Josip Juraj Strossmayer University of Osijek

Mechanical Engineering Faculty in Slavonski Brod

STUDY PROGRAMME

GRADUATE STUDY: MECHANICAL ENGINEERING

CONTENTS

1. GRADUATE STUDY PROGRAMME

1.1. Introduction

It is evident that in our economy we are technologically inferior to the manufacturing enterprises of the European Union. The Institutes that once existed at bigger companies have disappeared, as well as the Research and Development Departments of bigger enterprises.

The graduate study should educate the students to become the leaders of development in manufacturing industries and services striving to turn them into modern enterprises able to get readily adapted to the flexible demands of the market, application of new technologies, methods and procedures in order to compete successfully with others. Students of graduate study programme should acquire knowledge and skills necessary for design and management of power plants and facilities. Furthermore, they need to get familiar with the latest achievements in the field of ecology and economic aspests of energetics.

Acquiring the skills to implement the new manufacturing strategies, understand the properties and applications of new materials, new manufacturing technologies, possibilities of automation of production and its planning, the graduate students should be at the forefront of technological development in their work field.

In addition to acquiring professional knowledge in their field of study and learning about the most recent developments in the world, the graduate students will also get an insight into and be prepared for the scientific-research work (defining problems, analysing data, modelling processes and setting aims, using numerical and statistical methods to optimise models, ways of writing and presenting the results of a scientific-research study).

Comparison with similar programmes in the European Union and the world is given by degree programmes:

- Product Design and Development:
    - Chalmers University of Technology, Mechanical Engineering, Göteborg, Sweden (Chalmers tekniska högskola; TMASA - Maskinteknik)
    - Technical University of Denmark, Department of Mechanical Engineering, Lyngby, Denmark (Danmarks Tekniske Universitet, Institut for Mekanik, Energi og Konstruktion - MEK)
    - University of Maribor, Faculty of Mechanical Engineering, Mechanical Engineering, Slovenia (Univerza v Mariboru, Fakulteta za strojništvo)
    - University of Ljubljana, Faculty of Mechanical Engineering, Mechanical Engineering, Slovenia (Univerza v Ljubljani, Fakulteta za strojništvo)
    - University of Twente, Faculty of Engineering Technology – Mechanical Engineering, Enschede, the Netherlands (Universiteit Twente, Faculteit Construerende Technische Wetenschappen - CTW)
    - University of West Bohemia, Faculty of Mechanical Engineering, Pilsen, Czech Republic (Fakulta strojní Západočeské univerzity)
    - Carlos III University of Madrid, Electrical Engineering Department, Technical Industrial Engineering: Mechanics, Spain, (Universidad Carlos III de Madrid, Departamento de Ingeniería Eléctrica)

- Manufacturing Logistics:
    - Aristotle University of Thessaloniki, Faculty of Engineering, Department of Mechanical Engineering, Greece
    - Budapest University of Technology and Economics, The Faculty of Mechanical Engineering, Hungary, (Budapesti Műszaki és Gazdaságtudományi Egyetem)
    - University of Aveiro, Mechanical Engineering Department, Portugal, (Universidade de Aveiro, Departamento de Engenharia Mecânica)
    - University of West Bohemia, Faculty of Mechanical Engineering, Pilsen, Czech Republic (Fakulta strojní Západočeské university)
    - University of Maribor, Faculty of Mechanical Engineering, Slovenia (Univerza v Mariboru, Fakulteta za strojništvo)
    - Istanbul Technical University, Faculty of Mechanical Engineering, Department of Mechanical Engineering, Turkey, (İstanbul Teknik Üniversitesi, Makina Fakültesi)

- Materials Engineering:
    - University of Maribor, Faculty of Mechanical Engineering, Mechanical Engineering, Slovenia (Univerza v Mariboru, Fakulteta za strojništvo)
    - University of Ljubljana, Faculty of Mechanical Engineering, Mechanical Engineering, Slovenia (Univerza v Ljubljani, Fakulteta za strojništvo)

- Engineering Technologies:
    - University of Maribor, Faculty of Mechanical Engineering, Mechanical Engineering, Slovenia (Univerza v Mariboru, Fakulteta za strojništvo)

- Power Engineering:
    - Brandenburg University of Technology Cottbus, Faculty of Mechanical, Electrical and Industrial Engineering, Mechanical Engineering, Germany (Brandenburgische Technische Universität - BTU Cottbus, Die Fakultät für Maschinenbau, Elektrotechnik und Wirtschaftsingenieurwesen)
    - VŠB Tehnical University of Ostrava, Faculty of Mechanical Engineering, Mechanical Engineering, Czech Republic, (Technicka univerzita Ostrava, Fakulta strojni)

Our experience from the MEng degree programmes shows that there is a need for educating masters, as well as producing the master theses for specific areas of development in enterprises.

Many companies in the field of metal processing have shown interest in this new module of graduate study programme, e.g. Austrian Energy & Environment, Đuro Đaković Termoenergetska postrojenja d.o.o, Đuro Đaković Kotlovi d.o.o., Đuro Đaković Elektromont d.d. and Đuro Đaković Holding d.d. in Slavonski Brod, Bilfinger Berger Power Services and Đuro Đaković Montaža.

Service enterprises are interested in the programme, as well as those that need experts possessing skills for applying the new technologies and new strategies in maintaining machinery and equipment (thermal electric power plants, heating plants, cement plants, maintenance of rolling stock, maintenance of passenger transport vehicles, etc.).

2. GENERAL INFORMATION

2.1. Title of the study programme

The title of the study programme is **Mechanical Engineering**.

The programme modules are:

- Product Design and Development
- Manufacturing Logistics
- Materials Engineering
- Engineering Technologies
- Power Engineering

2.2. Responsible for the study

Responsible for the study is: Mechanical Engineering Faculty in Slavonski Brod of the Josip Juraj Strossmayer University of Osijek.

The study programme is carried out by Mechanical Engineering Faculty in Slavonski Brod. The members of teaching staff include lecturers teaching at other faculties of the University of Osijek (where our students can also attend lectures).

2.3. Duration of the graduate study programme

The duration of the study is 4 semesters, containing 120 ECTS points and providing students with further in-depth study of subjects dealt with at undergraduate level. The complexity and depth of the study and the skills thus obtained enable the graduates to solve the most complex engineering tasks.

After graduation, highly qualified engineers have a sound educational foundation for continuing the post-graduate study. The graduate student is given the academic title of Master of Mechanical Engineering (mag. ing. mech.).

2.4. Graduate study admission requirements

The candidates holding an undergraduate degree and at least 180 ECTS points from the same degree programme are admitted.

If they have finished related technical faculties, they must fulfil some additional requirements.

2.5. Competences and employment opportunities

Graduate students (with 300 ECTS points, i.e. 120 ECTS points earned at the graduate degree study) can enrol in post-graduate study if the grades are satisfactory or/and they have achieved outstanding results in the scientific-research work.

Some of the employment opportunities are:

- Organisation and work on development and research-development tasks in enterprises (development of a new product applying CAD, CAD/CAM, RP and FEM, implementation of new manufacturing technologies, research and application of new production and resources management methods and strategies, research and introduction of new materials and surface engineering, implementation of new maintenance strategies),
- Continuation of scientific-research education on the post-graduate study,
- Engagement in scientific-research institutes and development departments.

The students with undergraduate degrees from related technical faculties (with 180 ECTS points earned and the same stream programmes) can also be admitted to graduate degree programmes.

2.6. Academic title

A graduate student (with obtained 300 ECTS points) is awarded the academic title of Master of Mechanical Engineering (mag. ing. mech.).

3. DESCRIPTION OF THE GRADUATE STUDY PROGRAMME

The graduate study programmes last for 4 semesters during which 120 ECTS points can be earned. The knowledge obtained at the undergraduate level is broadened intensively. The students are provided with new, extended knowledge which will enable them to solve the most complex engineering tasks based on the scientific approach to problem solving.

In this way, top-quality professional engineers can be educated both for practical work and for obtaining the knowledge that will enable them to continue their education at the postgraduate study programme.

The graduate study offers the following modules:

- Product Design and Development

  The graduate students acquire the knowledge and skills for development, implementation and application of new methods and tools in creating, designing and constructing of products and developing their own scientific-research work in the product creation and design.

- Manufacturing Logistics

  The graduate students obtain the knowledge and skills necessary for conducting research, developing and applying the new models and methods in business, production, preparation of production and maintenance management.

- Materials Engineering

  The graduate students get the knowledge and skills needed for research and application of the new methods and processes in the materials engineering.

- Engineering Technologies

  The graduate students are provided with the knowledge and skills necessary for research, development and application of new manufacturing technologies.

- Power Engineering

  The graduate students acquire the knowledge and skills necessary for research, development and application of the new methods and tools in design, production, assembly and maintenance of power plants.

These modules provide students with specialised knowledge necessary for solving development tasks in manufacturing companies or for continuing education for research work.

3.1. The list of compulsory and elective subjects by modules

3.1.1. Modulated part of the graduate study

3.1.1.1. Product Design and Development

Semester I

Course	L	E	ECTS	S	Exam	Code number
Strength of Materials II	2	2	5	M	*	P 702
Design Theory	2	2	5	M	*	P 703
Computer Aided Design	2	2	5	M	*	P 712
Theory of Elasticity	2	2	5	M	*	D 904
Numerical Methods	2	2	5	M	*	D 903
Optional courses I	2	2	5	O	**	
	12	***12***	***30***		***5***	

Optional courses I	L	E	ECTS	S	Code number
Renewable Energy Sources	2	2	5	O	D 928
Metal Structures	2	2	5	O	D 809
Tribology of Machine Elements	2	2	5	O	P 704
Heat Transfer	2	2	5	O	D 728

Semester II

Course	L	E	ECTS	S	Exam	Code number
Ecodesign	2	2	5	M	*	D 801
Experimental Mechanics	2	2	5	M	*	D 806
Finite Element Method	2	2	5	M	*	P 705
Dynamics of Machinery	2	2	5	M	*	P 701
Optional courses II	2	2	5	O	**	
Optional courses III	2	2	5	O	**	
	12	***12***	***30***		***4***	

Optional courses II and III	L	E	ECTS	S	Code number
Evaluation Models	2	2	5	O	D 808
Design and Analysis of Structures	2	2	5	O	P 706
Advanced Strength of Mechanical Constructions	2	2	5	O	D 800
Thermodynamic Machinery	2	2	5	O	P 405

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Semester III

Course	L	E	ECTS	S	Exam	Code number
Industrial Design	2	2	5	M	*	D 900
Numerical Modeling and Simulations	2	2	5	M	*	D 803
Fracture Mechanics	2	2	5	M	*	D 802
Optional courses IV	2	2	5	O	*	
Optional courses V	2	2	5	O	**	
Seminary	0	4	5	M		D 911
	10	***14***	***30***		***4***	

Optional courses IV	L	E	ECTS	S	Code number
Design and Analysis of Experiments	2	2	5	O	D 923
New Production Technologies	2	2	5	O	D 843

Optional courses V	L	E	ECTS	S	Code number
Optimization of Structures	2	2	5	O	D 910
Theory of Plasticity	2	2	5	O	D 907
Vibration-Acoustic Analyses	2	2	5	O	D 908
Computational Fluid Mechanics	2	2	5	O	D 909
Power Plants	2	2	5	O	D 905

Semester IV

Course	L	E	ECTS	S	Exam	Code number
Product Development & Design	2	2	4	M	*	D 901
Standardization and Technical Regulations	2	2	4	M	*	D 1004
Optional courses VI	2	2	4	O	*	
Optional courses VII	2	2	4	O	*	
Graduation work	0	8	14	M		D 1020
	8	***16***	***30***		***4***	

Optional courses VI	L	E	ECTS	S	Code number
Materials Selection and Application	2	2	4	O	D 1026
Selected Chapters of Quality Control and Quality Assurance	2	2	4	O	D 1052

Optional courses VII	L	E	ECTS	S	Code number
Transport Systems and Lifts	2	2	4	O	D 1009
Recycling and Ecological Product Providing	2	2	4	O	D 1010
Robots and Manipulators	2	2	4	O	P 606

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3.1.1.2. Manufacturing Logistics

Semester I

Course	L	E	ECTS	S	Exam	Code number
Designing of Production Systems	2	2	5	M	*	P 604
New Production Strategies and Philosophies	2	2	5	M	*	P 726
Process Planning and Modeling	2	2	5	M	*	D 780
Maintenance Strategies	2	2	5	M	*	D 1021
Computer-Aided Design	2	2	5	M	**	D 781
Tribology	2	2	5	O	**	P 752
	12	***12***	***30***		***4***	

Semester II

Course	L	E	ECTS	S	Exam	Code number
Materials Management	2	2	5	M	*	D 921
Computer Aided Process Planning and Manufacturing	2	2	5	M	*	P 723
Production Management	2	2	5	M	*	D 820
Rapid Prototyping	2	2	5	M	**	D 1001
Optional courses I	2	2	5	O	*	
Optional courses II	2	2	5	O	*	
	12	***12***	***30***		***5***	

Optional courses I	L	E	ECTS	S	Code number
Flexible Manufacturing Systems	2	2	5	O	D 925
Designing of Technologies	2	2	5	O	D 857
Finite Element Method	2	2	5	O	P 705

Optional courses II	L	E	ECTS	S	Code number
Tool Materials	2	2	5	O	D 840
Composites and Polymers	2	2	5	O	D 842

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Semester III

Course	L	E	ECTS	S	Exam	Code number
Design and Analysis of Experiments	2	2	5	M	**	D 923
Application of Artificial Intelligence	2	2	5	M	*	P 724
Project Management	2	2	5	M	*	D 922
Information Systems of Production Enterprises	2	2	5	M	*	D 822
Optional courses III	2	2	5	O	*	
Seminary	0	4	5	M		D 911
	10	***14***	***30***		***4***	

Optional courses III	L	E	ECTS	S	Code number
New Production Technologies	2	2	5	O	D 843
Quality Management	2	2	5	O	D 926

Semester IV

Course	L	E	ECTS	S	Exam	Code number
Optimization of Tribomechanical Systems	2	2	4	M	*	D 1022
Materials Selection and Application	2	2	4	M	*	D 1026
Computer Integrated Manufacturing	2	2	4	M	*	D 1002
Optional courses IV	2	2	4	O	*	
Graduation work	0	8	14	M		D 1020
	8	***16***	***30***		***4***	

Optional courses IV	L	E	ECTS	S	Code number
Costs Management	2	2	4	O	D 824
Product Data Management	2	2	4	O	D 1006
Programming	2	2	4	O	D 1007

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3.1.1.3. Materials Engineering

Semester I

Course	L	E	ECTS	S	Exam	Code number
Designing of Production Systems	2	2	5	M	*	P 604
Microstructure and Properties of Materials	2	2	5	M	*	D 932
Special Steels	2	2	5	M	*	P 751
Surface Protection	2	2	5	M	*	P 759
Tribology	2	2	5	M	**	P 752
Optional courses I	2	2	5	O	**	
	12	***12***	***30***		***4***	

Optional courses I	L	E	ECTS	S	Code number
Renewable Energy Sources	2	2	5	O	D 928
Heat Transfer	2	2	5	O	D 728

Semester II

Course	L	E	ECTS	S	Exam	Code number
Tool Materials	2	2	5	M	*	D 840
Surface Heat Treatment and Surface Engineering	2	2	5	M	*	D 841
Composites and Polymers	2	2	5	M	*	D 842
Temperature Fields	2	2	5	M	**	P 794
Materials Management	2	2	5	M	*	D 921
Optional courses II	2	2	5	O	*	
	12	***12***	***30***		***5***	

Optional courses II	L	E	ECTS	S	Code number
Welding	2	2	5	O	D 851
Recycling and Ecological Product Providing	2	2	5	O	D 1010

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Semester III

Course	L	E	ECTS	S	Exam	Code number
Design and Analysis of Experiments	2	2	5	M	**	D 923
Quality Management	2	2	5	M	*	D 926
Alloys of Non-ferrous Metals	2	2	5	M	*	D 1033
Laboratory Materials Testings	2	2	5	M	**	D 844
Optional courses III	2	2	5	M	*	
Seminary	0	4	5	O		D 911
	10	***14***	***30***		***3***	

Optional courses III	L	E	ECTS	S	Code number
Project Management	2	2	5	O	D 922
Maintenance Strategies	2	2	5	O	D 1021

Semester IV

Course	L	E	ECTS	S	Exam	Code number
Welding Metallurgy	2	2	4	M	*	D 1031
Optimization of Tribomechanical Systems	2	2	4	M	*	D 1022
Materials Selection and Application	2	2	4	M	*	D 1026
Optional courses IV	2	2	4	O	*	
Graduation work	0	8	14	M		D 1020
	8	***16***	***30***		***4***	

Optional courses IV	L	E	ECTS	S	Code number
Programming	2	2	4	O	D 1007
Production Management	2	2	4	O	D 820

Abbreviations:
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* Oral or written exam; ** Knowledge verification (program, seminar, colloquy, test)

3.1.1.4. Engineering Technologies

Semester I

Course	L	E	ECTS	S	Exam	Code number
Casting Engineering	2	2	5	M	*	P 781
Machining Procedures	2	2	5	M	*	P 783
Surface Protection	2	2	5	M	*	P 759
Polymers Processing	2	2	5	M	*	P 784
Designing of Production Systems	2	2	5	M	*	P 604
Optional courses I	2	2	5	O	**	
	12	***12***	***30***		***5***	

Optional courses I	L	E	ECTS	S	Code number
Special Casting Procedures	2	2	5	O	P 790
Designing of Polymer Products	2	2	5	O	D 860

Semester II

Course	L	E	ECTS	S	Exam	Code number
Metal Forming I	2	2	5	M	*	D 782
Designing of Technologies	2	2	5	M	*	D 857
Technological Manufacturing of the Products	2	2	5	M	*	D 942
Welding	2	2	5	M	*	D 851
Optional courses II	2	2	5	O	**	
Optional courses III	2	2	5	O	**	
	12	***12***	***30***		***4***	

Optional courses II and III	L	E	ECTS	S	Code number
Foundries Automation	2	2	5	O	D 856
Flexible Manufacturing Systems	2	2	5	O	D 925
Temperature Fields	2	2	5	O	P 794
Technologies of Surface Protection	2	2	5	O	D 952

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Semester III

Course	L	E	ECTS	S	Exam	Code number
New Production Technologies	2	2	5	M	*	D 843
Technological Process Parameters Optimisation	2	2	5	M	*	D 941
Quality Management	2	2	5	M	*	D 926
Optional courses IV	2	2	5	O	*	
Optional courses V	2	2	5	O	**	
Seminary	0	4	5	M		D 911
	10	***14***	***30***		***4***	

Optional courses IV	L	E	ECTS	S	Code number
Maintenance Strategies	2	2	5	O	D 1021
Project Management	2	2	5	O	D 922

Optional courses V	L	E	ECTS	S	Code number
Mechanization, Automation and Robotization in Welding	2	2	5	O	D 1047
Tools and Devices II	2	2	5	O	D 951

Semester IV

Course	L	E	ECTS	S	Exam	Code number
Rapid Prototyping	2	2	4	M	**	D 1001
Reliability of Systems	2	2	4	M	*	D 1042
Optional courses VI	2	2	4	O	*	
Optional courses VII	2	2	4	O	*	
Graduation work	0	8	14	M		D 1020
	8	***16***	***30***		***3***	

Optional courses VI	L	E	ECTS	S	Code number
Welding Metallurgy	2	2	4	O	D 1031
Tool Materials	2	2	4	O	D 840

Optional courses VII	L	E	ECTS	S	Code number
Selected Chapters of Quality Control and Quality Assurance	2	2	4	O	D 1052
Metal Forming II	2	2	4	O	D 1043
Selected Chapters of Casting Engineering	2	2	4	O	D 1044

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3.1.1.5. Power Engineering

Semester I

Course	L	E	ECTS	S	Exam	Code number
Power Plants	2	2	5	O	*	D905
Selected Chapters of Thermodynamics	2	2	5	O	*	D761
Pressure Vessels and Pipelines	2	2	5	O	*	D762
Power System Control	2	2	5	O	*	D763
Ecology in Energetics	2	2	5	O	*	D764
Optional course I	2	2	5	I		
	12	***12***	***30***		***5***	

Optional courses I	L	E	ECTS	S	Code number
Selected Chapters of Mechanics and Strength	2	2	5	I	D766
Heat Exchangers	2	2	5	I	D767
Liberalization of the Energy Market	2	2	5	I	D768

Semester II

Course	L	E	ECTS	S	Exam	Code number
Energetic Machinery	2	2	5	O	*	D861
Steam Generators	2	2	5	O	*	D862
HVAC and R	2	2	5	O	*	D863
Drying of Hygroscopic Materials	2	2	5	O	*	D864
Special Steels in the Energy Sector	2	2	5	O	**	D865
Optional course II	2	2	5	I	**	
	12	***12***	***30***		***4***	

Optional courses II	L	E	ECTS	S	Code number
Electrical Switching Apparatus and Machines	2	2	5	I	D866
Design of Process Systems	2	2	5	I	D867
Maintenance Strategies	2	2	5	I	D1021

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Semester III

Course	L	E	ECTS	S	Exam	Code number
Wind Turbines	2	2	5	O	*	D961
Renewable Energy Sources	2	2	5	O	*	D928
Numerical Methods	2	2	5	O	*	D903
Production Processes in Power Engineering	2	2	5	O		D962
Optional course III	2	2	5	I	*	
Seminary	0	4	5	O		D911
	10	***14***	***30***		***4***	

Optional courses III	L	E	ECTS	S	Code number
Project Management of Energy Objects	2	2	5	I	D966
Water, Fuels and Lubricants	2	2	5	I	D967
Energy Efficieny	2	2	5	I	D968

Semester IV

Course	L	E	ECTS	S	Exam	Code number
Computational Fluid Mechanics	2	2	5	O	*	D 909
Modeling of Combustion and Heat Transfer	2	2	5	O	*	D1061
Engineering of Power Plants	2	2	5	O	*	D1062
Optional course IV	2	2	5	I	*	
Graduation work	0	8	10	O		D1020
	8	***16***	***30***		***4***	

Optional courses IV	L	E	ECTS	S	Code number
Selected Chapters of Quality Control and Quality Assurance	2	2	5	I	D1052
Costs Management	2	2	5	I	D824
Transport Systems and Lifts	2	2	5	I	D1009

Abbreviations:
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3.2. Description of subjects

A detailed description of each subject is given in this section. Development of general and specific competencies is given at the module level in Sections 2.5 and 2.6.

The credit value is given with each subject. ECTS points are defined in the following way:

The total number of hours of study workload which forms one ECTS point is determined on the basis of the total number of required working hours for each subject. Therefore, the total student workload includes the total time needed for successful completion of the programme.

Time structure:	Total time %
lectures	20 - 35
seminars	20 – 35
fieldwork	0 – 10
exercises	20 – 35
laboratory work	0 – 10
teaching material study	10 – 15
elaboration of programs	0 - 30
data processing	0 – 10
independent study	20 – 35
study excursions	0 - 10
term paper writing	0 – 10
technical literature reading and studying	10 – 30
exams	0 – 10

The percentage of student workload in defining the total number of ECTS points by subjects varies depending on the subject and amounts to a maximum of 35%.

For 1 credit point, the student workload for mastering of teaching material is 27 hours.

The way of monitoring achievements is given for the complete study in section 4.5.

P 405 Thermodynamic Machinery

Brief contents:

Types of thermodynamic machinery. Operation principles of basic types of thermodynamic machinery. Technical installation and power cycles. Piston engines with gaseous working medium. Theoretical and real cycles in reciprocating engines. Piston engines with steam as working medium. Steam turbines. Types, performance and thermal efficiency of steam turbines. Installation with gas turbine. Compressors. Combustion chamber. Gas turbine. Gas power cycles. Cogeneration. Boilers. Incinerators. Technical characteristics of fuels. Combustion. Furnaces. Principles of heat and mass transfer in steam boilers. Heat transfer surfaces: evaporators, preheaters, economizers and air heaters.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: Exercises are auditory and laboratory. The auditory exercises consist of task solving considering basic thermodynamic processes involving thermodynamic machinery and task solving considering various types of thermodynamic machinery.

Mandatory literature for study and for exam:

1. Požar, H.: Osnove energetike, I dio, Školska knjiga, Zagreb, 1992.
2. Požar, H.: Osnove energetike, II dio, Školska knjiga, Zagreb, 1992.

Additional list of recommended literature:

1. Galović, A: Termodinamika I, FSB, Zagreb, 2007.
2. Galović, A.: Termodinamika II, FSB, Zagreb, 2007.
3. Prelec, Z: Brodski generatori pare, Školska knjiga, Zagreb,1990.
4. Bogner, M: Termotehničar 1, Energetika marketing d.o.o, Zagreb, 2004.
5. Kreuh, L.: Generatori pare, Školska knjiga Zagreb, 1978.
6. Tehnika motornih vozila, HOK i Pučko otvoreno učilište , Zagreb 2004 .

Exam's type:

Written and seminar paper.

P 604 Designing of Production Systems

Brief contents:

Acquainting with and consideration of procedures and models for designing and optimization of production systems. Principles of designing, taking up of actual state, preliminary study. Calculation of production and storage areas. Functional areas, organisation forms of the production. Method of group processing, manufacturing cells, single place of complete manufacture, procedures for defining of product group. Preparation of layout plan, models for layout design. Legislation and preparation of design documentation. Examples of designing production processes in practice.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: computer, design

Mandatory literature for study and for exam:

1. I. Veža, Projektiranje proizvodnih procesa, FESB, Split, 1998.
2. B. Vranješ, B. Jerbić, Z. Kunica, Projektiranje proizvodnih sustava, Organizacija proizvodnje, sv.3., Biblioteka inženjerski priručnik 4/III, ISBN 953-0-31682-8, 73-130, Školska knjiga, Zagreb, 2002.

Additional list of recommended literature:

1. J.T. Black, The design of the factory with a future, McGraw-Hill, New York1991.
2. W. Rockstroh, Technologische Betriebsprojetierung I, II i III WEB Verlag Technik, Berlin, 1978.
3. J.A. Tompkins et al., Facilities Planning, John Wiley & sons, New Jork, 1996.

Exam's type:

Written and oral exam (preparation of a design with a colloquy).

P 606 Robots and Manipulators

Brief contents:

The main goal of the course is to introduce students to modern robotics, its development and applications in industrial and service activities. Students need to master the mechanical engineering aspects of robotics with a profound understanding of functioning of non-engineering components of robots. In addition to geometry, composition, kinematics, and dynamics of robots, special consideration is given to a systematic approach to forming robotic control modules and to a complete organization of end effects in each particular application. Students will master robot programming to industrial application standards.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Working on robots in a laboratory, solving general problems related to robot applications.

Mandatory literature for study and for exam:

1. Katalinic, B. Robotika, DAAAM International Vienna, Student Book, 2004.

Additional list of recommended literature:

1. Nof, Shimon Y.: Handbook of Industrial Robotics, 2nd Edition, Willey Publisher, ISBN: 0-471-17783-0
2. Wise, E.: Robotics Demystified, ISBN: 0-07-143678-2, McGraw-Hill High Education, 2004.
3. Ergić, T.: Repetitorij temeljnih pojmova iz robotike i zavarivanja pomoću robota, Strojarski fakultet Slavonski Brod, 1995.

Exam's type:

Continuous assessment (projects, theoretical questions, preliminary exams).

P 701 Dynamics of Machinery

Brief contents:

Introduce students to fundamentals of vibration theory and dynamics of machinery. Some chapters within this subject are: Systems with one degree of freedom, Systems with two and more degrees of freedom, Rotor balancing, Foundation of machines.
Enable students to independently recognize and solve discrete vibration models, and to use literature in vibration theory and dynamics of machinery.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Solving problems related to practice.

Mandatory literature for study and for exam:

1. Stegić, M.: Teorija vibracija linearnih diskretnih mehaničkih sustava, Sveučilište u Zagrebu, 2009.

Additional list of recommended literature:

1. Karnovsky, I.; Lebed, O.: Formulas for Structural Dynamics: Tables, Graphs and Solutions, ISBN 0071367128, McGraw-Hill Education, 2000.
2. De Silva, W. C.: Vibration: Fundamentals and Practice, CRC Press, London, 2000.
3. Meirovitch, L.: Fundamentals of Vibrations, McGraw-Hill, Boston 2001.
4. Kramer, E.: Maschinendynamik, Springer Verlag, Heidelberg 1984.

Exam's type:

Written and oral exam.

P 702 Strength of Materials II

Brief contents:

Familiarize students with the basics of energy calculation method of strength, sizing or determination of strength of elements of planar and spatial structures, with the basics of plane elasticity theory and application of thick vessels and pipes, rotating disks, bending of thin circular plates and calculation of membrane stresses axisymmetric shells. Introducing students to the quantitative methods for determining the durability of cyclically loaded parts of machines and the impact load. To train students for using literature in the field strength of structures and machine parts.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Students using PC software and solving problems in class under the guidance of instructor.

Mandatory literature for study and for exam:

1. Alfirević, I.: Nauka o čvrstoći II., Golden marketing, Zagreb 1999.

Additional list of recommended literature:

1. Alfirević, I.: Nauka o čvrstoći II., Golden marketing, Zagreb, 1999.
2. INŽENJERSKI PRIRUČNIK IP1, TEMELJI INŽENJERSKIH ZNANJA, Školska knjiga, Zagreb, 1996. (dio: Nauka o čvrstoći, str. 479-570)
3. Alfirević, I.: Linearna analiza konstrukcija, FSB Zagreb, Zagreb 1999.
4. Šimić, V.: Otpornost materijala II, Školska knjiga, Zagreb 1995.
5. http://www.sfsb.hr/ksk/cvrstoca/
6. http://www.mdsolids.com/ ⇒Projects ⇒Mechanics of Materials (ili http://web.umr.edu/~bestmech/preview_mechmatl.html), program MDSolids2.6

Exam's type:

Continuous assessment with four partial exams written during lectures.

P 703 Design Theory

Brief contents:

Introduction to the basics of Product Theory, Products as Systems, Design Theory and Technology, and Design Process. Acquiring knowledge needed for project analysis with construction (disposition) considerations – including all design steps. Concepts, methods. DSM - Design structure matrix. Design strategies: procedures and rules, strategy control.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Students solving practical problems.

Mandatory literature for study and for exam:

1. Otto, K.; Wood, K.: Product design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2000
2. Ullman, D.G.: The Mechanical Design Process, McGraw-Hill, 2002
3. Pahl, G.; Beitz, W.: Engineering Design: A Systematic Approach, Edited by Ken Wallace, Springer-Verlag, 1996.

Additional list of recommended literature:

1. Suh, N.P.: The Principles of Design, Oxford University Press, New York, 1990.
2. Hubka, V.; Ernst, E. W.: Design science: Introduction to the Needs, Scope and Organization of Engineering Design Knowledge, Springer-Verlag, 1996.
3. Pugh, S.: Total design: Integrated Methods for Successful Product Engineering, Prentice Hall, 1991
4. Pugh, S: Creating Innovative Products Using Total Design, Addison Wesley, 1996

Exam's type:

Continuous (1^{st} and 2^{nd} preliminary exams, project – group assignment, exam – project presentation).

P 704 Tribology of Machine Elements

Brief contents:

Knowledge about the influence of friction and wear on the functionality and efficiency of the machine elements. Explanation tribological system and interaction with members tribological system power transmission and motion. Tribomechanical lubrication characteristics in terms of dynamic power and motion. Wear process. Monitoring of the wear process. Design approach with regard to the tribological characteristics of materials and structural features of structural elements. Knowledge of control friction and wear of machine elements using tribological measures that can contribute to environmentally ecologically sustainable development and reduction in spending materials and energy. The principles of recycling lubricants and cooling due to the ecological environment protection.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Solving general problems, demonstrations.

Mandatory literature for study and for exam:

1. Stolarski, T. A.: Tribology in Machine Design, ISBN 0-7506-3623-8, Elsevier, 1990
2. Ivušić, V.: Tribologija, Hrvatsko društvo za materijale i tribologiju, Zagreb 1998.
3. Marušić, V.: Tribologija u teoriji i praksi. Slavonski Brod : Strojarski fakultet u Slavonskom Brodu, 2008 (udžbenik).

Additional list of recommended literature:

1. Czichos, H.: Tribology, Elsevier, Amsterdam 1989.
2. Neal, M. J.: Tribology Handbook, Buterworths, London 1973.

Exam's type:

Continuous assessment (preliminary exams, research papers).

P 705 Finite Element Method

Brief contents:

Generally about finite element method. Basic finite elements and applications possibilities. Variational formulation of the finite element method. The definition of the stiffness matrix. Method of displacement formulation. Basic equation of finite element method. Loading and boundary conditions. Global formulation of finite element method. Convergence of the solutions. One-dimensional finite elements: basic truss and basic beam element. Finite element for two-dimensional analysis: basic triangle and quadrilateral element. Lagrange interpolation polynom. Serendipity element. Finite element for 3D analysis: tetrahedral and prismatic elements. Axisymmetric elements. Isoparametric finite elements. Numerical integration. Finite elements for the solving of plate bending problems. Finite elements for shell-like-structures analysis. Examples of solved problems by using of finite element software as ANSYS. The advantages of the numerical modelling related to classical analytical methods will be emphasized. The efficiency and the accuracy of the analysis performed by finite elements will be discussed through several numerical examples.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. The procedure of global stiffness matrix derivation for some simple solid mechanics problems will be described. Solving of some example by using of truss and beam elements, analytically and numerically. Examples of solving the problems by using of plane and axisymmetric elements. CAD-FEM interaction, structure discretisation, boundary conditions setting and analysis of results in commercial software for FEA such as ANSYS and ABAQUS.

Mandatory literature for study and for exam:

1. Sorić, J.: Metoda konačnih elemenata, Golden marketing, Zagreb 2004.
2. Brnić, J.; Čanađija M.: Analiza deformabilnih tijela metodom konačnih elemenata, Fintrade & Tours d.o.o. Rijeka, suizdavač Tehnički fakultet Rijeka, 2009.

Additional list of recommended literature:

1. Reddy, J. N.: Introduction to the Finite Element Method, McGraw-Hill Education, 2005
2. Zienkiewicz, O.C. and Taylor, R.L.: The Finite Element Method: Volume 1 The Basis, 5th Edition, Butterworth-Heinemann, Oxford, 2000
3. Zienkiewicz, O.C. and Taylor, R.L.: The Finite Element Method: Volume 2 Solid Mechanics, 5th Edition, Butterworth-Heinemann, Oxford, 2000
4. Bathe, K.-J.: Finite Element Procedures, Second Edition, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1995.
5. Cook, R.D.; Malkus, D.S., Plesha, M.E.; Witt, R.J.: Concepts and Applications of Finite Element Analysis, 4th ed, John-Wiley & Sons, Inc., New York, 2002.
6. Huebner, H. K.; Thornton, A. E.; Byrom, G. T.: The finite element method for engineers, Fourth edition, Wiley-Interscience, New York, 2001.
7. http://urbana.mie.uc.edu/yliu/Showcase_FEA/showcase_fea.htm

Exam's type:

During the semester five working examples have to be solved, what replaces the written part of exam. For oral part of the exam it is necessary to show good knowledge of theoretical background of finite element method.

P 706 Design and Analysis of Structures

Brief contents:

Introduce students to the concept and principles of designing engineering structures; guides for proper construction design; the importance of material selection in structure strength; dimensioning, and stress analysis of vital components and details. Describe analysis types and methods; compare analytical to numerical analysis – capabilities and limitations, study analysis procedures given in standards. Use examples to illustrate modeling of planar and spatial problems; model discretization; setting boundary conditions; model verification; result convergence; presentation and analysis of results. Introduction to capabilities of current CAD software packages that contain a module for numerical analysis (for example, I-deas, SolidWorks, Algor, and others) and are capable of integrating with software packages for function optimization (MatLab, Mathematica, and others). By gaining necessary knowledge and experience through analyzing examples during lectures and discussions and working on assigned projects, students should develop an ability to solve given practical problems. Working on practical problems develops skills for using an analytical approach to solve structural problems. It also provides experience in using the knowledge gained in class, as well as using the scientific literature and information technology to gather information about problems for the course.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Solving complex practical problems by defining structural features, modeling, design and analysis of clamped joints, joint connections, elements for the transfer of power and motion, pressure vessels, etc. By analyzing structural features and through material selection, dimensioning, and stress analysis, students will apply knowledge gained in this and other courses to solve assigned research projects. Students will be organized in smaller groups to work on a research project with the goal of developing teamwork and analytical skills in solving a given assignment. The goal of the research project is to implement gained knowledge from previous courses through analysis and solving of the assigned problem. During discussions, there are two preliminary exams, and also constant monitoring and analysis of the research project progress under faculty guidance. At the end of the semester, each group gives a public oral presentation of their research project, with the goal of developing the ability to work in a team and to present results. It also builds confidence in analyzing structural problems of different complexity by using the knowledge gained during undergraduate studies.

Mandatory literature for study and for exam:

1. Young W. Kwon, Hyochoong Bang: The Finite Element Method Using MATLAB, Second Edition, CRC Press, 2000, ISBN: 0849300967,
2. Oberšmit, E.: Osnove konstruiranja. Tehnološki ispravno konstruktivno oblikovanje strojnih dijelova., Sveučilišna naklada Liber, Zagreb, 1983.
3. Ramamurti, V.: Computer-Aided Mechanical Design and Analysis, Mc Graw Hill, 1998, ASIN: 0070600368,
4. Pahl, G. and Beitz, W.: Konstruktionslehre, Methoden und Anwendung, 4. neubearbeitet Auflage, Springer, Berlin 1997. (i novije)

Additional list of recommended literature:

1. Haward, B. W.; Turcotte, L.H.; Halpern, D.: Advanced Mathematics And Mechanics Applications Using MATLAB, CRC Press, 2003

2. Matek, W.; Muhs, D.; Wittel, H.: Maschinenelemente Aufgabensammlung. Aufgaben, Lösungshinweise, Ergebnisse, Vieweg Verlag, 2000.
3. http://www.maedler.de/katalog_de/index_d.html
4. http://www.ndim.edrc.cmu.edu/
5. http://cadlab.mit.edu/about/
6. http://www.wildefea.co.uk/consulting/casestudies/

Exam's type:

Two preliminary exams will be given in place of the written part of the exam. Students will be divided into groups and assigned a research project. At the end of the semester, if the research project is presented successfully it will replace the oral part of the exam.

P 712 Computer Aided Design

Brief contents:

Introduction to Computer Aided Design (CAD) systems. The application of CAD systems in the development of computer models of components and assemblies based on their characteristics.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Solving practice problems in the computer lab.

Mandatory literature for study and for exam:

1. Kljajin, M.; Opalić, M.: Inženjerska grafika, Sveučilište J. J. Strossmayera u Osijeku, Strojarski fakultet u Slavonskom Brodu, 2010.

Additional list of recommended literature:

1. Lee, K.: Principles of CAD/CAM/CAE Systems, Addison-Wesley, Reading, Massachusetts, 1999.
2. Shah J. J.; Mäntylä, M.: Parametric and Feature-Based CAD/CAM, Wiliey-Interscience Publication, New York, 1995.

Exam's type:

Design a computer based model.

P 723 Computer Aided Process Planning and Manufacturing

Brief contents:

Basic terms. CIM (Computer Integrated Manufacturing) components. The objectives of the application of CIM systems. The importance of CAD/CAPP/CAM systems in computer integrated manufacturing. CAD/CAM product development. Advantages of CAD/CAM systems. The importance of CAD/CAPP connection. Types and characteristics of the CAPP system. Exchanging data between CAPP and ERP systems. Application of artificial intelligence in CAPP systems. Application of group technology in the process planning.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: Auditory and laboratory exercises, seminar work.

Mandatory literature for study and for exam:

1. Balic, J.: Contribution to Integrated Manufacturing, DAAAM Manufacturing technology, Vienna, Austria, 1999.
2. Jurković, M.; Tufekčić, Dž. Tehnološki procesi – projektiranje i modeliranje, Univerzitet u Tuzli, Tuzla, 2000.

Additional list of recommended literature:

1. Rehq J. A.; Kraebber H. W.: Computer Aided Manufacturing, Prentice Hall, 2004.
2. Zhang, H.; Alting, L.: Computerized Manufacturing Process Planning, Chapman &Hall, London, Glasgow, New York, Tokyo, Melbourne, Madras, 1994.
3. Scallan, P.: Process Planning: The design/manufacture interface, Butterworth-Heinemann, 2003.

Exam's type:

Written and oral.

P 724 Application of Artificial Intelligence

Brief contents:

Basic terms. Artificial intelligence philosophy, phenomenology, concept, ideas, state of art and new trends. Artificial intelligence and traditional computing. Artificial intelligence techniques. Expert systems. Information representation. Reasoning process. Reasoning from unreliable data. Hybrid expert systems. Knowledge engineering. Applying of expert systems. Neural networks. Architecture, concepts and knowledge based on collected data. Preparation of data for neural network. Optimisation problem. Genetic algorithms. Gene and chromosome. Population genetic operators. Applying of genetic algorithms. Particle swarm optimisation. Fuzzy logic.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: auditory and laboratory exercises.

Mandatory literature for study and for exam:

Materials from lectures.

Additional list of recommended literature:

1. Ćerić, Vlatko. Ekspertni sustavi, skripte, Ekonomski fakultet Zagreb, 2005.
2. Negnevitsky, Michael. Artificial Intelligence: A guide to intelligent systems, Addison Wesley, 2004.
3. Russell, Stuart; Norvig, Peter. Artificial Intelligence: A Modern Approach, The Intelligent Agent Book, Second Edition, Prentice Hall, 2002, ISBN: 0-13-790395-2
4. David E., Goldberg: Genetic Algorithm in Search, optimisation and machine learning, Adison Weslay Longman, USA, 1999.
5. J., Koza: Genetic Programming, MIT Press, 1992
6. Z., Michalewic:, Genetic Algorithms + Data Structures = Evolution Programs, Springer, 3rd ed., 1996
7. Marjan, Mernik; Matej, Ćrepinšek; Viljem, Žumer: Evolucijski algoritmi, Univerza v Mariboru, Fakultet za elektrotehniko, računalništvo in informatiko, 2003.
8. Milan, Brezočnik: Uporaba genetskog programiranja v inteligentnih proizvodnih sistemih, Univerza v Mariboru, Fakultet za strojništvo,2000.
9. Novaković, Branko; Majetić, Dubravko; Široki, Mladen. Umjetne neuronske mreže, FSB, Zagreb, 1998.
10. Rao, V., Rao, H. C++ Neural Networks and Fuzzy Logic, MIS Press, New York, USA, 1995.

Exam's type:

Written and oral.

P 726 New Production Strategies and Philosophies

Brief contents:

To provide a comprehensive examination of the management of both goods-producing and service-producing processes. To enable students understanding of different production types: from single till lot sizing production for metal-processing, wood, electro, food, construction, chemical and process industry. The syllabus includes production strategies like JIT, GT, MRP, MRPII, ERP, ERP II, Kanban, Kaizen, TQM, Taguchi method, Ishigawa diagram, quality circles, Jidoka, TPM, 5S, 6σ etc. and new organisational structures (virtual factory, lean production etc.). Digital factory and it functions (product design, process planning, time management and business applications, factory layout planning, ergonomics, simulation of robot usage and production process simulation etc,).

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: auditory and laboratory exercises.

Mandatory literature for study and for exam:

1. Majdandžić, Niko; Lujić, Roberto; Matičević, Gordana; Šimunović, Goran; Majdandžić, Igor. Upravljanje proizvodnjom, Strojarski fakultet, Slavonski Brod, 2001, 357 str.

Additional list of recommended literature:

1. Lujić, Roberto; Šarić, Tomislav; Šimunović, Katica. Genetic algorithm and ERP. // Digital Factory / Balič, Jože ; Majdandžić, Niko (ur.). Vienna : DAAAM International, 2008.. Str. 243-255.
2. Majdandžić, Niko: Izgradnja informacijskih sustava proizvodnih poduzeća, Slavonski Brod, Strojarski fakultet Slavonski Brod, 2004.
3. Rothar, Mike; Shook, John: Learning to see – Value- Stream Mapping to cretae value and eliminate muda, The Lean enterprise institute, Massachusetts, USA, 2003.
4. Polajner, A.; Buchneiter, B.; Leber, M.: Proizvodni menadžment, Univerza v Mariboru, Fakultet za strojništvo,2005.
5. Polajner, A.; Buchneiter, B.; Leber, M.; Pandža, K.; Kalpič, B.; Rojs, T.; Vujica-Herzog, N.; Palčič, I.; Fulder, T.; Meža, P.: Menadžment proizvodnih sistemov, Univerza v Mariboru, Fakultet za strojništvo,2004.
6. Clason, Tom: Fast Cycle Production: The Manufacturing Philosophy That Always Works, 1stBooks Library, December 2003.
7. xxx: 20 keys - Facilitator's manual, Practical Programme of Revolution in Factories and Other Organisations (PPORF), Development Institute. Tokyo, Japan, 2003.
8. Gary A., Langenwalte: Enterprise Resources Planning and Beyond, The ST Lucie Press/APICS series on Resources Management, USA, 2000.
9. Masayoshi, Shimizu; Kiyoshi, Wainai; Kazuo, Nagai. Value added productivity measurement and practical approach to management improvment,Asian productivity organisation, Tokyo, Japan, 1991.

Exam's type:

Written and oral.

P 751 Special Steels

Brief contents:

Introducing students in special steels. Special steels phases. Impurities and mixtures, carbides, nitrides, intermetallic phases. Thermodynamic activity of carbon in steel. Phase transformations in steel. Austenite grain growth. Transformation of austenite under cooling. Steels for working at very low temperatures (steels of cryogenic technique). Specific behaviur of steel at low temperatures. Steels and nonferrous alloys for long working at elevated and high temperatures (change of properties, creep, not alloyed steels for boiler plates and others). Superalloys. Ni-base alloys and Co-base alloys. Heat treatment of superalloys. Ultra-strength steels. Low alloyed low tempering ultra-strength steels. High alloyed Cr-Mo-V ultra-strength steels. Ultra-strength corrosion resistant precipitation hardening steels (PH steels). Steels for thermomechanical treatment. TRIP steels. Work hardening steels. Steels for nuclear applications.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises. Auditory exercises and laboratory classes.
During the teaching session semester project are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Novosel, M.; Krumes, D.: Posebni čelici, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1998.

Additional list of recommended literature:

1. Krumes, D.: Toplinska obradba, Strojarski fakultet, Slavonski Brod, 2000.
2. Novosel, M.; Krumes, D.: Željezni materijali, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1997.
3. Novosel, M.; Krumes, D.: Željezni materijali II dio Konstrukcijski čelici, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1995.
4. Vitez, I.; Kladarić, I.; Marković, R.: Europske norme za nove sustave označivanja čelika, Tehnički vjesnik 10, (2003), 1, 49-61.

Exam's type:

Written and oral (semester project development and presentation).

P 752 Tribology

Brief contents:

Introduction to friction and wear of materials and approach to solving tribological problems. Emphasize the influence of contact surfaces, Hertz pressures and friction process on the wear of products, equipment and parts of plants. Introduction to the basic mechanism of wear. Introduction to the current and new trends of wear process monitoring. Indicate the importance of defining correctly the elements of tribosystem and dominant wear mechanism. Introduction to the tribological measures and approach to selection of triboelement materials through surface protection from wear, influence of running in and lubrication. Through the analysis of direct and indirect losses (costs) of tribo-dispositions, demonstrate the possible criteria for tribological solutions. Abrasive, adhesive and chemical wear, surface fatigue, etc. Introduction to lubrication (hydrostatic and hydrodynamic), types of plain bearings, tribological properties of bearing materials.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises. Auditory exercises and laboratory classes.
During the teaching session, semester projects are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Marušić, V.: Tribologija u teoriji i praksi, Strojarski fakultet, Sveučilište u Osijeku, Slavonski Brod, 2008.

Additional list of recommended literature:

1. Ivušić, V.: Tribologija, HDMT, Zagreb, 2000. .
2. Vinograbov, V. N.; Sorokin, G. M.; Kolakoljnikov, M.G.: Abrazivnoe iznašivanie, Mašinostroenije, Moskva, 1990.
3. Rodin, Ju.A.; Suslov, P.G.: Beziznost detaljej mašin pri trenjiji, Mašinostroenie, Lenjingrad, 1989.

Exam's type:

Written and oral (project development and presentation).

P 759 Surface Protection

Brief contents:

Surface protection is engaged studying of corrosion and corrosion control. In the literature, the subject is also called Technology of corrosion control, materials protection or Corrosion technology.

In the subject Surface preparation the fundamentals are given for better understanding of mechanisms of corrosive effect of environment on structural material. Deeper knowledge about corrosion properties of materials enables engineers for correct selection and for optimum technological solutions in the design of equipment. The subject Surface protection thoroughly elaborates corrosion mechanisms with the purpose of understanding corrosion properties of materials and their behaviour in different corrosive media.

Subjects matter is treated in three chapters: Corrosion mechanisms, laboratory corrosion testing and Corrosion properties of structural materials.

Chapter 1: Corrosion mechanisms with concerning chemical and electrochemical corrosion in various corrosive and erosive media.

Chapter 2: Laboratory corrosion testing considering testing planning, choice of testing technique and of equipment, model of results treatment and their interpretation.

Chapter 3: Corrosion properties of structural materials comparing metals and non-metals (inorganic and organic). Non-alloyed and alloyed steels as well as light and heavy non-ferrous metals are especially treated.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises. Laboratory classes.

Mandatory literature for study for exam:

1. I. Esih, Z. Dugi: Tehnologija zaštite od korozije I i II, Zagreb, 1990.
2. I. Esih, Osnove površinske zaštite, Zagreb 2003.

Additional list of recommended literature:

1. P.R. Roberge: Handbook of corrosion enginering, McGrow Hill, new York, 1999.
2. D.A. Jones: principles and prevention of corrosion, Prentice Hall, New York, 1996.
3. I. Esih, Z.Dugi: Tehnologija zaštite od korozije I i II. FSB, Zagreb.

Exam type:

Written and oral.

P 781 Casting Engineering

Brief contents:

Acquainting of students with casting technology and engineering as economy branch. Schematic presentation of the course of the technological process in a foundry. Storage and transport of moulding sand, preparation of moulding mixture, mixing devices types for the preparation of moulds and cores mixtures. Transport of moulding mixtures. Basic principles of moulding and description of various types of moulding machines. General information about moulding lines for preparation of non-permanent (once applicable) moulds. Types of furnaces for metal melting. Transport and pouring in of the melt into moulds. General information about machines for pouring of the melt into moulds. Cooling and cleaning of castings. Control and defects detection in castings according to the location of the origin. Defects analysis.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: computer, design.

Mandatory literature for study and for exam:

1. Ivan Budić: Osnove tehnologije kalupljenja, Jednokratni kalupi I dio, II izmijenjeno i dopunjeno izdanje, Strojarsku fakultet, Slavonski Brod, 2010.

Additional list of recommended literature:

1. Ivan Budić, Zoran Bonačić-Mandinić: Osnove tehnologije kalupljenja, Jednokratni kalupi II dio, Strojarsku fakultet, Slavonski Brod, 2004.
2. Ivan Budić: Posebni ljevački postupci, I dio, Strojarsku fakultet, Slavonski Brod, 2006.
3. Ivan Budić: Posebni ljevački postupci, II dio, Strojarsku fakultet, Slavonski Brod, 2009.
4. I. Katavić, Ljevarstvo, Tehnički fakultet Sveučilišta, Rijeka, 2001.,
5. ASM Metal Handbook, Melting and Casting, vol. 5 B, ASM, Metals Park, Ohio, 1972.

Exam's type:

Written and oral exam.

P 783 Machining Procedures

Brief contents:
Exposing of knowledge about the theory of chips removal. Adoption of knowledge about the criteria and methods of determination of machinability and cutting parameters. Introduction of students with procedure of testing of cutting parameters influence on cutting effects. Introduction in advanced chips removal technologies.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises (auditory exercises, laboratory excercises), Introduction with machining procedures in machinery and demonstration of application of machining procedures in Laboratory (workshop) During the teaching session tests are provided to assess the theory and numerical examples.

Mandatory literature for study and for exam:

1. R. Cebalo: Obrada odvajanjem čestica, Vedograf, Zagreb 2000.
2. Š. Šavar: Obrada odvajanjem čestica svezak 1, Sveučilišna naklada liber, Zagreb 1991.

Additional list of recommended literature:

1. Š. Šavar : Obrada odvajanjem čestica svezak 2, Sveučilišna naklada liber, Zagreb, 1991.
2. R. Cebalo : Duboko Brušenje, Školska knjiga Zagreb, 1990.
3. M.C. Shaw: Metal Cutting Principles, Oxford University Press, New York, 1984.

Exam's type:

Written and oral (written, oral, semester project presentation, semester project proposal), submition of seminary work.

P 784 Polymers Processing

Brief contents:

Students are introduced to basics of polymer materials science and their processing into complete products. Elaborate of structure and properties of polymer materials as basis for understanding of their processing. Introduction of students to theoretical basis of polymer processing – rheology of polymer melts, viscous flowing of polymer melts, shear flowing, tensile flowing, measuring of viscous flowing characteristics. Considerations of production process systematization of polymer products and special work on continuous and cyclic processes.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises with tasks calculation. Carrying out seminary tasks (auditory exercises, laboratory classes, practical classes, and practice in programme drawing). The knowledge is assessed by tests during the teaching session.

Mandatory literature for study and for exam:

1. Raos, Pero; Šercer, Mladen. Teorijske osnove proizvodnje polimernih proizvoda. Slavonski Brod: Strojarski fakultet u Slavonskom Brodu Sveučilišta u Osijeku i Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu 2010.

Additional list of recommended literature:

1. Čatić, Igor. Proizvodnja polimernih tvorevina. Zagreb: Društvo plastičara i gumaraca, 2006.
2. Michaeli, Walter. Einführung in die Kunststoffverarbeitung. 5. Auflage. München: Hanser Verlag, 2007.
3. Osswald, Tim A. Polymer Processing. Fundamentals. Munich: Hanser Publishers, 1998.

Exam's type:

Written and oral.

P 790 Special Casting Procedures

Brief contents:

Acquainting of students with systematisation of casting into non-permanent moulds according to pattern type (permanent, fusible, volatile, combustible). General information about precise moulding, precision or investment casting and shell moulding casting. Precise moulding or precision casting. Materials for precise moulding casting and its application. Advantages and disadvantages. Master moulds, materials for moulds preparation. Materials for pattern fabrication (wax patterns, polymer patterns, mercury patterns). Wax pattern fabrication technology, preparation of pouring-in system, assemblage of patterns clusters. Preparation of the investment, pouring-in, cooling of castings. Shaking-out of castings from the investment. Castings cooling, cleaning and control. Castings, defects. Shell moulding casting. Casting materials and application of shell moulding casting. Advantages and disadvantages. Moulding mixtures for the preparation of shells (basic material, binders, types and preparation of moulding mixtures). Equipment for shells preparation. Pouring-in, castings cooling, shaking-out of castings from the shell. Cleaning of castings. Castings defects.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: computer, design.

Mandatory literature for study and for exam:

1. Ivan Budić, Zoran Bonačić-Mandinić: Osnove tehnologije kalupljenja, Jednokratni kalupi II dio, Strojarsku fakultet, Slavonski Brod, 2004.
2. Ivan Budić: Posebni ljevački postupci, I dio, Strojarsku fakultet, Slavonski Brod, 2006.
3. Ivan Budić: Posebni ljevački postupci, II dio, Strojarsku fakultet, Slavonski Brod, 2009.

Additional list of recommended literature:

1. Ivan Budić: Osnove tehnologije kalupljenja, Jednokratni kalupi I dio, II izmijenjeno i dopunjeno izdanje, Strojarsku fakultet, Slavonski Brod, 2010.
2. Ljevački priručnik, Savez ljevača Hrvatske, Zagreb, 1985.
3. Tehnička enciklopedija, Ljevarstvo, sv. 7, LZMH, Zagreb, 1986.
4. R. W. Heine, Principles of Metal Casting, McGraw-Hill, New York, 1967.
5. P. R. Beeley, Foundry Technology, Butterworths, London, 1972.

Exam's type:

Preparation of a project and colloquy.

P 794 Temperature Fields

Brief contents:

Temperature field in lumped systems, Bi<0,1. One and two dimensional transient heat conduction in solid using the boundary conditions of the first, second and third kind. Analytical and numerical methods for solving the problem. Temperature field in a solid effected by instantaneous, continuous and moving heat sources. The classification of solids (bodies) and heat sources. The concept of quasi-steady temperature field. (Analytical and numerical methods of calculation and its comparison) Solidification of geometrically simple bodies. The Stefan and Neumann's solution for solidification of flat layers. The quasi-steady approximation of solidification for flat layer, solidification inside and outside cylinder and sphere, respectively. One example of a numerical solving of solidification problem.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises. Programme drawing (auditory exercises, laboratory classes, practical classes, practice in programme drawing)

Mandatory literature for study and for exam:

1. Galović, A.: Termodinamika II, FSB, Zagreb, 2007.
2. http://www.fsb.hr/terma Galović, A: Odabrana poglavlja iz kondukcije,
3. Lukačević, Z. Zavarivanje, Strojarski fakultet u Slavonskom Brodu, 1998.

Additional list of recommended literature:

1. H.S. Carslaw; J.C. Jaeger: Conduction of Heat in Solids; Oxford University Press, Second Edition, 1959.
2. A. Bejan: Heat Transfer, John Wiley & Sons, New York, 1993.
3. Y.A. Cengel: Heat Transfer, (Practical Aproach), Mc Graw Hill, Second Edition, Boston, 2003.
4. T. Muneer, J. Kubie, T. Grassie: Heat Transfer, (A problem solving approach), Taylor & Francis, New York, 2003.
5. N.N. Rykalin: Waerme Vorgaenge beim Schweissen , WEB Verlag, 1950.

Exam's type:

Semester project development and presentation.

D 728 Heat Transfer

Brief contents:

Rewiev of basic mechanisms of heat and mass transfer. Importance and methodology of solving heat transfer problems. Differential equation of heat conduction and boundary conditions. One dimensional steady heat cnduction in a plane wall and cylindar. Two-dimensional stedy heat conduction. Unsteady heat conduction. Finite difference method for solving heat conduction problems. Fundamentals of heat transfer by convection. Natural and forced convection. Nondimensional form of convection equation. Boiling and condensation. Heat transfer coefficient for boiling and condensation. Fundamentals of thermal radiation. Black body radiation. Radiation heat transfer. The view factor. Black and gray surfaces. Heat exchange with emitting and absorbing gases. Protection from radiation and effects of radiation on measuring. Mass transfer. Boundary conditions. Steady mass transfer in a plane wall. Unsteady mass transfer.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: auditory, computational.

Mandatory literature for study and for exam:

1. Galović, A.: Termodinamika II, FSB, Zagreb, 2007.
2. Galović, A. Tadić, M, Halasz, B.: Nauka o toplini II, FSB, Zagreb, 2007.

Additional list of recommended literature:

1. Incropera, F.; DeWitt, D.; Bergman, T.L.; Lavine, A.S.: Introduction to Heat Transfer, John Wiley and Sons, 2007.
2. Cengel, Y.A.: Heat and Mass Transfer: A Practical Approach, McGraw Hill, 2003.

Exam's type:

Written and oral exam. Seminar paper.

D 780 Process Planning and Modeling

Brief contents:

Manufacturing and technological processes. The level of technology and technological processes. Concurrent design of products. Process planning for conventional machines. Process planning and group technologies. Process planning for high speed machining. Optimization of machining parameters. Production capacities. Production capacity calculation. Machining errors. Technological time calculation. Modelling methods. Modelling process. Modelling and optimization technology and machining processes. Development of analytical-algorithmic model of the technological process.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: auditory and laboratory exercises, seminar work

Mandatory literature for study and for exam:

3. Jurković, M.; Tufekčić, Dž. Tehnološki procesi – projektiranje i modeliranje, Univerzitet u Tuzli, Tuzla, 2000.
4. Milan Jurković : Matematičko modeliranje inženjerskih procesa i sistema, Mašinski fakultet Bihać, 1999.
5. Majdandžić, N.; Čuljak, S.: Priprema proizvodnje I, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1991.

Additional list of recommended literature:

4. Gačnik, V; Vodenik, F. Projektiranje tehnoloških procesa-optimizacija režima i vremena obrade, Tehnička knjiga Zagreb, 1990.
5. Buchmeister, B.; Polajnar, A. Priprava proizvodnje za delo v praksi, Fakulteta za strojništvo Maribor, Maribor 2000.
6. Scallan, P.: Process Planning: The design/manufacture interface, Butterworth-Heinemann, 2003.

Exam's type:

Written and oral.

D 781 Computer-Aided Design

Brief contents:

Introduction to programs for computer aided design. Concept design for manufacture and assembly. Overview and comparison of programs available. Parametric modeling of components and assemblies based on features. Design of complex surfaces on models. Application library. Making the presentation views: shading and animation. Shaping the plant and equipment.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Auditory and laboratory exercises on computers with the continuous monitoring and evaluation.

Mandatory literature for study and for exam:

1. Stephen J. Schoonmaker. CAD Guidebook: A Basic Manual for Understanding and Improving Computer-Aided Design. Marcel Dekker Inc, Basel, 2003.
2. Geoffrey Boothroyd, Peter Dewhurst, Winston Anthony Knight. Product Design for Manufacture and Assembly. Marcel Dekker Inc, Basel, 2002.

Additional list of recommended literature:

1. Patrick W. Jordan. Designing Pleasurable Products: An Introduction to the New Human Factors. Taylor & Francis Group, Philadephia, 2002
2. George A. Antaki. Piping and Pipeline Engineering: Design, Construction, Maintenance, Integrity, and Repair. Marcel Dekker Inc, Basel, 2003.
3. ENGINEERING SYMBOLOGY, PRINTS, AND DRAWINGS. U.S. Department of Energy, Washington, 1993.
4. Robert G. Campbell, Edward S. Roth. Integrated Product Design and Manufacturing Using Geometric Dimensioning and Tolerancing. Marcel Dekker Inc, Basel, 2003.
5. Wasim A. Khan, Abdul Raouf. Standards for Engineering Design and Manufacturing. CRC Press Taylor & Francis Group, Boca Raton, 2006.
6. Fabio Giudice, Guido La Rosa, Antonino Risitano. Product Design for the Environment: A Life Cycle Approach. CRC Press Taylor & Francis Group, Boca Raton, 2006.
7. Richard Crowson. Product Design and Factory Development. CRC Press Taylor & Francis Group, Boca Raton, 2006.

Exam's type:

Pass the tests of knowledge (program, seminars, colloquia, test).

D 782 Metal Forming I

Brief contents:

Continuation of introducing students in metal forming.
Technology of forging.
Selection of group forged parts. Approximate calculation of volume. Machine selection. Working additions and dimension tolerance. Real calculation of forging part volume. Fillets and radius. Plates for punching. Overflow fins (type 1,2,3,4 and 5). Distribution plane and die sectioning line. Forged part drawing.

Forging 1st type of forged parts. Upset forged parts. Complex upset forged parts. Calculation of material for 1st type of forged parts. Forging 2nd type of forged parts. Calculation for "m". Calculation of initial material. Forging phase for rounded forged parts (press forging). Forging square and cross parts. Forging 3rd type of forged parts. Drawings of hammers and squeezers. Calculation of deformation work. Calculation of deformation work at forging on hammers. Calculation of deformation work at forging on squeezers. Gravure for reduction sections, drawing out, squeezing, upsetting and bending. Correction of cold dimensions. Pressure of material. Opening for forging for tongs and inflow canal. Materials for dies. Compensation of horizontal forces. Cutting forces overflow fins. Forging technology.
Heater. Combustion.
Theory of plasticity.

Power and deformation work for 3D state of stress. Flow stress for 3D state of stress. Block diagram for analytical solution from metal deforming. Material flow. Equations for solving metal forming (10 equations with 10 unknown). Local deformations and velocities. Homogeneous forming. Model of material. Transformation of stress state. Main axles and invariants. Deviator and flow condition. Motion. Equation of continuity. Deformation velocities in tensor form. Flow law in tensor form. Balance equations in square and cylindrical coordinates.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises. Programme drawing.

Mandatory literature for study and for exam:

1. Grizelj, B.: "Alati i naprave", Strojarski fakultet Slavonski Brod 2004.
2. Grizelj, B.: "Oblikovanje metala deformiranjem", Strojarski fakultet Slavonski Brod 2002.
3. Grizelj, Branko; Seuček, Ivan, "Rezni alati: noževi, glodala". Slavonski Brod: Strojarski fakultet u Slavonskom Brodu(sveučilisni udžbenik), 2007.
4. Grizelj, Branko, "Strojevi za oblikovanje metala deformiranjem". Slavonski Brod: Strojarski fakultet u Slavonskom Brodu (sveucilisni udzbenik), 2007.
5. Grizelj, Branko, "Oblikovanje lima deformiranjem", Slavonski Brod: Strojarski fakultet u Slavonskom Brodu, 2009 (knjiga).

Additional list of recommended literature:

1. Povrzanović, A.: "Obrada metala deformiranjem", Fakultet strojarstva i brodogradnje Zagreb, 1996.
2. Hribar, J.: "Plastična obrada metala", Fakultet strojarstva i brodogradnje Zagreb,1975
3. Musafija, B.: "Obrada metala plastičnom deformacijom", Svjetlost Sarajevo, 1988.
4. Lange, K.: "Umformtechnik" Band I-IV, Spring Verlag, 1989-1993.
5. Fritz, H.; Schulze, G.: "Gertigungstechnik", VDI VERLAG, 1995.

6. Math, M.: "Uvod u tehnologiju oblikovanja deformiranjem", Fakultet strojarstva i brodogradnje, Zagreb, 1999.

Exam's type:

Written and oral.

D 800 Advanced Strength of Mechanical Constructions

Brief contents:

Introducing students to the quantitative methods for determining the durability of cyclically loaded structures and machine parts. Speed of crack propagation, Paris law. To enable students to independently use the calculation method and literature from the field strength of structures and machine parts at the time of changing loads.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises that are held auditory. Students solve the tasks under the supervision of assistants. Some tasks are set for the seminar. Assessment seminar provides a written assessment of the this subject.

Mandatory literature for study and for exam:

1. Alfirević, I.: Nauka o čvrstoći II, Golden marketing, Zagreb 1999.
2. Grubišić V.: Pogonska čvrstoća, FESB Split, 2004.
3. Haibach Erwin: Betriebsfestigkeit, Verfahren und Daten zur Bauteilberechnung, 3. korrigierte und ergänzte Auflage, Springer-Verlag Berlin Heidelberg New York, 2005, ISBN-13 978-3-540-29363-7

Additional list of recommended literature:

1. Dowling, N.E.: Mechanical Behavior of Materials: Engineering Methods for Deformation, Fracture, and Fatigue, Prentice Hall, 1998.
2. Radaj, D.: Ermüdungsfestigkeit der Konstruktionen, Springer-Verlag, Berlin 1995.
3. Anderson, T. L.: Fracture Mechanics, Fundamentals and Applications, CRC Press, Boca Raton, Florida 1995.
4. Buxbaum Otto: Betriebsfestigkeit, Sichere und wirtschaftliche Bemessung schwingbruchgefahrdeter Bauteile, Verlag Stahleisen mbH, Düsseldorf, 1986, ISBN 3-514-00376-9
5. Issler, L. i dr.: Festigkeitslehre - Grundlagen, Springer-Verlag, Berlin 1995.
6. http://www.gkss.de/pages.php?page=sintap.html&language=d&version=g ⇒ SINTAP (Structural Integrity Assessment Procedures for European Industry)
7. http://www.hse.gov.uk/research/otopdf/2000/oto00020.pdf ⇒ Partial safety factors for SINTAP procedure

Exam's type:

Exam (written and oral). Assessment seminar provides a written assessment of the this subject.

D 801 Ecodesign

Brief contents:

Introduction to product development with respect to the life cycle and enviroment protection. Students will be introduced to ecodesign processes and the integration of environmental influences into the product development. They will be acquainted with design tools and methods used in ecodesign. Ways to optimize systems for the End-of-Life System – recycling will be presented.

Teaching methods and the ways of knowledge assessment:

Lectures without exercises. Project assignment.

Mandatory literature for study and for exam:

1. Wimmer, W.; Züst, R.: Ecodesign Pilot - Product Investigation, Learning and Optimization Tool for Sustainable Development, with CD-ROM, Zürich, Verlag Industrielle Organisation, 2001.
2. Wimmer, W.; Züst, R.,: Ecodesign Pilot, Product Investigation, Learning und Optimization-Tool for Sustainable Product Development, with CD-ROM, Alliance for Global Sustainability Series Vol. 3, Kluwer Academic Publisher, Dordrecht, Boston, London, 2003 (ISBN 1-4020-0965-8)

Additional list of recommended literature:

1. Birkeland, J.: Design for Sustainability: A Sourcebook of Integrated, Eco-logical Solutions, Earthscan Publications Ltd., 2002 (ISBN 1853838977)
2. Alastair, Fuad-Luke: The Eco-Design Handbook - A Complete Sourcebook for the Home and Office, Thames & Hudson Ltd., London, 2002 (ISBN 0500 283435)

Exam's type:

Continuous assessment (project assignment), final exam.

D 802 Fracture Mechanics

Brief contents:

Introduce students to the analytical, numerical and experimental approach to structure analysis, when the planar failure, such as crack, is present. Define the finite elements features proper for the numerical analysis in linear-elastic and elastic-plastic fracture mechanics. Analysis of crack initiation and propagation in welded structures, pressure vessels, pipelines, etc. as well as the life cycle estimation and construction design by using of some contemporary procedures for structural integrity assessment, as SINTAP procedure.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Analytical calculation of fracture mechanics parameters such as: stress intensity factor K, crack tip opening displacement CTOD, crack mouth opening displacement CMOD and determination of critical crack length a_c and critical crack opening stress σ_c. Numerical determination of the K-parameter and J-integral will be performed using commercial computer packages, based on the finite element method. The fracture toughness of material - K_{Ic} will be determined by testing of compact tension (CT) specimen. Critical value of J-integral will be experimentally determined in the case of three point bend specimen using the single specimen method.

Mandatory literature for study and for exam:

1. Husnjak, M.: Mehanika loma, Inženjerski priručnik IP1, Školska knjiga, Zagreb 1996.
2. Gubeljak, N.: Mehanika loma, Univerza v Mariboru, Fakulteta za strojništvo, Maribor, 2009.

Additional list of recommended literature:

1. Anderson, T. L.: Fracture Mechanics: Fundamentals and Applications, CRC Press, Boca Raton, Florida, 1995.
2. Aliabadi, M. H.; Rooke, D. P.: Numerical Fracture Mechanics, Kluwer Academic Publishers, 1992.
3. Owen, D. R. J.; Fawkes, A. J.: Engineering Fracture Mechanics: Numerical Methods and Applications, Pineridge Press Ltd., Swansea, 1983

Exam's type:

Two preliminary exams will be given in place of the written part of the exam. The exam could be passed also by solving of complex working examples, which consist also the theory needed for their solution.

D 803 Numerical Modeling and Simulations

Brief contents:

Illustrate why, when, and how it is useful to model certain problems by using numerical methods, and also to simulate technological processes. Describe the process of modeling structures using one of the commercially available CAD software packages (Inventor, SolidWorks, SolidEdge). Indicate advantages and disadvantages of the 'bottom to top' approach (defining key points of the structure, lines, areas, and volumes) compared to the 'top to bottom' approach (spatial approach). List limitations of meshing and finite element selection in CAD software. Transfer of input-output structural data from CAD software to a software package that uses the finite element method (FEM). Verification of the computed model (created in one of the commercially available packages for FEM, such as ANSYS, ABAQUS, NASTRAN or ALGOR) compared to the actual structure. Classification of truss elements. Idealization errors. Defining symmetry conditions in created models. Material modeling and boundary conditions. Rigid connections. Modeling stress: static, dynamic, thermal. Analysis of complex engineering structures. Simulations of welding process, deformations, casting, machine processing, and thermal treatment of materials.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Showing examples of modeling products with their physical properties (type of material, liquid, gas) and in realistic operating conditions. Using software package ALGOR to demonstrate simulations of components in motion (mechanisms). Examples of modeling and simulations in solid mechanics, based on the finite element method: linear static analysis, eigen frequency analysis, analysis of thermal stresses, contact analysis. Modeling engineering problems: reinforcements, welded connections, bolted joints. Show examples of thermal field simulations in welding and calculating possible distortion components during welding using SYSWELD software package. Examples of metal forming through deformation are solved by using DEFORM software. Showing the simulation of chip formation during the machining process, as well as casting hardening and thermal treatment process.

Mandatory literature for study and for exam:

1. Sorić, J.: Metoda konačnih elemenata, Golden marketing, Zagreb 2004.
2. Pustaić, D; Wolf, H.; Tonković, Z.: Mehanika III, Golden marketing, Tehnička knjiga, Zagreb, 2005.
3. Brnić, J.; Čanađija M.: Analiza deformabilnih tijela metodom konačnih elemenata, Fintrade & Tours d.o.o. Rijeka, suizdavač Tehnički fakultet Rijeka, 2009.

Additional list of recommended literature:

1. Zimmermann, W. B. J.: Process Modelling and Simulation with Finite Element Methods, World scientific publishing Co, 2004.
2. Müller, G.; Rehfeld, I.; Katheder, W.: FEM für Praktiker, Die Methode der Finiten Elemente mit dem FE-Programm ANSYS, 2. verbesserte Anlage, Expert Verlag 1995.
3. Moaveni, S.: Finite Elemente Analysis, Theory and Application with ANSYS, Prentice Hall, New Jersey, 1999. Kobayashi, S.; Oh, S. I., and Taylan, A.: Metal Forming and the Finite-Element Method, Oxford University Press, 1989.
4. Oh, S. I.; Wu, W. T.; Tang, J.P. and Vedhanayagam, A.: Capabilities and Applications of FEM Code DEFORM: The Persepective of the Developer". Journal of Materials Processing Technology, 27, pp25-42, 1991
5. Kuang-O Yu: Modeling for Casting & Solidification Processing, Dekker, 2002.

6. Zienkiewicz, O.C. and Taylor, R.L.: The Finite Element Method: Volume 1 The Basis, 5th Edition, Butterworth-Heinemann, Oxford, 2000
7. Bathe, K.-J.: Finite Element Procedures, Second Edition, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1995.
8. Cook, R.D.; Malkus, D.S., Plesha, M.E.; Witt, R.J.: Concepts and Applications of Finite Element Analysis, 4th ed, John-Wiley & Sons, Inc., New York, 2002.
9. Huebner, H. K.; Thornton, A. E.; Byrom, G. T.: The finite element method for engineers, Third edition, John Wiley & Sons Inc., New York, 1995.
10. Liu, Y.: Lecture notes: Introduction to the Finite Element Method, University of Cincinnati, 1997-2003 (http://urbana.mie.uc.edu/yliu/FEM_Lecture_Notes_Liu_UC.pdf)

Exam's type:

Two research projects are assigned in place of the written part of the exam and their presentation will replace the oral part of the exam. One research project will involve numerical analysis in solid mechanics, and the second will involve a simulation of a given technological process.

D 806 Experimental Mechanics

Brief contents:

Familiarize students with basic principles of measurement of different mechanical units by collecting, processing and analyzing measured data. Train students for autonomous application of mechanics and strength of materials for solving of engineering problems, for use of literature and codes in field of technical measurements, on the basis of measurement example on different structures.

Teaching methods and the ways of knowledge assessment:

Lectures, auditory and laboratory exercises on practical structures in form of practicum, under assistant's supervision.

Mandatory literature for study and for exam:

1. Alfirević, I.; Jecić, S.: Fotoelasticimetrija, FSB, Zagreb 1997.

Additional list of recommended literature:

1. Boršić, M.: Iskazivanje mjernih rezultata, str. 963-976; Heidl, I.: Tenzometrija, str. 986-990; Jecić, S.: Fotoelasticimetrija, str. 990-1005; Butković, M.: Mjerenje vibracija, str. 1005-1015, Inženjerski priručnik, IP1 Temelji inženjerskih znanja, Školska knjiga, Zagreb 1996.
2. Rohrbach, C.: Handbuch für experimentelle Spannungsanalyse, VDI-Verlag, Düsseldorf 1989.
3. http://www.sfsb.hr/ksk/index.html ⇒ Elektronički Udžbenik Statika ⇒ Nauka o čvrstoći ⇒ Eksperimentalna analiza naprezanja
4. http://newton.fsb.hr/tenzometrija (zabilješke s predavanja dr. sc. M. Husnjak-FSB Zagreb)

Exam's type:

Continuous assessment with two partial exams and research project.

D 808 Evaluation Models

Brief contents:

Introduce students to the design process and information system about the product (PDM). Introduce students to different levels of complexity in product model definition; multi-criteria analysis, synthesis of structure characteristics. Modeling by using mappings; consistency in transforming structural characteristics; elements of proposition and predicative logic; basic terms in set theory and vector algebra; basic terms in graph theory. Introduction to decision making as a measuring instrument; principle of consistency in evaluation; evaluation models for structure characteristics; evaluation model based on π- similarity theorem; evaluation model using the efficiency function (MEDA - Methodology for the Evaluation of Design Alternatives); evaluation model for conceptual structure characteristics (CDEM - Conceptual Design Evaluation Method); AHP (Analytical Hierarchy Process) evaluation model based on applying generic vector method (MS Discussion); evaluation through the method of potentials (MP). Use practical examples for analytical and numerical evaluation models to illustrate the level of mathematical formalization and the possibility of applying evaluation in structural characteristics of products. By gaining necessary knowledge and experience through examples done in class and while working on the assigned research project, students should develop abilities needed for evaluating different variables in different stages of product development. This course is intended to develop the ability of students to use scientific literature in different languages, and to be able to use information technology to gather information about the course and to analyze problems in the course.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Analysis of examples using different evaluation models according to the complexity level of product development and its type. Students will be divided into smaller groups and will be assigned a research project. This is intended to develop teamwork skills and analytical thinking while solving the problem. The goal of the research project is to implement gained knowledge from previous courses through analysis and while solving the assigned problem so that evaluation process can be completed. During discussions, there are two preliminary exams, and also constant monitoring and analysis of the research project progress under faculty guidance. At the end of the semester, each group gives a public oral presentation about their research project, with the goal of developing the ability to work in a team and to present results. It also builds confidence in analyzing structural problems of different complexity by using the knowledge gained during undergraduate studies.

Mandatory literature for study and for exam:

1. Zhengxin, C.: Computational Inteligence For Decision Support, CRC Press, 1999.
2. Oberšmit, E.: Nauka o konstruiranju. Metodičko konstruiranje i konstruiranje pomoću računala., Sveučilišna naklada Liber, Zagreb, 1989.
3. Saaty, T.L.: The Analitic Hierarchy Process, RWS Publications, Pittsburgh, 1996.
4. Rozenburg, E.: Product Design Fundamentals and Methods, Willey 1995.
5. French, M.: Conceptual Design for Engineers, Springer 1998.
6. Schneeweiss, C.: Distributed Decision Making, Springer, Berlin, 2003

Additional list of recommended literature:

1. Sen, P.; Yang, J.B.: Multiple Criterion Decision Support in Engineerng Design, Springer-Verlag, London, 1998.
2. Andreasen ... Otto Wood: Product Design, Prentice Hall 2001.
3. Suh, N.P.: The Principles of Design, Oxford Univ. Press, New York, Oxford 1990.

4. Kesserling, F.: Bewertung von Konstruktionen, Deutscher Ingenieur – Verlag GmbH, Dusseldorf, 1951.
5. Duhovnik, J.; Tavčar, J.: Elektronsko poslovanje in tehnični informacijski sistemi, LECAD, Univerza v Ljubljani, 2000.
6. Bjarnemo, R.: Towards a Computer Implementable Evaluation Procedure for the Mechanical Engineering Design process, Lunds University, Division of Machine Design of Department od Design Science, Sverige, 1994.
7. Čaklović, L.: Geometrija linearnog programiranja, PMF, Zagreb, 2004.
8. http://www.technalithics.com/engineer.html
9. http://pc205.math.hr/Decision/
10. http://www.princeton.edu/~rvdb/LPbook
11. http://cognet.mit.edu/MITECS/Front/topic_index.html

Exam's type:

Two preliminary exams will be given in place of the written part of the final exam. Students will be divided into groups and assigned a research project. At the end of the semester, if the research project is presented successfully it will replace the oral part of the exam.

D 809 Metal Structures

Brief contents:

Introduction to basic terms in metal structures, types and classification of metal structures using different criteria. Analysis of material selection process during forming and designing of metal structures. Stress analysis and dimensioning of metal structures expose students to fundamental approaches, analytical and numerical methods specific to this area, and the application of current standards in this area (HRN, DIN, and EU norms and regulations). The analysis of safety in metal structures points out the importance of metal structures and industrial objects developed from them with regard to property, people, and biological surroundings. Other topics include manufacturing, mounting, and protection of metal structures while considering parameters in the analysis of the useful life of industrial objects created from different concepts of metal structures. By gaining necessary knowledge and experience through examples done in class and while working on the assigned research project, students will develop abilities needed for complex approach in analyzing metal structures from different aspects.

Teaching methods and the ways of knowledge assessment:

Lectures without exercises. Solving practical problems at home. Students will be working at home on a research project under faculty guidance. Students will be divided into smaller groups and will be assigned a research project. This is intended to develop teamwork skills and analytical thinking while solving the problem. The goal of the research project is to implement the knowledge already acquired while analyzing and solving the assigned problem in metal structures. At the end of the semester, each group gives a public oral presentation of their research project, with the goal of developing the ability to work in a team and to present results. It builds confidence in analyzing structural problems of different complexity by using the knowledge gained during the course.

Mandatory literature for study and for exam:

1. Oberšmit, E.: Nauka o konstruiranju. Metodičko konstruiranje i konstruiranje pomoću računala., Sveučilišna naklada Liber, Zagreb, 1989.
2. Oberšmit, E.: Osnove konstruiranja. Tehnološki ispravno konstruktivno oblikovanje strojnih dijelova., Sveučilišna naklada Liber, Zagreb, 1983.
3. Pahl, G. and Beitz, W.: Konstruktionslehre, Methoden und Anwendung, 4. neubearbeitet Auflage, Springer, Berlin, 1997.

Additional list of recommended literature:

1. Ehrlenspiel, K.; Kiewert, A.; Lindeman, V: Kostengünsting Entwickeln und Konstruiren, Springer 1999.
2. Androić, B.; Dujmović, D.; Džeba, I.: Metalne konstrukcije 1, Institut Građevinarstva Hrvatske, Zagreb, 1994.
3. Androić, B.; Dujmović, D.; Džeba, I.: Metalne konstrukcije 2, Institut Građevinarstva Hrvatske, Zagreb,1998.
4. Androić, B.; Dujmović, D.; Džeba, I.: Metalne konstrukcije 3, Institut Građevinarstva Hrvatske, Zagreb, 1998.
5. Androić, B.; Dujmović, D.; Džeba, I.: Metalne konstrukcije 4, Institut Građevinarstva Hrvatske, Zagreb, 2000.
6. http://www.fesb.hr/kk/

Exam's type:

Two preliminary exams will be given in place of the written part of the final exam. Students will be divided into groups and assigned a research project. At the end of the semester, if the research project is presented successfully it will replace the oral part of the exam.

D 820 Production Management

Brief contents:

Scope and definition of management and entrepreneurial management. Tasks and mission of management. Basics of modern management. Management approaches. Manager skills. State of art and trends. Introduction to production management. Basic terms. Production management strategies. Production functions and strategies. Influence factors. Production planning and leading. Product life cycle. Quality management. Cost management. Warehouse management. Technological assumptions and transfer of technology. Logistics and it tasks. Methods and techniques for process analysis. State of art and applying of informatics and information technology.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: auditory.

Mandatory literature for study and exam:

1. A. Polajner; B. Buchneiter; M.Leber: Proizvodni menadžment, Univerza v Mariboru, Fakultet za strojništvo,2005.
2. Ž., Dulčić; I., Pavić; M., Rovan; I., Veža: Proizvodni menadžment, Ekonomski fakultet Split, FESB Split, 1996.
3. H., Koontz; H., Weihrich: Menadžment, Mate, Zagreb, 1994.

Additional list of recommended literature:

1. Milan, Ikonić; Aleksandar, Vuković: Projektni menadžment, Tehnički fakultet, Zavod za industrijsko inženjerstvo i management, Rijeka, 2009.
2. Tonči, Mikac; Dalibor, Blažević: Planiranje i upravljanje proizvodnjom, Tehnički fakultet, Zavod za industrijsko inženjerstvo i management, Katedra za organizaciju i operacijski management, Rijeka, 2007.
3. A. Polajner; B. Buchneiter; M.Leber; K. Pandža; B. Kalpič; T. Rojs; N. Vujica-Herzog; I. Palčič; T. Fulder; P. Meža: Menadžment proizvodnih sistemov, Univerza v Mariboru, Fakultet za strojništvo,2004.
4. A. Polajner; B. Buchneiter; M.Leber: Organizacija proizvodnje, Univerza v Mariboru, Fakultet za strojništvo,2002.
5. N., Majdandžić; R., Lujić; G., Matičević; G., Šimunović; I., Majdandžić: Upravljanje proizvodnjom, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 2001.
6. M., Buble: Management, Ekonomski fakultet Split, Split, 2000.
7. Roger, G. Schroeder: Upravljanje proizvodnjom – Odlučivanje u funkciji proizvodnje, Četvrto izdanje, Mate d.o.o, Zagreb, 1999.

Exam's type:

Written and oral.

D 822 Information Systems of Production Enterprises

Brief contents:

The future of modern production. The core activity of contracting, preparation and production. The application of information technology in the organization of the production enterprises. Management and information. The process of obtaining information. Development of IT support in production enterprises. Stages of development activities of information systems in production enterprises. Types of information systems of production enterprises. The structure of information systems of production enterprises. Subsystems of information systems: Common database, Sales and calculation, Material purchasing and store, Product definition and technology, Planning, scheduling, launching and monitoring of production, Controlling and management, Quality management, Maintenance. Specificity of information systems: metal, wood, electrical, food, construction, chemical and processing industries. The implementation of information systems. Evaluation of information systems in production enterprises. Expected benefits from the implementation of information systems.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: Laboratory exercises (working with various modules of information system of the production enterprises).

Mandatory literature for study and for exam:

1. Majdandžić, N.: Izgradnja informacijskih sustava proizvodnih poduzeća, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 2004.

Additional list of recommended literature:

1. Srivastava, D.; Batra, A. ERP systems, I K International Publishing House, 2010.

Exam's type:

Written and oral.

D 824 Costs Management

Brief contents:

The importance of costs management in business decision making. Classification of costs. Models of costs management. Direct and indirect costs. Fixed and variable costs. Standard costs. The costs of production. Costs of material. Maintenance costs. Costs Analysis. The relationship cost-volume-profit production. Business decisions based on the relationship between costs and revenues. Pricing strategies. Product cost calculation. Incremental or differential analysis. Costs and supply conditions. Influence of cost management to improve business results.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: auditory and laboratory exercises.

Mandatory literature for study and for exam:

Additional list of recommended literature:

1. Hilton,R, Maher,M, Selto,F, Cost Management, McGraw Hill Edition, 2002.
2. Blacher, E.J, Kung,H.C, Lin,T.W, Cost management, McGraw Hill Edition, 2002.

Exam's type:

Written and oral.

D 840 Tool Materials

Brief contents:

Basic and production requests on characteristics of tool materials. Work principle of tools and stress in tools.
Special heat treatment of steel tools. Low-alloy (carbon) steel tools. Low-alloy cold work steel tool. High-alloy cold work steel tools.
Steel tools for moulds to work in a hot condition. High speed steels.
Work conditions, alloy principles and metaleographic characteristics of high-speed tool steels. Heat treatment of high-speed steels. Tool application of MARAGING steel. Types and characteristics of MARAGING steel for cold and hot work.
Tool materials and tools produced by special procedures. Casting tools (EPT process).
Sintered tools and tool materials. Sintered (non iron) hard alloys.
Hard alloys based on: WC-Co, WC-TiC-Co and WC-TiC-TaC-Co.
Sintered ceramic materials. Cutting materials on silicon carbides and nitrides basis.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises. Auditory exercises and laboratory classes.
During the teaching session semester project are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Novosel, M.; Cajner, F.; Krumes, D.: Alatni materijali, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1996.
2. Novosel, M.; Krumes, D.: Posebni čelici, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1998.

Additional list of recommended literature:

1. Novosel, M.; Krumes, D.: Željezni materijali (metalografske osnove i tehnička primjena željeznih ljevova), Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1997.
2. Krumes, D.: Površinske toplinske obrade i inženjerstvo površina, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 2004.

Exam's type:

Written and oral (semester project development and presentation).

D 841 Surface Heat Treatment and Surface Engineering

Brief contents:

Introduction to processes of steel surface modifications. Flame hardening. Induction hardening. Surface modifications with laser beam. Surface modifications with ion implantation. Introduction to thermochemical treatments: carburizing, carbonitriding, nitriding, ionitriding, boronizing and sulfonitrocarburizing processes. Introduction to coating (deposition) procedure from gas phase. Procedure of PVD (Physical Vapour Deposition). Procedure of CVD (Chemical Vapour Deposition). CVD- procedure sustained by plasma. Deposition of thin coatings by ion beam. Multi-component and multi-layer structures and super-lattices. Materials for hard coatings. Multi-component layers. Thermal barrier coatings (TBC). Characteristics and application of thermal barriers. Deposition procedure of TBC layers sustained by plasma. Tribological characteristics of the surface layers and influence of the type and amount of structure elements on the wear resistance.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises. Auditory exercises and laboratory classes.
During the teaching session, semester projects are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Krumes, D.: Površinske toplinske obrade i inženjerstvo površina, Strojarski fakultet, Sveučilište u Osijeku, Slavonski Brod, 2004.
2. Marušić, V.: Tribologija u teoriji i praksi, Strojarski fakultet, Sveučilište u Osijeku, Slavonski Brod, 2008..

Additional list of recommended literature:

1. Novosel, M.; Cajner, F.; Krumes, D.: Alatni materijali, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1996.

Exam's type:

Written and oral (semester project development and presentation).

D 842 Composites and Polymers

Brief contents:

Introduction to properties of composites and polymers and their advantages and disadvantages compared to other structural materials. Introduction to current trends in "design" of composites. Analysis of characteristics of composites reinforced with particles and fibres. Composites with polymer matrix (PMC), metal matrix (MMC) and ceramic matrix (CMC). The production procedure and processing of composites. Introduction to the application of polymers in mechanical engineering. Introduction to potential use of these materials through analysis of properties such as mechanical, thermal, electrical, tribological and corrosion-resistance .Polymers used for constructional purposes; for use with aggressive media and for use under conditions of friction and wear.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises. Auditory exercises and laboratory classes.
During the teaching session, semester projects are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Filetin, T.; Kovačiček, F.; Indof, J.: Svojstva i primjena materijala, Fakultet strojarstva i brodogradnje, Zagreb, 2002.
2. *** Grupa autora: Materijali u strojarstvu – Tendencije razvoja i primjene, Indof, J.: Razvoj i primjena kompozitnih materijala, HDMT, Zagreb, 1993.

Additional list of recommended literature:

1. Filetin, T.: Izbor materijala pri razvoju proizvoda, Fakultet strojarstva i brodogradnje, Zagreb, 2000.

Exam's type:

Written

D 843 New Production Technologies

Brief contents:

Students are introduced into modern production processes in polymer processing field, casting field, shaping of metal by deformation, by chip-forming machining and by welding. Modern production process characterizes high efficiency and high machining process quality with maximum materials yield, minimum wasting of energy and minimum contamination of human environment.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises carrying out seminary tasks (auditory exercises, and practice in programme drawing).

Mandatory literature for study and for exam:

1. Lukačević, Zvonimir; Raos, Pero; Stoić, Ante; Stubičar, Mladen. Nove tehnologije. Slavonski Brod: Strojarski fakultet u Slavonskom Brodu, 1998.
2. Raos, Pero; Lucić, Mirjana. Konstrukcijsko lijepljenje // autorizirana predavanja. Slavonski Brod: Strojarski fakultet u Slavonskom Brodu, 2003.

Additional list of recommended literature:

1. Stoić, Mirjana. Doprinos istraživanju mehaničkih karakteristika nosivosti jednostrukih preklopnih lijepljenih spojeva. Magistarski rad. Slavonski Brod: Strojarski fakultet u Slavonskom Brodu, 2003
2. Onusseit, Hermann. Klebtechnik, Band 1: Grundlagen. Heidelberg: Hüthig Verlag, 2008. (ISBN 978-3-7785-4011-4)
3. Gierenz, Gerhard; Karmann, Werner. Adhesiver and adhesive tapes. Weinheim: Wiley-VCH, 2001. (ISBN 3-527-30110-0)
4. Brockmann, Walter et al. Klebtechnik. Weinheim: Wiley-VCH, 2005. (ISBN 3-527-31091-6)

Exam's type:

Carrying out seminary tasks

D 844 Laboratory Materials Testings

Brief contents:

Introduce students into some important laboratory material testings. By laboratoric testings test samples from halfproducts and finished parts (new or damaged during using) we obtain in complete group of important facts. That are facts for comparison from basic importance for calculations structures, for control changes of properties by production and processing of materials, for investigation defects during using, for development new materials, for selection materials etc.
Influence factors on properties and behaviour materials in use. Systematized elaboration group properties and characteristics of materials. Some important methods laboratoric material testings are: chemical composition, mechanical static and dynamic-properties, micro- and macrostructure, physical properties, resistance on corrosion and biological influences, technological properties, tribological properties, exploitation properties, nondestructive methods of testing. Sorts of laboratories for relevant kinds of material testing and introduce of students into equipment and devices for testing.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises. Auditory exercises and laboratory classes.
During the teaching session semester project are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Marušić, V.: Tribologija u teoriji i praksi, Strojarski fakultet Sveučilište u Osijeku, Slavonski Brod, 2008.
2. Mladen Franz: Mehanička svojstva materijala, Sveučilište u Zagrebu, FSB, Zagreb, 1998.
3. Krstelj, V.: Ultrazvučna kontrola – odabrana poglavlja, Sveučilište u Zagrebu, FSB, Zagreb, 2003.

Additional list of recommended literature:

1. Filetin, T.; Kovačiček, F.; Indof, J.: Svojstva i primjena materijala, Sveučilište u Zagrebu, FSB, Zagreb, 2002.

Exam's type:

Written

D 851 Welding

Brief contents:

Students will be introduced to possible welded joints modes of failure and possibilities for assurance against failure. Examples of characteristic failures are explained and potential failure risks are quoted. Different examples of welded production and construction failures in Croatia and in the world are specified and analysed in order to determine types of failure and causes and activities necessary for quality assurance against failures. Failures in welded joints exist due to fact that welding causes the weakening of base material. But, failures are deviations that are over acceptance criteria and can be detected by appropriate quality control techniques. Weakening mechanisms in welded joints, weakening factor of base material due to welding, weld joint and weld product classes, weldability and problems of materials weldability used in engineering practice are explained. Materials weldability is explained from the standpoint of metallurgical, operative and global construction weldability. Special attention is given to conditionally and hardly weldable materials and welding of dissimilar materials.

Teaching methods and the ways of knowledge assessment:

Lectures. Auditorium, laboratory and industrial exercises. During the teaching session tests are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Lukačević, Z. Zavarivanje, Strojarski fakultet u Slavonskom Brodu, 1998.
2. Kralj, S., Andrić, Š.: Osnove zavarivačkih i srodnih postupaka, Sveučilište u Zagrebu, 1992., ISBN 86-7819-043-4
3. Samardžić i dr. Analiza tehnologičnosti zavarenih konstrukcija, digitalni udžbenik, http://www.sfsb.hr/kth/zavar/index.html

Additional list of recommended literature:

1. Podloge za stručni seminar: Visokoučinski postupci zavarivanja, HDTZ, 2002.
2. Zbornik radova 1. međunarodnog znanstveno-stručnog savjetovanja «Ekonomski i kvalitativni aspekti visokoučinskih postupaka zavarivanja», izdavač Đuro Đaković, Slavonski Brod, 2001.
3. Zbornik radova 2. međunarodnog znanstveno-stručnog savjetovanja «Specijalni postupci i proizvodi u tehnici zavarivanja», izdavač Strojarski fakultet u Slavonskom Brodu, 2003.
4. Meden, G.; Pavletić, A.; Pavletić, D.: Osnove zavarivanja, Rijeka, Tehnički fakultet u Rijeci, 2000.
5. Gojić, M: Tehnike spajanja i razdvajanja materijala, Sisak, Metalurški fakultet Sisak, 2003.
6. Kralj, S., Andrić, Š.: Osnove zavarivačkih i srodnih postupaka, Sveučilište u Zagrebu, 1992., ISBN 86-7819-043-4

Exam's type:

Written and oral.

D 856 Foundries Automation

Brief contents:

Acquainting of students with classification and types of foundries. Automatic preparation of moulding mixtures (dosage of sand, binders, additives and water), mixing devices, pneumatic and conveyor transport of sand and moulding mixtures. Equipment for regeneration and cooling of moulding mixtures. Mechanized moulding lines, automatic moulding lines for single article production, automatic moulding lines with horizontal and vertical mould partition. Automatic control of metal melting. Melt transport and automatic casting machines. Machines for castings cleaning. Machines for pressure die casting, precise mould casting, centrifugal and vacuum casting respectively.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: computer and design exercises

Mandatory literature for study and for exam:

1. Ivan Budić: Osnove tehnologije kalupljenja, Jednokratni kalupi I dio, II izmijenjeno i dopunjeno izdanje, Strojarsku fakultet, Slavonski Brod, 2010.
2. Ivan Budić, Zoran Bonačić-Mandinić: Osnove tehnologije kalupljenja, Jednokratni kalupi II dio, Strojarsku fakultet, Slavonski Brod, 2004.
3. Ivan Budić: Posebni ljevački postupci, I dio, Strojarsku fakultet, Slavonski Brod, 2006.
4. Ivan Budić: Posebni ljevački postupci, II dio, Strojarsku fakultet, Slavonski Brod, 2009.

Additional list of recommended literature:

1. I. Katavić, Ljevarstvo, Tehnički fakultet Sveučilišta, Rijeka, 2001.,
2. Ljevački priručnik, Savez ljevača Hrvatske, Zagreb, 1985.
3. Tehnička enciklopedija, Mehanizacija ljevaonica, LZMH, Zagreb, 1986.
4. P. R. Beeley, Foundry Technology, Butterworths, London, 1972.

Exam's type:

Preparation of a project with a colloquy.

D 857 Designing of Technologies

Brief contents:

Acquainting of students with activities in the designing of technologies of welding, machining, casting, metal shaping by deformation, polymers processing and surface protection. Each of the mentioned technologies has peculiarities which are to be known for successful technological designing. Emphasis is given on the use of informatics technology that will certainly make easier and accelerate the activities in the designing of technology making at the same time possible the accumulation of knowledge from former and actual production procedures. Mechanical engineering structures and products are considered as combined structures and products made often using simultaneously several mechanical technologies. Emphasis is laid on close connection between product technological suitability and the designing of production technology, too.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: auditory, industrial

Mandatory literature for study and for exam:

1. Ivan Budić: Osnove tehnologije kalupljenja, Jednokratni kalupi I dio, II izmijenjeno i dopunjeno izdanje, Strojarsku fakultet, Slavonski Brod, 2010.
2. Ivan Budić, Zoran Bonačić-Mandinić: Osnove tehnologije kalupljenja, Jednokratni kalupi II dio, Strojarsku fakultet, Slavonski Brod, 2004.

Additional list of recommended literature:

1. Ljevački priručnik, Savez ljevača Hrvatske, Zagreb, 1985.
2. Tehnička enciklopedija, Ljevarstvo, sv. 7, LZMH, Zagreb, 1986.
3. P. R. Beeley, Foundry Technology, Butterworths, London, 1972.
4. Osswald, T.A., Turng, T., Gramann, P.J.: Injection Molding Handbook, Hanser Publishers, Munich, 2001.
5. Stitz, S., Keller, W.: Spritzgiesstechnik, Hanser Verlag, München, 2001.
6. Johannaber, F., Michaeli, W.: Handbuch Spritzgiessen, Hanser Verlag, München, 2002.
7. Zbornik radova 1. međunarodnog znanstveno-stručnog savjetovanja «Ekonomski i kvalitativni aspekti visokoučinskih postupaka zavarivanja», izdavač Đuro Đaković, Slavonski Brod, 2001.
8. Patrick D. T. OConnor. A Concise Guide to Cost-effective Design, Development and Manufacture.
   2001. ISBN: 0471498823. Edition: Hardcower. (www.amazon.com)
9. Krumes, D.; Aračić, S.; Marušić, V.: The effect of steel boriding layers on exposure to H_2S, Proceedings of the 13th International DAAAM Symposium, 2002, Vienna, 289-290.
10. Krumes, D.; Aračić, S.: Wearing of low carbon steel W.Nr. 1.1191 in 5% NaCl, 15th International Corrosion Congress Frontiers in corrosion science and technology, 2002, Granada (Spain).

Exam's type:

Examination or seminar work.

D 860 Designing of Polymer Products

Brief contents:

Students are introduced into modern approach to the development and designing of polymer products which include integral technological considering of product development. Thereby, beside of basic technical criteria, all of social, ecological and economic aspects of products and their development are presented.

Teaching methods and the ways of knowledge assessment:

Lectures. carrying out seminary tasks (auditory exercises, , practice in programme drawing). The knowledge is assessed by oral presentation of seminary paper.

Mandatory literature for study and for exam:

1. Raos, P., Čatić, I.: Razvoj injekcijski prešanih polimernih tvorevina, Društvo plastičara i gumaraca, Zagreb, 1992.

Additional list of recommended literature:

1. Šercer, Mladen; Križan, Božidar; Basan, Robert. Konstruiranje polimernih proizvoda. Zagreb: Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu i Tehnički fakultet Sveučilišta u Rijeci, 2008. (ISBN 978-953-6313-94-5)
2. Ehrenstein, Gottfried W. Mit Kunststoffen konstruieren. München: Carl Hanser Verlag, 2007. (ISBN 978-3-446-41322-1)

Exam's type:

Performing seminary work and oral presentation.

D 900 Industrial Design

Brief contents:

Introduction to basic terms and methods in industrial design. The purpose of industrial design, esthetic components of the product, and multidimensionality of the design process. Visual presentation and consideration. Forms in the creative process, methods and procedures for designing forms. Interdisciplinary characteristics of design: quality, marketing, ergonomics, application value, value analysis, durability, style, graphics.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Research paper.

Mandatory literature for study and for exam:

1. Quarante, D.: Osnove industrijskog dizajna, Sveučilišna naklada Zagreb, 1991.

Additional list of recommended literature:

1. Muller, Wim: Order and Meaning in Design, Lemma Publishers, Utrecht 2001.
2. Hannah, B.: Becoming a Product Designer, John Wiley & Sons, Inc., New Jersey 2004.

Exam's type:

Continuous assessment (two preliminary exams).

D 901 Product Development Design

Brief contents:

Introduction to the concept of multidisciplinary aspect in product development. Analysis of a product as a technical system; design process and product information system (PDM); methods and principles of design. Introduction to defining a list of requirements; transformation matrices; compatibility analysis of structural characteristics and reshaping. Concepts, design, and structural development. Emphasize the need for an objective approach in analyzing solution variations; evaluation and mathematical models; innovations, principles of creativity, and modular approach to product development. Emphasize the need for accepting principles of industrial design. The importance of respecting basic principles in ergonomic shaping of products; guides to accurate structural forming. Emphasize the importance of material selection; dimensioning and stress analysis of vital components and details. Draw attention to ecologically responsible product development; basic risk analysis for people, property, and biological surroundings. By gaining necessary knowledge and experience through examples done in class and during discussions, and while working on the assigned research project, students should develop abilities needed for solving given structural problems using structural analysis in all stages of the design process. Students should also be able to use scientific literature and information technology to gather information about the course and to analyze problems in the course.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Analysis of examples using different design models during different stages of product development and with different complexity levels. By analyzing structural characteristics, during the material selection process, dimensioning, and stress analysis, students will apply knowledge gained in this and other courses to solve the assigned research project. Students will be divided into smaller groups and will be assigned a research project. This is intended to develop teamwork skills and analytical thinking while solving the problem. The goal of the research project is to implement gained knowledge from previous courses through analysis and while solving the assigned problem. During discussions, there are two preliminary exams, and also constant monitoring of the research project progress under faculty guidance. At the end of the semester, each group gives a public oral presentation of their research project, with the goal of developing the ability to work in a team and to present results. It also builds confidence in analyzing structural problems of different complexity by using the knowledge gained during the course.

Mandatory literature for study and for exam:

1. Oberšmit, E.: Nauka o konstruiranju. Metodičko konstruiranje i konstruiranje pomoću računala., Sveučilišna naklada Liber, Zagreb, 1989.
2. Oberšmit, E.: Osnove konstruiranja. Tehnološki ispravno konstruktivno oblikovanje strojnih dijelova., Sveučilišna naklada Liber, Zagreb, 1983.
3. Adamsen P.B.: A Framework for Complex System Development, CRC Press, 2000.
4. Hubka, V.; Eder, W. E.: Theory of Technical Systems, Springer 1988.
5. Hubka, V.; Andreasen, M. M.; Eder W. E.: Practical Studies in Systematic Design, Butterworth & Co., 1988.
6. Quarante, D.: Osnove industrijskog dizajna, Sveučilišna naklada Zagreb, 1991.
7. Pahl, G. and Beitz, W.: Konstruktionslehre, Methoden und Anwendung, 4. neubearbeitet Auflage, Springer, Berlin, 1997.

Additional list of recommended literature:

1. Ehrlenspiel, K.; Kiewert, A.; Lindeman, V.: Kostengüusting Entwicheln und Konstruiren, Springer 1999.
2. Rozenburg, Eekels: Product Design Fundamentals and Methods, Willey 1995.
3. Andreasen ... Otto Wood: Product Design, Prentice Hall 2001.
4. Suh, N.P.: The Principles of Design, Oxford Univ. Press, New York, Oxford 1990.
5. Andreasen, M. M.; Hein, L.: Integrated Product Development, IFS (Publications) Ltd, 1987.
6. Duhovnik, J.; Tavčar, J.: Elektronsko poslovanje in tehnični informacijski sistemi, LECAD, Univerza v Ljubljani, 2000.
7. Muftić, O.; Veljović, F.; Jurčević-Lulić, T.; Milčić, D.: Osnovi ergonomije, Univerzitet u Sarajevu, 2001.
8. http://www.maedler.de/katalog_de/index_d.html
9. http://www.ndim.edrc.cmu.edu/
10. http://cadlab.mit.edu/about/
11. http://www.cad-portal.com/
12. http://www.memagazine.org/index.html

Exam's type:

Two preliminary exams will be given in place of the written part of the final exam. Students will be divided into groups and assigned a research project. At the end of the semester, if the research project is presented successfully it will replace the oral part of the exam.

D 903 Numerical Methods

Brief contents:

The aim of the course is to familiarize students with numerical methods used in the analysis of engineering designs and constructions. Matrixes, index notation, mathematical transformations. Basic mathematical models in continuum mechanics. Finite difference method. Solving the Poisson's equation and partial differential equations, two-dimensional problems.
Finite element method. One dimensional linear element. Solving the problem of an axially - loaded bar. The basis beam element. Two-dimensional finite element. Unsteady one-dimensional and two- dimensional problems.
Finite volume method. General form of low of conservation of physical quantity. Mathematical nature of general partial differential equations. General conditions for discretization of partial differential equations. Steps in the finite volume method. Time integration methods of equations.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Demonstration of characteristic examples of the application of different numerical methods (weighted residual method, finite differences, finite elements, boundary elements, finite volumes and other.) Discussion on the area of application of some methods and comparison of obtained results.

Mandatory literature for study and for exam:

1. Sorić, J.: Uvod u numeričke metode u strojarstvu, FSB, Zagreb, 2009.
2. Sorić, J.: Metoda konačnih elemenata, Golden marketing, Zagreb, 2004.
3. www.sfsb.hr/~mzivic, M. Živić: Metoda konačnih volumena

Additional list of recommended literature:

1. Zienkiewicz, O.C. and Taylor, R.L.: The Finite Element Method: Volume 1 The Basis, 5th Edition, Butterworth-Heinemann, Oxford, 2000
2. Bathe, K.-J.: Finite Element Procedures, Second Edition, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1995.
3. Cook, R.D.; Malkus, D.S., Plesha, M.E.; Witt, R.J.: Concepts and Applications of Finite Element Analysis, 4th ed, John-Wiley & Sons, Inc., New York, 2002. Schäfer, M.: Numerik im Maschinenbau, Springer, Berlin 1998.
4. Hartmann, F.: Introduction to Boundary Elements, Springer, Berlin 1989.
5. Marshal, D.: Finite Differenzen und Elemente, Springer, Berlin 1989.

Exam's type:

Two preliminary exams held during lecture. Passing scores on preliminary exams replace the written part of exam. Oral exam.

D 904 Theory of Elasticity

Brief contents:

Familiarize students with the basics of elasticity theory and application in solving problems of stress distribution and deformation of the technical structures. Based on illustrative examples to enable students to independently apply the methods of the theory of elasticity in the technical strength calculations of structures and machine parts as well as the use of literature in the field of theory of elasticity.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises that are held auditory. Students solve the tasks under the supervision of assistants. Some tasks are set for the seminar. Assessment seminar provides a written assessment of the this subject.

Mandatory literature for study and for exam:

1. Jecić, S.; Semenski, D.: Jednadžbe teorije elastičnosti, FSB-Zagreb, Zagreb 2001.
2. Alfirević, I.: Linearna analiza konstrukcija, FSB Zagreb, Zagreb 1999.
3. Alfirević, I.: Uvod u tenzore i mehaniku loma (dio: 7 - Mehanika elastičnih tijela), Golden marketing, Zagreb, 2003.

Additional list of recommended literature:

1. Alfirević, I.: Teorija elastičnosti, str. 571-587, Inženjerski priručnik, IP1 Temelji inženjerskih znanja, Školska knjiga, Zagreb 1996.
2. Benham, P. P.; Crawford, R. J.; Armstrong. C. G.: Mechanics of Engineering Materials, Longman Group Lmtd., London 1996.
3. Boresi, A. P.; Schmidt, R. J.; Sidebottom, O. M.: Advanced mechanics of materials, J. Wiley, New York 1993.
4. Megson, T. H. G.: Structural and stress analysis, Arnold, London 1996.
5. Issler, L. i dr.: Festigkeitslehre - Grundlagen, Springer-Verlag, Berlin 1995.
6. http://www.mdsolids.com/ ⇒Projects ⇒Mechanics of Materials
7. http://web.umr.edu/~bestmech/preview_mechmatl.html), program MDSolids2.6

Exam's type:

Exam (written and oral). Assessment seminar provides a written assessment of the this subject.

D 905 Power Plants

Brief contents:

Introduction to the basic parameters and technologies for electric energy production. The division of the conventional power plants with corresponding characteristic features. Hydropower plants (HPP): historical development, functional description of the consisted parts, components and equipment selection by parameters of available watercourses, types of HPP (flow, storage, derivative, pumped-reversible, small), operation of HPP and the importance of HPP in power system. Thermal power plants (TPP): description of the functional parts, types of TPP according to final energy form (electric energy, hot water heating energy and electrical energy, steam heating energy and electrical energy), gas thermal power plants and the importance of TPP in power system. The impact of power plants on ecology.

Teaching methods and the ways of knowledge assessment:

Lectures.
Auditory exercises: Calculation examples with numerical data from all teaching units according to the lectures. The student has to complete one seminar paper.

Mandatory literature for study and for exam:

1. Požar, H.: Osnove energetike 1, 2 i 3, Školska knjiga-Zagreb, 1992.
2. Udovičić, B.: Energetika, Školska knjiga Zagreb, 1993.

Additional list of recommended literature:

1. Udovičić, B.: Elektroenergetski sustav, Kigen Zagreb, 2004.
2. Jozsa, L.: Energetski procesi i elektrane, Interna skripta, ETF Osijek, 2004.

Exam's type:

Seminar paper and oral exam.

D 907 Theory of Plasticity

Brief contents:

Familiarising students with strength calculation methods of basic elements of engineering constructions when the plastic deformation is present. Some chapters in this course are: Experimental data about plastic deformation of materials; Axial loading of the bar, which induce plasticity; Shaft torsion; Bending in plastic zone caused by forces; Analysis of boundary condition of continuous straight trusses and frames; Analysis of triaxial strain and deformation; Invariants of strain and deformation tensor. Yielding surface of isotropic materials; Constitutive equations of linear elastic and ideal plastic materials; Isotropic hardening of material; Deformational theory of plasticity; Theorems of boundary analysis; Elastic-plastic deformation of thick-walled pipes.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Practices are held auditory, students solve the tasks under the supervision of assistants. Some tasks are set for the seminar. Assessment seminar provides a written assessment of the this subject.

Mandatory literature for study and for exam:

1. Alfirević, I.: Uvod u tenzore i mehaniku loma (dio: 8 - Mehanika elastplastičnih tijela), Golden marketing, Zagreb, 2003.
2. Alfirević, I.; Pustaić, D.: Teorija plastičnosti, Inženjerski priručnik, IP1 Temelji inženjerskih znanja, Školska knjiga, Zagreb 1996.

Additional list of recommended literature:

1. Alfirević, I.: Mehanika kontinuuma, Tehnička enciklopedija 8, Leksikografski zavod "Miroslav Krleža", Zagreb, Zagreb 1984.
2. Malinin, N. N.: Prikladnaja teorija plastičnosti i polzučesti, Mašinostroenie, Moskva 1975.

Exam's type:

Exam (written and oral). Assessment seminar provides a written assessment of the this subject.

D 908 Vibration-Acoustic Analyses

Brief contents:

Introduce students to basic theories and applications of vibration-acoustics in diagnostics of machines and mechanisms. Enable students to recognize abnormal machine operation. Some of the topics included are: Periodic motion; Machine as a diagnostics object; Types of vibration-acoustic signals; Characteristics of vibration-acoustic process; State recognition and forming diagnostics symptoms; Characteristics of diagnostics mechanisms during manufacturing and service; Means of vibration-acoustic diagnostics; Vibration-acoustic diagnostics of gears, bearings, reducers, engine pistons, and electrical machinery; Measuring equipment for continuous or periodic monitoring.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Working in laboratory, solving general problems from practice.

Mandatory literature for study and for exam:

1. De Silva, W. C.: Vibration: Fundamentals and Practice, CRC Press, London, 2000.
2. Rao, S.S.: Mechanical Vibrations, 4/E, ISBN 0-13-048987-5, Prentice Hall, 2004

Additional list of recommended literature:

1. Chu, E.: Inside the FFT – Black Box, CRC Press, London, 2000.
2. Genkin, M.D.; Sokolova, G.A.: Vibroakustičnaja diagnostika mašini i mehanizmov, Mašinostrojenje, Moskva, 1987.
3. Thomson, W.T.; Dahleh, M.D.: Theory of Vibrations with Applications, 5/E, ISBN 0-13-651068-X, Prentice Hall, 1998.
4. Inman, D.J.: Engineering Vibrations, 2/E, ISBN 0-13-726142-X, Prentice Hall, 2001

Exam's type:

Continuous assessment (projects, theoretical questions, preliminary exams).

D 909 Computational Fluid Mechanics

Brief contents:

Historical development of fluid mechanics. Fluid mechanics today. Fluid mechanics as theoretical and experimental science. Computational fluid mechanics – CFD. Physical modeling of fluid flow. Mathematical modeling of fluid flow. Continuum as mathematical model of substance. Mathematical bases: index notation and tensors. Mathematical description of fluid flow by differential and integral forms of fundamental physical lows: conservation of mass, momentum, moment of momentum, energy and the second low of thermodynamics. System of Navier-Stokes partial differential equations for tree-dimensional, viscous, unsteady, compressible flow. Constitutive relations: Newton low of viscosity, Fourier's low of heat conduction and equation of state of an ideal gas. Modelling of turbulence. Types and levels of approximation of mathematical model for fluid flow: DNS, LES, RANS, TSL, PNS, BL, DLM, EM, SIRF, PM. Mathematical nature of partial differential equations. Analytical and numerical solution of system of partial differential equations. Numerical methods for solving a system of partial differential equations. Finite volume method. Space discretization by finite volumes. Grid generation. Discretization of partial differential equations by finite volume method. Numerical methods for solving the system of discretized partial differential equation i.e. system of linear algebraic equations. Time discretization. Modern CFD software.

Application of acquired knowledge in a numerical CFD simulation of fluid flow by using a commercial grid generator Gambit and commercial RANS CFD software (solver) Fluent, and post processing and analysis of obtained results in the numerical simulation.

Teaching methods and the ways of knowledge assessment:

Lectures. Auditory and computational exercises and pedagogical workshops.

Mandatory literature for study and for exam:

1. Zdravko Virag: Računalna dinamika fluida, Sveučilište u Zagrebu, FSB Zagreb, 2009/2010.
2. Zdravko Virag: Predavanja iz kolegija Mehanika fluida II, Sveučilište u Zagrebu, FSB Zagreb, on line materijali http://www.fsb.hr/hydro/web_sites/Biblioteka.htm.
3. Zdravko Virag: Vježbe iz kolegija Mehanika fluida II, Sveučilište u Zagrebu, FSB Zagreb, on line materijali http://www.fsb.hr/hydro/web_sites/Biblioteka.htm.

Additional list of recommended literature:

1. Petar Kesić: Osnove aerodinamike, Sveučilište u Zagrebu, FSB Zagreb, 2003.
2. John D. Anderson, Jr.: Fundamentals of Aerodynamics, Mc Graw Hill, New York, 1995.
3. John D. Anderson, Jr.: Computational Fluid Dynamics (The Basics with Applications), Mc Graw Hill, New York, 1995.

Exam's type:

Written and oral exam.

D 910 Optimization of Structures

Brief contents:

Introduction to basic terms and general principles of optimizing structural characteristics in engineering structures. Analytical, numerical, and experimental methods for structure optimization. Calculus of variations and engineering problem analysis. Evaluation of structural characteristics in order to achieve required goals. Using the inverse function for increased accuracy in achieving result variables. Optimization based on dimensions and format of structural elements; stress concentration analysis; distribution of individual elements in the structure; individual component material, structure stability; optimization of mechanical structure mechanisms; mass reduction and lowering manufacturing costs. Risk analysis with respect to people, property, and environment. Introduction to one of the current CAD software packages, which includes a module for numerical analysis (for example: I-deas, SolidWorks, Algor, and others), and the capability of integration with software for function optimization (MatLab, Mathematica, SAS, and others). By gaining necessary knowledge and experience through examples done in class and during discussions, and while working on the assigned research project, students should develop abilities needed for solving given problems. By working on a research project, students should gain knowledge and develop the ability to use an analytical approach needed for optimizing structural characteristics when solving structural problems. Students should also be able to use scientific literature and information technology to gather information about the course and to analyze problems in the course.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Analysis of complex structural problems through defining structural characteristics, modelling, formatting, and optimizing by using examples of clamped connections, joint connections, elements for power and motion transfer, pressure vessels, etc. By analyzing and optimizing structural characteristics, during the material selection process, dimensioning, and stress analysis, students will apply knowledge gained in this and other courses to solve the assigned research project. Students will be divided into smaller groups and will be assigned a research project. This is intended to develop teamwork skills and analytical thinking while solving the problem. The goal of the research project is to implement gained knowledge from previous courses through analysis and while solving the assigned problem. During discussions, there are two preliminary exams, and also constant monitoring of the research project progress under faculty guidance. At the end of the semester, each group gives a public oral presentation of their research project, with the goal of developing the ability to work in a team and to present results. It also builds confidence in analyzing and optimizing structural problems of different complexity by using the knowledge gained during the course.

Mandatory literature for study and for exam:

1. Young W. Kwon; Hyochoong Bang: The Finite Element Method Using MATLAB, Second Edition, CRC Press, 2000, ISBN: 0849300967
2. Polak, E.: Computational Methods in Optimization, Academic Press, New York 1971.
3. Ramamurti, V.: Computer-Aided Mechanical Design and Analysis, Mc Graw Hill, 1998, ASIN: 0070600368
4. Tsai, L.W.: Mechanism Design - Enumeration of Kinematic Structures According to Function, CRC Press London 2001.

Additional list of recommended literature:

1. Haward, B.W.; Turcotte, L.H.; Halpern, D.: Advanced Mathematics And Mechanics Applications Using MATLAB, CRC Press, 2003.
2. Matek, W.; Muhs, D.; Wittel, H.: Maschinenelemente Aufgabensammlung. Aufgaben, Lösungshinweise, Ergebnisse, Vieweg Verlag, 2000.
3. http://www.maedler.de/katalog_de/index_d.html
4. http://www.ndim.edrc.cmu.edu/
5. http://cadlab.mit.edu/about/
6. http://www.wildefea.co.uk/consulting/casestudies/

Exam's type:

Two preliminary exams will be given in place of the written part of the final exam. Students will be divided into groups and assigned a research project. At the end of the semester, if the research project is presented successfully it will replace the oral part of the exam.

D 921 Materials Management

Brief contents:

A high level of materials costs in total production costs emphasizes importance of materials management discipline. Therefore, the main objective of this course is to focus on materials preparation and management activities emphasizing on the information and documentation flow about material. Following themes will be discussed: planning of required material quantity for particular products and services; ordering of required material quantity and selecting the most appropriate supplier; inventory control and classification; materials documentation. Possibilities of optimization and rationalization as well as computer support to materials management also have been covered in the course. Therefore, the course also includes: the selection of optimum variant of raw material and manufacturing process by the application of quantitative methods with the main aim of cost decreasing and materials utilization increasing; computer supported materials management (databases, appropriate modules of informational systems).

Teaching methods and the ways of knowledge assessment:

Lectures (theoretical basis illustrated by examples).
Exercises: auditory exercises – the selection of optimum variant of raw material and manufacturing process calculation, solving problems of inventory control and classification, materials documentation examples; laboratory exercises – using of materials management modules of informational system to create and/or generate materials documentation and reports.

Mandatory literature for study and for exam:

1. Majdandžić, Niko; Lujić, Roberto; Matičević, Gordana; Šimunović, Goran; Majdandžić, Igor: Upravljanje proizvodnjom. Slavonski Brod; Sveučilište u Osijeku, Strojarski fakultet u Slavonskom Brodu, 2001.
2. Filetin, Tomislav: Izbor materijala pri razvoju proizvoda. Zagreb; Fakultet strojarstva i brodogradnje, 2006.

Additional list of recommended literature:

1. Arnold, J.R. T.; Chapman, N.S.: Introduction to Materials Management. Prentice Hall (5th edition), 2003.
2. Farag, M.M.: Selection of Materials and Manufacturing for Engineering Design. Prentice Hall, London, 1989.
3. Ashby, M.F.: Materials Selection and Mechanical Design. 3rd edition, Butterworth Heinemann, Oxford, 2001.
4. Ferišak, Vilim.: Elementi managementa nabave, Vlastito izdanje, Zagreb, 1999.

Exam's type:

Written and oral.

D 922 Project Management

Brief contents:

The significance and complexity of project management in modern organisation. Basic terms. Definition and scope of project and project management. State of art and trends in project management. Project management steps. Project life cycle. Managing process of project. Project integration management: project plan, monitor and control of project, project execution and close project. Computer based programs for project management. Project risk management. Project cost management.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: Laboratory work on computer based programs for project management.

Mandatory literature for study and for exam:

1. Majdandžić, N.; Lujić, R.; Matičević, G.; Šimunović, G.; Majdandžić, I.: Upravljanje proizvodnjom, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 2001.

Additional list of recommended literature:

1. Milton D. Rosenau; Gregory D. Githens: SUCCESSFUL PROJECT MANAGEMENT: A Step-by-Step Approach with Practical Examples, 4th Edition, 2005.
2. Kerzner H. Project management: A systems approach to planning, scheduling and controlling, 8th Edition, John Wiley & Sons, 2003.
3. Meredith J.R; Mantel S.J. Project management: a managerial approach, Wiley Text Books; 5th edition, 2002.
4. Mc Mahon P. E.: "Virtual Project Management: Software Solutions for Today and the Future". CRC Press LLC, Boca Raton, 2001.
5. Goodman, F. Alan: "Process-Based Software Project Management". Taylor & Francis Group, Boca Raton, 2006.
6. Jonathan F. Hutchings: "Project Scheduling Handbook". Marcel Dekker, Inc. Basel, 2004.
7. Benator, B., Thumann, A.: "Project Management and Leadership Skills for Engineering & Construction Projects". Marcel Dekker Inc. Basel, 2003.
8. Humphhreys, K. K.: "Project and Cost Engineers' Handbook". Marcel Dekker Inc. Basel, 2005.
9. Burke R. Project management: planning and control techniques, third edition, John Wiley & Sons, 1999.
10. Lockyer K;Gordon J. Project management and project network techniques, sixth edition, Financial Times Pitman Publishing, 1996.
11. Project Management Institute (PMI), http://www.pmi.org.

Exam's type:

Continuous monitoring, evaluation of project tasks and seminars, written and oral exam (if is necessary).

D 923 Design and Analysis of Experiments

Brief contents:

Performing of experiments plays an important role in new process or product design and development as well as in improving and optimizing of existing products and processes. The students are introduced to the main activities for designing experiments: definition of the problem, selection of the design factors and responsible variable, selection of experimental design, performing of experiment, statistical analysis of the data from the experiment as well as inferences and practical suggestions. The basic statistical terms and methods, unbiased estimations and confidence intervals as well as hypothesis testing have been covered in the course. There is more emphasis on the analysis of variance for one and more design factors. The course also deals with factorial designs (full and fractional) as well as regression models useful for prediction and optimization.

Teaching methods and the ways of knowledge assessment:

Lectures (theoretical basis illustrated by examples).
Exercises: laboratory exercises – computer support to: graphical presentation of data from the experiment; statistical analysis of designed experiments and fitting linear regression models.

Mandatory literature for study and for exam:

1. Bahovec, Vlasta; Šakić, Nikola: Vjerojatnost i statistika. Inženjerski priručnik 1. Zagreb; Školska knjiga, 1996, str. 112-135.
2. Montgomery, C. Douglas: Design and Analysis of Experiments. John Wiley & Sons, 2008, 680 str.

Additional list of recommended literature:

1. Ban, Željko; Matuško, Jadranko; Petrović, Ivan: Primjena programskog sustava MATLAB za rješavanje tehničkih problema. Zagreb; Graphis, 2010.

Exam's type:

Colloquy.

D 925 Flexible Manufacturing Systems

Brief contents:

Introduction of students in basics of flexible production. Technological capabilities of flexible machining structures (Flexible cell/FC, Flexible machining systems/FMS and Flexible transfer lines) and modular erection.
Planning, projecting and introduction of FMS. Handling with material and transportation into the flexible system. Modelling and simulation of flexible system when is running. CIM concept, integrated management of production. Economical indicators and adequacy of project realisation (investment).

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises (auditory exercises, laboratory excercises), Introduction with machine tools and devices in machinery and demonstration of application of machining procedures in Laboratory (workshop) During the teaching session tests are provided to assess the theory and numerical examples.

Mandatory literature for study and for exam:

1. R. Cebalo, D. Ciglar, A. Stoić: Obradni sustavi fleksibilni obradni sustavi (drugo izmijenjeno izdanje), Vedograf, ISBN 953-96501-6-X, Zagreb 2005.
2. Majdandžić, N.: Računalom integrirana proizvodnja, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1997.
3. N. Majdandžić, R. Lujić, G. Matičević, G. Šimunović, I. Majdandžić: Upravljanje proizvodnjom 2001., 357 str., ISBN: 953-6048-20-5

Additional list of recommended literature:

1. Majdandžić, N.; Čuljak, S.: Priprema proizvodnje I, II, III, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1991.
2. R. Cebalo: Obradni sustavi, Vedograf, Zagreb 2000.
3. H.B. Kief : FFS- Handbuch '92/93 – Einführung in Flexible Fertigungssysteme, Carl Hanser Verlag München Wien, 1992, ISBN 3-446-16326-3

Exam's type:

Seminar paper, colloquy.

D 926 Quality Management

Brief contents:

Introduction of students to terms and modern techniques of Quality Management that are now beginning to be used at industry. Unification of requirements of norms ISO 9000, ISO 14000 and OHSAS 18000 to one integrated system is emphasized. Benchmark techniques and practical example on actual organisation are described. Methods to be explained are data analysis, process capability analysis, process stability analysis. Direct and indirect methods for measurement of customer satisfaction will be explained. Basic terms and methods to perform Six-sigma and Lean six sigma method will be explained.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises. Auditory and laboratory exercises. During the teaching session tests are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Kondić, Ž. Kvaliteta i ISO 9000, 2002
2. Kondić, Ž. Kvaliteta i metode poboljšanja, 2004

Additional list of recommended literature:

1. Dusman, F. Odabrana poglavlja iz kontrole kvalitete, FSB Zagreb, 1990

Exam's type:

Written and oral.

D 928 Renewable Energy Sources

Brief contents:

Introduction to the basic characteristics of renewable energy sources, technologies and trends of development of renewable energy sources, renewable system designing. Analysis and calculation of the energy potential for application of solar energy, wind, biomass, biogas, biodiesel, geothermal and hydropower energy. Distributed power generation and the basics of legal regulations related to renewable energy. Benefits of renewables on ecology.

Teaching methods and the ways of knowledge assessment:

Lectures.
Auditory exercises: Calculation examples with numerical data from all teaching units according to the lectures. The student has to complete one seminar paper.

Mandatory literature for study and for exam:

1. Knap V.; Kulišić, P.: Novi izvori energije, Školska knjiga, Zagreb, 1985.
2. Požar, H.: Osnove energetike1, Školska knjiga, Zagreb, 1992;

Additional list of recommended literature:

1. Udovičić, B.: Energetika, Školska knjiga Zagreb, 1993.
2. Šljivac, D., Šimić, Z.: Obnovljivi izvori energije s osvrtom na gospodarenje, ETF HKAIG, 2008.

Exam's type:

Seminar paper and oral exam.

D 932 Microstructure and Properties of Materials

Brief contents:

Changes in microstructures of iron-alloys by quenching of austenite. Types of microstructures in steels. The appearances during quenching alloys without phase transformation. Ageing of alloys. Metallographic testing of steel, casts and non-ferrous metals. Measuring of ferrite and primary austenite grain size. Nonmetallic inclusions in steel. Mechanism of plastic deformation and fracture of materials. The real stress – strain diagram. Crystallographic defects: point, line, planar and bulk. Interaction of dislocations. The mechanism of hardening metals by: alloying, martensitic transformation, plastic deformation and precipitation. Micro-alloyed steels, mechanism of hardening and thermo-mechanical treatment. Structure of polymers, dependence of mechanical properties on the microstructures. Ceramics and composites, microstructures and properties.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises. Auditory exercises and laboratory classes.
During the teaching session, semester projects are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Novosel, M.; Krumes, D.: Posebni čelici, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1998.
2. Vitez, I.. Ispitivanje mehaničkih svojstava metalnih materijala, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 2006.

Additional list of recommended literature:

1. Novosel, M.; Krumes, D.: Željezni materijali, Strojarski fakultet, Sveučilište u Osijeku, Slavonski Brod, 1997.
2. Novosel, M.; Krumes, D.: Željezni materijali II dio Konstrukcijski čelici, Strojarski fakultet, Sveučilište u Osijeku, Slavonski Brod, 1995.

Exam's type:

Written and oral (semester project development and presentation).

D 941 Technological Process Parameters Optimisation

Brief contents:

Goal of this subject is to introduce students to technological parameters optimization, a and help them to get knowledge to perform this in praxis. Introduction include systematization of technological processes, tasks and methods of optimization, and computer support. Emphasize is on a) increase of speed or b) increase of quality or c) cost reduction. First part is about systematic analysis of technological procedures in production engineering, using of block scheme and mass and energy consumption. Process analysis and models and parameters of technological processes are defined. Second part is about issues related to mathematic logic, group theory, probability and statistics. Simple problems of technological processes solved by computer software are presented. Third part is about preparation and performing of experiments at laboratory and in production, and processing of experimental results. Production processes of chip removal, heat treatment, welding, bonding and corrosion protection are analysed. Fourth part is analyse of application of different methods for optimization of technological processes. Heuristic optimization is discussed, too.

Teaching methods and the ways of knowledge assessment:

Lectures. Auditorium, and laboratory exercises. During the teaching session tests are provided to assess the knowledge. Students perform two seminars related to experiments performed at excersises.

Mandatory literature for study and for exam:

1. Pavlić,I. Statistička teorija i primjena. Tehnička knjiga Zagreb, 1987.
2. Šakić;N. Planiranje pokusa i optimiranje parametara zavarivanja. HDTZ Zagreb, 1985, podloge za seminar.
3. Kolumbić Z., Samardžić I.: Optimiranje parametara tehnoloških procesa, u fazi izrade: http://www.sfsb.hr/~zkolum/OptimiranjeParametaraTehnoloskihProcesa/

Additional list of recommended literature:

1. Šakić,N.,Benić,D. Statistika u kontroli. Podloge za seminar iz statističke kontrole kvalitete. 1997.
2. Šakić,N. Matematičko modeliranje i optimiranje procesa zavarivanja uz primjenu računala. Časopis Zavarivanje br. 4-5, 1990.
3. Šakić,N. Optimiranje parametara zavarivačkih procesa. Časopis Zavarivanje br. 2, 1984.
4. Šakić,N. Neki aspekti planiranja jednostavnih pokusa za usporedbu uzoraka. Časopis Zavarivanje br. 3, 1982.
5. Šošić I.; Primijenjena statistika, Školska knjiga 2004.
6. Montgomery D.C., Runger G.C.; Applied Statistics and Probability for Engineers, Third Edition; 706 p; John Wiley and Sons 2002
7. Montgomery D.C. Design and Analysis of Experiments, Fifth Edition 2-Volume Set, Wiley 2000.
8. Ranjit R.K. Design of Experiments Using The Taguchi Approach – 16 Steps to Product and Process Improvement, John Wiley and Sons, 2001.
9. Hicks, C.R. Fundamental concept of the design of experiment. Holt, Rhinehart and Winston, N.Y. 1974.
10. Davies,O. Design and Analysis of Industrilal Experiment. Oliver and Boyd, Edinburg, 1971.
11. StatSoft; STATISTICA – data analysis software system, www.statsoft.com.

Exam's type:

In writing and oral or seminar project development and presentation.

D 942 Technology Manufacture of the Products

Brief contents:

Introducing students into technological forming, polymers, casting, welding and surface treatment. Examples of various mechanical constructions and products (vessels, compensators, bearing steel constructions, castings, polymer products, machined products etc.) are given with technological analyses in all phases of product lifetime, starting with designing, through production and to exploitation and storage products. By method approach of technological analyses with appliances various mechanical technologies, there is explanation of own computer programs. This programme are convenient for analyses various variants of technological solutions, for faster obtaining of optimum solutions.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: Programme drawing and auditory exercises.

Mandatory literature for study and for exam:

1. Grizelj, B.: "Alati i naprave", Strojarski fakultet Slavonski Brod 2004.
2. Grizelj, B.: "Oblikovanje metala deformiranjem", Strojarski fakultet Slavonski Brod 2002.
3. Grizelj, Branko; Seuček, Ivan, "Rezni alati : noževi, glodala". Slavonski Brod : Strojarski fakultet u Slavonskom Brodu(sveucilisni udzbenik), 2007.
4. Grizelj, Branko, "Strojevi za oblikovanje metala deformiranjem". Slavonski Brod : Strojarski fakultet u Slavonskom Brodu(sveucilisni udzbenik), 2007.
5. Grizelj, Branko, "Oblikovanje lima deformiranjem", Slavonski Brod : Strojarski fakultet u Slavonskom Brodu, 2009 (knjiga).
6. Zbornik radova 1. međunarodnog znanstveno-stručnog savjetovanja «Ekonomski i kvalitativni aspekti visokoučinskih postupaka zavarivanja», izdavač Đuro Đaković, Slavonski Brod, 2001.
7. Lukačević, Z. Zavarivanje, Strojarski fakultet u Slavonskom Brodu, 1998.
8. Samardžić, I. i dr. Analiza tehnologičnosti zvarenih konstrukcija, digitalni udžbenik, http://www.sfsb.hr/kth/zavar/index.html.
9. Raos, P., Čatić, I.: Razvoj injekcijski prešanih polimernih tvorevina, Društvo plastičara i gumaraca, Zagreb, 1993. (ISBN 86-7483-010-9)
10. Bonačić Mandinić, Z.; Budić, I.: Osnove tehnologije kalupljenja, Jednokratni kalupi - I dio, 253 str., Strojarski fakultet u Slavonskom Brodu, 2001, odobreno kao udžbenik od senata Sveučilišta J. J. Strossmayera u Osijeku.

Additional list of recommended literature:

1. Povrzanović, A.: "Obrada metala deformiranjem", Fakultet strojarstva i brodogradnje Zagreb, 1996.
2. Hribar, J: "Plastična obrada metala", Fakultet strojarstva i brodogradnje Zagreb, 1975
3. Musafija, B.: "Obrada metala plastičnom deformacijom", Svjetlost Sarajevo, 1988.
4. Lange, K.: "Umformtechnik" Band I-IV, Spring Verlag, 1989-1993.
5. Fritz, H.; Schulze, G.: "Gertigungstechnik", VDI VERLAG, 1995.
6. Math, M.: "Uvod u tehnologiju oblikovanja deformiranjem", Fakultet strojarstva i brodogradnje, Zagreb, 1999.
7. Bonten, Ch.: Produktentwicklung – Technologie-Management für Kunststoffprodukte, Hanser Verlag, München, 2002.

8. Patrick D. T. OConnor. A Concise Guide to Cost-effective Design, Development and Manufacture.
   2001. ISBN: 0471498823. Edition: Hardcower. (www.amazon.com)
9. Katavić, I.: Ljevarstvo, Tehnički fakultet Sveučilišta, Rijeka, 2001.,
10. ASM Metal Handbook, Melting and Casting, vol. 5 B, ASM, Metals Park, Ohio, 1972

Exam's type:

Written and oral.

D 951 Tools and Devices II

Brief contents:

Continuation of introducing the students into tools and devices.
Classification of tools and devices.
Bending tools. Calculation and construction.
Deep drawing tools. Calculation and construction.
Cutting tools.
Calculation and construction of reaming tool.
Calculation and construction of broaching needle.
Calculation and construction of grinding tool.
Automation of devices.

Teaching methods and the ways of knowledge assessment:

Programme drawing.

Mandatory literature for study and for exam:

1. Grizelj, B.: "Alati i naprave", Strojarski fakultet Slavonski Brod 2004.
2. Grizelj, B.: "Oblikovanje metala deformiranjem", Strojarski fakultet Slavonski Brod 2002.
3. Grizelj, Branko; Seuček, Ivan, "Rezni alati : noževi, glodala". Slavonski Brod : Strojarski fakultet u Slavonskom Brodu(sveucilisni udzbenik), 2007.
4. Grizelj, Branko, "Strojevi za oblikovanje metala deformiranjem". Slavonski Brod : Strojarski fakultet u Slavonskom Brodu(sveucilisni udzbenik), 2007.
5. Grizelj, Branko, "Oblikovanje lima deformiranjem", Slavonski Brod : Strojarski fakultet u Slavonskom Brodu, 2009 (knjiga).

Additional list of recommended literature:

1. Rebec, B.; Margić, S.: "Štance I dio", Fakultet strojarstva i brodogradnje Zagreb, 1990.
2. Rebec, B.; Margić, S.: "Štance II dio", Fakultet strojarstva i brodogradnje Zagreb, 1990.
3. Rebec, B.: "Naprave", Fakultet strojarstva i brodogradnje Zagreb, 1990.
4. Rebec, B.: "Rezni alati" Fakultet strojarstva i brodogradnje Zagreb, 1990.
5. Musafija, B.: "Obrada metala plastičnom deformacijom", Svjetlost, Sarajevo 1988.
6. Popović, B.: "Proizvodne tehnologije", Beograd 1990.

Exam's type:

Program development and presentation.

D 952 Technolologies of Surface Protection

Brief contents:

Expansion of knowledge about technologies that are at disposal of engineers for the purpose of corrosion protection and of decrease of corrosion damages. Selection of technology in the phase of designing surface protection that in the most important technical-economical part making possible high quality and competitive production. Analyses of technology, equipment selection and flexibility in the production (in workshop and on building site) are necessary for understanding and selection of available solutions for surface protection.

Teaching methods and the ways of knowledge assessment:

Lectures. Laboratory exercises.

Mandatary literature for study and for exam:

1. I. Esih, Z.Dugi: Tehnologija zaštite od korozije I i II. Zagreb, 1990.
2. I. Esih, Osnove površinske zaštite, Zagreb, 2003.

Additional list of recommended literature:

1. P. R. Roberge: Handbook of corrosion engineering, McGrow Hill, New York, 1999.
2. D.A. jones: Principles and prevention of corrosion, Prentice hall, New York, 1996.

Exam's type:

Written and oral. Preparing and presentation of semestral work.

D 1001 Rapid Prototyping

Brief contents:

The students are introduced to fundamentals of modern rapid prototyping process. Since prototype production is the most important part of the product design process (concept, project, design, dimension), the course Rapid Prototyping (RP) will introduce students to current procedures that are used for rapid development of prototypes or products. Students will acquire theoretical and practical basic knowledge (through discussions) for its efficient application in industry.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Solving practical problems in the Laboratory for intelligent production systems (LIPS) using the machine for rapid prototyping called ZPrint 310.

Mandatory literature for study and for exam:

1. Pham, D.T.; Dimov, S.S.: Rapid Manufacturing, Springer, London, 2001.

Additional list of recommended literature:

1. Wood, L.: Rapid Automated Prototyping: An Introduction, Industrial Press, 1993, ISBN 0-8311-3047-4.
2. Jacobs, P.F.: Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography, Society of Manufacturing Engineers, 1992.
3. Binstock, L.: Rapid Prototyping Systems: Fast Track to Product Realization, Society of Manufacturing Engineers, 1994, ISBN 0-87263-454-X.
4. Kochan, D.: Solid Freeform Manufacturing, Elsevier Science Publisher B.V, 1993, ISBN 0-444-89652-X.
5. Jacobs, P.F.: Stereolithography and Other RP&M Technologies: From Rapid Prototyping to Rapid Tooling, Society of Manufacturing Engineers, 1995, ISBN 0-87263-467-1.
6. Chua Chee Kai and Leong Kah Fai: Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, Inc., 1998, ISBN 0-471-19004-7.

Exam's type:

Continuous assessment, preparation of CAD data bases, prototyping based on prepared CAD data base, theoretical questions.

D 1002 Computer Integrated Manufacturing

Brief contents:

Definition and scope of Computer Integrated Manufacturing. Production systems and enterprise integration. State of art and trends. Computer Integrated Manufacturing concepts and components. Automatisation principles in the frame of Computer Integrated Manufacturing. Automatisation of preparation and production processes. Computer aided design. Computer aided engineering. Computer aided manufacturing, Program systems for managing of production and resources. Significance of human resources in Computer Integrated Manufacturing.

Teaching methods and the ways of knowledge assessment:

Lectures
Exercises: auditory and laboratory exercises, seminar papers.

Mandatory literature for study and for exam:

1. Majdandžić, N.: Računalom integrirana proizvodnja, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1997.
2. Nastavni materijali s predavanja.

Additional list of recommended literature:

1. Balič, J.; Majdandžić, N.: Digital Factory , DAAAM International, Vienna 2008.
2. Rehq J. A.; Kraebber H. W.: Computer Integrated Manufacturing, Prentice Hall, 2004.
3. Balič J.: Računalniško integrirana proizvodnja, Fakulteta za strojništvo, Maribor, 1998.

Exam's type:

Written and oral exam.

D 1004 Standardization and Technical Regulations

Brief contents:

Introduce mechanical engineering students to legal regulations and rules in design, construction, and operation of machines and structures, work protection and fire protection. For example, some of the topics included are: Introduction to construction laws in RH, Standardization laws, Workplace protection laws, Fire protection laws, Laws about binding relations, and other; Analyzing regulations with examples from practice; Workplace protection laws and existing regulations and rules for mechanical and civil engineering, etc.

Teaching methods and the ways of knowledge assessment:

Lectures without exercises.

Mandatory literature for study and for exam:

1. Zakoni, tehnički propisi i pravilnici, norme i propisi s primjenom na području Republike Hrvatske te EN i ISO norme.

Additional list of recommended literature:

1. Zakoni, tehnički propisi i pravilnici, norme i propisi s primjenom na području Republike Hrvatske te EN i ISO norme.

Exam's type:

Continuous assessment (preliminary exams and a final exam).

D 1006 Product Data Management

Brief contents:

Overview of product data management in computer systems. Vault and document management. Workflow management. Notification and communication. Data transfer. Review and comparison of available software for managing product information. Integration of available solutions with other engineering and economic systems.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Auditory and laboratory exercises on computers with the continuous monitoring and evaluation.

Mandatory literature for study and for exam:

1. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist. Implementing and Integrating Product Data Management and Software Configuration Management. Artech House Inc, Norwood, 2003.

Additional list of recommended literature:

1. Antti Sääksvuori, Anselmi Immonen. Product Lifecycle Management. Springer-Verlag, Berlin, 2008.
2. Rodger Burden. PDM: Product Data Management. Resource Publishing, 2003
3. Great Britain. Dept. of Trade and Industry, CIMdata. Product-data management: the executive guide.

Exam's type:

Pass the tests of knowledge (program, seminars, colloquia, test).

D 1007 Programming

Brief contents:

Understanding the basis of procedural programming, by the selected programming language: Basic data types, commands, expressions and operators, program structure, control flow, control input and output; functions. Object-oriented programming through the selected programming language: objects and classes; the basic elements of the class; encapsulation; inheritance; polymorphism. Guidelines development and implementation of own software solutions in the field of industrial engineering.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Auditory and laboratory exercises on computers with the continuous monitoring and evaluation.

Mandatory literature for study and for exam:

1. Julio Sanchez, Maria P. Canton. Java Programming for Engineers. CRC Pres LLC, Boca Raton, 2002.
2. Jakopec, Ratko. C++ programiranje za apsolutne početnike. PRO-MIL, Varaždin, 2006.
3. Eck, David J. Introduction to Programming Using Java. Department of Mathematics and Computer Science, Hobart and William Smith Colleges, 2009.

Additional list of recommended literature:

1. Hang Tong Lau. Numerical Library in Java for Scientists and Engineers. CRC Pres LLC, Boca Raton, 2004.
2. Yen-Ching Pao. Engineering Analysis: Interactive Methods and Programs with FORTRAN, QuickBASIC, MATLAB, and Mathematica. CRC Pres LLC, Boca Raton, 2000.
3. Partha Kuchana. Software Architecture Design Patterns in Java. CRC Pres LLC, Boca Raton, 2004.
4. Charles W. Kann. Creating Components: Object Oriented, Concurrent, and Distributed Computing in Java. CRC Pres LLC, Boca Raton, 2004.
5. Fionn Murtagh. Correspondence Analysis and Data Coding with Java and R. CRC Pres LLC, Boca Raton, 2005.
6. Michael Kupferschmid. Classical FORTRAN: Programming for Engineering and Scientific Applications. Marcel Dekker Inc, Basel, 2002.

Exam's type:

Pass the tests of knowledge (program, seminars, colloquia, test).

D 1009 Transport Systems and Lifts

Brief contents:

Introduction to design and analysis of transport systems and lifts. Combining knowledge acquired in various courses, motivation for independent work through analysis and design of complex mechanical systems for lifting and load transport. For example, some of the topics included are: Design of gantry crane mechanism; Dynamic stresses of driving mechanisms and structures; Guiding gantry crane on rails; Bearing structure of gantry crane; Means of continuous supply (conveyers), lifts, cable gantry crane, sloped lifts and cable cars.

Teaching methods and the ways of knowledge assessment:

Lectures without exercises.

Mandatory literature for study and for exam:

1. Ščap, D.: Prenosila i dizala, podloge za konstrukciju i proračun, Liber, Zagreb, 2004.

Additional list of recommended literature:

1. Ščap, D.: Prenosila i dizala, podloge za konstrukciju i proračun, Liber, Zagreb, 1990.

Exam's type:

Preliminary exams and research project.

D 1010 Recycling and Ecological Product Providing

Brief contents:

Introduction to the principles of design and material selection depending on product life cycle. Introduction to the organization, processes, and impact of materials recycling and products renewing. Introduction to the methods, plants, and equipment for recycling and ecological products providing at the end of their life cycle.

Teaching methods and the ways of knowledge assessment:

Lectures without exercises.

Mandatory literature for study and for exam:

1. Lund, H.F. (Ed.); Ruckelshaus, W.D.: Recycling Handbook, 2nd Edition, McGraww-Hill Professional, ISBN 0070391564, 2000.
2. Kljajin, Milan; Opalić, Milan; Pintarić Antun. Recikliranje električnih i elektroničkih proizvoda. Slavonski Brod : Strojarski fakultet u Slavonskom Brodu, 2006.

Additional list of recommended literature:

1. Hornbogen, E.; Bode, R.; Donner, P.: Recycling - Materialwissenschafftliche Aspekte, Springer Verlag, Berlin, 1993.
2. Šercer, M.; Opsenica, D.; Barić, G.: Oporaba plastike i gume, Mtg topgraf d.o.o., Zagreb, 2000.
3. Nickel, W.: Recycling Handbuch, VDI Verlag, Düsseldorf, 1996.
4. Bilitewski, B., Härdtle, G., Marek, K.: Abfall-Wirtschaft, Springer Verlag, Berlin, Heidelberg, 2000.

Exam's type:

Preliminary exams and research project.

D 1021 Maintenance Strategies

Brief contents:

The ideas, approaches and changes of new maintenance strategies and methods will be given. Implementation of different cost effective models will be given through examples. Teach students about basic characteristics of modern system and methods for condition monitoring of technical systems. Explanation of planning, evaluation and control of maintenance costs in equipment life cycle. Role of Maintenance Information System on maintenance management will be shown. Importance of long life learning of maintenance managers and skills that he must have.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises. Auditory and laboratory exercises in PC laboratory with available maintenance information systems and instruments for condition monitoring of technical systems.

Mandatory literature for study and for exam:

1. Majdandžić, N. Strategije održavanja i informacijski sustavi održavanja, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod, 1999.

Additional list of recommended literature:

1. Dhillon, B.S.: Engineering Maintenance – A Modern Approach, CRC Press, USA, 2002.
2. Levitt, J.: Managing Factory Maintenance, Industrial Press, Inc., USA, 1996.
3. Levitt, J.: Handbook of Maintenance Management, Industrial Press, Inc., USA, 1997.
4. Rao, B.K.N.: Handbook of Condition Monitoring, Elseviar Advanced Technology, Oxford, UK, 1996.
5. Adamović, Ž.: Tehnička dijagnostika u mašinstvu, Privredni pregled, Beograd 1986.

Exam's type:

Written and oral.

D 1022 Optimization of Tribomechanical Systems

Brief contents:

The main objective of this course is to study tribology and maintenance in an interactive way, the two areas being in fact closely connected. Knowledge on tribology can influence the increase of maintenance efficiency and vice versa. Wear processes and mechanisms play an important role and can result in many maintenance problems, so tribology, as a more recent scientific discipline, offers solution to these problems. The students are introduced to modern tribology and maintenance trends, calculation of costs due to tribological losses, wear monitoring methods and methods of wear process decreasing as well as effective measures and procedures to extend service life.
One of the objectives of this course is to show how to use knowledge on tribology to reduce maintenance costs due to energy and material losses caused by friction and wear.

Teaching methods and the ways of knowledge assessment:

Lectures (theoretical basis illustrated by examples).
Exercises: auditory, laboratory.

Mandatory literature for study and for exam:

1. Marušić, Vlatko: Tribologija u teoriji i praksi. Slavonski Brod; Strojarski fakultet u Slavonskom Brodu, 2008.
2. Majdandžić, Niko: Strategije održavanja i informacijski sustavi održavanja. Slavonski Brod; Strojarski fakultet, 1999.

Additional list of recommended literature:

1. Y. Kimura: Tribology as a maintenance tool: in I. M. Hutchings: New directions in tribology, Mechanical Engineering Publ. Ltd, London, 1997
2. K. Holmberg: Tribology in reliability design and operational control. In: Proceedings of 11th International Congress on Condition Monitoring and Diagnostic Engineering Management, Monash University, Clayton, 1998
3. K. Holmberg: Reliability aspects of tribology, Tribology International 34, 2001

Exam's type:

Written and oral.

D 1026 Materials Selection and Application

Brief contents:

One of the objectives of this course is to teach students about proper selection of optimal material, because it is very important part of product development. Materials selection is very complex problem that includes balancing many demands, properties and characteristics of materials. It is closely connected with design and manufacturing process selection. Usually, materials selection is implemented in design phase, and rarely in manufacturing process or purchase phase.
Some of the factors influencing materials selection are not quantitative. Usually, materials selection is conducted by the required product and material service properties. Materials and production costs are very important factors influencing optimal material selection.
Characteristics of materials selection steps. Algorithm procedure of product development and materials selection. Design and materials selection. Materials selection methodology and algorithm of selection. Seven groups criteria for materials selection. Materials properties influencing decision of adequate selection of optimal material. Procedures and assistant tools for materials selection and application.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises (auditory and laboratory: materials selection software).

Mandatory literature for study and for exam:

1. Filetin, T.: Izbor materijala pri razvoju proizvoda, Sveučilište u Zagrebu, Fakultet strojarstva i brodogradnje, Zagreb, 2000.
2. Filetin, T.; Kovačiček, F.; Indof, J.: Svojstva i primjena materijala, Sveučilište u Zagrebu, Fakultet strojarstva i brodogradnje, Zagreb, 2002.
3. Novosel, M.; Krumes, D.: Posebni čelici, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 1998.

Additional list of recommended literature:

1. Farag, M. M.: Selection of Materials and Manufacturing for Engineering Design, Prentice Hall, London, 1989.
2. Ashby, M. F.: Materials Selection and Mechanical Design, 3rd edition, Butterworth Heinemann, Oxford, 2001.

Exam's type:

Seminar paper, preliminary exam.

D 1031 Welding Metallurgy

Brief contents:

Students will be introduced to selected chapters in process and physical metallurgy which treats areas of material weldability. Welding temperature cycle analysis and its influence on metallurgical changes and properties of individual welding joint areas. Detail explanation of failure appearance mechanism in welded joints, determination of main influencing variables and mechanism for failure avoidance. Application of different experimental methods for materials weldability assessment. An overview of welding metallurgy for the most important structural materials.

Teaching methods and the ways of knowledge assessment:

Lectures. Auditorium, laboratory and industrial exercises. During the teaching session tests are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Hrivnak, I. Theory of weldability of metals and alloys.,,,, Elsevier Science Publishing Company, INC. New York (USA), ISBN 0-444-98707-X, 1992.
2. Lukačević, Z.: Zavarivanje, Strojarski fakultet, Slavonski Brod, 1998.
3. Kralj, S.; Andrić, Š.: Osnove zavarivačkih i srodnih postupaka, Sveučilište u Zagrebu, 1992., ISBN 86-7819-043-4.

Additional list of recommended literature:

1. Pavlović, P.: Materijal čelik, Savez kemičara i tehnologa Hrvatske, 1990., ISBN 86-80907-10-3
2. Seyffarth, P.; Meyer, B.; Schaff, A.: Grosser Atlas Schweiss – ZTV-Schauilder, Die Deutche Bibliothek – CIP Einheitsavfnahme, 1992., ISBN 3-87155-127-9
3. Gojić, M.: Tehnika spajanja i razdvajanja materijala, Sisak, Metalurški fakultet Sisak, 2003.
4. Baggerud, A.: Metalurgija zavarivanja, Dokument IIW 196-64, prijevod dokumenta tiskan u obliku brošure u Hrvatskom društvu za tehniku zavarivanja, Zagreb, 1987. (preveo prof.dr.sc. Zvonimir Lukačević).

Exam's type:

Seminar project development and presentation.

D 1033 Alloys of Non-ferrous Metals

Brief contents:

Introduce students into alloys of non-ferrous metals, which are very important in mechanical engineering for different parts and structures.
Non-ferrous metals and their alloys are usually more expensive than steels, but are unequalled for specific engineering solutions due to certain suitable properties. Designation of non-ferrous metals and their alloys. Aluminium and its alloys. Metallurgy of aluminium. The properties of pure aluminium, properties of aluminium alloys. Equilibrium diagrams of aluminium alloys.
Precipitation hardening aluminium alloys. Cast and squeezed aluminium alloys.
Copper and their alloys. Metallurgy of copper. The properties of pure copper. The properties of copper alloys with zinc (brasses). The properties of copper alloys without zinc (bronzes). Copper alloys with nickel. Nickel and its alloys.
Cobalt and its alloys. Titanium and its alloys. Magnesium and its alloys.
Zinc and its alloys. Lead and its alloys. Tin and its alloys. Alloys for soldering. Alloys for sliding bearings.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises. Auditory exercises and laboratory classes.
Preliminary exam I, II during the teaching session.

Mandatory literature for study and for exam:

1. Filetin, T.; Kovačiček, F.; Indof, J.: Svojstva i primjena materijala, Sveučilište u Zagrebu, FSB, Zagreb, 2002.

Additional list of recommended literature:

1. *** Grupa autora s FSB: Proizvodno strojarstvo, prvi svezak Materijali, Školska knjiga, Zagreb, 1998.

Exam's type:

Written and oral.

D 1042 Reliability of Systems

Brief contents:

Terms, definitions. Reliability. Unreliability (Risk). Failures. Dominant failure. Failure consequences. Human, economy and environment risk due to failure. Correlation and difference between quality and reliability.

Statistical distributions for reliability: Binominal, Poisson, Gauss, exponential, Weibull distribution. Calculation of reliability based on failure distribution. Calculation of MTBF. Adjust exponential data to theoretical distribution.

Reliability of elements and systems. Serial, parallel and combined relationships between elements of system. Mean value and confidence limits of reliability function. Allocation of reliability: system-subsystem-elements. Reliability presentation. Reliability index.
Reliability models:

- strength-stress model (deterministic, semi-probabilistic and probabilistic approach)
- failure intensity, (Mind Time To Failure, Mind Time Before Failure)
- Failure Tree
- Event Tree
- Failure Mode and Event Analyze
- Ishikawa analyysis (cause-consequence analysis)
- Other reliability models

Teaching methods and the ways of knowledge assessment:

Lectures. Auditorium type of exercises. During the teaching session tests are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Kondić, Ž. Kvaliteta i pouzdanost tehničkih sistema, Varaždin, 2001.

Additional list of recommended literature:

1. Zbornik radova 1. međunarodnog znanstveno-stručnog savjetovanja «Ekonomski i kvalitativni aspekti visokoučinskih postupaka zavarivanja», izdavač Đuro Đaković, Slavonski Brod, 2001.
2. Zbornik radova 2. međunarodnog znanstveno-stručnog savjetovanja «Specijalni postupci i proizvodi u tehnici zavarivanja», izdavač Strojarski fakultet u Slavonskom Brodu, 2003.
3. Kostić,C.M. Metodi statističke analize. Naučna knjiga, Beograd, 1998. ISBN 86-23-20017-
4. Ivanović, G. i dr. Pouzdanost tehničkih sistema.Mašinski fakultet, Beograd 1987. ISBN 86-7083-045-0.

Exam's type:

Seminar or exam.

D 1043 Metal Forming II

Brief contents:

Continuation of introducing students into metal forming.
Bending. Stress calculation. Force calculation. Bending methods.
Deep drawing. Stress calculation. Force calculation. Deep drawing methods.
Extrusion. Stress calculation. Force calculation. Extrusion methods.

Teaching methods and the ways of knowledge assessment:

Programme drawing.

Mandatory literature for study and for exam:

1. Grizelj, B.: "Alati i naprave", Strojarski fakultet Slavonski Brod 2004.
2. Grizelj, B.: "Oblikovanje metala deformiranjem", Strojarski fakultet Slavonski Brod 2002.
3. Grizelj, Branko; Seuček, Ivan, "Rezni alati : noževi, glodala". Slavonski Brod : Strojarski fakultet u Slavonskom Brodu(sveucilisni udzbenik), 2007.
4. Grizelj, Branko, "Strojevi za oblikovanje metala deformiranjem". Slavonski Brod : Strojarski fakultet u Slavonskom Brodu(sveucilisni udzbenik), 2007.
5. Grizelj, Branko, "Oblikovanje lima deformiranjem", Slavonski Brod : Strojarski fakultet u Slavonskom Brodu, 2009 (knjiga).

Additional list of recommended literature:

1. Povrzanović, A.: "Obrada metala deformiranjem", Fakultet strojarstva i brodogradnje Zagreb, 1996.
2. Hribar, J.: "Plastična obrada metala", Fakultet strojarstva i brodogradnje Zagreb, 1975
3. Musafija, B.: "Obrada metala plastičnom deformacijom", Svjetlost Sarajevo, 1988.
4. Lange, K.: "Umformtechnik" Band I-IV, Spring Verlag, 1989-1993.
5. Fritz, H.; Schulze, G.: "Gertigungstechnik", VDI VERLAG, 1995.
6. Math, M.: "Uvod u tehnologiju oblikovanja deformiranjem", Fakultet strojarstva i brodogradnje, Zagreb, 1999.

Exam's type:

Program development and presentation.

D 1044 Selected Chapters of Casting Engineering

Brief contents: for a technology of casting

Design and elaboration of the technological procedure for a technology of casting. Fundamentals of castings construction. Quality requirements, moulding requirements. Technological procedure of the fabrication of non-permanent moulds. Determination of casting position in the mould. Design of casting mould. Example of technological elaboration of casting drawing. Pattern devices. Criteria for materials selection for pattern devices. Fabrication of sand cores by various procedures. Regeneration of cores mixtures.

Teaching methods and the ways of knowledge assessment:

Lectures.
Exercises: computer, design.

Mandatory literature for study and for exam:

1. Ivan Budić: Osnove tehnologije kalupljenja, Jednokratni kalupi I dio, II izmijenjeno i dopunjeno izdanje, Strojarsku fakultet, Slavonski Brod, 2010.
2. Ivan Budić, Zoran Bonačić-Mandinić: Osnove tehnologije kalupljenja, Jednokratni kalupi II dio, Strojarsku fakultet, Slavonski Brod, 2004.
3. Ivan Budić: Posebni ljevački postupci, I dio, Strojarsku fakultet, Slavonski Brod, 2006.
4. Ivan Budić: Posebni ljevački postupci, II dio, Strojarsku fakultet, Slavonski Brod, 2009.

Additional list of recommended literature:

1. I. Katavić, Ljevarstvo, Tehnički fakultet Sveučilišta, Rijeka, 2001.,
2. Ljevački priručnik, Savez ljevača Hrvatske, Zagreb, 1985.
3. Tehnička enciklopedija, LZMH, Zagreb.
4. ASM Metal Handbook, Melting and Casting, vol. 5 B, ASM, Metals Park, Ohio, 1972.

Exam's type:

Preparation of a design with a colloquy.

D 1047 Mechanization, Automation and Robotization in Welding

Brief contents:

Assessment of current state and possible trends in development and application of mechanization, automation and robotization of welding. Students will be introduced to details of current state of mechanization, automation and robotization of welding. Basic technological and economical assumptions for productivity and quality of welded joints and products improvement are explained. Practical examples of welding mechanization and automation application, and application of CNC automats and robots for welding are analyzed. Main conditions for successful application of automats and robots for welding in production workshops are specified. Examples of flexible manufacturing systems for welded products (principles, items, purposes, application) are explained.

Teaching methods and the ways of knowledge assessment:

Lectures. Auditorium, laboratory and industrial type of exercises. During the teaching session tests are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Lukačević, Z. Zavarivanje, Strojarski fakultet u Slavonskom Brodu, 1998.
2. Ergić, T. Roboti za zavarivanje. Skripta. Strojarski fakultet, Sl. Brod, 1995.

Additional list of recommended literature:

1. Podloge za stručni seminar: Visokoučinski postupci zavarivanja, HDTZ, 2002. (Ivan Samardžić jedan je od autora navedene referencije).
2. Zbornik radova 1. međunarodnog znanstveno-stručnog savjetovanja «Ekonomski i kvalitativni aspekti visokoučinskih postupaka zavarivanja», izdavač Đuro Đaković, Slavonski Brod, 2001.
3. Zbornik radova 2. međunarodnog znanstveno-stručnog savjetovanja «Specijalni postupci i proizvodi u tehnici zavarivanja», izdavač Strojarski fakultet u Slavonskom Brodu, 2003.
4. Kordić, Z.: Elektrootporno zavarivanje, HDTZ Zagreb, 1987., YU-ISBN 86-80649-01-5
5. SUGITANI, Y. Automation Technology of Arc Welding, Japan Welding Society, 1996.

Exam's type:

Seminar project development and presentation or examination.

D 1052 Selected Chapters of Quality Control and Quality Assurance

Brief contents :

This course describes application of different methods of Quality Control which are used in mechanical engineering praxis. Beside explanation for specific Quality Control methods (scope of application, limitations, advantages and shortcomings related to comparative methods, precision and reliability of measurement …) practical examples and presentation of Quality Control methods at samples from production will be given. Most applied Statistical process control techniques are described. Performing of these methods is exercised on practical examples. Requests that are necessary for laboratory accreditation will be explained due to performing of calibration of measuring equipment. Organisation and performing of internal calibration will be explained in a detailed way.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises. Laboratory classes, practical classes. During the teaching session tests are provided to assess the knowledge.

Mandatory literature for study and for exam:

1. Kondić, Ž. Kvaliteta i metode poboljšanja, 2004

Additional list of recommended literature:

1. Pennella, Managing the Metrology system, ASQC, Quality press, 1992, USA
2. Dusman, F. Odabrana poglavlja iz kontrole kvalitete, FSB Zagreb, 1990

Exam's type:

Written exam.

D 761 Selected Chapters of Thermodynamics

Brief contents:

Gas mixtures. The composition of gas mixture: mass and mole fractions. Properties of gas mixtures. Ideal and real gases. Gas-vapor mixtures. Dry and atmospheric air. Relative humidity of air. Dew point. Some characteristic processes using moisture air: heating, cooling, dehumidification, humidification, adiabatic mixing of airstreams. Process of evaporation. Adiabatic boundary of cooling. The psyhrometric chart. Wet and dry bulb temperature.
Chemical reactions. Fuels and combustion. Theoretical and actual combustion process. Stehiometric equations of complete combustion. A necessary mass (amount) of atmospheric air and mass (amount) of products of combustion. Incomplete combustion. Mass balance of elements during incomplete combustion. High and low heatings value of fuel. Actual and theoretical (adiabatic) flame temperature assuming incomplete or complete combustion respectively. Heat losses during combustion processes. First law analysis of reacting systems. Second law analysis of reacting systems.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory, computational.

Mandatory literature for study and for exam:

1. Galović, A.: Termodinamika II, FSB, Zagreb, 2007.
2. Galović, A. Tadić, M, Halasz, B.: Nauka o toplini II, FSB, Zagreb, 2007.

Additional list of recommended literature:

1. Cengel, Y.A.; Boles, M: Thermodynamics: An Engineering Approach, McGraw Hill, 2003.

Exam type:

Written and oral exam. Seminar paper.

D 762 Pressure Vessels and Pipelines

Brief contents:

Overview of pressure vessels and standards (API 579, ASME Boiler & Pressure Vessel Code – Section VIII, BS 5500, AD Merkblätter, HRN EN 13445, etc.). Pressure vessel design philosophy. Structural design criteria. Linear theory of elasticity. Thick-walled vessels. Stresses in axisymmetric shells. Modes and theories of failure. Design for cyclic loading. Stress categories and stress limits. Primary, secondary and peak stress. Design of spherical and cylindrical shells. Design of heads and covers. Design of nozzles and openings. Design of vessel supports. Case studies. Use of technical literature in the field of pressure vessels. Pressure Equipment Directive (PED). Pressure equipment (widely used in energy production). Pipline transportation. Pipeline (isometric projection). Pipeline representation. Types of pipes and elements for joining – pipe threads, flanges, etc. Pipe fittings - types and characteristics. Flexible pipes, special fittings. Pipeline suspension; dilation. Thermal insulation of pipeline – technoeconomic criteria, materials, regulations. Bellows. Coupling elements. Profiling elements. Optimal pipe diameter. Importance of pipelines.

Teaching methods and the ways of knowledge assessment:

Lectures and auditory exercises. Students have to solve tasks under supervision of the assistant. Some tasks are part of homework which is graded.

Mandatory literature for study and for exam:

1. Alfirević, I.: Nauka o čvrstoći II., Golden marketing, Zagreb 1999.
2. Chattopadhyay, S.: Pressure vessels: Design and practice, CRC Press, 2005.

Additional list of recommended literature:

1. Alfirević, I.: Nauka o čvrstoći, str. 479-570, Inženjerski priručnik, IP1 TEMELJI INŽENJERSKIH ZNANJA, Školska knjiga, Zagreb 1996.
2. Alfirević, I.: Linearna analiza konstrukcija, FSB Zagreb, Zagreb 1999.
3. Šimić, V.: Otpornost materijala II, Školska knjiga, Zagreb 1995.
4. API Standard 579-1/ASME FFS-1, Fitness-For-Service, Second Edition
5. 2010 Boiler and Pressure Vessel Code, ASME
6. Antaki, A. G.: Piping and Pipeline Engineering 2003.
7. Grote, H. K., Antonnsson E. K.: Handbook of Mechanical Engineering, Springer, New York 2008
8. Koharić, V.: Uvod u projektiranje cjevovoda, Zagreb, 1994.
9. Neukirchner J. u.a.: Rohrleitungen und Rohrleitungsarmaturen, VEB Verlag, Leipzig 1972.
10. Wossog, G. u.a.: Handbuch für den Rohrleitungsbau, VEB Verlag Technik, Berlin, 1989.

Exam type:

Two short tests during the semester. Two seminars and public presentation.

D763 Power system control

Brief contents:

Public power system – interrelation between the power system requirements and the process control in individual power plant. Electricity production: prime mover – AC generator set, island operation, operation to the grid. Frequency control in island operation. Frequency control in a public grid. Primary, secondary and tertiary control. Operation of conventional thermal power plant with water-steam Rankine cycle: constant pressure and sliding pressure regimes. Typical modes of the block control ("turbine leads", "turbine follows", coordinated mode) and their influence to dynamic performance of the block. Combined heat and power plant operation in heat following regime. Control of hydro power plants. Requirements and technical limitations of various power sources in conditiosn imposed by increased penetration of renewable energy sources.

Teaching methods and the ways of knowledge assessment:

Lectures. Laboratory exercises through simulation demonstrations in Matlab/Simulink environment. Knowledge assessment is performed through colloquiums.

Mandatory literature for study and for exam:

Šerman, N.:The roles of frequency controller, web textbook, in Croatian
Šerman, N., Lončar D., Inflence of power plant components and operating strategies on dynamic perfromences of the thermal power plant, web textbook in Croatian

Additional list of recommended literature:

Welfonder, E., Dynamic interactions between power plants and power systems, Control Engineering Practice 7 (1999) 27-40

Lausterer, G. K., Improved maneuverability of power plants for better grid stability, Control Engineering Practice 6 (1998) 1549-1557

Proceedings of IFAC Symposium on Power Plants and Power Systems Control, 2006, Elsevier

Exam's type:

Written exam as substitute for 2 colloquiums
Oral exam

D764 Ecology in Energetics

Brief contents:

Introduction to the ecology in the energetics. The objective and scope of ecology in the energetics. Energy pyramid. Ecological efficiency of energy transfer. Energy strategy, calculations and the principle of distribution. The concept of energy. Ecological carrying capacity and limiting factors. Preventing industrial pollution. Environmental engineering and eco-technologies and their importance for human civilization. The development and evolution of ecosystems and the principles and concepts relating to the communities in the ecosystem. Energy flow and circulation of materials in ecosystems. Productivity in ecosystems. The classification of eco-technologies. Principles and components of the system and the possibility of modeling. Structural and functional interactions in natural systems. Human modification of the environment. Eco-indicator 99 method (methodology of environmental impact assessment). Adaptation of ecological engineering system to potential catastrophic events. Determination of sustainable ecosystem stress. Risk management in the energetics. Techno-economic analysis of environmental protection. Mathematical modeling in environmental protection. BAT (Best Available Techniques) principles, the implementation of sustainable and appropriate processes for the environment. Evaluation of environmental impact. Influence of industrial processes on the environment.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory, computational.

Mandatory literature for study and for exam:

1. Authorised lectures of head professor.

Additional list of recommended literature:

1. Mitsch, J. W.; Jorgensen, S. E. Ecological Engineering – An Introdution to Ecotechnology, John Wiley & Sons, New York, 1989.
2. White, I. D.; Mottershed, D. N.; Harrison, S. J. Environmental Systems – An Introductory text, Chapman, Hall, London, 1994.
3. Bishop, P. L. Pollution Prevention: Fundamentals and Practice, McGraw-Hill International, 2000.
4. http://en.wikibooks.org/wiki/Ecology/Energy_in_ecosystems (28.02.2011)
5. Martinez-Alier, J. Ecological Economics: Energy, Environment and Society. Oxford, England: Basil Blackwell, 1990.
6. Kiely, G.: Environmental Engineering, McGraw-Hill, 1998.
7. Liu, D.; Liptak, B.: Environmental Engineering's Handbook, Lewis Publishers, 1997.
8. Allen D.: Green Engineering Environmentally Conscious Design of Chemical Processes Prentice Hall, New York, 2001.

Exam type:

Seminar paper with public presentation.

D 766 Selected Chapters of Mechanics and Strength

Brief contents:

Basics of energy methods for calculating strength, dimensioning or determining load-carrying capacity of structures. Basics of thermoelasticity. Use of numerical fracture mechanics in analysis of fracture initiation and propagation in welded structures, pressure vessels, pipelines, etc. and for determining service life and design of structures. Basics of vibrations and self-induced vibrations.

Teaching methods and the ways of knowledge assessment:

Lectures and auditory exercises. Students have to solve tasks under supervision of the assistant. Some tasks are part of homework which is graded.

Mandatory literature for study and for exam:

1. Alfirević, I.: Nauka o čvrstoći II, Golden marketing, Zagreb 1999.

Additional list of recommended literature:

1. Alfirević, I.: Nauka o čvrstoći, str. 479-570, Inženjerski priručnik, IP1 TEMELJI INŽENJERSKIH ZNANJA, Školska knjiga, Zagreb 1996.
2. Alfirević, I.: Linearna analiza konstrukcija, FSB Zagreb, Zagreb 1999.
3. Šimić, V.: Otpornost materijala II, Školska knjiga, Zagreb 1995.
4. Grote, H. K., Antonsson E. K.: Handbook of Mechanical Engineering, Springer, New York 2008.

Exam type:

Two short tests during the semester. Two seminars and public presentation.

D 767 Heat Exchangers

Brief contents:

Classification of heat exchangers. The single – pass of recuperative heat exchangers. The relevant non-dimensional numbers of recuperators. Calculation of recuperators using ε, *NTU* – method. The calculation of recuperators using LMTD – method. The calculation of evaporators and condensers as a special case of recuperators. (The phase change of one or both streams!). The achieved minimal temperature differences of the streams. Comparison of the recuperators using effectiveness as a criterion. Some solutions of recuperators with multi-passes of the streams. Calculation of the pressure drops of the streams passing through recuperators. Analysis and discussion of the overall heat transfer coefficient value including fouling factor.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory, computational.

Mandatory literature for study and for exam:

1. Galović, A.: Termodinamika II, FSB, Zagreb, 2007.
2. Galović, A. Tadić, M, Halasz, B.: Nauka o toplini II, FSB, Zagreb, 2007.

Additional list of recommended literature:

1. Cengel, Y.A.: Heat and Mass Transfer: A Practical Approach, McGraw Hill, 2003.
2. Shah, R.; Sekulić, D: Fundamentals of heat exchanger design, John Wiley and Sons, 2003.
3. Kakac, S; Liu, H.: Heat exchangers, selection, rating and thermal design, CRC Press, 2002.

Exam type:

Written and oral exam. Seminar paper.

D 768 Liberalization of the Energy Market

Brief contents:

Liberalization process of energy market and its features. Basics of European energy policy. The definition of market power. Mathematical calculations of market concentration (Market share, Herfindahl-Hirschmann Index, Concentration Ratio, Rosenbluth-Hall-Tideman Index, Entropy Index, Comprehensive Concentration Index, Bain Index of Monopoly, Lerner Index of Monopoly Power and the Landes-Posner Index). Energy prices and tariff systems. Definition of energy-related activities. Regulation of Energy Activities (goals, historical determination, methods of regulation, Rate-of-return regulation, Price-cap regulation Revenue-cap regulation, hybrid forms of regulatory formula). Understanding the benefits and limitations of the power system: regulation of active and reactive power, voltage and frequency. Power system's management in terms of regulation and costs. Power and energy, fixed and variable costs. Basic concepts related to the electricity market. Introducing the legislation in the areas of energy markets: oil, gas, electricity, heating, renewable sources. Estimated costs of construction of power plants and transport networks, maintenance and use of facilities and permitted regulated profit. Fundamentals of engineering economics, profitability of investments in the energy sector.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory with practical examples.

Mandatory literature for study and for exam:

1. S. Tešnjak, E. Banovac, I. Kuzle: Tržište električne energije, Graphis, Zagreb, 2009.
2. Steven Soft. Power System Economics, J. Wiley and Sons, New York, USA, 2002.
3. A. E. Kahn. The Economics of Regulation: Principles and Institutions, Vol. I, II, John Wiley and Sons Inc, New York, 1971.
4. Directive 2009/73/EC concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC, Official Journal of the European Union 2009.
5. Directive 2009/72/EC concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC, Official Journal of the European Union 2009.
6. Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC, Official Journal of the European Union L 52/50, 2004.

Additional list of recommended literature:

1. H. Požar, Izvori energije, Sveučilišna naklada, Liber, Zagreb, 1980.
2. G. Rothwell, T. Gomez: Electricity Economics: Regulation and Deregulation. J. Wiley 2003.
3. M. Shahidehpour, H. Yamin, Z. Li: Market operations in electric power systems: Forecasting, Scheduling, and Risk Management, J. Wiley 2002.
4. B. Udovičić: Energetika i okoliš u globalizaciji, vlastita naklada, Zagreb, 2002.
5. Tehnička enciklopedija, svezak 4, Leksikografski zavod, Zagreb, 1988.

Exam type:

Seminar paper and oral exam.

D 824 Costs Management

Brief contents:

The importance of costs management in business decision making. Classification of costs. Models of costs management. Direct and indirect costs. Fixed and variable costs. Standard costs. The costs of production. Costs of material. Maintenance costs. Costs Analysis. The relationship cost-volume-profit production. Business decisions based on the relationship between costs and revenues. Pricing strategies. Product cost calculation. Incremental or differential analysis. Costs and supply conditions. Influence of cost management on business results.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory and laboratory.

Mandatory literature for study and for exam:

Additional list of recommended literature:

1. Hilton, R., Maher, M., Selto, F., Cost Management, McGraw Hill Edition, 2002.
2. Blacher, E.J., Kung, H.C., Lin, T.W., Cost management, McGraw Hill Edition, 2002.

Exam type:

Written and oral.

D861 Energetic machinery

Brief contents:

The course deals with the basic characteristics and forms of energy conversion in energetic machinery of various types: turbomachines, positive displacement machines and internal combustion engines. The different turbomachines, both with compressible working fluid (steam and gas turbines, centrifugal and axial compressors) and with compressible working fluid (fans, wind turbines, pumps and water turbines) are analyzed. After comparing of the turbomachines and positive displacement machines, the different positive displacement machines with linear moving and rotary piston (reciprocating compressors and pumps, blowers), as well as internal combustion engines are analyzed. The basic characteristics of plants in which some of these machines work (steam-turbine plant, gas-turbine plants and pumping plants) are given, with description of other devices that appear in them (steam generators, heat exchangers, etc.). In the end, an overview of energy sources and the basics of energy management and environmental protection are given.

Content:

INTRODUCTION. Classification of energy engines with regard to different criterions. Basic principles of work and characteristics. CYCLES OF HEAT ENGINES. Carnot cycle. Constant pressure cycle. Otto cycle. Diesel cycle. Dual combustion cycle. Stirling and Ericsson cycles. STEAM TURBINE POWER PLANT. Basic cycle (Rankine). Methods of thermal efficiency improvement of basic cycle. Steam boilers. Condenser and condenser plant. Nuclear power plant. GAS-TURBINE PLANT. Basic cycle (Brayton). Methods of thermal efficiency improvement of basic cycle. Combustion chamber. AXIAL TURBINES. Working principle, construction and classification. Geometrical characteristics of stage. Losses, efficiency and work. Stages with long blades. Cooling at gas turbines. Governing and emergency governing. Multistage turbines. RADIAL TURBINES. Types. Thermodynamics and aerodynamics of stage. Power, losses and efficiency. Off-design operating conditions. FANS. Centrifugal and axial fans. Thermodynamics and aerodynamics of stage. Fan work in installation (system). AXIAL TURBOCOMPRESSORS. Geometrical characteristics of cascades. Thermodynamics and aerodynamics of stage. Working characteristic. Non-stable operation. Multistage axial compressor. CENTRIFUGAL TURBOCOMPRESSORS. Geometrical characteristics of stage. Thermodynamics and aerodynamics of stage. Working characteristic. The surge and its prevention. PUMPS AND PUMP PLANTS. Types of pumps. Power, losses and efficiency. Multistage pump. Working characteristics. Pump plant - working point. Cavitation. WATER TURBINES AND PLANTS. Types of water turbines. Basic concepts and definitions. Dimensionless groups. Basic dimensions. Principles of hydraulic calculation. Hydraulic power utilization. Types of water turbine plants and their importance in electro-energy system. Auxiliary equipment of water turbine plant. WIND TURBINES AND PLANTS. Basic characteristics of wind. Types of wind turbines. Principles of aerodynamical calculation. Types of wind turbine plants and and their importance in electro-energy system. POSITIVE DISPLACEMENT MACHINES. Classification of positive displacement machines. Basic characteristics of positive displacement pumps and compressors. Vane, gear and screw pumps, compressors (blowers) or motors. INTERNAL COMBUSTION ENGINES. Types and basic elements. The two and four stroke cycles. Working characteristics and factors which influence on them. Fuel systems. Supercharging. THE SOURCES, USE AND MANAGEMENT OF ENERGY, AND ENVIRONMENT PROTECTION. Sources of energy and energy demands. Energy management and energy audits. The new technology of energy saving. alternative energy supplies. Use of energy and environment. Environment protection.

Teaching methods and the ways of knowledge assessment:

Teaching methods are lectures and auditory exercises with solving of numerical examples. Knowledge assessment is through colloquia.

Mandatory literature for study and for exam:

1. Guzović, Z.: Toplinski strojevi (interna skripta), FSB, Zagreb, 1992.
2. Matijašević, B., Guzović Z., Novko I.: Turbostrojevi I. (interna skripta), FSB, Zagreb, 1994.
3. Eastop, T.D.; McConkey, A.: Applied Thermodynamics for Engineering Technologists, Longman, Hong Kong, 1986.
4. Dixon, S.L.: Fluid Mechanics, Thermodynamics of Turbomachinery, Pergamon Press Ltd., Madras, 1998.

Additional list of recommended literature:

1. Kadambi, V.; Prasad, M.: An Introdustion to Energy Conversion - Turbomachinery, Wiley Eastern Limited, New Delhi, 1986.
2. Joel, R.: Basic Engineering Thermodynamics, Longman Scientific Technical, New York, 1987.
3. Chernyak, O.V.; Rybchinskaya, G.B.: Basic Hydraulics and Heat Engineering, Mir Publisher, Moscow, 1984.

Exam's type:

The exam consists of the theoretical knowledge assessment through several colloquia and the seminar work which includes numerical examples solving.

D 862 Steam Generators

Brief contents:

Introduction to steam generators. Basics of steam generators, types, working parameters. Thermodynamic process in steam generators. Heat balance, heat losses and efficiency. Fuels and combustion. Thermal calculation of heat transfer surfaces. Water circulation. Air and fuel gas flow. Strength calculation and materials of pressure parts. Steam generators control. Types and design of steam generators. Structure parts of steam generators. Auxiliary devices.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory, computational. Examples of steam generators calculation.

Mandatory literature for study and for exam:

Lecture notes; materials available on Faculty's web pages

Prelec, Z.: Brodski generatori pare, Školska knjiga Zagreb, 1992.

Additional list of recommended literature:

Kreuh L.: Generatori pare, Školska knjiga Zagreb, 1978.

Reznikov M.I., Lipov Yu. M.: Steam Boilers of Power Stations, Mir Publishers, Moscow, 1985.

Exam type:

Two short written exams, seminar work and final oral exam.

D 863 Heating, Ventilation, Air Conditioning and Refrigeration

Brief contents:

Heating, ventilation, air conditioning and refrigeration applications. Indoor environmental quality, thermal comfort. Heating and cooling load calculations for heating, air conditioning and refrigerated storage. Heating and air conditioning systems. Heating equipment and components. Air-handling equipment and components. Thermodynamic processes of heating and refrigeration. Types and analysis of refrigeration machines. Refrigerants. Fundamentals and constructive features of refrigeration compressors, evaporators and condensers. Throttling devices, pipelines, valves and fittings. Heat pump design and applications. Automatic control of temperature, humidity and air flow.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory, computational.

Mandatory literature for study and for exam:

Unpublished script – lectures: Heating and air-conditioning

Unpublished script – lectures: Refrigeration

Additional list of recommended literature:

Recknagel, Sprenger, Schramek: "*Heizung und Klimatechnik 05/06"*, Springer Verlag, München, 2005.
ASHRAE: *"2010 ASHRAE HANDBOOK- REFRIGERATION"*, ASHRAE Atlanta, 2010.
ASHRAE: *"2009 ASHRAE HANDBOOK- FUNDAMENTALS"*, ASHRAE Atlanta, 2009.
ASHRAE: *"2008 ASHRAE HANDBOOK- HVAC SYSTEMS AND EQUIPMENT"*, ASHRAE Atlanta, 2008.
ASHRAE: *"2007 ASHRAE HANDBOOK- HVAC APPLICATIONS"*, ASHRAE Atlanta, 2007.

Exam type:

Written and oral exam. Seminar paper.

D 864 Drying of Hygroscopic Materials

Brief contents:

Drying: definition, process, classification, significance, application, hygroscopic and non-hygroscopic materials. Determination and description of moisture material parameters. Thermo-physical and mechanical properties of moisture materials. Humid air: properties, condition diagrams („h – x“, psychometric diagram), ideal and real thermodynamic condition changes (heating, cooling, mixing, mixing whilst heating/cooling, dampening, dehumidification, circular and gradable drying). Vapourisation. Drying statics and kinetics: terms, definitions, relations, correlations (free, bound, chemically bound moisture, saturation point, balance moisture, drying phases, heat and mass transfer during the drying process, drying speed curves). Drying duration (analytical, graphical). Influential parameters on the speed, duration and quality of drying on air and hygroscopic material side. Drying characteristics and specific features of thin-walled, broken, thicker soft and hard hygroscopic materials having a regular or irregular formation. Natural drying: conditions, application, duration, performance, effectiveness. Artificial convective drying: drying kiln formation, capacity and thermal calculation, calculation and dimensioning of elements and equipment (air flow, heating, moisturizing, ventilation) of regulation and plant assemblies. Drying regime and sharpness. Vacuum drying. Measurement methods, measuring instruments and drying control. Computer management of the drying process. Possible causes of appearance of defects during drying and ways of minimizing them. Thermal energy consumption in all drying phases. Thermal source dimensioning for more drying kilns operation with various drying regimes. Drying processes of agricultural and food products, plants and tobacco, various wood sortiments, building products... Characteristic technical solutions of drying kilns for various types of hygroscopic materials drying. Advanced technical solutions of drying kilns. Techno-economic drying parameters. Secondary and alternative energy sources for drying.

Teaching methods and ways of knowledge assessment:

Lectures. Exercises: auditory with active participation of students, presentation of practical systems with calculation examples. During the semester, the knowledge shall be tested by short tests (up to five tests per semester), seminar paper.

Mandatory literature for study and for exams:

1. Bogner, M.: Termotehničar 2, odabrano poglavlje „Sušenje“, Smeits, Beograd, 2004.
2. Bošnjaković, F.: Nauka o toplini – II dio, Tehnička knjiga, Zagreb, 1976.
3. Halasz, B.: Inženjerski priručnik IP1, „Vlažni zrak“, Školska knjiga, Zagreb, 1996.
4. Topić, M., R.: Osnove projektiranja, proračuna i konstruiranja sušara, Naučna knjiga, Beograd, 1989.
5. Lectures and exercises; Čikić, A.: Konvektivno sušenje drva, (book in its final publishing stage)

Additional list of recommended literature:

1. Galović, A.: Termodinamika II, FSB, Zagreb, 2007.
2. Krischer, O., Kroll, K.: Die wissenschaftlichen Grundlagen der Trocknungstechnik, Springer – Verlag, Berlin / Gottingen / Heidelberg, 1963.
3. Sažin, B., S.: Osnovi tehniki suški, Himija, Moskva, 1984.
4. Likov, A.V.:Teorija suški, Energija, Moskva, 1968.
5. Voronjec, D., Kozić, Đ.: Vlažni zrak, Naučna knjiga, Beograd, 1989.
6. Benitez, J.: Principles and Modern Applications of Mass Transfer Operations, Wiley-Interscience, 2002.
7. Nedeljkov, M., Stakić, M.: Osnove tehnike sušenja, FTN, Novi Sad, 1994.
8. web sources

Exam type:

All passed short tests during the semester and positively marked seminar paper 50%, oral exam 50%.
Written and oral exam.

D 865 Special Steels in the Energy Sector

Brief contents:

Structural steels. Steels resistant to corrosion and aggressive media. Steels and non-ferrous alloys for work at elevated and high temperatures. Heat resistant non-ferrous alloys (super-alloys). Nickel based alloys and cobalt based alloys. Fire-resistant steels. Valve steels. Ultra-high strength steels. Steel for the construction of nuclear devices (reactors, steam-generators, primary pipe circle, etc.). Steels for secondary pipe circles and equipment of nuclear facilities.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: Auditory exercises and laboratory. Preliminary exam I, II, III during the semester.

Mandatory literature for study and for exam:

1. Novosel, M.; Krumes, D.: Željezni materijali, II dio Konstrukcijski čelici, Strojarski fakultet, Slavonski Brod, 1995.
2. Novosel, M.; Krumes, D.: Posebni čelici, Strojarski fakultet, Slavonski Brod, 1995.

Additional list of recommended literature:

Journals:

1. EGE – Energetika – Gospodarstvo – Ekologija – Etika, Energetika Marketing, Zagreb
2. Solarna tehnologija, Hrvatska stručna udruga za sunčevu energiju HSUSE, Zagreb

Exam type:

Written and oral

D 866 Electrical Switching Apparatus and Machines

Brief contents:

Review of electrical switching devices and their functions. Disconnectors, switches, earthing switches, contactors, switches, circuit breakers, fuses, lightning arresters. Classification of switchgear assemblies. Voltage stresses and insulation coordination. Current stresses. Bus and insulated conductors, insulators, power cables, grounding. Electromechanical conversion. Types of machinery: synchronous, asynchronous and DC. Moment of synchronous machine. Synchronous motor. Torque characteristic of induction machine. DC machines. The transformer device and its role in the electrical system. Losses, cooling and heating of transformer.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory with practical examples.

Mandatory literature for study and for exam:

1. B. Belin, Uvod u teoriju električnih sklopnih aparata, Školska knjiga, Zagreb 1978.
2. Flurscheim C.H., Power Circuit Breakers - theory and design, Peter Peregrinus, Ltd., London 1975.
3. Wolf, R., Osnove električnih strojeva, Školska knjiga, Zagreb 1991.
4. Dolenc, A. i dr., Električni strojevi, TE/4 JLZ, Zagreb 1973.
5. Kelemen, T., Transformator, TE/13 HLZ, Zagreb 1997.
6. M. Pužar, Transformatori, predavanja, Elektrotehnički fakultet Osijek, 2000.
7. M. Pužar, I., Mandić, Električni strojevi II, predavanja, Elektrotehnički fakultet Osijek, 2000.

Additional list of recommended literature:

1. Piotrovskij, L.M., Električni strojevi, Tehnička knjiga, Zagreb 1970.
2. Dolenc, A. i dr., Transformatori I i II, skripta ETF Zagreb, Zagreb 1978.
3. Bego, V., Mjerni transformatori, TE/8 JLZ, Zagreb 1982.
4. Sirotić, Z., Maljković, Z., Sikroni strojevi, skripta ETF Zagreb, 1996.
5. H. Požar, Visokonaponska rasklopna postrojenja. Tehnička knjiga, Zagreb, 1967.
6. John D. Mc. Donald, Electric Power Substations Engineering, CRC Press, 2003.

Exam type:

Seminar paper and oral exam.

D 867 Design of Process Systems

Brief contents:

Process systems. Investment objects. Types of technical documentation. Data analysis. Types of project assignment. Regulations and standards. Preliminary solution. Feasibility study. Study of environmental protection. Main technological projects: special terms, general and technical terms, regulations and standards, calculations, technical description, specification of equipment, materials and work (with specified price), graphical representation. Work safety regulations, fire safety regulations, environmental protection. Basics of design. Computer Aided Design (CAD). Tender documentation. Oversight of the project. Final report. Process systems in plants and industry (metal processing, food processing, etc.): micro-climate and technological conditions, types, forms, production and transportation of energy, heating installation and devices, airconditioning, accumulation of heat and steam, water supply and installation, primary and alternative energy sources, rational energy use, closed and open systems. Auxiliary and service facilities. Efficiency of process systems.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory with active participation of students, presentation of practical examples. During the semester, the knowledge shall be tested by short tests (up to five tests per semester), seminar paper.

Mandatory literature for study and for exam:

1. Beer, E.: Priručnik za dimenzioniranje uređaja kemijske i procesne industrije, SKTH/kemija u industriji, Zagreb, 1985.
2. Bogner, M.: Projektiranje termotehničkih i procesnih sistema, Smeits, Beograd, 2002.
3. Olujić, Ž., Šef, F.: Projektiranje procesnih postrojenje, SKTH, Zagreb, 1988.

Additional list of recommended literature:

1. Balać, M., Stambolić, M.: Upravljanje u procesnoj industriji i energetici, Beograd, 2010.
2. Duncan, M., T., Reimer, A., J.: Chemical Engineering Design and Analysis, Cambridge University Press, 1998.
3. Peters, S., M., Timmerhaus, D., K., West, E., R.: Plant Design and Economics for Chemical Engineers, 5th Edition, McGraw-Hill, 2003.
4. Udovičić, B.: Energetika, Školska knjiga, Zagreb, 1993.
5. Bogner, M.: Termotehničar 1 i 2, odabrana poglavlja, Smeits, Beograd, 2004.

Exam type:

All passed short tests during the semester and positively marked seminar paper 50%, oral exam 50%.
Written and oral exam.

D 905 Power Plants

Brief contents:

Introduction to the basic parameters and technologies for electric energy production. The division of the conventional power plants with corresponding characteristic features. Hydropower plants (HPP): historical development, functional description of the key components, equipment selection by parameters of available watercourses, types of HPP (flow, storage, derivative, pumped-reversible, small), operation of HPP and the importance of HPP in power system. Thermal power plants (TPP): description of the functional parts, types of TPP according to final energy form (electric energy, hot water heating energy and electrical energy, steam heating energy and electrical energy), gas thermal power plants and the importance of TPP in power system. The impact of power plants on ecology.

Teaching methods and the ways of knowledge assessment:

Lectures. Auditory exercises: Calculation examples with numerical data from all teaching units according to the lectures. Seminar paper.

Mandatory literature for study and for exam:

1. Požar, H.: Osnove energetike 1, 2 i 3, Školska knjiga Zagreb, 1992.
2. Udovičić, B.: Energetika, Školska knjiga Zagreb, 1993.

Additional list of recommended literature:

1. Udovičić, B.: Elektroenergetski sustav, Kigen Zagreb, 2004.
2. Jozsa, L.: Energetski procesi i elektrane, Interna skripta, ETF Osijek, 2004.

Exam type:

Seminar paper and oral exam.

D 928 Renewable Energy Sources

Brief contents:

Introduction to the basic characteristics of renewable energy sources, technologies and trends of development of renewable energy sources, renewable system designing. Analysis and calculation of the energy potential for application of solar energy, wind, biomass, biogas, biodiesel, geothermal and hydropower energy. Distributed power generation and the basics of legal regulations related to renewable energy. Benefits of renewables (for ecology).

Teaching methods and the ways of knowledge assessment:

Lectures. Auditory exercises: Calculation examples with numerical data from all teaching units according to the lectures. Seminar paper.

Mandatory literature for study and for exam:

1. Knap V.; Kulišić, P.: Novi izvori energije, Školska knjiga, Zagreb, 1985.
2. Požar, H.: Osnove energetike 1, Školska knjiga, Zagreb, 1992;

Additional list of recommended literature:

1. Udovičić, B.: Energetika, Školska knjiga Zagreb, 1993.
2. Šljivac, D., Šimić, Z.: Obnovljivi izvori energije s osvrtom na gospodarenje, ETF HKAIG, 2008.

Exam type:

Seminar paper and oral exam.

D 961 Wind turbines

Brief contents:

In the course students are introduced with the types, aerodynamics, design, production technology and exploitation of wind turbines and wind farms. Students will adopt aerodynamic and other calculations required for the construction of wind turbines and wind farms. In order to design and operation of wind turbines i.e. wind farm to be successful a good knowledge of wind characteristics and the good disposition of individual wind turbines are necessary. The power control of wind turbine, wind turbines work on the network and safety and security matters are also analyzed. Part of the lecture is devoted to possibilities of using wind energy in the Republic of Croatia. In the end, the basics of economic analysis of wind turbines and wind farms, as well as environmental issues are given.

Content

INTRODUCTION. History of wind energy exploitation and of windmills development. Types of wind turbines and plants. Basic characteristics. BASIC CHARACTERISTICS OF WIND. Types: global, local and mountain winds. The wind rose. Velocity and the energy in the wind: wind speed measurement. Betz' law. The winds map. ENERGY OUTPUT OF WIND TURBINE. The Weibull distribution. Average power of the wind. Power density function. The power curve and the power coefficient. Annual energy output. TYPES, WORKING PRINCIPLES AND BASIC ELEMENTS OF WIND TURBINES. With vertical and horizontal axis. Small and large turbines. Rotor aerodynamics: lift, stal and drag. The size of turbine. Description of the basic parts. AERODYNAMICAL CALCULATION. Aerodynamic forces and moment. Effective specific speed. Power. WINDTURBINE DESIGN. Load considerations. Horizontal or vertical axis wind turbine. Upwind or downwind machines. Number of rotor blades. Wind turbines optimizing. Low mechanical and low aerodynamic noise. OTHERS PARTS OF WIND TURBINE. Nacelle. Electrical generator. Gearbox. Yaw mechanism. Tower. MANUFACTURING AND COMPONENTS TESTING. Fatigue, strength and vibrations testing of rotor blades. POWER CONTROL. Pitch controlled wind turbines. Passive and active stall controlled wind turbines. PROTECTION AND WIND TURBINE SAFETY. Vibration sensor. Mechanical braking system. Aerodynamic braking system with hydraulic system. Electronic controller. WIND TURBINES AND PLANTS IN THE ELECTRICAL GRID. Seasonal variation in wind energy. Output power and availability factor. Quality of electrical power from wind turbine plants. Wind energy and electrical tariffs. WIND TURBINE POWER PLANT SITING. Roughness and shear. Escarpments. Park effect. The tunnel and hill effect. Turbulence and wake trailing. Variability of wind speed and direction. POSSIBILITY OF WIND ENERGY EXPLOITATION IN CROATIA. Wind map of Croatia. Possible locations and types of applied turbines. ECONOMICS OF WIND TURBINES AND PLANTS. Manufacturing, installation, operation and maintenance costs. Investment in wind energy exploitation and traps in analyses. Investment in manufacturing of wind turbines and appertaining equipment. ENVIRONMENT PROTECTION. Landscape and turbines. Obstruction markings on wind turbines. Sound from turbines and sound measurement. Birds protection. Shadow casting and blinking.

Teaching methods and the ways of knowledge assessment:

Teaching methods are lectures and auditory exercises with solving of numerical examples. Knowledge assessment is through colloquia.

Mandatory literature for study and for exam:

1. Guzović, Z.: Vjetroturbine i vjetroelektrane (interna skripta), FSB, Zagreb, 2010.
2. Pilić-Rabadan, Lj.; Poje, D.: Sistemi za korištenje energije vjetra, R.U. Đuro Đaković, Sarajevo, 1988.
3. Gasch, R.; Twele, J.: Wind Power Plants – Fundamentals, Design, Construction and Operation, Solarpraxis, Berlin, 2002.

Additional list of recommended literature:

1. Manwell, J.F.; McGowan, J.G.; Rogers, A.L.: Wind Energy Explained – Theory, Design and Application, John Wiley & Sons, Ltd., West Sussex, 2003.
2. Johnson, G.L.: Wind Energy Systems, Prentice - Hall, Englwood Cliffs, 1985.
3. Taylor, R.H.: Alternative Energy Sources for the Centralised Generation of Electricity, A. Hilger, Bristol, 1983.

Exam's type:

The exam consists from the theoretical knowledge assessment through several colloquia and the seminar work which includes numerical example solving.

D 962 Production Processes in Power Engineering

Brief contents:

Overview of production processes used in power engineering. Modern production processes of metal forming, chip-forming, joining, welding, etc. Processes of metal forming include technology of production, calculation and design of tools for construction of components of power plants (pressure vessel walls, pipe walls, pipe beams, membrane pipe walls, etc.). Since components of power plants are subjected to extreme corrosion during service, special emphasis is put on corrosion and quality control during production and service. Due to specific demands (concerning quality and reliability of components of power plants), the emphasis is put on modern and highly efficient production processes, as well as automation and robotisation of production processes.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory, laboratory

Mandatory literature for study and for exam:

1. Lukačević, Z. Zavarivanje: Strojarski fakultet u Slavonskom Brodu, 1998.

Additional list of recommended literature:

1. Proceedings (1.-5. international conference on welding, 2000-2009, Mechanical Engineering Faculty in Slavonski Brod)
2. Journal (Zavarivanje, HDTZ Zagreb)

Exam type:

Written and/or oral exam or seminar paper (with public presentation).

D 966 Project Management of Energy Objects

Brief contents:

To provide a comprehensive examination of complexity and significance of project management in modern organisations. The students will be introduced to the broad concept of project and project management. The module will cover existing and new trends, basic concepts, ideas and content of project management. The syllabus includes necessary project management methodology steps. Project management methods. Processes in Project management. Project goals. Project planning. Risk management. Project monitoring. The use of different project management tools. To develop student awareness of importance of project management.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: computational – program systems (MS Project, Micro Planer Manager).

Mandatory literature for study and for exam:

1. Majdandžić, N.; Lujić, R.; Matičević, G.; Šimunović, G.; Majdandžić, I.: Upravljanje proizvodnjom, Sveučilište u Osijeku, Strojarski fakultet, Slavonski Brod, 2001.
2. Burke R. Project management: planning and control techniques, third edition, John Wiley & Sons, 1999.
3. Lockyer K; Gordon J. Project management and project network techniques, sixth edition, Financial Times Pitman Publishing, 1996.
4. Kerzner H. Project management: A systems approach to planning, scheduling and controlling, eighth edition, John Wiley & Sons, 2003.
5. Meredith J.R; Mantel S.J. Project management: a managerial approach, Wiley Text Books; 5th edition, 2002.
6. Galeta, T.: "Upravljanje projektom: Računalni programi - podloge za uvodno predavanje". Strojarski fakultet, Slavonski Brod, 2010.
7. Mc Mahon P. E.: "Virtual Project Management: Software Solutions for Today and the Future". CRC Press LLC, Boca Raton, 2001.
8. Goodman, F. Alan: "Process-Based Software Project Management". Taylor & Francis Group, Boca Raton, 2006.
9. Jonathan F. Hutchings: "Project Scheduling Handbook". Marcel Dekker, Inc. Basel, 2004.
10. Benator, B., Thumann, A.: "Project Management and Leadership Skills for Engineering & Construction Projects". Marcel Dekker Inc. Basel, 2003.
11. Humphreys, K. K.: "Project and Cost Engineers' Handbook". Marcel Dekker Inc. Basel, 2005.

Exam type:

Written and oral exam. Seminar paper.

D 967 Water, Fuels and Lubricants

Brief contents:

Introduction. Basic terms, physical and chemical water features. Water hardness. Technological procedure for water preparation: filtering, eliminating of CO_2, O_2 and other chemical substances. Softening of water: procedures, plants, calculation of necessary capacities. Construction of facilities for ions alternation. Problems connected with inadequate processing of water. Fuels: liquid, gas and rigid; sources: fossil, renewable, crude oil, natural gas; processing and exploitation. Liquid and gas fuels: partitions, features, structures and applicability. Diesel, heavy and residual fuels: partitions and features. Fuel combustion process. Fuel quality and problems connected with combustion of heavy fuels. Standards for fuel quality features. Lubricants, lubricants classifications and specifications, lubrication, places of lubrication, production. Lubricant features. Types of lubricant for high temperature requirements. Systemic oils and their characteristics. Lubrication of thermal turbines and other machines; conditions and requirements. Handling of lubricants (oils and greases), waste treatment of lubricants. Oil quality control, oil treatment in facilities, recommendations for substitution of lubricants.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory, computational.

Mandatory literature for study and for exam:

1. Jugoma: Maziva i podmazivanje, Zagreb, 1996.
2. Krstulović, R. Tehnološki procesi anorganske industrije, Školska knjiga, Zagreb 1982.
3. Zima, V. Goriva i maziva, Tehnički fakultet, Rijeka.
4. Korać, V. Tehnologija vode za potrebe industrije, Beograd, 1985.

Additional list of recommended literature:

1. E. Tireli; Goriva i njihova primjena na brodu, knjiga, Pomorski fakultet u Rijeci.

Exam type:

Written and oral exam. Seminar paper.

D 968 Energy Efficiency

Brief contents:

Energy sources and energy conversion. Energy balance and energy consumption. Exergy analysis in industry and building sector: production of electricity, heat transfer, combustion, heating and cooling of buildings. EU directives and Croatian bylaws for energy efficiency and energy management. Energy audits in buildings and industry. Energy certification of buildings. Energy efficiency measures. Economic analysis of energy efficiency measures. Systematic energy management. Monitoring and analysis of energy consumption in buildings. Application of electricity as auxiliary power in heating, ventilation, air conditioning and hot water preparing. Types of appliances and consumer equipment. Introduction of new ways to increase energy efficiency. Lighting & LENI factor. Lighting system, savings, control and management. Selection of electrical appliances and machinery. Comparison of system and device efficiency. Energy-independent buildings and examples. Static capacitor banks for reactive power compensation. Important preconditions for technological processes management in terms of energy efficiency. DC motors fed by inverter. Inverters for AC motors. Energy relations and the optimal load.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises: auditory, computational.

Mandatory literature for study and for exam:

Unpublished script – lectures: *Energy efficiency*

Additional list of recommended literature:

Kotas, T.J.: Exergy method of Thermal Plant Analysis, Buterworths, London 1985.
Von Cube, H.L. (Ed.): Handbuch der Energiespartechniken Bd. 1, 2 u 3, C.F. Müller, Karlsruhe, 1983.
Pavković, B., Zanki, V. (Ur.): Priručnik za energetsko certificiranje zgrada, UNDP, 2010.
Morvaj, Z; Sučić, B. Zanki, V; Čačić, G: Priručnik za provedbu energetskih pregleda zgrada, UNDP, 2010
Morvaj, Z; Gvozdenac, D; Applied Industrial Energy and Environmental Management, October 2008, Wiley-IEEE Press
Zanki, V; et al., Tipske mjere za povećanje energetske efikasnosti u kućanstvima, UNDP, 2009
Čačić, G; Priručnik za tjednu i dnevnu analizu i interpretaciju podataka o potrošnji energije, UNDP, 2010

Exam type:

Written and oral exam. Seminar paper.

D 1021 Maintenance Strategies

Brief contents:

The ideas, approaches and changes of new maintenance strategies and methods will be given. Implementation of different cost effective models will be given through examples. Teach students about basic characteristics of modern system and methods for condition monitoring of technical systems. Explanation of planning, evaluation and control of maintenance costs in equipment life cycle. Role of Maintenance Information System in maintenance management will be shown. Importance of life-long learning for maintenance managers and skills that they must have.

Teaching methods and the ways of knowledge assessment:

Lectures. Exercises. Auditory and laboratory exercises in PC laboratory with available maintenance information systems and instruments for condition monitoring of technical systems.

Mandatory literature for study and for exam:

1. Majdandžić, N. Strategije održavanja i informacijski sustavi održavanja, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod, 1999.

Additional list of recommended literature:

1. Dhillon, B.S.: Engineering Maintenance – A Modern Approach, CRC Press, USA, 2002.
2. Levitt, J.: Managing Factory Maintenance, Industrial Press, Inc., USA, 1996.
3. Levitt, J.: Handbook of Maintenance Management, Industrial Press, Inc., USA, 1997.
4. Rao, B.K.N.: Handbook of Condition Monitoring, Elseviar Advanced Technology, Oxford, UK, 1996.
5. Adamović, Ž.: Tehnička dijagnostika u mašinstvu, Privredni pregled, Beograd 1986.

Exam type:

Written and oral.

D 1062 Engineering of Power Plants

Brief contents:

Introduction to computer engineering programs for power plants. Review and comparison of available programs. The designing of power plants. Elements of the technological design of the facility. Related standards. Understanding the basic diagrams: flow, piping and instrumentation. Engineering of equipment, piping and auxiliary structures. Overview of utilities for the calculation of equipment and pipelines. Technical documentation: pipeline isometrics, design documents and equipment support structures. Bill of material (BOM). Preparation of shaded and animated plant presentation. Digital data exchange with other professions involved in the project.

Teaching methods and the ways of knowledge assessment:

Lectures and exercises. Auditory and laboratory exercises on computers with the continuous monitoring and evaluation.

Mandatory literature for study and for exam:

1. Stephen J. Schoonmaker. CAD Guidebook: A Basic Manual for Understanding and Improving Computer-Aided Design. Marcel Dekker Inc, Basel, 2003.
2. Geoffrey Boothroyd, Peter Dewhurst, Winston Anthony Knight. Product Design for Manufacture and Assembly. Marcel Dekker Inc, Basel, 2002.

Additional list of recommended literature:

1. Patrick W. Jordan. Designing Pleasurable Products: An Introduction to the New Human Factors. Taylor & Francis Group, Philadephia, 2002
2. George A. Antaki. Piping and Pipeline Engineering: Design, Construction, Maintenance, Integrity, and Repair. Marcel Dekker Inc, Basel, 2003.
3. ENGINEERING SYMBOLOGY, PRINTS, AND DRAWINGS. U.S. Department of Energy, Washington, 1993.
4. Robert G. Campbell, Edward S. Roth. Integrated Product Design and Manufacturing Using Geometric Dimensioning and Tolerancing. Marcel Dekker Inc, Basel, 2003.
5. Wasim A. Khan, Abdul Raouf. Standards for Engineering Design and Manufacturing. CRC Press Taylor & Francis Group, Boca Raton, 2006.
6. Fabio Giudice, Guido La Rosa, Antonino Risitano. Product Design for the Environment: A Life Cycle Approach. CRC Press Taylor & Francis Group, Boca Raton, 2006.
7. Richard Crowson. Product Design and Factory Development. CRC Press Taylor & Francis Group, Boca Raton, 2006.

Exam type:
Tests of knowledge (program, seminars, colloquia and test).