulation, resistance (viscous, turbulent), boundary layers, and separation with applications to drag and lift on objects. Learn methods for computing headlosses and flows in simple pipes and channels.

Literature:

Compulsory:

- Lakatos Á. Basics of Heat Transfer and Fluid Mechanics. 2014, Terc Kft.

- Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, (2009) Fundamentals of Fluid Mechanics, John Wiley and Sons, ISBN 978-0470262849, 776 pages
- Robert W. Fox, Alan T. McDonald, Robert W Fox, (1998) John Wiley and Sons, ISBN 978-0471124641, 762 pages
- Shashi Menon (2004) Piping Calculations Manual, ISBN 978-0071440905 666 pages

Schedule

1st week Registration week	
2nd week: Introduce concepts, principles, laws, observations, and models of fluids at rest and in motion **Lecture:** Provide basis for understanding fluid behavior and for engineering design and control of fluid systems. **Practice:** Solving problems in the theme of the lecture	**3rd week:** **Lecture:** Develop competence with mass balances for determining resultant interactions of flows and engineered and natural systems. **Practice:** Solving problems in the theme of the lecture
4th week: **Lecture**: Develop competence with energy balances for determining resultant interactions of flows and engineered and natural systems. **Practice:** Solving problems in the theme of the lecture	**5th week:** **Lecture:** Develop competence with momentum balances for determining resultant interactions of flows and engineered and natural systems. **Practice:** Solving problems in the theme of the lecture
6th week: **Lecture:** Develop basis for correlating experimental data, designing tests, and using scale models of fluid flows. **Practice:** Solving problems in the theme of the lecture	**7th week:** **Lecture, practice:** Solving problems in the theme of the lecture
8th week: 1st drawing week	
9th week: **Lecture:** Learn nature of rotation, circulation, resistance (viscous, turbulent), boundary layers, and separation with applications to drag and lift on objects. **Practice:** Solving problems in the theme of the lecture	**10th week:** **Lecture:** Learn methods for computing headlosses and flows in simple pipes and channels. **Practice:** Solving problems in the theme of the lecture
11th week: **Lecture:** Navier- Stokes equation	**12th week:** **Lecture**: Losses in pipes.

Practice: Solving problems in the theme of the lecture.	**Practice:** Solving problems in the theme of the lecture
13th week:	**14th week:**
Lecture: Bernoulli equation.	**Lecture:** Law of impulse and momentoum.
Practice: Solving problems in the theme of the lecture	**Practice:** Solving problems in the theme of the lecture
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance on the lectures is recommended, but not compulsory.

Participation at practice is compulsory. Student must attend the practices and my not miss more than three practice during the semester. In case a student misses more than three, the subject will not be signed and the student must repeat the course. Student can't make up a practice with another group. The attendance on practice will be recorded by the practice leader. Being late is counted as an absence. In case of further absences, a medical certificate needs to be presented. Missed practices should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments for the course with them to each practice. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate their participation as an absence due to the lack of active participation in class.

During the semester there are two tests: the mid-term test is in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

B, for grade:

The course ends with exam grade. Based on the average of the test results x 0.3 + the exam grade from the theory x 076 the mid-semester grade is calculated as an average of them:

The minimum requirement for the mid-term, end-term tests and for the exam is 50%. Based on the score of the tests separately, the grade for the tests is given according to the following table:

Score / Grade

0-50 = fail (1); 51-60 = pass (2); 61-74 = satisfactory (3); 75-89 = good (4); 90-100 = excellent (5);

Electrotechnics and Electronics

Code: MK3ELTER06RX17-EN

ECTS Credit Points: 6

Evaluation: mid-semester grade

Year, Semester: 2nd year, 1st semester

Its prerequisite(s): Mathematics I, Engineering Physics

Further courses are built on it: Yes/No

Number of teaching hours/week (lecture + practice): 2+2

Topics:

Introduction to DC circuits: voltage, current, basic components. Network analysis: Ohm's Law, Kirchhoff's Law, current and voltage divider, superposition, Thevenin and Norton's Law. Alternating current circuits: sinusoidal wave, calculation on the complex plane, power and effective values. Transient signals in the AC circuits: series and parallel RLC circuits. 3 phases circuit.

Introduction to electronics: features of electronic circuits, solid state devices. Transistors, unipolar and bipolar transistors. Operation, characteristics, and basic circuits. Amplifiers: 4 port theory, transfer functions, feedback: positive and negative. Semiconductors, diode, special diode. Common emitter amplifier. Differential amplifier: operational modes, circuit. Class A and AB amplifiers. Power amplifiers. Operational amplifiers: inverting and non-inverting type. Filters: Low and high pass filter, band pass filter.

Literature:

Compulsory:

- Electronic Circuits: Handbook for Design and Application, U. Tietze, Ch. Schenk, 2nd edition, 2008, ISBN-10: 3540004297

Schedule

1st week Registration week	
2nd week: **Lecture:** Electrostatics, DC networks: basic electrical concepts of electric charge, electric current (amperage), electric field, electric field work, electric voltage (potential), electric circuit **Practice:** General description, laboratory regulations, Safety regulations and safety instruction	**3rd week:** **Lecture:** Power source (ideal real), Power Source (ideal for real), Consumer, Ohm's Law, Resistance - design, characteristic data, division, marking according to IEC standard. Passive resistance of bipolar networks, Star-delta, delta-star conversion, Electrical work, electric power, efficiency **Practice:** introduction to measurements and instrumentation (measuring error, power supply, digital multimeter, signal generator)

4th week: **Lecture:** Network analysis: Kirchhoff's laws, Voltage divider, potentiometer, extending measuring range of a Volt meter current divider, extending measuring range of an Amp meter, Wheatstone bridge. Nodal analysis, Mesh analysis. **Practice:** 1st measurement: measuring the characteristics of DC voltage (U, I, RB, P) using Ohm's Law. Measuring the values of DC circuit. Using Kirchhoff's lows. Report writing.	**5th week:** **Lecture:** Network analysis: superposition theory, Northon and Thevenin theory. **Practice:** Perform a complex DC measurement and calculation task. Report writing.
6th week: **Lecture:** AC circuit, complex number, AC circuit mean value (RMS). Behavior of a resistance in AC circuit, inductance behavior in AC circuit, capacitance behavior in AC circuit. **Practice:** introduction to AC measurements and instrumentation (AC type digital multimeter, signal generator, oscilloscope, LRC meter). Report writing.	**7th week:** **Lecture:** Performance of AC circuits, power factor correction, Three-phase systems **Practice:** measurements of AC power. Report writing.
8th week: 1st drawing week	
9th week: **Lecture:** Pure and doped semiconductor characteristics, PN junction behavior at forward and reverse bias conditions. **Practice:** Silicon diode opening and closing characteristics measurements. Analysis of rectifier circuits. Report writing.	**10th week:** **Lecture:** Characteristics and applications of semiconductor diodes, the rectifier circuit operation, the one-way, two-way rectifier circuits operation. **Practice:** Analysis of rectifier circuits. Report writing.
11th week: **Lecture:** Bipolar transistor structure, gain, transistor parameters and characteristics, the FE connection, adjusting the set point. Areas of application of bipolar transistor, circuits transistor basic (CB, CC circuits), **Practice:** Analysis of common emitter basic circuit. Report writing.	**12th week:** **Lecture:** Principles of operation of field-effect transistors. **Practice:** Analysis of common source basic circuit. Report writing.
13th week: **Lecture:** Operation and characteristics of basic operational amplifier circuits	**14th week:** **Lecture:** Filters: Low and high pass filter, band pass filter.

(inverting, non-inverting, follower, summing, differential, differentiator and integrator basic circuit) **Practice:** Analysis of summing operational amplifier basic circuit. Report writing.	**Practice:** Analysis of filters basic circuit. Report writing.
15th week: 2nd drawing week	

Requirements

A, for a signature:

Attendance at lectures is recommended, but not compulsory. Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. Missed practice classes must be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as absence because of the lack of active participation in class. During the semester there are one test. Students have to sit for these tests.

Preparing measurement reports until deadline.

B, for grade:

At the end of the course a test must be taken. The minimum requirement for end-term test is 41%. Score Grade 0-40 fail (1) 41-55 pass (2) 56-70 satisfactory (3) 71-85 good (4) 86-100 excellent (5)