University of Rijeka
Faculty of Engineering

CURRICULUM
GRADUATE UNIVERSITY STUDY OF MECHANICAL ENGINEERING

Rijeka, April 2021

1. CURRICULUM DESCRIPTION

1.1. The list of compulsory and elective courses with the number of active classes required for their performance and ECTS credits

1. semester							
	Subject title	Hours / week					ECTS
		L	aT	IT	dT	L+T	
	Mathematics for Engineers	3	2			5	7
	Strength of Materials II	3	1	1		5	7
	Thermodynamics II	3	2			5	7
Subjects from elective group Mechanical Engineering Design and Mechatronics:							
	Mechanical Design of Machine Components	2			3	5	5
	Engineering Visualization	1			2	3	4
Subjects from elective group Computational Mechanics and Engineering:							
	Vibrations	2	1	1		4	4
	Modelling in Engineering	2			2	4	5
Subjects from elective group Industrial and Manufacturing Engineering:							
	Machining Processes	2	1	1		4	5
	Joining of Materials	2		1		3	4
Subjects from elective group Thermal Engineering:							
	Heat Exchangers	2	2			4	4
	Laboratory Practice in Thermal Engineering	1		2		3	5
Subjects from elective group Process and Energy Engineering:							
	Heat Exchangers	2	2			4	4
	Laboratory Practice in Thermal Engineering	1		2		3	5
Subjects from elective group Marine Engineering:							
	Marine Electrical Engineering	2	1			3	4
	Laboratory Practice in Thermal Engineering	1		2		3	5
Subjects from elective group Materials Engineering:							
	Metal Materials	2	2			4	5
	Non-Metal Materials	2	1			3	4
	TOTAL					**23**	**30**

L - lectures, aT – auditory tutorials, lT – laboratory tutorials, dT – design tutorials.

2. semester							
	Subject title	Hours / week					ECTS
		L	aT	IT	dT	L+T	
	Project I[1]				2	2	5
	Elective Subject I						5
	Free Elective Subject I[2]						5
	Professional Practice II						5
Subjects from elective group Mechanical Engineering Design and Mechatronics:							
	Systematic Engineering Design and Product Development	2			2	4	5
	Power Transmissions	3		1	2	6	5
Subjects from elective group Computational Mechanics and Engineering:							
	Finite Element Analysis of Solids	2		2		4	5
	Fluid Dynamics	2		2		4	5
Subjects from elective group Industrial and Manufacturing Engineering:							
	Forming Technology	2		2		4	5
	Production Management	2	1	1		4	5
Subjects from elective group Thermal Engineering:							
	Energy and Process Devices	3	2			5	5
	Numerical Modelling in Thermodynamics	2		2		4	5
Subjects from elective group Process and Energy Engineering:							
	Energy and Process Devices	3	2			5	5
	Heat Turbines	3	2			5	5
Subjects from elective group Marine Engineering:							
	Ship Systems	3		1		4	5
	Heat Turbines	3	2			5	5
Subjects from elective group Materials Engineering:							
	Casting	2	1			3	5
	Materials Protection	2	1	1		4	5
	TOTAL					**20**	**30**

[1] Enroll one subject.

[2] Enroll one subject in the 2nd semester from other elective groups or from other graduate studies at the Faculty of Engineering University of Rijeka, worth 5 ECTS or more.

Subjects from which can be enrolled Project I according to the elective groups:

Mechanical Engineering Design and Mechatronics: Engineering Visualization, Mechanical Design of Machine Components, Power Transmissions, Robot Elements Design, Systematic Engineering Design and Product Development**,** Components of Mechatronics Systems

Computational Mechanics and Engineering: Modelling in Engineering, Vibrations

Industrial and Manufacturing Engineering: Forming Technology, Production Management, Materials Protection

Thermal Engineering: Compressors, Energy and Process Devices, Heat Turbines, Numerical Modelling in Thermodynamics

Process and Energy Engineering: Compressors, Energy and Process Devices, Heat Turbines, Numerical Modelling in Thermodynamics

Marine Engineering: Compressors, Numerical Modelling in Thermodynamics, Ship Systems

Materials Engineering: Metal Materials, Materials Protection

Elective Subject I							
	Subject title	Hours / week					ECTS
		L	aT	IT	dT	L+T	
Subjects from elective group Mechanical Engineering Design and Mechatronics:							
	Robot Elements Design	2			2	4	5
	Components of Mechatronics Systems	2		2		4	5
Subjects from elective group Computational Mechanics and Engineering:							
	Theory of Machines and Mechanisms	2		1	1	4	5
	Thermomechanics	2		2		4	5
	Visualization and Preparation of Computer Simulations	2			2	4	5
	Numerical Modelling in Thermodynamics	2		2		4	5
Subjects from elective group Industrial and Manufacturing Engineering:							
	Materials Protection	2	1	1		4	5
	Casting	2	1			3	5
	Maintenance	2	1			3	5
Subjects from elective group Thermal Engineering:							
	Compressors	2	1			3	5
	Heat Turbines	3	2			5	5
Subjects from elective group Process and Energy Engineering:							
	Numerical Modelling in Thermodynamics	2		2		4	5
	Compressors	2	1			3	5
Subjects from elective group Marine Engineering:							
	Numerical Modelling in Thermodynamics	2		2		4	5
	Compressors	2	1			3	5
	Power Transmissions	3	1		2	6	5
	Offshore Structures and Vessels	2	2			4	5
Subjects from elective group Materials Engineering:							
	Production Management	2	1	1		4	5
	Systematic Engineering Design and Product Development	2			2	4	5
	Numerical Modelling in Thermodynamics	2		2		4	5
	Offshore Structures and Vessels	2	2			4	5

3. semester							
	Subject title	Hours / week					ECTS
		L	aT	IT	dT	L+T	
	Project II[3]				2	2	5
	Free Elective Subject II[4]						5
Subjects from elective group Mechanical Engineering Design and Mechatronics:							
	Precision Engineering and Microsystems Technologies	3	2			5	6
	Elements of Transport Technic	3			2	5	4
	Elective Subject II						5
	Elective Subject III						5
Subjects from elective group Computational Mechanics and Engineering:							
	Mechanics of Composites	2		2		4	5
	Engineering Optimization	2			2	4	5
	Elective Subject II						5
	Elective Subject III						5
Subjects from elective group Industrial and Manufacturing Engineering:							
	Designing the Production Systems	2	1		1	4	5
	Processes Planning	2	1	1		4	5
	Quality Management and Metrology	2	2			4	5
	Elective Subject II						5
Subjects from elective group Thermal Engineering:							
	Thermodynamics of Mixtures	3	2			5	5
	Air Conditioning and Automation Systems	3	1			4	5
	Refrigeration	3	2			5	5
	Elective Subject II						5
Subjects from elective group Process and Energy Engineering:							
	Thermodynamics of Mixtures	3	2			5	5
	Internal Combustion Engines	3	1	1		5	5
	Thermal Power Plants	3	1			4	5
	Elective Subject II						5
Subjects from elective group Marine Engineering:							
	Internal Combustion Engines	3	1	1		5	5
	Marine HVAC&R systems	3	2			5	5
	Marine Energy Devices	3	1			4	5
	Elective Subject II						5
Subjects from elective group Materials Engineering:							
	Non Conventional and Additive Manufacturing Processes	2	2			4	5
	Materials Characterization and Fracture Analysis	2		2		4	5
	Thermal Processes of Materials	2	1	1		4	5
	Elective Subject II						5
	TOTAL					**24**	**30**

[3] Enroll one subject.

[4] Enroll one subject in the 3rd semester from other elective groups or from other graduate studies at the Faculty of Engineering University of Rijeka, worth 5 ECTS or more.

Subjects from which can be enrolled Project II according to the elective groups:

Mechanical Engineering Design and Mechatronics: CAE in Product Design, Elements of Transport Technic, Modelling of Hydraulics and Pneumatics Systems, Precision Engineering and Microsystems Technologies

Computational Mechanics and Engineering: Finite Element Analysis of Solids, Fluid Dynamics, Optimal Control in Engineering, Theory of Machines and Mechanisms

Industrial and Manufacturing Engineering: Designing the Production Systems, Industrial Robotics, Processes Planning

Thermal Engineering: Air Conditioning and Automation Systems, Refrigeration, Renewable Energy Sources, Thermal Power Plants

Process and Energy Engineering: Air Conditioning and Automation Systems, Internal Combustion Engines, Refrigeration, Renewable Energy Sources, Thermal Power Plants

Marine Engineering: Heat Turbines, Internal Combustion Engines, Marine Energy Devices, Marine HVAC&R systems, Renewable Energy Sources

Materials Engineering: Materials Characterization and Fracture Analysis, Thermal Processes of Materials

Elective Subjects							
	Subject title	Hours / week					ECTS
		L	aT	IT	dT	L+T	
Subjects from elective group Mechanical Engineering Design and Mechatronics:							
	Modelling of Hydraulics and Pneumatics Systems	3		1	1	5	5
	CAE in Product Design	2			2	4	5
	Control of Mechatronics Systems	2		2		4	5
Subjects from elective group Computational Mechanics and Engineering:							
	Stability of Structures	2		2		4	5
	Control of Dynamic Systems	2	1		1	4	5
	Application of Parallel Computing	2			2	4	5
	Systems and Data Analysis	2			2	4	5
	Programming: Scripting Languages	2	2			4	6
Subjects from elective group Industrial and Manufacturing Engineering:							
	Non Conventional and Additive Manufacturing Processes	2	2			4	5
	Industrial Robotics	2		2		4	5
	Engineering Logistics	2	2			4	5
Subjects from elective group Thermal Engineering:							
	Thermal Power Plants	3	1			4	5
	Renewable Energy Sources	3	2			5	5
Subjects from elective group Process and Energy Engineering:							
	Air Conditioning and Automation Systems	3	1			4	5
	Renewable Energy Sources	3	2			5	5
	Refrigeration	3	2			4	5
Subjects from elective group Marine Engineering:							
	Renewable Energy Sources	3	2			5	5
	Offshore Operations	2	2			4	5

Subjects from elective group Materials Engineering:							
	Quality Management and Metrology	2	2			4	5
	CAE in Product Design	2			2	4	5
	Industrial Robotics	2		2		4	5

4. semester							
	Subject title	**Hours / week**					**ECTS**
		L	**aT**	**IT**	**dT**	**L+T**	
	Free Elective Subject III[5]						5
	Graduate Work						10
Subjects from elective group Mechanical Engineering Design and Mechatronics:							
	Numerical Methods in Design	2	2			4	5
	Elective Subject IV						5
	Elective Subject V						5
Subjects from elective group Computational Mechanics and Engineering:							
	Computational Fluid Dynamics	2			2	4	5
	Experimental Testing in Mechanics of Structures and Machines	2		2		4	5
	Elective Subject IV						5
Subjects from elective group Industrial and Manufacturing Engineering:							
	CNC/NC Machine Tools	2			1	3	5
	CAD/CAPP/CAM	2		2		4	5
	Elective Subject III						5
Subjects from elective group Thermal Engineering:							
	Gas Engineering	3	1			4	5
	Thermal Measurements	2		2		4	5
	Elective Subject III						5
Subjects from elective group Process and Energy Engineering:							
	Environmental Engineering	2	2			4	5
	Process Plants Equipment	2	2			4	5
	Elective Subject III						5
Subjects from elective group Marine Engineering:							
	Ship Propulsion Devices	2	1		1	4	5
	Marine Deck Machinery	2			2	4	5
	Elective Subject III						5
Subjects from elective group Materials Engineering:							
	Polymer Processing	2			1	3	5
	Mechanical Behaviour and Selection of Materials	2	1	1		4	5
	Elective Subject III						5
	TOTAL					**16**	**30**

[5] Enroll one subject in the 4th semester from other elective groups or from other graduate studies at the Faculty of Engineering University of Rijeka, worth 5 ECTS or more.

Elective Subjects							
	Subject title	Hours / week					ECTS
		L	aT	IT	dT	L+T	
Subjects from elective group Mechanical Engineering Design and Mechatronics:							
	Transport Systems	2			2	4	5
	Laboratory Excercises A	1		2		3	5
	Micro- and Nanoelectromechanical Systems	2	1			3	5
	Laboratory Exercises B	1		2		3	5
	Mechanical Behaviour and Selection of Materials	2	1	1		4	5
Subjects from elective group Computational Mechanics and Engineering:							
	Durability of Machines and Structures	2		1	1	4	5
	Dynamics of Offshore Structures	2	2			4	5
	Numerical Modelling of Hydraulic Machines	2			2	4	5
	Programming of Engineering Applications	2			2	4	5
Subjects from elective group Industrial and Manufacturing Engineering:							
	Application of Artificial Intelligence	2		1		3	5
	Project management	2	1			3	5
	Computer Integrated Manufacturing	2		1		3	5
	Computer Simulation of Production Processes	2		1		3	5
Subjects from elective group Thermal Engineering:							
	Fuels, Lubricants and Water	2	2			4	5
	Environmental Engineering	2	2			4	5
	Computational Modeling of Hvac & Thermal Power Systems	2	2			4	5
Subjects from elective group Process and Energy Engineering:							
	Fuels, Lubricants and Water	2	2			4	5
	Gas Engineering	3	1			4	5
	Thermal Measurements	2		2		4	5
	Computational Modeling of Hvac & Thermal Power Systems	2	2			4	5
Subjects from elective group Marine Engineering:							
	Fuels, Lubricants and Water	2	2			4	5
	Gas Engineering	3	1			4	5
	Environmental Engineering	2	2			4	5
	Ship Outfitting and Repair	3			1	4	5
Subjects from elective group Materials Engineering:							
	Thermal Measurements	2		2		4	5
	Ship Outfitting and Repair	3			1	4	5
	Numerical Methods in Design	2	2			4	5

GRADUATE UNIVERSITY STUDY OF MECHANICAL ENGINEERING TOTAL	Hours	ECTS
	83	120

Basic description		
Course title	**Air Conditioning and Automation Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+15+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Within the course students acquire theoretical knowledge and skills that are required to solve practical problems related to the design and use of ventilation and air conditioning systems and building automation systems.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Define and describe the psychophysical factors that affect human comfort in enclosed spaces. Analyze the influence and explain the use of climate-meteorological data in building energy balance calculations. Comment the influence of thermal properties of building materials and building characteristics on building energy consumption. Calculate energy demand for building heating and cooling. Compare natural and forced ventilation and air-conditioning systems. Differentiate methods of air distribution. Explain classification and designs of basic elements of ventilation and air-conditioning systems. Apply acquired knowledge to solve practical problems of sizing and selection of the elements of ventilation and air-conditioning systems. Define and describe basic elements of automation systems. Define and describe basic types of controllers. Define basic elements and describe the operation of central automatic control and management systems for HVAC installations. Apply acquired knowledge to solve practical problems.		
1.4. Course content		
Psychophysical factors that affect human comfort in enclosed spaces. Thermal comfort and indoor air quality. Comfort indices. The influence of local climate-meteorological data on design of thermotechnical systems in buildings. Energy performance of buildings. Basics of building physics. Building characteristics. Thermal properties of building materials. Heating and cooling demand calculations. Ventilation requirements. Natural and forced ventilation. Local and central ventilation and air-conditioning systems. Air handling units. Heating and cooling coils. Water and steam humidifiers. Fans. Waste heat recovery systems. Air diffusion devices. Air distribution. Air ducts. Air pressure drop calculations. Sound attenuators. Heat generators and chillers in ventilation and air-conditioning systems. Sizing and selection of the elements of ventilation and air-conditioning systems. Principles of control systems. Control loop and its elements. Control loop feedback mechanisms. Elements and devices of control systems. Hydronic schemes for heating and air-conditioning control systems. Temperature control, frost protection. Air humidity control. Air pressure control. Outside air flow rate control. Energy efficient control strategies. Summer and winter compensation. Cascade and sequential control. Building automation systems.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other

1.6. Comments	

1.7. Student's obligations

Course attendance, activity, homework, studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, continuous knowledge testing (two mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Bošnjaković, F.: Thermodynamics, Vol. I, II and III (reprint editions of 1978, 1976 and 1986), Graphis d.o.o., Zagreb, 2012. (in Croatian)
Group of authors: Buildings Energy Certification Handbook, UNDP, Zagreb, 2010. (in Croatian)
P. Donjerković: Basics and Control of HVAC Systems, Vol. I and II, Alfa Zagreb, 1996. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Recknagel, Sprenger, Schramek: Heating and Ventilation Handbook, Springer Verlag, München (in German or in Serbian)
ASHRAE: Handbook of Fundamentals, ASHRAE, Atlanta
ASHRAE: Handbook of HVAC Systems and Equipment, ASHRAE, Atlanta
ASHRAE: Handbook of HVAC Applications, ASHRAE, Atlanta

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Bošnjaković, F.: Thermodynamics, Vol. I, II and III (reprint editions of 1978, 1976 and 1986), Graphis d.o.o., Zagreb, 2012. (in Croatian)	38	19
Group of authors: Buildings Energy Certification Handbook, UNDP, Zagreb, 2010. (in Croatian). (free download from www.energetska-efikasnost.undp.hr/images/stories/prirucnici/prircert.pdf)	unlimited	19
P. Donjerković: Basics and Control of HVAC Systems, Vol. I and II, Alfa Zagreb, 1996. (in Croatian)	3	19

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Application of Artificial Intelligence**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+15+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Acquisition of theoretical and practical knowledge on the application of advanced algorithms in complex systems.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Define the term artificial intelligence. Analyze the problem-solving methodology. Explain knowledge-based information system. Define and analyze an artificial neural network. Identify and analyze the techniques of evolutionary computation. Define and analyze machine learning algorithms. Identify and analyze the theory of games. Apply artificial intelligence in optimization problems. Analyze systems of learning and visual recognition. Apple autonomous agents with collaborative behavior. Applied game theory in economic systems. Apply artificial intelligence to simulate a social system.		
1.4. Course content		
Definition of artificial intelligence. A historical overview and a look into the future. Problem solving methodology. Knowledge and reasoning: knowledge-based information system. Unreliability of knowledge and reasoning. Artificial neural networks. Convolutional neural networks. Evolutionary computation: genetic algorithms, fuzzy logic. Particle swarm optimization and artificial bee colony. Support vector method and k-nearest algorithm neighbors. Expert systems. Machine learning: learning from perception, learning in neural and belief networks, learning on mistakes, knowledge in learning. Game theory: complex multi-agent systems, autonomous intelligent agents. Data mining. Application of artificial intelligence, optimization and planning of real problems, learning systems, visual recognition systems, artificial intelligent systems in robotics, autonomous agents with collaborative behavior, game theory in economic systems, application of artificial intelligence algorithms in medicine, language processing and recognition, social simulation. Automated devices. Driven tools.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		
Attendance, activities in the classroom, homework and self-study.		
1.8. Evaluation of student's work		

Course attendance	1.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam	1	Essay		Research	
Project	1	Sustained knowledge check		Report		Practice	0.5
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Oral explanation of simulation exercises or project task, continuous knowledge test (two control tasks), written final and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Bramer, M., Devedzic, l, Artificial Intelligence application and Innovations, 2004.
Arbir, M.A.,The Handbook of Brain Theory and Neural Networks, 2002.
Russell, S.J., Norvig P., Artificial Intelligence: A Modern Approach, 2009.
Understanding Artificial Intelligence (Science Made Accessible), 2002.
George F. Luger. Artificial Intelligence: Structures and Strategies for Complex Problem Solving. Addison-Wesley, 2005

1.11. Optional / additional reading (at the time of proposing study programme)

Ritter, G.X., Wilson, J.N., Handbook of Computer Vision Algorithms in Image Algebra, 1996.
Thalmann, N.M., Thalmann, D., Artificial Life and Virtual Reality, 1994.
Blay Whitby. Artificial Intelligence. Oneworld Publications, 2003.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Bramer, M., Devedzic, l, Artificial Intelligence application and Innovations, 2004.		
Arbir, M.A.,The Handbook of Brain Theory and Neural Networks, 2002.	1	
Russell, S.J., Norvig P., Artificial Intelligence: A Modern Approach, 2009.	1	
Understanding Artificial Intelligence (Science Made Accessible), 2002.		

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through a structured quality assurance system of the Faculty.

Basic description		
Course title	**Application of Parallel Computing**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Obtaining theoretical knowledge and develop skills in parallel computing.							
1.2. Course enrolment requirements							
Attended course Modelling in Engineering.							
1.3. Expected course learning outcomes							
Define and describe computer architectures classification by Flynn. Describe clusters, ccNUMA concepts, constellations, cloud and grid concepts, SMP cluster. Describe and analyse network topologies. Analyse and apply the knowledge of the domaing decomposition concepts. Analyse parallel programs and their efficiency. Describe and analyse shared memory and distributed memory programing. Analyse and apply the knowledge of the linear solver parallelisation and algebraic domain decomposition.							
1.4. Course content							
Introduction to supercomputing. Computer architecture classification by Flynn DM-SIMD, SM-SIMD. Computer architectures SM-MIMD, DM-MIMD. Clusters, ccNUMA, constellations, cloud and grid concepts. SMP cluster. Network topologies. Parallel computing concepts.. Numerical assignment – domain decomposition. Parallel program analysis – efficiency. Parallel program models. Shared memory computers programing concepts. Distributed memory computers programing concepts. Parallel programming assignment – integration. Linear solver parallelisation. Algebraic domain decomposition.							
1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, studying.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation	0.5	Seminar paper	0.5	Experimental work	
Written exam		Oral exam		Essay		Research	
Homework	1	Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, two mid-term seminar presentations.

1.10. Assigned reading (at the time of the submission of study programme proposal)

J. Dongarra, I. Foster, G. Fox , K. Kennedy, A. White, L. Torczon, W. Gropp, The Sourcebook of Parallel Computing, Elsevier Science, San Francisco, CA, 2003
A. Grama, A. Gupta, G. Karpypis, V. Kumar, Introduction to Parallel Computing
G. E. Karniadakis, R. M. Kirby; Parallel Scientific Computing in C++ and MPI, Cambridge University Press, 2003.

1.11. Optional / additional reading (at the time of proposing study programme)

P.S. Pacheco, Parallel Programming with MPI
B. Chapman, G. Jost, R. Van der Pas, Using OpenMP

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
J. Dongarra, I. Foster, G. Fox , K. Kennedy, A. White, L. Torczon, W. Gropp, The Sourcebook of Parallel Computing, Elsevier Science, San Francisco, CA, 2003	1	10
A. Grama, A. Gupta, G. Karpypis, V. Kumar, Introduction to Parallel Computing	1	10
G. E. Karniadakis, R. M. Kirby; Parallel Scientific Computing in C++ and MPI, Cambridge University Press, 2003.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**CAD/CAPP/CAM**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Acquisition of specialized knowledge and skills in the project design, reconstruction and production of complex parts based on the use of computers with the intensive application of CAD / CAM software packages.							
1.2. Course enrolment requirements							
Completed course Processes planning.							
1.3. Expected course learning outcomes							
Explain the problems of transferring data from CAD systems in NC programming system. Implement CAM software package in the area of the NC programming with the CAD basics. Critically evaluate the advantages and disadvantages of CAPP techniques (variant and generative approach to the use of computers in the process planning). Specify and analyse different methods and techniques of digitization. Implement the existing software for data conversion of CT/MRI systems to CAD/CAM data and build the model with additive technology processes.							
1.4. Course content							
Elaborating of hypothesis, solutions and trends in the development of automation technology of preparation of fabrication and assembly of the product, and automation of the control plans. Computer-supported programming numerically controlled machines. Methods and techniques of digitization, transformation of a series of 2D image data into a 3D model. CAD / CAM systems in medical engineering. Conversion of CT and MRI system data into CAD / CAM data and standardization of digital formats. Implementation of CAD/CAM software solutions for reconstruction, design and manufacturing of complex parts. Generating the "tool" path for the processes of additive technologies.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, class participation, program assignment, self-learning.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	

Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio						Program assignment	1

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance and activity on teaching, continuous knowledge check, program assignment and written and/or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

El Wakil, S.D.: Processes and Design for Manufacturing, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1989.
Instructions for using the software packages SolidWorks, Mastercam i Geomagic Design X

1.11. Optional / additional reading (at the time of proposing study programme)

Nelson, D.H., Schneider G.: Applied Manufacturing Process Planning, 2002, ISBN: 0831131586.
Besant, B., Lui, C.W.K.: Computer-Aided Design and Manufacture, Ellis Horwood 2007.
Kusiak, A.: Intelligent Manufacturing Systems, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1990.
Groover, M.P.: Automation Production Systems and Computer Integrated Manufacturing, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1987.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
El Wakil, S.D.: Processes and Design for Manufacturing, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1989.	1	25
Instructions for using the software packages SolidWorks, Mastercam i Geomagic Design X		25

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**CAE in Product Design**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Acquisition and application of advanced knowledge and skills in developing and constructing the elaborate machine elements and assemblies with intensive use of current software tools and applications.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Indicate and describe the basic concepts of CAE's and the ways and aspects of its application in product development. Distinguish and describe the ways and means of applying CAE in product development. Describe the current status and trends and directions of development of CAE methods and tools. Define the types of product models and features that it should have given its purpose and stage of product development. Analyze examples of a computational model of the product. Characterize computer modelling of elements and assemblies, and drafting and documentation. Describe the features of functional and numerical analysis of elements and assemblies. Describe methods of communication and information transfer characteristics between the individual CAE systems and applications. Generate a computer model of the product suited for a particular application of CAE and analyze it as part of a project to solve the task.		
1.4. Course content		
Introduction, basics and advanced concepts of CAE (Computer Aided Engineering). Review of currently implemented of CAE methods and techniques in product design, trends in development of CAE software tools. Product Lifecycle Management (PLM). Implementation of modern methods and software tools in product development and design (concurrent engineering, teamwork, automatization and integration of design process). 3D modelling of product elements and assemblies (requirements and correct techniques). Functional analysis of elements and assemblies (mass, moment of inertia, overlap analysis). Numerical analysis (static, kinematic, dynamic), topology optimization, generative design. Rapid prototyping technology overview, 3D printing, 3D scanning, digital image correlation. Information and data transfer between different CAE applications and packages. Overview of software tools and modules for other CAE applications.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other _
1.6. Comments		
1.7. Student's obligations		
Attendance, class participation, studying, program assignments.		

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Homework		Program assignments	1		

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance, continuous assessment (partial exams), program assignments, written / oral examination.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Teaching materials and notes from lectures.

Instructions for the use of Autodesk INVENTOR, Fusion 360, Ansys.

1.11. Optional / additional reading (at the time of proposing study programme)

Adams, V., Askenazi, A.: Building Better Products with Finite Element Analysis, Onword Press, Santa FE, 1999.

Lieu, D. K., Sorby, S. A..: Visualization, Modeling, and Graphics for Engineering Design, Delmar Cengage Learning, Clifton Park [etc.], 2009.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Instructions for the use of Autodesk INVENTOR, Fusion 360, Ansys.		12

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Casting**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+15+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Acquiring knowledge of the casting processes and methods for the production of castings. Understanding the process of solidification in the mold. Acquiring knowledge about the principles of construction of castings. Acquiring skills in designing pouring and risering system.							
1.2. Course enrolment requirements							
No requirements.							
1.3. Expected course learning outcomes							
Explain and differentiate casting processes and equipment in the production of castings. Describe the process of solidification of alloys in a mold. Define the pouring and risering system. Describe casting properties of alloys. Describe the principles of construction of castings. Define casting defects. Analyze residual stresses in the casting. Define the casting process based on construction and technological requirements.							
1.4. Course content							
Basic principles of molding. Models. Molding processes and materials. Equipment and machinery in the foundry. Schematic representation of the flow of the technological process in the foundry. Casting processes and methods. Basic aspects and terminology. Solidification of metal. Casting and risering of castings. Melting of metals and alloys. Castability of metals. Casting alloys. Modeling and simulation of solidification of the melt in the mold. Principle constructions of castings. Casting defects. Residual stresses in the casting. Cleaning and inspection of castings. The impact of the foundry on the environment.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork			☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other			
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, preparation of seminar papers, independent learning.							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper	1.5	Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge	1	Report		Practice	

		check					
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, sustained knowledge check, seminar papers, written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Katavić, I., Casting, Sveučilište u Rijeci, 1993. (in Croatian)
Campbell J., Complete casting handbook : metal casting processes, metallurgy, techniques and design, 2nd ed, Oxford : Elsevier, cop. 2015.

1.11. Optional / additional reading (at the time of proposing study programme)

Casting manual, Savez ljevača Hrvatske. (in Croatian)
ASM Handbook, Volume 15, Casting, ASM International, Materials Park, OH, 1998.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Katavić, I., Casting, Sveučilište u Rijeci, 1993. (in Croatian)	21	20
Campbell J., Complete casting handbook : metal casting processes, metallurgy, techniques and design, 2nd ed, Oxford : Elsevier, cop. 2015.	1	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**CNC/NC Machine Tools**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+15+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Assuming theoretical and practical knowledge about CNC/NC technology.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Describe characteristics of NC/CNC/DNC/AC. Analyse of measuring, drive and tooling systems, then clamping system, storage, transportation of tools and workpiece. Analyse of machine tools structural elements. Compare and describe control systems of NC/CNC. To define and apply virtual simulation of CNC machine tools. Apply PLC programming system and postprocessors. Describe modern manufacturing systems. Analyse of fixtures design.							
1.4. Course content							
Introduction in NC/CNC technology. NC/CNC/DNC/AC characteristics. Measuring systems and sensors at CNC machine tools. Machine tools structural elements and drive systems (main and feed drives). Tooling systems (tools selection, holders, presetting, driven tools, tool storage, and tool identification systems and tools transportation). Clamping system, workpiece changing and transport. Machining centers (horizontal, vertical). High speed machine tools. Parallel kinematics. Control systems CNC/NC (PLC and SoftPLC). Design of CNC/NC systems. Computer control and machine tool simulation graphics. Theory of making postprocessors. Fixtures.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Class attendance and activity, homework and independent learning.							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project		Sustained knowledge check	2.5	Report		Practice	

Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Class attendance and activity, homework, continuous knowledge assessment, and written and/or oral examination.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Tadić, B., Vukelić, Đ., Jurković, Z.: *Tools, Jigs and Fixtures*, ISBN: 978-86-6335-000-7, Fakultet inženjerskih nauka u Kragujevcu, Kragujevac, 2013. (in Serbian)
Lopez de Lacalle, L. N. ; Lamikiz, A.: *Machine Tools for High Performance Machining*, ISBN 978-1-84800-379-8, Springer, 2009.
Apro, K.: *Secrets of 5-Axis Machining*, ISBN-13: 978-0831133757, Industrial Press, 2008.

1.11. Optional / additional reading (at the time of proposing study programme)

Weck, M.: *Werkzeugmaschinen Fertigungssysteme*, Band 1-5, Springer-Verlag, 1998-2002.
Smid, P.: *CNC programming handbook*, ISBN-13: 978-0831133474, Industrial Press, 2008.
Kief H. B., Roschiwal, H. A.: *CNC Handbook*, ISBN-13: 978-0071799485, McGraw-Hill Education, 2012.
Ito, Y.: *Modular Design for Machine Tools*, ISBN-13: 978-0071496605, McGraw-Hill Education, 2008.
Suh, S.-H., Kang, S.-K., Chung, D.-H., Stroud, I.: *Theory and Design of CNC Systems*, ISBN-13: 978-1849967877, Springer, 2010."

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Tadić, B., Vukelić, Đ., Jurković, Z.: *Tools, Jigs and Fixtures*, ISBN: 978-86-6335-000-7, Fakultet inženjerskih nauka u Kragujevcu, Kragujevac, 2013. (in Serbian)	12	27
Lopez de Lacalle, L. N. ; Lamikiz, A.: *Machine Tools for High Performance Machining*, ISBN 978-1-84800-379-8, Springer, 2009.	1	27
Apro, K.: *Secrets of 5-Axis Machining*, ISBN-13: 978-0831133757, Industrial Press, 2008.	1	27

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Components of Mechatronic Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Integration of mechanical engineering, electrical engineering and computer sciences. Acquiring of the theoretical knowledge about essential elements of mechatronic systems: actuators, sensors and control hardware & software. Understanding the relationships between different parts of a mechatronic system.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Define and explain the idea of mechatronics systems as well as a concept of mechatronics as an interdisciplinary branch. Differentiate components of mechatronic systems. Describe and explain the principles and features of different control hardware and software. Describe working principles and applications of different actuators and sensors. Understand connection between sensors, actuators and control hardware. Gain basic knowledge of LabVIEW programming environment.							
1.4. Course content							
Definition and concept of mechatronics systems. Control and data acquisition hardware in mechatronics. Power amplifiers. Sensors and their applications. Sensors (proximity, position, speed, acceleration, force, stress, temperature). Actuators and their applications. DC motors. AC motors. Servo motors. Stepper motors. Linear motors. Hydraulic and pneumatic actuators. The basics of the LabVIEW programming environment and its integration with sensors, actuators and data acquisition and control hardware.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Attendance, class participation, preparation and problem solving, independent learning.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation	0.5	Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	

Portfolio		Laboratory exercises	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance, program assignments, continuous assessment (partial exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Teaching materials and notes from lectures.

1.11. Optional / additional reading (at the time of proposing study programme)

S. Zelenika, E. Kamenar: „Precizne konstrukcije i tehnologija mikro i nanosustava I – Precizne konstrukcije“, Tehnički fakultet Sveučilišta u Rijeci, 2015.

S. Zelenika, E. Kamenar, M. Korda, I. Mezić: „Application of Koopman-Based Control in Ultrahigh-Precision Positioning“. In The Koopman Operator in Systems and Control (pp. 451-479). Springer, Cham, 2020.

R. M. Schmidt, G. Schitter, A. Rankers, J van Eijk: „The Design of High Performance Mechatronics“ – 2nd ed., Delft University Press, 2014.

R. H. Bishop: „The Mechatronics Handbook“ – 2nd ed., CRC Press, Washington, D. C., 2007.

R. H. Bishop: „Mechatronics - an Introduction“, Taylor and Francis Group, LLC, 2006.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Compressors**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	1.	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+15+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Assuming theoretical knowledge and development of skills for solving of practical problems in application of compressors.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
To specify classification and thermodynamic fundamentals of compressors. Calculation of parameters and analysis of single stage and multi stage compression processes. Description of design, parts and constructive features of positive displacement and dynamic compressors, calculation of main constructive features. Specification and comparison of capacity controls for different compressor types. Description of compressors application in refrigeration and compressed gas installations. Description of installation, operation and maintenance of compressors.							
1.4. Course content							
Classification and application of compressors. Thermodynamic fundamentals of compressor operation. Compressor power consumption and efficiency. Reciprocating compressors: construction, design calculations, kinematics and dynamics of a reciprocating mechanism, ideal and actual capacity, valves, capacity control, lubrication. Rolling piston, sliding vane, screw and scroll compressors: constructive features, capacities and control. Turbo compressors: constructive features, performance and control. Ejectors: constructive features and basic design calculations. Installation, operation and maintenance of compressors. Application of compressors in refrigeration and compressed gas installations. A design project can be chosen from subject contents.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, activity, studying.							
1.8. Evaluation of student's work							
Course	1.5	Activity/Participation		Seminar paper		Experimental	

attendance						work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	2.5	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Activity, continuous knowledge testing (two mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Pavković, B.: Compressors, (lectures), https://moodle.srce.hr

1.11. Optional / additional reading (at the time of proposing study programme)

Ludwig, E.E.: Applied Process design for Chemical and Petrochemical Plants, Volume I, II and III, (book), Gulf Publishing Company, Houston 1984.
Boyce, M.P.: Centrifugal Compressors: A Basic Guide, (book), Penn Well Corp., Tulsa 2003.
Andrassy, M.: Compressors, (book), FSB, Zagreb 2004. (in Croatian)
V. Brlek: Compressor, Tehnička enciklopedija Sv. 7, (book), pp. 221-255. (in Croatian)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Pavković, B.: Compressors, (lectures), https://moodle.srce.hr	unlimited	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Computational Fluid Dynamics**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Defining and modelling problems in engineering practice. Application of suitable methods for specific classes of fluid flow. Usage of commercial and open-source software for fluid flow analysis in engineering practice.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Description and assessment of mathematical model for given physical problem in fluid mechanics. List and description of numerical methods in fluid mechanics. Usage and appropriate elaboration of finite volume method for mathematical model in fluid mechanics problems. Usage and appropriate elaboration of turbulent models for specific classes of fluid flow. Application of software packages for fluid flow simulation of simple problems. Application of high order schemes. Assessment and proper evaluation of simulation results of steady and unsteady fluid flows. Proper evaluation of simulation results of compressible fluid flow. Assessment and proper evaluation of simulation results of free surface flow.							
1.4. Course content							
Mathematical models of fluid flow. Reynolds averaging. Space-time discretization. Numerical methods. Finite difference method. Finite volume method. Approximation and interpolation. Boundary conditions. Initial conditions. Navier-Stokes equations. Turbulence modelling. Error estimation. Steady flow. Unsteady flow. Compressible flow. Free surface flow.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Lectures, exercises, long distance education, individual assignment, consultations.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	

Project	2	Sustained knowledge check		Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, continuous knowledge testing (two mid-term exams), written and oral exam

1.10. Assigned reading (at the time of the submission of study programme proposal)

Ferziger J.H. & Peric M. (1999) Computational Methods for Fluid Dynamics, Springer, Berlin, Germany.
Zikanov O. (2010) Essential Computational Fluid Dynamic, John Wiley & Sons Inc., ISBN 978-0-470-42329-5
J. D. Anderson. Computational fluid dynamics : the basics with applications McGraw-Hill series in mechanical engineering, McGraw-Hill, New York, 1995.

1.11. Optional / additional reading (at the time of proposing study programme)

P. Wesseling. Principles of computational fluid dynamics. Springer-Verlag, Berlin Heidelberg, 2001.
C. Hirsch. Numerical Computation of Internal and External Flows vol 1, 2, John Wiley & Sons, 1990

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Ferziger J.H. & Peric M. (1999) Computational Methods for Fluid Dynamics, Springer, Berlin, Germany.	1	30
Zikanov O. (2010) Essential Computational Fluid Dynamic, John Wiley & Sons Inc., ISBN 978-0-470-42329-5	1	30
J. D. Anderson. Computational fluid dynamics : the basics with applications McGraw-Hill series in mechanical engineering. McGraw-Hill, New York, 1995.	1	30

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Computational Modeling of HVAC & Thermal Power Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Developing skills and competencies for solving technical problems of analysis, synthesis and optimisation of thermal power & HVAC systems in buildings, plants and industry.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Indicate and demonstrate the properties of computer programs for simulation of thermal power and HVAC systems. Creating of a test reference year for meteorological data. Creating models of electrical and thermal energy consumers including thermal model of building suitable for calculating of energy properties. Definition and explanation of main operating parameters for thermal power and energy processes in buildings and industry. Explanation of basic process concepts. Creation of models describing thermal, cooling and electricity production systems with distribution and energy consumption models. Calculation of main operating parameters and consumption of useful, delivered and primary energy. Analysis and explanation of factors relevant for the process efficiency. Analysis of economic parameters of the process. Definition and justification of optimization criteria and system optimization.		
1.4. Course content		
Methods of energy systems modeling. Available computer software. Modelling the test reference year for meteorological data. Thermal model of energy consumption and the building. Influential factors on energy consumption. Modelling of heating, cooling and electricity production equipment (boilers, turbines, motors, heat pumps, chillers, cogeneration units, heat exchangers and storage tanks). Modelling of thermal energy distribution elements (air ducts, pipelines, pumps, fans). Modeling of heating and cooling energy emission (surface heating and cooling, radiators, fan convectors, units for air treatment and distribution). Modelling of the control system. Integration of elements into the system. Calculations of system working parameters, useful, supplied and primary energy. Process optimization by changing operating parameters, set points of control system, component properties or system configuration. Monitoring and analysis of process parameters. Economic analysis of the system.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☒ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Course attendance, activity, studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Assessment and evaluation of student's work during classes and on final exam

Activity, continuous knowledge testing (two midterm exams), project, written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Pavković, B., Delač, B.: Numerical modeling of HVAC & thermal power systems (lectures), https://moodle.srce.hr

1.11. Optional / additional reading (at the time of proposing study programme)

ASHRAE: 2017 ASHRAE HANDBOOK- FUNDAMENTALS, (book) ASHRAE Atlanta, 2017.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Pavković, B., Delač, B.: Numerical modeling of HVAC & thermal power systems (lectures), https://moodle.srce.hr	unlimited	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's system of quality control.

Basic description		
Course title	**Computer Integrated Manufacturing**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+15+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Understanding the principles of integration of IT within the concept of Industry 4.0. Understanding computer-aided engineering. Ability to analyze software solutions for business integration and smart factory.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Explain the application of IT within the production process. Define the structure and principles of design of integrated information systems. Explain the integral elements of the Industry 4.0 concept. Explain the concept of CAD-CAM systems. Describe the integrated quality control CAQ. Explain the concept of Assembly System 4.0. Explain integrated production planning and control: MRPII, ERP and PLM solutions. Analyze software solutions for automatic control of production. Simulate the activities in the integrated production system/assembly system. Describe flexible manufacturing systems, industrial robots and tool management.							
1.4. Course content							
Basic notions and definitions. Structure and basic principles for design of integral information system. Integral elements of the Industry 4.0: autonomous robots, computer simulations, system integration, internet of things, cyber security, cloud computing, additive technologies, augmented reality, large data sets. Enterprise organization and information flow. Principles of simultaneous engineering. CAD in production engineering. CAM. Control systems. CAQ. CNC machine tools. Integral production planning and control. MRPII, ERP and PLM software solutions. Characteristics of software for production planning and control. Flexible manufacturing systems. Industrial robots. Tool management. Software solutions for discrete simulations. Trends and future development.							
1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☐ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Attendance, class participation, making the seminar work, independent learning.							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper	1	Experimental work	
Written exam	1	Oral exam		Essay		Research	1

Project		Sustained knowledge check	0.5	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance and activity on lessons, project solution, written and/or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Mikac, T.: Computer Integrated Manufacturing, script on web, Tehnički fakultet Rijeka, 2004. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Groover, M.P.: Automation, Production Systems, and Computer-Integrated Manufacturing, 5th edition, Pearson, 2019.
Koren, Y.: The Global Manufacturing Revolution, John Wiley and Sons, Inc., 2010.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Mikac, T.: Computer Integrated Manufacturing, script on web, Tehnički fakultet Rijeka, 2004. (in Croatian)	As needed	16

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Computer Simulation of Production Processes**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+15+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
The development of theoretical and computer simulation knowledge and their application to concrete examples of production processes with an indication of their optimality. Acquisition of specialized skills of modeling and simulation of production processes with the use of current software packages.							
1.2. Course enrolment requirements							
Completed course Processes planning.							
1.3. Expected course learning outcomes							
Explain the theoretical basis of simulation. Identify adequate simulation methods for given engineering formulations of production problems. Describe the discrete event simulation. Apply available simulation software packages to production problems. Plan, model and perform simulation experiments to improve the performance of production systems and production processes. Solve production problems by applying computer simulations. Evaluate the results of computer simulations of production processes.							
1.4. Course content							
Theoretical basis of simulations. Classification of computer simulation methods. Simulation concept. Methodology for making a simulation model. Discrete event simulation (DES). Modeling and simulations of production systems and production processes using available DES software packages, such as: Tecnomatix Plant Simulation, Arena, etc. Examples of simulation of machining and production processes. Optimization tools. Simulation-optimization approach. Application of genetic algorithms and neural networks in the optimization of production processes and production planning and scheduling. Application of simulation-optimization approach on concrete examples.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork			☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other			
1.6. Comments							
1.7. Student's obligations							
Course attendance, class participation, program assignment, self-learning.							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project		Sustained knowledge	2	Report		Practice	

		check					
Portfolio		Homework		Laboratory work		Program assignment	1

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance and activity on teaching, program assignment, continuous knowledge check and written and/or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Carrie, A.: Simulation of Manufacturing Systems, Internationalbooks, 1998.
Pinedo, M.: Scheduling, 5th edition, Springer, 2016.
Instructions for using the software packages Tecnomatix Plant Simulation, Arena

1.11. Optional / additional reading (at the time of proposing study programme)

Banks, J. et al.: Discrete-Event System Simulation, 5th edition, Pearson Education, 2010.
Bangsow, S.: Manufacturing Simulation with Plant Simulation and SimTalk, Springer, 2010.
Bangsow, S.: Tecnomatix Plant Simulation, 2nd edition, Springer, 2020.
Hurrion, R.D.: Simulation: Applications in Manufacturing (International Trends in Manufacturing Technology), Internationalbooks, 1998.
Law, A.M. & Kelton, W.D.: Simulation Modelling and Analysis, 2nd edition, McGraw-Hill, 1991.
Winston, W.L. & Goldberg, J.B.: Operations Research - Applications and Algorithms, 4th edition, Thomson Brooks/Cole, 2004.
Askin, R.G.: Modelling and Analysis of Manufacturing Systems, John Willey and Sons, 1993.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Carrie, A.: Simulation of Manufacturing Systems, Internationalbooks, 1998.	1	19
Pinedo, M.: Scheduling, 5th edition, Springer, 2016.	1	19
Instructions for using the software packages Tecnomatix Plant Simulation, Arena		19

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Control of Dynamic Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Obtaining theoretical knowledge of linear system control and the ability to analyze its performance. Solving practical examples of dynamic systems control.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
For a simple dynamic system determine the transfer function and its step response. Define state space equation for a simple dynamic system. Describe the Hurwitz stability criterion. Analyze system stability based on the poles of a given transfer function. Describe differences between Bode and Nyquist plot and apply them to show given transfer function. Describe PID controller and specify basic methods for its tuning. Analyze response of the PID controller for a given test signal. Analyze feedback control systems in the time and frequency domain by using Matlab.							
1.4. .Course content							
Classifications of dynamical systems. SISO i MIMO models of dynamic systems. Continuous- and discrete time signals. Continuous state space models. Transfer functions and Laplace transforms. Response of dynamic systems in time domain. Response of dynamic systems in frequency domain. Stability of dynamic systems. PID control. Sensitivity and robustness of control system. Basics of Digital system control. Software tools: MATLAB and Simulink. Practical problem solving: Active suspension control.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork			☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other			
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, project reports, studying							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Project assignment	1				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, project reports, written exam

1.10. Assigned reading (at the time of the submission of study programme proposal)

Novaković, B.: Control systems, Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu, 1990. (in Croatian)
Vukić, Z., Kuljača, Lj.: Automatic control; Linear system analysis, Kigen, Zagreb, 2005. (in Croatian)
Moon, F.C.: Applied Dynamics; With application to Multibody and Mechatronic Systems, Wiley VCH Weinheim, 2004.

1.11. Optional / additional reading (at the time of proposing study programme)

Genta, G.: Vibration of Structures and Machines, Springer, third edition, 1999.
Gawronski, W.K.: Advanced Structural Dynamics and Active Control of Structures, Springer, New York, 2004.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Novaković, B.: Control systems, Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu, 1990. (in Croatian)	1	8
Vukić, Z., Kuljača, Lj.: Automatic control; Linear system analysis, Kigen, Zagreb, 2005. (in Croatian)	2	8
Moon, F.C.: Applied Dynamics; With application to Multibody and Mechatronic Systems, Wiley VCH Weinheim, 2004.	1	8

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Control of Mechatronics Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Understanding of basic terminology in control of mechatronics systems. Application of control systems to real control problems. Development of student's capabilities to work autonomously in groups - team work. Presentation of achieved results.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Explain the role and principles of control in mechatronics. Use Laplace transforms to solve linear differential equations that describe a mechatronics system being analysed. Define a block diagram of the considered system. Determine the transfer function of the system. Describe standard excitation functions. Define stability criteria for controled system. Draw Bode and Nyquist plots for the given transfer function. Describe the basic characteristics of the PID controller. Use Matlab/Simulink software packages for the analysis and solution of problems. Describe control of a mechatronics system by using control hardware and LabVIEW programming environement. Teamwork and written and oral communication with experts in the field. Implementation of the acquired knowledge to solve practical problems.							
1.4. Course content							
Fundamental principles of control. Dynamic models and responses. Laplace transforms. Basic principles of feedback. Transfer function. Standard excitation functions. Nyquist and Bode methods. Systems stability criteria. Analysis and synthesis of linear continuous control systems in the time and frequency domain. Conventional control via a PID regulator, control with compensation of disturbances and cascade regulation. Examples of control of mechatronics systems by using control hardware and corresponding software interface.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, activity, project work and autonomous study.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	

Written exam		Oral exam	0.5	Essay		Research	
Project	2	Sustained knowledge check	0.5	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Active participation to classes and project work. Knowledge review via quizzes and on final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

S. Zelenika, E. Kamenar, M. Korda, I. Mezić: „Application of Koopman-Based Control in Ultrahigh-Precision Positioning". In The Koopman Operator in Systems and Control (pp. 451-479). Springer, Cham, 2020.
G. F. Franklin, J. D. Powell, A. Emami-Naeini: Feedback Control of Dynamic Systems - 8th ed., Pearson Higher Education, 2019.
S. Zelenika, E. Kamenar: Precizne konstrukcije i tehnologija mikro- i nanosustava I – Precizne konstrukcije (Precision Engineering and Micro- and Nanosystems Technologies – Precision Engineering), University of Rijeka – Faculty of Engineering, Rijeka (HR), 2015.

1.11. Optional / additional reading (at the time of proposing study programme)

D. Matika, D. Brnobić: Osnove regulacijske tehnike, Tehnički fakultet Rijeka, 2004.
T. Šurina: Automatska regulacija, Školska knjiga, Zagreb, 2001.
V. Kuljača, Z. Vukić: Automatic Control Systems (in Croatian), Školska knjiga., Zagreb, 1985.
D. E. Seborg, T. F. Edgar, D. A. Mellichamp: Process Dynamics and Control, John Wiley & Sons, New York, 1989.
Nise, N.: Control System Engineering. New York; John Wiley & Sons, New York, 2000.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
S. Zelenika, E. Kamenar, M. Korda, I. Mezić: „Application of Koopman-Based Control in Ultrahigh-Precision Positioning". In The Koopman Operator in Systems and Control (pp. 451-479). Springer, Cham, 2020.	1	20
G. F. Franklin, J. D. Powell, A. Emami-Naeini: Feedback Control of Dynamic Systems - 8th ed., Pearson Higher Education, 2019.	1	20
S. Zelenika, E. Kamenar: Precizne konstrukcije i tehnologija mikro- i nanosustava I – Precizne konstrukcije (Precision Engineering and Micro- and Nanosystems Technologies – Precision Engineering), University of Rijeka – Faculty of Engineering, Rijeka (HR), 2015.	5	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Via the institutionalised quality assurance system of the Faculty of Engineering. Constant interaction and work with the students with the aim of improving the quality of teaching.

Basic description		
Course title	**Designing the Production Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Qualified for the design of production systems. Ability to analyze models of production structures. Understanding the principles of group technology.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Define the production system. Describe the characteristics of the production program. Explain the production availability of equipment and manpower. Analyze capacity utilization and system: technical and economic. Distinguish the models the flow of material and processing workflows. Define the correlation coefficient of operations and equipment. Explain the handling and transport of the workpiece, the input, between operations and exit transport. Define the processing cycle: explain the processing time, time of control, transport and waiting. Explain the models of production systems, a single or multi-workpiece lines, serial and flexible systems. Explain the organization of the work flow through the production system. Explain the method of grouping articles. Describe the layout of the plant, equipment and organization of the warehouse. Develop the project of production system: the task, analysis the variables, the concept of the project, plans of processing, optimization solutions, and the choice of the production model (lines, serial or flexible system). Choose of the transportation system.		
1.4. Course content		
Definition of the production system. Characteristics of the production program. Time availability of equipment and manpower. Capacity and system utilization: technical and economic. Automatization levels. Models flow of material: current, wavy, linear, and flexible. Workflow processing: one-way, two-way. The correlation coefficient of operations and equipment. Handling and transport of the workpiece. Input, between operations and exit transport. The level of automation of transport. Quality control systems. Workpiece processing cycle: during processing, time of transport and waiting. Models of production systems. Single or multi-workpiece line, serial and flexible systems. The organization of the work flow through the production system. Methods of grouping of workpieces. The process of designing production systems: the task, analysis of variables, the concept of the project, plans processing, optimization solutions, the choice of the production model (lines, serial or flexible system). Choosing of the transportation system. Discrete simulation of production. Production systems within Industry 4.0.		
1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Attendance and activity on class, seminar work.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper	2	Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance, class participation, seminar work, written and/or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Mikac, T.: Designing the Production Systems, script, Faculty of Engineering, Rijeka, 2004. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Koren, Y.: The Global Manufacturing Revolution, McGraw Hill, New York, 2010.
Tolio, T.: Design of Flexible Production Systems, Springer-Verlag Berlin Heidelberg, 2009.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Mikac, T.: Designing the Production Systems, script, Faculty of Engineering, Rijeka, 2004. (in Croatian)	As needed	27

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Durability of Machines and Structures**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Obtaining theoretical and practical knowledge required for assessment of life cycle of dynamically loaded machine and structure elements.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Describe the concept of fatigue. Describe the terms, load cycle and loading spectrum. Describe different approaches to the fatigue characterization and their application in assessment of durability. Explain how to plot Smith, Haigh. Explain Miner's rule. Describe experimental characterization of material and assessment of fatigue parameters. Describe stress concentration influence on durability. Explain the concept of safety with respect to the fatigue life. For a simple machine part and given operating condition perform assessment of the total life.							
1.4. Course content							
Load histories. Cycle counting technique. High-cycle fatigue and S-N curve. Smith, Haigh diagram. Counting techniques and Palmgren-Miner's rule. Different Influences on fatigue limit: temperature, stress concentration, surface treatment, environment condition. Strain based fatigue approach. Life prediction according to crack initiation. Experimental assessment of fatigue parameters. Consepts of linear–elastic and linear plastic fracture mechanics. Crack growth analysis and life assessment. The concepts of safety. Probabilistic aspect of safety.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, project reports, studying							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	

Portfolio		Project reports	2				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, project reports, written exam

1.10. Assigned reading (at the time of the submission of study programme proposal)

Schijve, J.: Fatigue of structures and materials, Springer, 2008.
Dowling N.E., Kampe N.E., Kral M.V.: Mechanical Behavior of Materials, 5th ed., Global ed., Pearson, 2020.
Lee Y.L., Barkey, M.E., Kang, HT.: Metal fatigue analysis handbook: practical problem-solving techniques for computer-aided engineering, Elsevier Butterworth Heinemann, 2012.

1.11. Optional / additional reading (at the time of proposing study programme)

Haibach, E.: Betriebs-Festigkeit, VDI Verlag, Duesseldorf, 1989.
…Fracture and Fatigue, ASM Handbook, 1997.
Zehnder, A.T.: Fracture Mechanics, Springer, London, 2012.
Richard H.A., Sander M.: Fatigue Crack Growth: Detect-Asses-Avoid, Springer, 2016.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Schijve, J.: Fatigue of structures and materials, Springer, 2008.	2	9
Dowling N.E., Kampe N.E., Kral M.V.: Mechanical Behavior of Materials, 5th ed., Global ed., Pearson, 2020.	1	9
Lee Y.L., Barkey, M.E., Kang, HT.: Metal fatigue analysis handbook: practical problem-solving techniques for computer-aided engineering, Elsevier Butterworth Heinemann, 2012.	1	9

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Dynamics of Offshore Structures**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Understanding stochastic models of sea waves, current and wind loads on offshore constructions. The ability to estimate the probability of exceedance for certain dynamic effects criteria. Developing the ability to work in small groups (teamwork).							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Specify the basic methods of dynamic analysis of offshore structures. Properly explain, and interpreted the basic parameters of the waves as a random process. Explain stochastic model of action of waves, currents and wind on offshore structures. Indicate the design and operational parameters which have an influence on the dynamic response of offshore structures on the sea waves. Describe the procedures for short-term and long-term prediction of the dynamic response of offshore structures. Calculate the probability of exceedance of certain dynamic effects.							
1.4. Course content							
Dynamic aspects of importance for various offshore structures. Methods of analysis. Fundaments of probabilistic processes. Sea waves and sea states. Wave spectrums. Wave forces on slender structures (Morison's equation). Wave forces on large structures (diffraction theory). Effect of currents and winds. Response of a one-degree-of-freedom system. Multi-degree-of-freedom linear system. Deterministic and stochastic design methods. Response of offshore structures on sea waves. Short-term and long term prediction.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, activity, studying.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper	0.5	Experimental work	

Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, seminar paper, activity, continuous knowledge testing, written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Prpić-Oršić J.: Basic ship dynamics, Faculty of Engineering University of Rijeka, Fintrade &Tours, 2009. (in Croatian)
Journee, J.M.J., Massie, W.W.: Introduction in Offshore Hydromechanics, Delft University of Technology, Delft, Netherlands, 2001.

1.11. Optional / additional reading (at the time of proposing study programme)

Prpić-Oršić J., Čorić V.: Seakeeping, Zigo, University of Rijeka, 2006. (in Croatian)
Brebbia, C.A., Walker, S.: Dynamics Analysis of Offshore Structures, Newnes-Butterwoths, London, 1979.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Prpić-Oršić J.: Basic ship dynamics, Faculty of Engineering University of Rijeka, Fintrade &Tours, 2009. (in Croatian)	10	9
Journee, J.M.J., Massie, W.W.: Introduction in Offshore Hydromechanics, Delft University of Technology, Delft, Netherlands, 2001.	Available on internet	9

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Elements of Transport Technic**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	4
	Number of hours (L+E+S)	45+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Acquiring knowledge and skills about topics related to transport technic. The development of the ability to calculate, design and apply transport technic in industrial praxis, using modern materials and taking into consideration demands regarding reliability, safety, quality, cost, ecology, ergonomics, engineering ethics, etc.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Explain term, purpose, classification, application and historical development of transport technic. Explain and define classification and characteristics of transportational materials. Explain standards and service classes of hoisting appliances. Explain and define elements and devices for material handling. Define calculation and design of elements and devices for material handling. Explain and define elements of transport equipment and devices. Define calculation and design of transport equipment and devices. Understand the importance of using transportation ecology and engineering ethics in design and application of transport technic. Apply acquired knowledge in design and application of transport technic.		
1.4. Course content		
Introduction. Transport of materials and people. Historical development. The importance and place of transport in the industry. Basic concepts, application, divisions and characteristics of transport technic. Classification and characteristics of transportational materials. Standards and service classes of hoisting appliances. Elements and devices for material handling: hooks, stirrups, nippers, baskets, grabs, electro-magnets, steel wire ropes, chaines, pulleys, drums, brakes, wheels, rails, motor drives: - principal features, types, purpose, description, calculation and design. Industrial winches: - principal features, types, purpose, description, calculation and design. Belt conveyors, bucket elevators, table top chain conveyors, overhead chain conveyors, roller conveyors, vibratory conveyors, screw conveyors, pneumatic conveyors, air conveyors, flight conveyors: - principal features, types, purpose, description, calculation and design. Analysis of the importance of using transportation ecology and engineering ethics in design and application of transport technic.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Course attendance, activity, solving assigned project work, studying.

1.8. Evaluation of student's work

Course attendance	2.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project	0.5	Sustained knowledge check	0.5	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, 2 mid-term exams, project work, final written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Piršić, T.: Transport in Industry, FESB, Split, 2005. (in Croatian)
Ščap, D.: Transport Devices, Fakultet strojarstva i brodogradnje, Zagreb, 2004. (in Croatian)
Trešćec, I.: Theory, Calculation and Application of Belt Conveyors, Zavod za produktivnost, Zagreb, 1983. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Oluić, Č.: Transport in industry, Sveučilišna naklada d.o.o., Zagreb 1991. (in Croatian)
Herold, Z., Ščap, D., Hoić, M.: Lifting and Handling Equipment, Part 1, Fakultet strojarstva i brodogradnje, Zagreb, 2020. (in Croatian)
Herold, Z., Ščap, D., Hoić, M.: Lifting and Handling Equipment, Part 2, Fakultet strojarstva i brodogradnje, Zagreb, 2020. (in Croatian)
Dundović, Č., Hess, S.: Indoor Transport and Warehousing, Pomorski fakultet, Rijeka, 2007. (in Croatian)
Baura, Gail, D.: Engineering Ethics: An Industrial Perspective, Elsevier Academic Press, USA, 2006.
Fayed, M.E., Skocir, T.S.: Mechanical Conveyors, CRC Press, U.S.A., 2009.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Piršić, T.: Transport in Industry, FESB, Split, 2005. (in Croatian)	1	26
Ščap, D.: Transport Devices, Fakultet strojarstva i brodogradnje, Zagreb, 2004. (in Croatian)	1	26
Trešćec, I.: Theory, Calculation and Application of Belt Conveyors, Zavod za produktivnost, Zagreb, 1983. (in Croatian)	1	26

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Energy and Process Devices**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Acquisition of theoretical knowledge and develop the skills needed to design, calculation and exploitation of power and process equipment, especially steam generators and heat generators.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Explain thermodynamic process of the steam generator and heat generator. Describe the changes of the working fluids in the steam generator and heat generator. Explain and calculate the heat exchange inside the steam generator and heat generator. Calculate combustion in the furnace (air volume, quantity and composition of flue gases). Explain heat losses in the steam generator and heat generator and define its efficiency. Explain the heat calculation of the steam generator and heat generator. Draw basic configurations of main types of steam generators and heat generators. Explain and describe the characteristics of fluidised bed furnaces. Explain the calculation of strength of main pressure parts. Calculate main dimensions. Describe and explain the hydrodynamic process inside of the steam generator and heat generator: circulation, flow of air and flue gas. Describe and explain auxiliary systems and equipment of steam generators and heat generators. Explain regulations regarding the design and exploitation of energy and process devices.		
1.4. Course content		
The introduction of s steam generators and heat generators. Fundamentals of steam generators and heat generators, types, operating parameters. Thermodynamic process in the steam generator and heat generator. Fludised bed combustion. Heat balance, losses and efficiency. Fuel and combustion. The thermal balance, calculation of heating surface. The circulation of water. Flow of glue gas and air. Utilisation of condensing heat of flue gases from a heat generator. Strength calculation and materials for pressure parts. Basics of automatic regulation and control of energy and process devices . Design and construction of steam generators and heat generators. Structural parts. Auxiliary devices. Other energy and process equipment.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	-	

1.7. Student's obligations

Course attendance, activity, studying.

1.8. Evaluation of student's work

Course attendance	2.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	1.5	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, continuous knowledge testing (two mid-term exams), written or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

- Prelec, Z.: Ship steam generators (in Croatian), Školska knjiga, Zagreb, 1992.
- Prelec, Z.: Summary of lectures (pdf. on Faculty web)

1.11. Optional / additional reading (at the time of proposing study programme)

- Kreuh, L.: Steam generators (on Croatian), Školska knjiga, Zagreb, 1978.
- Reznikov, M. I.: Lipov, Yu. M.: Steam Boilers of Power Stations, Mir Publishers, Moscow, 1985.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
- Prelec, Z.: Ship steam generators (in Croatian), Školska knjiga, Zagreb, 1992.	4	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's system of quality control

Basic description		
Course title	**Engineering Logistics**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Introduction to engineering logistics. Acquiring knowledge about engineering logistics topics through the study of materials transport, organisation, cost planning, and management.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Explain the term, purpose and historical development of engineering logistics. Explain technology and organisation of material handling. Explain and define storage of materials using pallets, boxes, warehouse shelves, warehouse racks and containers. Explain and define occasional and continuous transport systems. Analyse costs, planning, management and design of transport systems. Explain and define warehousing systems and processes. Analyse the technology, organisation, management and automation of warehousing systems. Explain and define industrial transport equipment and devices in warehouses. Analyse the technology and costs of vehicles in warehouses. Understand the importance of green logistics, city logistics, reverse logistics, transport logistics and engineering ethics in the design and management of engineering logistics. Explain, define and analyse the impact of inventories, strategic procurement, locations and distribution network of supply chains. Apply acquired knowledge in the design of engineering logistics systems.		
1.4. Course content		
Engineering and business logistics. Historical development of logistics. Logistic systems and processes. Material handling processes. Design, planning and management of engineering logistics. Technology and management of material handling. Basic principles, unit load, pallet, forklift. Storage of materials using pallets, boxes, warehouse shelves, warehouse racks and containers. Occasional and continuous transport systems. Conventional and automated transport systems in warehouses. Palletising and depalletising systems. Application of industrial transport equipment and devices in warehousing processes. Applications of green logistics, city logistics, reverse logistics, transport logistics and engineering ethics in processes of engineering logistics. Software and expert systems for design, analysis and simulation of engineering logistics systems. Location theory, distribution network planning and design, green supply chain management, inventory management, return logistics, strategic procurement.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Course attendance, activity, solving assigned project work, studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project	0.5	Sustained knowledge check	1.5	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, mid-term exams, project work, final written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Oluić, Č.: Warehousing in Industry, FSB, Zagreb, 1997. (in Croatian)
Zlonoga, D., Lukačević, M.: Pallets and Palletisation, August Šenoa, Zagreb, 1993. (in Croatian)
Dundović, Č., Hess, S.: Indoor Transport and Warehousing, Pomorski fakultet, Rijeka, 2007. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Habus, J., Zlonoga, D.: Applications of Forklifts, Nakladništvo & Marketing, Zagreb, 1997. (in Croatian)
Oluić, Č.: Transport in Industry, Sveučilišna naklada d.o.o., Zagreb 1991. (in Croatian)
Bowen, R. W.: Engineering Ethics, Springer-Verlag London Limited, 2009.
Richards, G.: Warehouse Management, Kogan Page Limited, London, 2015.
Canen, A. G., Canen, A.: Logistics in global corporations, Društvo za plastiku i gumu, Zagreb, 2011. (in Croatian)
Stroh, M. B.: A Practical Guide to Transportation and Logistics, Logistics Network, USA, 2006.
Frazelle, E. H.: World-Class Warehousing and Material Handling, McGraw-Hill, USA, 2002.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Oluić, Č.: Warehousing in Industry, FSB, Zagreb, 1997. (in Croatian)	5	5
Zlonoga, D., Lukačević, M.: Pallets and Palletisation, August Šenoa, Zagreb, 1993. (in Croatian)	3	5
Dundović, Č., Hess, S.: Indoor Transport and Warehousing, Pomorski fakultet, Rijeka, 2007. (in Croatian)	1	5

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Engineering Optimization**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Understand fundamental ideas of optimization methods. Mathematically formulate given optimization problems in engineering practice, recognize type and application of appropriate methods.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Analyze described optimal control problems. Set appropriate mathematical formulation of the problem. Classify optimization problems. Solve optimization problems with the aid of software. Evaluate results of applied methods. Correctly explain fundamental ideas and properties of some optimization methods. Develop basic ideas for optimization enhancements such as upgrades or simplification of optimization problem or underlying model, enhancements of optimization method, sensitivity analysis, metamodel use, and improvement of optimization process computational effectiveness.							
1.4. Course content							
Transport problem, work schedule problem, and similar problems. Linear programming. Basics of the simplex method. Application of LP software. Examples of nonlinear optimal control problems. Mathematical analysis tools. Numerical methods. Golden section search method. Powel methods. Ameba. CGD method. Application of software. Traveling salesman problem and similar problems. Genetic algorithms. GA operators: selection, crossover, and mutation. Application of GA software. Stochastic, heuristic and metaheuristic methods. Swarm intelligence methods: particle swarm optimization, ant colony optimization and related methods. Parametrization, shape optimization and topology optimization. Solving and presenting the results of complex engineering and multidisciplinary project tasks.							
1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, project, seminar paper.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	

Written exam		Oral exam	0.5	Essay		Research	
Project	1.5	Sustained knowledge check		Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, project, seminar paper, oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Andries P. Engelbrecht, Computational Intelligence: An Introduction, 2nd Edition, John Wiley & Sons Ltd, 2007.
Deb, K., Multi-objective optimization using evolutionary algorithms, John Wiley & Sons, Ltd., 2004
Cheng, F., Truman, K., Structural optimization : dynamic and seismic applications, Spon Press, 2010.
Winston, L.W., Operations Research – Applications and Algorithms, Duxbury Press, Belmont, 1994.
Bendsoe, M.P., Sigmund, O., Topology optimization : theory, methods and applications, Springer Verlag, 2004.

1.11. Optional / additional reading (at the time of proposing study programme)

Press, W., et al: Numerical Recipes for C/C++/Pascal/fortran, Cambridge University Press, 1992.
Goldberg, D. E., Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley Professional, 1989.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Andries P. Engelbrecht, Computational Intelligence: An Introduction, 2nd Edition, John Wiley & Sons Ltd, 2007.	1	20
Deb, K., Multi-objective optimization using evolutionary algorithms, John Wiley & Sons, Ltd., 2004	1	20
Cheng, F., Truman, K., Structural optimization : dynamic and seismic applications, Spon Press, 2010.	1	20
Winston, L.W., Operations Research – Applications and Algorithms, Duxbury Press, Belmont, 1994.	1	20
Bendsoe, M.P., Sigmund, O., Topology optimization : theory, methods and applications, Springer Verlag, 2004.	1	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Engineering Visualization**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	4
	Number of hours (L+E+S)	15+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Development of the ability to transform information into a visual form that enables visual perception of hidden features in the data that are required for data exploration and analysis.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Analyze input data. Select an appropriate visualization technique. Apply acquired knowledge to actual engineering issues.		
1.4. Course content		
Definitions, history, goals and principles of visualization. Overview of visualization applications. Visual perception, visualizations (images) and visual attributes. Visualization techniques. Data characteristics.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	-	
1.7. Student's obligations		
Course attendance and activity (lectures, exercises), constructive work, continuous knowledge testing.		
1.8. Evaluation of student's work		

Course attendance	1.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project		Sustained knowledge check	0.5	Report		Practice	
Portfolio		Constructive work	1.5	Homework			

1.9. Procedure and examples of learning outcome assessment in class and at the final exam
Constructive work, continuous knowledge testing, written or oral exam.
1.10. Assigned reading (at the time of the submission of study programme proposal)
H. Wright: *Introduction to Scientific Visualization*, Springer, 2007.

G. Scott Owen, et al.: *HiperVis-Teaching Scientific Visualisation Using Hyper Media* (on –line), ACM SIGGRAPH Education Committee http://www.siggraph.org/education/materials/HyperVis/vistoc.htm, 1999.

1.11. Optional / additional reading (at the time of proposing study programme)

K. Brodlie, et al : *Scientific Visualization, Techniques and Applications*, Springer Verlag, 1992.
J. Brown, et al: Visualization Using Com. Graph. to Explore Data and Present Inform., John Wiley, 1995.
D. Thompson, et al: OpenDX - Paths to Visualization, Visualization and Imagery Solutions, Inc., 2004.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
H. Wright: *Introduction to Scientific Visualization*, Springer, 2007.	2	16

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution`s quality assurance system.

Basic description		
Course title	**Environmental Engineering**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Develop the capacity and competence to solve a variety of engineering problems in the field of environmental protection so as to find effective technical solutions to prevent or reduce pollution of the environment. Develop the ability to introduce and use the latest technologies that enable sustainable development.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Analyze the energy and industrial processes from the viewpoint of environmental protection. Describe the types and methods of formation of harmful effects on the environment. Define and calculate the emission into the atmosphere from the combustion process. Explain and calculate the impact of weather conditions on emissions into the atmosphere. Define and describe the technical procedures to reduce emissions of harmful substances into the environment. Develop and describe the schematic representations of flue gas treatment processes, wastewater and solid waste. Analyze and explain the driving factors wastewater treatment processes. Describe the procedures for the reduction, evaluation and treatment of waste. Describe the process of formation of biogas and landfill gas. Define and explain identifying characteristics of hazardous waste. Describe the main procedures for the treatment, removal and disposal of hazardous waste.		
1.4. Course content		
Introduction to environmental protection, basic ecological terms, the balance in the ecosystem, disturbances in the ecosystem. Pollution of the atmosphere, hydrosphere, lithosphere. Legislation. The impact of power and process plants on pollution emissions by flue gas, waste water, waste materials, emissions underground, thermal pollution, effects of pollution legislation. Technical measures to reduce environmental pollution: reduction of flue gas, flue gas treatment, changes in the combustion process, changes in process technology, preventive measures, treatment of waste water, treatment of waste materials (reuse, disposal, incineration), eliminating the effects of pollution. Waste to energy processes. Biogas and landfill gas. Hazardous waste and landfill gas. Ecological projects, the state of technical development in the field of environmental protection, new technologies, sustainable development.		
1.5. Teaching methods	X lectures ☐ seminars and workshops X exercises ☐ long distance education	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship

	X fieldwork	☐other
1.6. Comments	-	

1.7. Student's obligations

Course attendance, activity, studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1.5	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, continuous knowledge testing (two mid-term exams), written or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Prelec, Z.: Summary of lectures (pdf. on Faculty web)

1.11. Optional / additional reading (at the time of proposing study programme)

- Prelec, Z.: Energy and process industry (Croatian), Školska knjiga, Zagreb, 1994.

- Kiely, G.: Environmental Engineering, Mc Graw-Hill, International Editions, 1998.-

Nelson L., Nemerow Frank J. Agardy, Strategies of industrial and hazardous waste managment, Wiley, 1998."

- Karl B. Schnelle, Jr. et. al., Air pollution control technology handbook, CRC press, 2002

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's system of quality control.

Basic description		
Course title	**Experimental Testing in Mechanics of Structures and Machines**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Obtaining theoretical knowledge and develop skills to solve practical problems by experimental techniques in mechanics of structures and machines.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Describe basic elements of measurement system and define sensor characteristics and operation principles. Define basic procedures in experimental strain and stress analysis. Define operational principles of strain gages and describe possible strain gage circuits. Define basic sources of errors and techniques for eliminating the errors. Apply strain gages on practical problems. Describe operating principle of contact and non-contact vibration sensors and measurements in frequency and time domain. Apply vibration sensors and other measurement equipment on practical problems. Describe operating principle of sensors and equipment for noise measurements, Apply noise measurement equipment on practical problems. Describe and apply norms for machine dynamics testing.		
1.4. Course content		
Introduction. Measurement instruments in structural mechanics. Elements of measurement system. Sensors. Sensor characteristics. Principles of operations of sensors. Experimental methods of stress and strain analysis. Strain gages. Application of strain gages. Elimination of errors during strain gages measurements. Application to elementary strength of materials. Standard tests on testing machine. Measurement instruments in machine dynamics. Elements of measurement system. Vibration sensors. Sensor characteristics. Principles of operations of vibration sensors. Experimental methods in machine vibrations analysis. Contact and noncontact sensors. Calibration of sensors. Measurements in frequency and time domain. Norms in machine dynamics testing.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other
1.6. Comments	-	
1.7. Student's obligations		
Couse attendance, activity, laboratory work, two seminar papers, studying.		
1.8. Evaluation of student's work		

Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	1.5
Written exam	0.5	Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, laboratory work, two seminar papers, written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Dally, J. W. & Riley, F. W: "Experimental stress analysis", McGraw-Hill, Tokyo, 1987.
Butković, M.: "Measurement of vibrations ", in Alfirević, I. (Ed.): "Engineering handbook I", Školska knjiga, Zagreb, 1996. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Hoffmann, K: "An introduction to measurements using strain gages", HBM, Darmstadt, 1989.
"Machine Diagnosis: Methods and Instruments for Analyzing Machine Condition and for Early Recognition of Machine Damage using Vibrations Measurements", Carl Schenck AG, Darmstadt, 1993.
Webster J. G.: "Measurements, Instrumentation and Sensors Handbook, CRC Press, Boca Raton, 1999.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Dally, J. W. & Riley, F. W: "Experimental stress analysis", McGraw-Hill, Tokyo, 1987.	2	14
Butković, M.: "Measurement of vibrations ", in Alfirević, I. (Ed.): "Engineering handbook I", Školska knjiga, Zagreb, 1996. (in Croatian)	2	14

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Finite Element Analysis of Solids**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
The main objectives of this course are developing the knowledge, ability and skills in the field of structural modelling and analysis of stresses and strains.							
1.2. Course enrolment requirements							
Basic knowledge from mechanics of rigid and deformable bodies and finite element method.							
1.3. Expected course learning outcomes							
Define the load vector, displacement vector and stiffness matrix. Define the basic equilibrium equation of the finite element based on the displacement method. Basic transformation matrix. Determine the global equilibrium equation. Analyze the structural response: beams, plates, structures, etc. Analyse also the simpler cases of the dynamic response of structure. Apply the finite element method in structural optimization.							
1.4. Course content							
Fundamentals and development of Finite Element Method. Matrix formulations of theory of elasticity. Variational formulation of Finite Element Method. Other possible formulations. Interpolation functions and interpolation matrix. Finite element and structure: Load vector, displacement vector and stiffness matrix. Transformation matrix. Boundary conditions. Rods, beams, plates, etc. Introduction to dynamic of structure. Application of Finite Element Method: Theory of elasticity, plasticity, stability, dynamics and structural optimization.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☐ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, exercises, homework, partial exams, final exam.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam
Continuous knowledge testing. Written and oral exam.
1.10. Assigned reading (at the time of the submission of study programme proposal)

Brnić, J., Čanađija, M.: Analysis of Solid Bodies by Finite Element Method, Fintrade & Tours, d.o.o., Rijeka, 2009. Brnić, J.: Elastomechanics and Plastomechanics, Školska knjiga, Zagreb, 1996.
1.11. Optional / additional reading (at the time of proposing study programme)

Bathe, K. J.: Finite Element Procedures, Prentice Hall, Englewood Cliffs, 1996. Zienkiewicz, O. C., Taylor, R. L.: The Finite Element Method, Vol. 1, Butterworth-Heinemann, 2000. Przemieniecki, J . S.: Theory of Matrix Structural Analysis, Dover Publication, New York, 2012.
1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Brnić, J., Čanađija, M.: Analysis of Solid Bodies by Finite Element Method, Fintrade & Tours, d.o.o., Rijeka, 2009.	10	19
Brnić, J.: Elastomechanics and Plastomechanics, Školska knjiga, Zagreb, 1996.	13	19

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences
Through the Institution’s quality assurance system.

Basic description		
Course title	**Fluid Dynamics**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION			
1.1. Course objectives			
Understanding the physical meaning of laws and equations of fluid dynamics and develop the ability of students to solve problems related to the field of fluid dynamics and creation of independent works and projects related to different set problems involving fluid			
1.2. Course enrolment requirements			
None.			
1.3. Expected course learning outcomes			
Specify and correctly interpret the basic laws and equations of fluid dynamics: transport theorem, the law of conservation of mass and continuity equation, the law of conservation of momentum. Specify and correctly interpret the Euler equation for a perfect fluid, Navier Stokes equations for a viscous fluid and examples of elementary solutions. Specify and correctly interpreted the law of conservation energy and flow equations for compressible fluids. Specify and correctly interpret turbulence, ways of modelling turbulence and Reynolds equations of turbulent flow. Apply a commercial software for the simulation of turbulent fluid flow, different problems engineering practices, unsteady flow in pipelines, unsteady flow with free surface			
1.4. Course content			
Basic laws and equation of fluid dynamics. Navier Stokes equations for viscous fluid and some solutions. Turbulence. Turbulence models. Flow in pipe systems. Free surface flow. Flow around bodies. Application on engineering problems using software.			
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other	
1.6. Comments			
1.7. Student's obligations			
Course attendance, activity, homework, studying.			
1.8. Evaluation of student's work			

Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, continuous knowledge testing (three mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

L.G.Loicansky. Mechanics of fluids and gases. Moscow, Nauka, 1970
L D Landau,E.M. Lifshitz, Fluid Mechanics, Second Edition: Volume 6 , Butterworth Heinemann, 1987.

1.11. Optional / additional reading (at the time of proposing study programme)

L. Sopta, L. Kranjčević, Mehanika fluida, skripta. Tehnički fakultet Rijeka, 2004.
Bruce R. Munson, D. F. Young, T. H. Okiishi, Fundamentals of Fluid Mechanics, 4th Updated Edition, John Wiley and
Sons, 2003.
Streeter, V.L, Wylie E.B., Fluid mechanics, 8th edition, McGraw Hill, 1985

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
L.G.Loicansky. Mechanics of fluids and gases. Moscow, Nauka, 1970	1	6
L D Landau,E.M. Lifshitz, Fluid Mechanics, Second Edition: Volume 6 (Course of Theoretical Physics), Butterworth	1	6

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Forming Technology**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION			
1.1. Course objectives			
Acquisition of theoretical knowledge and training for performing calculations in forming technology and use of available software.			
1.2. Course enrolment requirements			
None.			
1.3. Expected course learning outcomes			
To calculate the required amount of input material for forming process. To define and to analyze the parameters of the given forming process. To compare different forming processes. To evaluate and to argue the choice of forming process. To apply the available software in forming technology.			
1.4. Course content			
Classification of forming processes. Physical foundations of forming by deformation. Fundamentals of plasticity theory. Basic concepts of forming by deformation (plasticity and ductility, degrees of deformation, strain rate, flow stress, deformation force and work, plastic flow condition and deformability). Contact friction. Deformation processes of massive (3D) parts: forging, rolling, extrusion and drawing. Sheet metal forming processes (2D): bending, deep drawing and cutting (shearing, punching and blanking). Special and non conventional forming processes. Application of available software in forming technology.			
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☒ laboratories ☐ mentorship ☐ other	
1.6. Comments			
1.7. Student's obligations			
Course attendance, control tasks, preparation a report of computer exercises, independent learning.			
1.8. Evaluation of student's work			

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio		Report of computer exercises	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, sustained knowledge check, report of computer exercises, written and / or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Duplančić, I.: Metal Forming Processes, Fakultet elektrotehnike, strojarstva i brodogradnje Sveučilišta u Splitu, 2007. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Kampuš. K., Kuzman, K.: Metal Forming Recommendations, Fakulteta za strojništvo, Ljubljana, 2007. (in Slovenian)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Duplančić, I.: Metal Forming Processes, Fakultet elektrotehnike, strojarstva i brodogradnje Sveučilišta u Splitu, 2007. (in Croatian)	2	16

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Fuels, Lubricants and Water**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Getting acquainted with the theoretical aspects of fuels, lubricants and water. Understanding the structure, properties and processing of fuels. Understanding the functions and properties of lubricants and additives. Understanding the properties, application and processing of water.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Describe the basic properties of fuels and the technological processes of production and processing of certain types of fuel. Understand the dependency of hydrocarbon properties and chemical structure. Sketch the basic fuel production processes. Describe lubricant functions in machines. Define the characteristic lubricant properties. Understand the properties, application and treatment of water.							
1.4. Course content							
The role of fuel in the society. The origin and classification of fuels. Combustion. solid, liquid and gaseous fuels. Processes of production, transport and processing of fuels. Chemical composition and fuel properties. Octane and cetane number. Fuel and environmental protection. Basic lubricants functions. Friction and lubrication. Base oils and additives. Lubricant greases. Lubrication types. Lubricant properties, classification and standards. Lubricant deterioration. Properties, applications and treatment of water.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork		☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Lectures and excercises attendance, individual learning							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, continuous knowledge testing (two mid-term exams), written or oral final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1.11. Optional / additional reading (at the time of proposing study programme)

Enco Tireli: Fuels and its Marine Applications, Sveučilište u Rijeci, Pomorski fakultet, Rijeka 2005 (in Croatian)
Enco Tireli, Joško Dvornik, Josip Orović: Lubricants and their Marine Applications, Sveučilište u Rijeci, Pomorski fakultet, Rijeka
2010 (in Croatian)
George E. Totten, editor; section editors, Steven R. Westbrook, Rajesh J. Shah: Fuels and Lubricants Handbook: Technology, Properties, Performance, and Testing, ASTM International, 2003..

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
		27

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Gas Engineering**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+15+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Acquiring theoretical knowledge and training of skills for solving practical problems in the field of gas engineering.		
1.2. Course enrolment requirements		
Attended course Thermodynamics II.		
1.3. Expected course learning outcomes		
Classify fuel gases with respect to their properties, production technology and industrial processing, transport and distribution, storage and consumption. Describe the physical properties, storage and application of technical gases. Analyze the interchangeability of fuel gases. Design and calculate domestic gas installations and gas connections for natural gas and liquefied petroleum gas. Describe the procedures for the testing of strength and tightness of gas installations. Describe the fire protection measures and the workplace safety precautions in gas engineering. Analyze and evaluate the performance of low-carbon fuels and technologies. Describe the physical properties, the production, storage, transport and consumption of hydrogen, liquefied natural gas (LNG), compressed natural gas (CNG) and the carbon capture, compression and storage technology (CCS).		
1.4. Course content		
Classification and types of gaseous fuels. Gas fields exploitation and types. Natural gas processing industry. Physical properties of gaseous fuels, gas mixtures and technical gases: density, critical state, compressibility, boiling point, heating value, flammability, interchangeability of gas fuels. Transport and distribution of natural gas. Management of natural gas systems. Natural gas pipelines, equipment, regulation and measurement. Design of home gas connections and domestic installations using natural gas or liquefied petroleum gas installations. Design of gas boiler rooms, air intake and flue gases discharge systems. Safety, control and maintenance of gas systems and gas installations. Test procedures for strength and tightness. Fire protection measures and workplace safety precautions in gas engineering. Production, storage and application of technical gases: acetylene, carbon dioxide, nitrogen and oxygen. Physical properties, transport, storage and consumption of liquefied petroleum gas. Application of low-carbon fuels and technologies in gas engineering. Hydrogen energy and fuel cells. Production, transport and storage of hydrogen. Liquefied natural gas (LNG): liquefaction, transport, storage and regasification. Capture, compression and storage of carbon dioxide (CCS). Carbon capture technologies. CO_2 storage and use for enhanced oil recovery. Gaseous fuels in transport and their environmental impact.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other

1.6. Comments	

1.7. Student's obligations

Lectures, exercises and fieldwork attendance. Individual learning.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam	1.5	Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, continuous knowledge testing (two mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Strelec V.: Gas Engineering Handbook, 7th ed., Energetika marketing, Zagreb, 2014. (in Croatian)
Strelec V.: Gas Engineering Handbook, 5th ed., Energetika marketing, Zagreb, 1995. (in Croatian)
Technical rules for the design, construction, use and maintenance of gas installations, HSUP-P600, 2. ed., Zagreb, 2017. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Technical rules for the design and construction of domestic gas installations GPZ-PI600, Zagreb, 1993. (in Croatian)
Reminder for the design maintenance of gas installations, 3rd ed., Energetika Marketing, Zagreb, 2018. (in Croatian)
Labudović, B.: Basics of liquefied petroleum gas engineering, Energetika marketing, Zagreb, 2007. (in Croatian)
Treloar, R. D.: Gas Installation Technology, 2nd ed., Wiley-Blackwell, 2010.
Hazlehurst, J.: Tolley's Basic Science and Practice of Gas Service: Gas Service Technology Volume 1, 5th ed., Elsevier, 2009.
Hazlehurst, J.: Tolley's Domestic Gas Installation Practice: Gas Service Technology Volume 2, 5th ed., Elsevier, 2009.
Hazlehurst, J.: Tolley's Industrial and Commercial Gas Installation Practice: Gas Service Technology Volume 3, 5th ed., Elsevier, 2009.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Strelec V.: Gas Engineering Handbook, 7th ed., Energetika marketing, Zagreb, 2014. (in Croatian)	1	20
Strelec V.: Gas Engineering Handbook, 5th ed., Energetika marketing, Zagreb, 1995. (in Croatian)	1	20
Technical rules for the design, construction, use and maintenance of gas installations, HSUP-P600, 2. ed., Zagreb, 2017. (in Croatian)	1	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Graduate Work**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	compulsory	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	10
	Number of hours (L+E+S)	-

1. COURSE DESCRIPTION							
1.1. Course objectives							
Graduate work is an individual assignment and verification of student expertises, which should show the appropriate level of engineering skills for individually solving specific professional task.							
1.2. Course enrolment requirements							
Enrolled course from which the Graduate Work is selected.							
1.3. Expected course learning outcomes							
Apply acquired knowledge, expertises and skills of the content of Graduate Work associated course. Solve practical task. Acquire competence for individually solving specific professional task.							
1.4. Course content							
The content of the Graduate Work is based on the application of acquired knowledge from educational programs at the graduate university studies. Final thesis can be specified from a particular course specific professional content and exceptionally from course that belongs to the group of shared content, when it represents a broader entity with a particular course specific content of the studies. Student enrollers the Graduate Work by enrolling the last semester. Thesis of the Graduate Work is establishes by Commission for Graduate Works, based on suggestion of teacher who will mentor the Graduate Work.							
1.5. Teaching methods	☐ lectures ☐ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork			☒ individual assignment ☐ multimedia and network ☐ laboratories ☒ mentorship ☐ other			
1.6. Comments							
1.7. Student's obligations							
Attending the consultation, individually solving task and writing the Graduate Work report.							
1.8. Evaluation of student's work							
Course attendance		Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio		Individual task solving	8	Final work in written form	2		
1.9. Procedure and examples of learning outcome assessment in class and at the final exam							

Assesses and evaluates the accuracy and completeness of a given task solving process, the Graduate Work written report, and its oral presentation

1.10. Assigned reading (at the time of the submission of study programme proposal)

1.11. Optional / additional reading (at the time of proposing study programme)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Heat Exchangers**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	4
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Obtaining theoretical knowledge and develop skills to solve practical problems in the field of heat transfer as well as performing thermal analyses of heat exchangers as parts of thermal and energy systems.		
1.2. Course enrolment requirements		
Basic knowledge of thermodynamics.		
1.3. Expected course learning outcomes		
Define and describe the heat transfer. Define tasks and describe and compare the basic types of heat exchangers. Describe models and analyze the heat transfer in the recuperative heat exchangers with single-pass of fluids. Analyze and compare the recuperative heat exchangers with parallel-flow, counter-flow and cross-flow. Describe and analyze the heat transfer in the recuperative heat exchangers with multi-pass of fluids. Describe models and analyze the heat transfer in shell and tube heat exchangers with and without baffles. Describe models and analyze the heat transfer in plate heat exchangers. Describe models and analyze the heat transfer in the regenerative heat exchangers. Describe the thermal analysis of counter-flow reversal heat regenerator using Hausen's method. Describe the main characteristics and analyze the heat transfer in the rotary regenerative heat exchangers. Describe the heat transfer in direct heat exchangers. Apply acquired knowledge to solve thermodynamic tasks (practical problems) and to perform thermal analyses of heat exchangers.		
1.4. Course content		
Heat transfer. The task and classification of heat exchangers. Recuperative heat exchangers. Models and calculation. Heat exchangers with single-pass of fluids. Parallel-flow, counter-flow and cross-flow heat exchangers. Universal thermal analysis for various types of heat exchangers. The logarithmic mean temperature difference. Heat effectiveness. Thermal efficiency. Optimum surface size. Heat exchangers with multi-pass of fluids. Shell and tube heat exchangers. Heat exchangers without baffles. Heat exchangers with baffles. Plate heat exchangers. Regenerative heat exchangers. Main characteristics and classification. Models of regenerators and calculation methods. Thermal analysis of counter-flow reversal heat regenerator using Hausen's method. Rotary regenerators. Main characteristics and classification. Thermal analysis using Hausen's method. Direct heat exchangers.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		

Course attendance, activity, homework, studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, continuous knowledge testing (three mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Bošnjaković, F.: Thermodynamics, Vol. I, II and III (reprint editions of 1978, 1976 and 1986), Graphis d.o.o., Zagreb, 2012. (in Croatian)
Galović, A.: Termodynamics II, (book), Fakultet strojarstva i brodogradnje, Zagreb, 2007. (in Croatian)
Slipčević, B.: Heat exchangers, (book), SMEITS, Beograd, 1989. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Kakac, S., Liu, H.: Heat exchangers, CRC Press, Florida, 2002.
Kays, W.M., London, A.L.: Compact heat exchangers, McGraw-Hill Book Co., NY,1984.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Bošnjaković, F.: Thermodynamics, Vol. I, II and III (reprint editions of 1978, 1976 and 1986), Graphis d.o.o., Zagreb, 2012. (in Croatian)	23	30
Galović, A.: Termodynamics II, (book), Fakultet strojarstva i brodogradnje, Zagreb, 2007. (in Croatian)	2	30
Slipčević, B.: Heat exchangers, (book), SMEITS, Beograd, 1989. (in Croatian)	4	30

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Heat Turbines**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Assuming of theoretical knowledge and developing of skills to solve practical problems in the field of steam and gas turbines for performing numerical analysis and design of turbines, its parts and systems.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Description and analysis of the thermal process in steam turbine plant. Analysis of the steam turbines processes. Analysis of the flow in turbine nozzles and blades. Description and comparison of the energy conversion process action and the reaction turbine stages. Identification and analysis of the flow losses in turbine stages. Analysis of the turbine stage and turbines efficiency. Performing the thermodynamic calculations of the turbine and the turbine stage. Analysis of the variations of turbine operating modes. Description and analysis of the basic design concept of steam turbines. Description of the basic design of gas turbines, components and systems. Combined systems of gas and steam turbines. Description and analysis of the turbine control and protection systems. Description of the operation and exploitation of the turbine. Modern turbine maintenance description and analysis. Calculate and analyze the losses of steam and gas turbines.		
1.4. Course content		
Overview of the development of steam turbines and directions for their further development. Thermal process of the steam turbine. Basic techno-economic indicators of a steam turbine plants. Classification and applications of steam turbines. Thermal process in the turbine stage. Basically calculation and design of turbine stages. Thermal process in multistage turbine. Steam turbines in nuclear power plants. Condenser. Structural characteristics and strength calculation of turbine parts. Design of modern steam turbines for different purposes. Control and protection systems of steam turbines. Lubricating and control oil system of steam turbine. Gas turbine plants. The development of gas turbines. The basics of gas-turbine plants. Characteristics of the design of modern gas turbines. Control and protection systems for gas turbines. Combined and cogeneration plants. Operation and maintenance of the turbines. Marine steam and gas turbines. Energy and exergy analysis of steam and gas turbines.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	None	
1.7. Student's obligations		

Course attendance, activity, homework, studying.

1.8. Evaluation of student's work

Course attendance	2.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project	0.5	Sustained knowledge check	1	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, continuous knowledge testing (two mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Miler, J.: Steam and Gas Turbines, Parts I & II, Tehnička knjiga, Zagreb 1955. i 1965. (in Croatian)
Kostjuk, A. G., Frolov, V. V.: Steam and Gas Turbines, Mir Publishers, Moscow, 1988.
Shlyakhin, P.: Steam Turbines – Theory and Design, University Press of the Pacific, Honolulu,Hawaii, 2005.
Kanoglu, M., Cengel, Y. A., Dincer, I.: Efficiency Evaluation of Energy Systems, SpringerBriefs in Energy, Springer, 2012.

1.11. Optional / additional reading (at the time of proposing study programme)

Leyzerovich , A. S.: Steam Turbines for Modern Fossil-Fuel Power Plants , The Fairmont Press , 2008.
Bloch, H. P., Singh, M. P.: Steam Turbines - Design, Applications, and Rerating , The McGraw-Hill Companies, Inc. , 2009.
Elčić, Z.: Parne Turbine, Nacionalna i sveučilišna biblioteka, Zagreb, 1995.
Kitto, J. B., Stultz, S. C.: Steam/its generation and use, 41st edition, The Babcock & Wilcox Company, Ohio, 2005.
Woodruff, E. B., Lammers, H. B., Lammers, T. F.: Steam plant operation, The McGraw-Hill Companies, Inc., 2005.
Sutton, I.: Plant Design and Operations, Elsevier Inc., 2015.
Sarkar, D. K.: Thermal Power Plant - Design and Operation, Elsevier Inc., 2015.
Tanuma , T.: Advances in Steam Turbines for Modern Power Plants , Woodhead Publishing ,Elsevier Ltd. , 2017.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Miler, J.: Steam and Gas Turbines, Parts I & II, Tehnička knjiga, Zagreb 1955. i 1965. (in Croatian)	2	50
Kostjuk, A. G., Frolov, V. V.: Steam and Gas Turbines, Mir Publishers, Moscow, 1988.	1	50
Shlyakhin, P.: Steam Turbines – Theory and Design, University Press of the Pacific, Honolulu,Hawaii, 2005.	1	50
Kanoglu, M., Cengel, Y. A., Dincer, I.: Efficiency Evaluation of Energy Systems, SpringerBriefs in Energy, Springer, 2012.	1	50

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Industrial Robotics**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
This course provides introduction to the kinematics and dynamics of robots and robotic systems. The acquisition of specific skills in programming and simulation of robots and robotic systems.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Define the concept of robot and robotics and robot configuration. Analyze mechanical and control systems. Explain the kinematics and dynamics of robots. Analyze nonlinear robot control. Explain planning and intelligent control. Apply robotic programming languages. Explain off-line programming systems. Apply software in simulation and programming of industrial robots. Give examples of the use of robots in production processes and industrial material handling. Analyze mobile, flexible and parallel connected robots. Explain telepresence and virtual reality.							
1.4. Course content							
Definition of robotics and robots as systems. Robot configuration. End effectors. Mechanics and control of robots. Sensors and actuators. Spatial description and transformation: position, orientation and quadrants. Mapping: change descriptions from quadrant to quadrant. Operators: translation, rotation, transformation. Robot kinematics. Robot dynamics and control. Nonlinear robot control: nonlinear and time-varying systems, multi-input, multi-output control systems. Planning and intelligent management. Robotic vision systems: complex and smart systems. Robotic programming languages and systems: coding examples in three programming languages. Off-line programming systems. Application of robots in production. Application of robots in production processes and industrial material manipulation. Mobile, flexible and parallel robots. Telepresence and virtual reality. Introduction to modern software for simulation and programming of industrial robots.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork			☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other			
1.6. Comments							
1.7. Student's obligations							
Attendance, activities in the classroom, homework and self-study.							
1.8. Evaluation of student's work							
Course	2	Activity/Participation		Seminar paper		Experimental	

attendance						work	
Written exam	1.5	Oral exam		Essay		Research	
Project	0.5	Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Oral explanation of simulation exercises or project task, continuous knowledge test (two control tasks), written final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

B. Siciliano, K. Oussama: Springer handbook of robotics. Springer, 2016.

1.11. Optional / additional reading (at the time of proposing study programme)

L. W. Tsai: Robot analysis: the mechanics of serial and parallel manipulators. John Wiley & Sons, 1999.
L. T. Ross, S. W. Fardo, M. F. Walach: Industrial Robotics, The Goodheart-Willcox Company, 2008.
Z. Kovačić, S. Bogdan, V. Krajčí: Osnove robotike, Graphis, Zagreb, 2002.
F. Lamb: Industrial automation: hands-on. McGraw-Hill Education, 2013.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
B. Siciliano, K. Oussama: Springer handbook of robotics. Springer, 2016.	1	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Internal Combustion Engines**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Assuming of theoretical knowledge and developing of skills to solve practical problems in the field of internal combustion engines for performing numerical analysis and design of engines, its parts and systems.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Application of the mechanics and the theory of vibration to the cranking mechanism in analyzing the kinematics, dynamics, loads and vibrations of the cranking mechanism. Application of the laws of thermodynamics and fluid mechanics to processes in internal combustion engines. Analysis of the processes in internal combustion engine and its equipments and its impact to the characteristics of the engine as a whole in steady and transient operation. Applications of the laws of thermodynamics and fluid mechanics to change the working fluid exchange and cylinder filling. Analysis of fuel/air mixture preparation and combustion in the engine. Thermal load analysis of the engine parts and structures. Analysis of the processes of pollutants formation and reduction controll for environment protection.							
1.4. Course content							
Introduction. Engines division. Historical development. Basic dimensions of the engine and cranking mechanism. Kinematics and dynamics of the cranking mechanism. The dynamics of multi-cylinder engines. Balancing of engine mechanism. Fuels and their properties. Fuel mixture. Engine thermodynamic processes. Mathematical modelling of engine real processes and numerical simulations. Indicating the engine process, measuring of engine power and other characteristics. Exchange of the working fluid. Supercharging and turbocharging. Preparation of the combustible mixture. Introduction to combustion. Ignition and combustion of the fuel/air mixture. The pollutants emission and measures for their reduction. The design of the engine. Auxiliary equipment and engine systems. Engine control and protection systems.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork		☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments	None						
1.7. Student's obligations							
Course attendance, activity, homework, studying.							
1.8. Evaluation of student's work							
Course	2.5	Activity/Participation		Seminar paper		Experimental	

attendance						work	
Written exam		Oral exam	1	Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, continuous knowledge testing (two mid-term exams), written or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Heywood, J. B.: Internal Combustion Engine Fundamentals, McGraw Hill Book Co., 1988.
Pavletič, R.: Internal Combustion Engines, Univerza v Ljubljani, Ljubljana, 2000. (in Slovene)

1.11. Optional / additional reading (at the time of proposing study programme)

Parat, Ž.: Marine Internal Combustion ENgines, Sveučilište u Zagrebu, Zagreb, 2005. (in Croatian)
Jeras, D.: Internal Combustion Engines - Devices, Školska knjiga, Zagreb, 1995. (in Croatian)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Heywood, J. B.: Internal Combustion Engine Fundamentals, McGraw Hill Book Co., 1988.	1	30
Jeras, D.: Internal Combustion Engines - Devices, Školska knjiga, Zagreb, 1995. (in Croatian)	1	30

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Joining of Materials**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	4
	Number of hours (L+E+S)	30+15+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
The course is designed to provide the student with knowledge in joining of materials and welding engineering topics. Student is introduced with practical application of several welding processes.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Classify methods of joining of materials. Describe the basic welding processes and classify welding power sources. Interpret characteristics of arc and mechanisms of formation of the welded joint. Explain weldability and describe the specifics of welding alloy steel, cast iron, aluminum and copper alloys. Classify welding consumables and types of welds. Calculate power requirements for welding and consumption of welding consumables for arc welding. Classify errors in welding and describe methods for quality assurance of welding.							
1.4. Course content							
Methods of joining of materials. Development of welding processes. Arc welding. Power source equipment. Welding metallurgy. Microstructure of welded joints. Heat affected zone. Weldability. Welding of alloys. Welding symbols. Welding consumables. Productivity of welding. Quality of welds. Welds imperfections. Inspections of welds. Solid state joining of metals. Joining processes by diffusion, friction, explosion and ultrasound vibration. Bonding. Brazing and soldering. Thermal spraying.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork		☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, active participation in the course, attendance at on-site training and independent learning.							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	

Portfolio		Fieldwork	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Sustained knowledge check and final written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Meden, G., i dr.: *Osnove zavarivanja*, Sveučilište u Rijeci, Tehnički fakultet, Rijeka, 2000.

1.11. Optional / additional reading (at the time of proposing study programme)

Brandon, D, Kaplan, W. D.: Joining processes, John Wiley & Sons, 1997.
Gojić, M.: Tehnike spajanja i razdvajanja materijala, Sveučilište u Zagrebu, Metalurški fakultet, 2003.
Messler, R. W.: Joining of Materials and Structures, Elsevier Buterworth-Heinemann, 2004.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Meden, G., i dr.: Osnove zavarivanja, Sveučilište u Rijeci, Tehnički fakultet, Rijeka, 2000.	12	-

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Laboratory Excercises A**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	15+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
To make a plan through the testing process. Critically evaluation the obtained measurement results. To acquire skills for teamwork.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Explain and classify the different measurements in the field of construction and transportation techniques. Distinguish measurement devices from areas of construction and transportation techniques. Plan through the testing process. Implement treated measurement techniques. Critically evaluate the obtained measurement results. Writing and orally presentation the results and their evaluation. Team work and oral and written communication with experts in these areas.							
1.4. Course content							
Theoretical and practical setting performance measurements on field courses in elective group "Construction and Transport technology." Special attention will be addressed to measurement techniques in the field of: roughness, photoelastic, industrial acoustics, hydraulics, electronics, stroboscopy and tensometry.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☐ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, class participation, laboratory exercises, homework (essays) and independent study							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper	2	Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	1
Portfolio		Homework					
1.9. Procedure and examples of learning outcome assessment in class and at the final exam							

Attendance, activity in the laboratory, writing and defense of the seminar work, final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Specifically, for each type of laboratory exercises.

1.11. Optional / additional reading (at the time of proposing study programme)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Laboratory Exercises B**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	15+30+0

1. COURSE DESCRIPTION			
1.1. Course objectives			
Competences in appropriate choice and usage of measurement instrumentation and methods in mechatronics systems. Team work and capability to communicate with experts.			
1.2. Course enrolment requirements			
None.			
1.3. Expected course learning outcomes			
Explain, classify and compare the methods of measurement of the physical quantities in the field of mechatronics and robotics. Distinguish and characterise the measurement devices in this field. Plan the execution of measurements. Implement the treated measurement techniques. Critically evaluate the obtained measurement results. Present results and their validation in written and oral form. Teamwork and written and oral communication with experts in this and other fields.			
1.4. Course content			
Theoretical foundations and practical execution of measurements in the field of the topics covered by the courses in the electoral graduate courses group "Mechanical Engineering Design and Mechatronics". Special attention will be dedicated to measurement techniques in the fields of: measurement of high-precision displacements and vibrations, micro- and nanosystems technologies, determination of mechanical properties of materials, electrical engineering, control systems and usage of artificial intelligence, robotics and hydraulics.			
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other	
1.6. Comments	-		
1.7. Student's obligations			
Course attendance, activity, laboratory exercises, homework assignments (seminar papers) and autonomous study.			
1.8. Evaluation of student's work			

Course attendance	1.5	Activity/Participation		Seminar paper	1.5	Experimental work	1.5
Written exam		Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check		Report		Practice	

Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Active participation to classes, laboratory exercises and homework assignments (seminar papers) and oral checks on acquired knowledge.

1.10. Assigned reading (at the time of the submission of study programme proposal)

***: „The Mechatronics Handbook“ – 2nd ed., ed. R.H. Bishop, CRC Press, Boca Raton (FL, USA), 2007.
C. W. de Silva: **„**Mechatronics – An Integrated Approach**“**, CRC Press, Boca Raton, (FL, USA), 2005.
S. Zelenika, E. Kamenar: **„**Precision Engineering and Micro- and Nanosystems Technologies – Precision Engineering**“**, University of Rijeka – Faculty of Engineering, Rijeka (HR), 2015. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

R. M. Schmidt, G. Schitter, A. Rankers, J van Eijk: “The Design of High Performance Mechatronics” - 2nd ed., Delft University Press, 2014.
A. H. Slocum: „Precision Machine Design“, Society of Manufacturing Engineers, Dearborn (MI, USA), 1992.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
***: „The Mechatronics Handbook“ – 2nd ed., ed. R.H. Bishop, CRC Press, Boca Raton (FL, USA), 2007.	1	10
C. W. de Silva: „Mechatronics – An Integrated Approach“, CRC Press, Boca Raton, (FL, USA), 2005.	1	10
S. Zelenika, E. Kamenar: „Precision Engineering and Micro- and Nanosystems Technologies – Precision Engineering“, University of Rijeka – Faculty of Engineering, Rijeka (HR), 2015. (in Croatian)	5	10
R. M. Schmidt, G. Schitter, A. Rankers, J van Eijk: “The Design of High Performance Mechatronics” - 2nd ed., Delft University Press, 2014.	1	10
A. H. Slocum: „Precision Machine Design“, Society of Manufacturing Engineers, Dearborn (MI, USA), 1992.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Via the institutionalised quality assurance system of the Faculty of Engineering. Constant interaction and work with the students with the aim of improving the quality of teaching.

Basic description		
Course title	**Laboratory Practice in Thermal Engineering**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	15+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Assuming theoretical knowledge and development of practical skills in organizing and performing measurements and presenting the results of experimentation.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Description of measurement and data acquisition systems. Description of sensors and ways of performing measurements of temperature, pressure, fluid flow velocity, mass flow, noise level and air humidity. Description of complex measurements for determination of thermal conductivity of insulation and constructive materials, caloric values of solid and gaseous fuels, characteristic features and fuel consumption of engines with internal combustion, composition of produced flue gas by combustion, mechanical properties of materials, detection of surface and internal material defects. Planning and performance of experiments. Analysis and comparison of measurement results. Presentation of measurement results.							
1.4. Course content							
Planning of experiments. Setting and calibration of sensors. Measurement and data acquisition. Dynamic behavior of sensors. Analysis and processing of experimental data. Reporting and presentation of results. Pressure measurements. Temperature measurements. Determination of heating values of gaseous and solid fuels. Humidity and velocity measurements in air flow. Mass flow measurements. Thermal conductivity measurements. Combustion flue gas measurements. Noise measurements. Mechanical testing and testing of internal defects in materials. Motor braking and fuel consumption measurements.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, activity, homework - measurement reports preparation, studying.							
1.8. Evaluation of student's work							
Course	1.5	Activity/Participation		Seminar paper		Experimental	

attendance						work	
Written exam		Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	2	Report	1	Practice	
Portfolio		Measurement reports					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Measurement report preparation, sustained knowledge check (three mid-term exams), oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Delač, B., Blecich, P., Dragičević, V., Vrcan, Ž., Iljkić, D., Bukovac, .O: Laboratory practice in thermal engineering, (lectures), https://moodle.srce.hr

1.11. Optional / additional reading (at the time of proposing study programme)

Figliola, R. S.,Beasley, D. E.:Theory and Design for Mechanical Measurements, (book), John Wiley & Sons, New York, 2000.
Montgomery, D. C.: Design and Analysis of Experiments,(book), John Wiley & Sons, New York, 1996.
Holman, J.P., Gajda, W.J.: Experimental Methods for Engineers, (book), Mc Graw-Hill Book Co., New York, 1989.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Delač, B., Blecich, P., Dragičević, V., Vrcan, Ž., Iljkić, D., Bukovac, O.: Laboratory practice in thermal engineering, (lectures), https://moodle.srce.hr	unlimited	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Machining Processes**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Acquisition of theoretical knowledge and training for analytical modeling of cutting force and temperature, experimental modeling of machinability functions, conducting analysis of economic aspects of metal cutting, performing calculations and specifying optimal cutting parameters.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
To interpret the physical foundamentals of cutting theory. To apply the analytical and experimental modeling of cutting process. To analyze the economic aspects of cutting process, to assess the influencing factors and to set the appropriate mathematical formulation of the production efficiency optimization problem. To apply the tool life equation for the calculation and specification of optimal cutting parameters. To identify and to describe the high speed machining, turn-milling, hard machining and gear machining. To identify and to describe the alternative cooling and / or lubrication techniques for environmentally friendly (sustainable) metal cutting.							
1.4. Course content							
Fundamentals of cutting theory. Physically based modeling of the cutting process: models of cutting force and cutting temperature. Static and dynamic deformations in cutting: models. Economic aspects of cutting: models of tool wear and tool life, and the cutting process optimization models. Tool condition monitoring systems: examples of industrial application. Experimentally based modeling of the cutting process and optimization: statistical methods (single and multiple linear regression analysis, analysis of variance, Taguchi method, gray relational analysis and Taguchi entropy-gray relational analysis) and evolutionary algorithms. Integrity of the machined surface: models. High speed machining. Sustainability of metal machining. Turn-milling. Hard machining. Gear machining.							
1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☒ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, control tasks, preparation of seminar, independent learning.							
1.8. Evaluation of student's work							
Course	2	Activity/Participation		Seminar paper	1	Experimental	

attendance						work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Report of laboratory work					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, sustained knowledge check, seminar paper, written and / or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Cukor, G.: Metal Cutting, internal script, Tehnički fakultet Sveučilišta u Rijeci, 2021. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Shaw, M.C.: Metal Cutting Principles, 2nd ed., Oxford University Pres, Inc., 2005.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Cukor, G.: Metal Cutting, internal script, Tehnički fakultet Sveučilišta u Rijeci, 2021. (in Croatian)	50	24

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Maintenance**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+15+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Assuming theoretical knowledge and develop skills to solve practical problems in the field of Maintenance Engineering systems, and training for the design of the organization, design technologies, as well as planning and managing maintenance tasks.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Define and describe the main functions and tasks of maintenance. Describe and analyse maintenance strategies. Define and describe availability and reliability of technical systems. Identify and describe methods of technical diagnostics. Describe and analyse maintenance technology, organization and management of maintenance activities and tasks.							
1.4. Course content							
The importance and function of maintenance of technical systems. The historical development, characteristics and scope of application of different applied maintenance strategies. Maintenance strategy selection. Availability and reliability of technical systems. Design technology maintenance. The methods of technical diagnostics and monitoring of technical systems. Planning inspection, repairs and costs of production, procurement and storage of parts and assemblies for maintenance. Organization of maintenance functions, and information systems to support the process of maintenance management.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork			☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other			
1.6. Comments							
1.7. Student's obligations							
Class attendance and activity, independent learning.							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper	1	Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Class attendance and activity, seminar paper, continuous knowledge assessment, and written examination.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Majdandžić, N.: Maintenance Strategies and Information Systems of Maintenance, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod, 1999. (in Croatian)
Sebastijanović, S.: Basics of Engineering Construction Maintenance, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod, 2002. (in Croatian)
Čala, I.: Equipment Maintenance, Inženjerski priručnik 4, sv.3, Školska knjiga, Zagreb, 2002. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Dhillon, B.S.: Engineering Maintenance – A Modern Approach, CRC Press, USA, 2002.
Nyman, D. & Levitt, J.: Maintenance Planning, Coordination & Scheduling, 2nd edition, Industrial Press, 2010.
Palmer, R.D.: Maintenance Planning and Scheduling Handbook, 4th edition, Mc Graw-Hill, 2019.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Majdandžić, N.: Maintenance Strategies and Information Systems of Maintenance, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod, 1999. (in Croatian)	1	14
Sebastijanović, S.: Basics of Engineering Construction Maintenance, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod, 2002. (in Croatian)	2	14
Čala, I.: Equipment Maintenance, Inženjerski priručnik 4, sv.3, Školska knjiga, Zagreb, 2002. (in Croatian)	2	14

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Marine Deck Machinery**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Acquiring knowledge and skills about topics related to marine deck machinery. The development of the ability to calculate, design and apply marine deck machinery on ships, using modern materials and taking into consideration demands regarding reliability, safety, quality, cost, ecology, ergonomics, engineering ethics, etc.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Explain term, purpose, classification, application and historical development of marine deck machinery. Explain and define cargo handling equipment on ships: marine cargo cranes, derricks, cargo winches, cranes for tankers and provision handling and service cranes. Explain standards and service classes of hoisting appliances. Explain and define classification and characteristics of transportational materials. Explain and define anchor handling equipment (anchor, anchor chain, chain stoppers, anchor winch), mooring winches, capstans, fishing winches, winches and winch equipment for offshore and harbour tugs, life saving equipment (lifeboats, lifeboat devices), hatch covers, accommodation ladder, pilot ladder and container handling equipment. Understand the importance of using ecology and engineering ethics in design and application of marine deck machinery. Apply acquired knowledge in design and application of marine deck machinery on ships.		
1.4. Course content		
Introduction. Ship transport of materials and people. Historical development. The importance and place of ship transport in the modern world economy. Basic concepts, application, divisions and characteristics of marine deck machinery. Elements and devices for material handling: hooks, stirrups, nippers, baskets, grabs, electro-magnets, steel wire ropes, chaines, pulleys, drums, brakes, wheels, rails, motor drives: - principal features, types, purpose, description, calculation and design. Classification and characteristics of transportational materials. Standards and service classes of hoisting appliances. Cargo handling equipment on ships (marine cargo cranes, derricks, cargo winches, cranes for tankers and provision handling, service cranes): - principal features, types, purpose, description and design. Anchor handling equipment (anchor, anchor chain, chain stopper, anchor winch), mooring winches, capstans, fishing winches, winches and winch equipment for offshore and harbour tugs, life saving equipment (lifeboats, lifeboat devices), hatch covers, accommodation ladder, pilot ladder, container handling equipment: - principal features, types, purpose, description and design. Analysis of the importance of using ecology and engineering ethics in design and application of marine deck machinery on ships.		
1.5. Teaching	☒ lectures	☒ individual assignment

methods	☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Course attendance, activity, solving assigned project work, studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project	1	Sustained knowledge check	1.5	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, 2 mid-term exams, project work, final written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Ozretić, V.: Marine Auxiliary Machines and Devices, Split Ship Management Ltd., Split, 1996. (in Croatian)
Ščap, D.: Transport Devices, Fakultet strojarstva i brodogradnje, Zagreb, 2004. (in Croatian)
Piršić, T.: Transport in Industry, FESB, Split, 2005. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Belamarić, G.: Container Transport Technology, Manual, Pomorski fakultet, Split, 2011. (in Croatian)
Herold, Z., Ščap, D., Hoić, M.: Lifting and Handling Equipment, Part 1, Fakultet strojarstva i brodogradnje, Zagreb, 2020. (in Croatian)
Herold, Z., Ščap, D., Hoić, M.: Lifting and Handling Equipment, Part 2, Fakultet strojarstva i brodogradnje, Zagreb, 2020. (in Croatian)
Bowen, R. W.: Engineering Ethics, Springer-Verlag London Limited, 2009.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Ozretić, V.: Marine Auxiliary Machines and Devices, Split Ship Management Ltd., Split, 1996. (in Croatian)	5	6
Ščap, D.: Transport Devices, Fakultet strojarstva i brodogradnje, Zagreb, 2004. (in Croatian)	1	6
Piršić, T.: Transport in Industry, FESB, Split, 2005. (in Croatian)	1	6

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Marine Electrical Engineering**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	4
	Number of hours (L+E+S)	30+15+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
The course is a professional discipline for all the students of naval architecture. The goal is to introduce the students to ships electric devices.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Define and explain the requirements for ships electric devices. Evaluate systems for electric power generation on crafts. Evaluate systems for electric power distribution on crafts. Define and explain technical measures for protection from electric current shock. Apply measures for personal safety on work with ships electric power system. Analyse electric protections of ship electric devices. Define and explain ships electric drives. Define and explain ships lighting system.							
1.4. Course content							
Requirements for ships electric devices. Generation and transformation of electric energy. Distribution and transmission of electric energy. Electric energy consumption on ship. Electric propulsion. Safety. Monitoring, inspection, disturbances and maintenance of ships electric power system.							
1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, seminar paper, studying.							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper	0.5	Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio							
1.9. Procedure and examples of learning outcome assessment in class and at the final exam							

Course attendance, activity, seminar paper, continuous knowledge testing (two mid-term exams), written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

I. Vlahinić: Electrical systems of vessels, Faculty of Maritime Studies, Rijeka 1988
B. Skalicki, J. Grilec: Marine electrical devicei, Faculty of Mechanical Engineering and Naval Architecture, Zagreb 2000

1.11. Optional / additional reading (at the time of proposing study programme)

D.T. Hall: Practical Marine Electrical Knowledge, Witherby London 1999
IEC International Standard
Croatian Register of Shipping

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
I. Vlahinić: Electrical systems of vessels, Faculty of Maritime Studies, Rijeka 1988	3	
B. Skalicki, J. Grilec: Marine electrical devicei, Faculty of Mechanical Engineering and Naval Architecture, Zagreb 2000	3	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Marine Energy Devices**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+15+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Obtaining theoretical knowledge and develop skills to solve practical problems in the field of marine energy devices and design of marine energy devices.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Describe thermodynamic processes of marine steam generator. Describe change of working fluid states in marine steam generator. Describe types of heat exchange in marine steam generator. Define efficiency and explain losses in marine steam generators. Sketch basic configurations of main types of marine steam generators. Explain procedure of marine steam generator heat calculation. Explain stress calculation of marine steam generator main parts under pressure. Calculate main dimensions of marine steam generator. Describe hydrodynamic processes in marine steam generators: working fluid circulation, flow of air and exhaust gases. Define and describe auxiliary systems and equipment of marine steam generators.							
1.4. Course content							
Generally on marine steam generators. Marine steam propulsion plant. Types, working parameters and main parts of marine steam generators. Thermodynamic processes in marine steam generator. Heat balance, losses, efficiency. Characteristics of fuel oils for marine steam generators. Combustion, combustion control. Steam generator calculation, dimensions of heat transfer surfaces. Water circulation. Flow of air and exhaust gases. Materials and stress calculation of parts under pressure. Automatic control basics. Types and designs of marine steam generators. Parts, equipment, auxiliaries. Failures and damages. Maintenance. Economical running. Marine utilizators. Marine thermal oil heaters . Other marine energy devices.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, studying.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam	1	Essay		Research	

Project		Sustained knowledge check	2	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, continuous knowledge testing (two mid-term exams), oral or written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Prelec Z.: Marine Steam Generators, Školska knjiga, Zagreb, 1992. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Milton J.H:, Marine Steam boilers, Newnes-Butterworths, London, 1990.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Prelec Z.: Marine Steam Generators, Školska knjiga, Zagreb, 1992. (in Croatian)	5	12

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Marine HVAC&R Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+30+0

1. COURSE DESCRIPTION

1.1. Course objectives

Assuming theoretical knowledge and development of skills for practical solving of problems in design and application of process equipment.

1.2. Course enrolment requirements

None.

1.3. Expected course learning outcomes

List the methods of application of refrigeration devices on ships. Calculate the required cooling capacity for the cold store. Show, calculate and analyze thermodynamic processes, distinguish and describe different designs of compression refrigeration devices. Describe the properties of refrigerants and heat transfer substances, compare methods of their application and impact on the environment. Interpret the design and construction of marine refrigeration compressors, evaporators, condensers, expansion valves, fittings and pipelines. Analyze the operating characteristics and method of regulation of crefrigeration systems.
Define and describe the requirements for the design of marine ventilation and air conditioning systems. Analyze energy consumption for heating and cooling the ship. Describe and calculate the capacities of the system of natural and forced ventilation, heating, cooling and air conditioning of ship spaces. Interpret the performance and construction of the basic elements of ventilation and air conditioning systems. Distinguish methods of distribution of supply air in space. Define the basic elements and explain the mode of operation of the control of the heating and air conditioning system of the ship. Apply the acquired knowledge to solve practical problems.

1.4. Course content

Application of refrigeration devices on ships. Calculation of refrigeration load for cooling ship warehouses and cargo. Thermodynamic processes and designs of compression refrigeration devices. Refrigerants. Fundamentals of operation and construction characteristics of refrigeration compressors, evaporators and condensers. Expansion cvalves, piping and fittings. Control of cooling systems.
Requirements for the design of marine ventilation and air conditioning systems. Natural and forced ventilation. Partial air conditioning and air conditioning systems. Calculations of effects and energy consumption for heating, cooling and air conditioning on ships. Air treatment units. Heaters and coolers, water and steam humidifiers, filters, fans. Waste air heat recovery systems. Air distribution in space. Air inlet and outlet openings. Air flow regulators. Noise attenuators. Calculation and selection of elements of ventilation and air conditioning systems. Control of heating, cooling and air conditioning systems. An elective project from the course content is planned.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	-	

1.7. Student's obligations

Course attendance, activity, homework, studying.

1.8. Evaluation of student's work

Course attendance	2.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Activity, continuous knowledge testing (two mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Pavković, B.: Marine HVAC&R systems, (lectures), https://moodle.srce.hr

1.11. Optional / additional reading (at the time of proposing study programme)

ASHRAE: 2018 ASHRAE HANDBOOK- REFRIGERATION, (book) ASHRAE Atlanta, 2018.

ASHRAE: 2016 ASHRAE HANDBOOK- RHVAC SYSTEMS AND EQUIPMENT, (book) ASHRAE Atlanta, 2016.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Pavković, B.: Marine HVAC&R systems, (lectures), https://moodle.srce.hr	unlimited	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Materials Characterization and Fracture Analysis**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Introduction to the methods of microscopy, spectroscopy and macroscopic testing and training for their application in practice. Understanding the basics of material fracture analysis. Understanding the causes and mechanisms of crack propagation under different load conditions. Characterization of brittle materials and assessment of fatigue life.		
1.2. Course enrolment requirements		
Basic knowledge of metal materials.		
1.3. Expected course learning outcomes		
Describe and analyze the structure and basic properties of technical materials. Describe and analyze methods of material characterization and methods of taking and preparing samples for material characterization. Analyze the results of materials testing by microscopy, spectroscopy and macroscopic testing. Select appropriate material characterization methods in material quality assessment. Understand brittle and ductile fracture. Understand Griffith's criteria of fracture. Explain the causes and mechanisms of crack initiation and propagation in various loading conditions. Explain the basic terms and concepts of fracture analysis. Describe the procedures and explain the meaning of fractography.		
1.4. Course content		
Classification and main groups of material characterization methods: microscopy, spectroscopy and macroscopic testing. Structure characteristics and basic properties of technical materials. Microstructure testing. Optical microscopy. Electron microscopy. Chemical composition testing. Optical spectrometry. X-ray spectrometry. Electron spectrometry. Thermal analysis. Solidification cooling curves. Osmond curve. Dilatometric analysis. Static test methods. Dynamic test methods. Static long-term testing. Hardness testing. Technological testing. Liquid penetrants testing. Magnetic particle testing. Radiographic testing. Ultrasonic testing. Damaging processes in materials. Definition of fracture and deformation. Types of fractures. Micromechanisms of brittle fracture. Griffith's theory of brittle fracture, energy criterion of crack propagation. Macro and micro damage analysis. Fractography.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other
1.6. Comments	-	
1.7. Student's obligations		
Course attendance, seminar paper, studying.		

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, sustained knowledge check, seminar papers, written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Franz, M., Mechanical properties of materials, FSB, Zagreb, 1998. (in Croatian)
Callister, W. D., Jr., Materials science and engineering: An Introduction, John Wiley & Sons, New York, Chichester, etc., 1996.
Križan, B., Fundamentals of Calculation and Design of Machine Elements, Zagreb : Školska knjiga, 2008. (in Croatian)
Materials Characterization, ASM Handbook Vol. 4, ASM International, Materials Park, OH, 1986.
Vitez, I., Testing of mechanical properties of metallic materials, Slavonski Brod: Strojarski fakultet u Slavonskom Brodu, Trg I.B. Mažuranić 2, Sveučilište J.J. Strossmayera u Osijeku, 2006. (in Croatian)
ASM Handbook, Volume 8, Mechanical Testing and Evaluation, ASM International, Materials Park, OH, 2000.
Smokvina Hanza, S., E-podloge za predavanja: Karakterizacija materijala i analiza loma, RITEH, Rijeka, 2021. (na Merlinu) (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Dieter, George E., Mechanical Metallurgy, McGraw-Hili Book Company, London, etc., 1986.
Hosford, William F., Mechanical behavior of materials, Cambridge University Press, Cambridge, etc., 2010.
Roesler, J., Mechanical behaviour of engineering materials: metals, ceramics, polymers, and composites, Springer, Berlin, New York, 2007.
Analytical Chemistry and Its Applications, John Wiley & Sons, Inc., 1996.
Smith, G. C., Quantitative Surface Microanalysis by Auger and x-ray Photoelectron Spectroscopy, Vol. 25, No.1, 1990.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Franz, M., Mechanical properties of materials, FSB, Zagreb, 1998. (in Croatian)	3	12
Callister, W. D., Jr., Materials science and engineering: An Introduction, John Wiley & Sons, New York, Chichester, etc., 1996.	1	12
Križan, B., Fundamentals of Calculation and Design of Machine Elements, Zagreb : Školska knjiga, 2008. (in Croatian)	18	12
Materials Characterization, ASM Handbook Vol. 4, ASM International, Materials Park, OH, 1986.	1	12
Vitez, I., Testing of mechanical properties of metallic materials, Slavonski Brod: Strojarski fakultet u Slavonskom Brodu, Trg I.B. Mažuranić 2, Sveučilište J.J. Strossmayera u Osijeku, 2006. (in Croatian)	1	12
ASM Handbook, Volume 8, Mechanical Testing and Evaluation, ASM International, Materials Park, OH, 2000.	1	12
Smokvina Hanza, S., E-podloge za predavanja: Karakterizacija materijala i analiza loma, RITEH, Rijeka, 2021. (na Merlinu) (in Croatian)	available on Merlin	12

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Materials Protection**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Students will learn about types of corrosion and damage that can cause corrosion and methods implementing material protection of corrosion.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Define the corrosion, thermodynamics and kinetics of corrosion of metal materials. Explain the mechanisms of corrosion. Analyze internal and external factors that affect corrosion. Analyze corrosion protection principles. Describe the methods and procedures of protection against corrosion of metals and their alloys. Define the advantages and disadvantages of certain protection procedures. Describe the methods of determining the corrosion rate and compare the effectiveness of various corrosion protection procedures. Define the appropriate corrosion protection method based on technological and construction requirements.							
1.4. Course content							
Definition of corrosion. Costs and damages caused by corrosion. Classification of corrosion processes. Mechanisms of corrosion. Chemical corrosion. The quality of the oxide films. Electrochemical corrosion. Corrosion cell. Hydrogen and oxygen depolarization. Standard electrode potential of metal. Pourbaix diagrams. Causes of electrochemical corrosion. Electrochemical corrosion rate. Examination and analysis of corrosion damages. Types of corrosion: uniform, pitting, subsurface, crevice, galvanic, selective and intergranular corrosion. Corrosion under mechanical stresses: stress corrosion cracking, corrosion fatigue, fretting corrosion, erosion corrosion, and cavitation corrosion. Corrosion protection methods. Application of corrosion-resistant materials. Designing to prevent corrosion. Electrochemical protection. Protection using corrosion inhibitors. Corrosion protection using coatings - metallic, inorganic and organic coatings.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, homework, preparation for participation in classes, seminar paper, independent learning.							
1.8. Evaluation of student's work							
Course	2	Activity/Participation		Seminar paper	1	Experimental	

attendance						work	
Written exam	0.5	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, homework, sustained knowledge check, seminar paper, written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Smokvina Hanza, S., E-Lectures: Materials Protection, RITEH, Rijeka, 2021. (in Croatian)
Juraga, I., Alar, V., Stojanović, I., Corrosion and coatings for corrosion protection, FSB, Zagreb, 2014. (in Croatian)
Roberge, P. R., Handbook of Corrosion Engineering, Mc Graw-Hill, New York, 2000.
Filetin, T., Kovačiček, F., Indolf, J., Properties and application of materials, FSB, Zagreb, 2011. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Esih, I., Dugi, Z., Corrosion protection technology, Školska knjiga, Zagreb, 1990. (in Croatian)
Esih, I., Basics of surface protection, FSB, Zagreb, 2007. (in Croatian)
Novosel, M., Krumes, D., Special steels, Strojarski fakultet, Slavonski Brod, 1998. (in Croatian)
Corrosion: Materials, ASM Handbook Vol. 13B, ASM International, Materials Park, OH, 2005.
Fontana M. G., Greene, N. D., Corrosion Engineering, Mc Graw-Hill, New York, 1978.
Talbot, D., Talbot, J., Corrosion Science and Technology, CRC Press, 1998.
Askeland, D. R., Wright, W. J., The science and engineering of materials, Boston [etc.]: Cengage Learning, cop. 2016.
Callister, W. D., Jr., Materials science and engineering: An Introduction, John Wiley & Sons, New York, Chichester, etc., 1996.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Juraga, I., Alar, V., Stojanović, I., Corrosion and coatings for corrosion protection, FSB, Zagreb, 2014. (in Croatian)	1	8
Roberge, P. R., Handbook of Corrosion Engineering, Mc Graw-Hill, New York, 2000.	1	8
Filetin, T., Kovačiček, F., Indolf, J., Properties and application of materials, FSB, Zagreb, 2011. (in Croatian)	5	8
Smokvina Hanza, S., E-Lectures: Materials Protection, RITEH, Rijeka, 2021. (in Croatian)	available on Merlin	8

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Mathematics for Engineers**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	compulsory	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	7
	Number of hours (L+E+S)	45+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Acquiring basic knowledge in mathematical analysis and vector analysis.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Define and correctly interpret basic notions in trigonometric polynomials approximations, partial differential equations, and vector analysis. Compute approximations of some functions with trigonometric polynomials, determine analytical solutions for typical equations of mathematical physics on simple domains, and find solutions of problems in vector analysis. Give physical interpretation for: typical equations of mathematical physics, gradient of scalar fields, divergence and rotor of vector fields, solenoid and conservative fields, and curve and surface integrals.							
1.4. Course content							
Approximation of functions with trigonometric polynomials. Applications. Partial differential equations of mathematical physics. Applications. Vector analysis Applications. Curve integrals. Surface integrals. Triple integrals. Integral theorems Applications.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, activity/participation, studying							
1.8. Evaluation of student's work							
Course attendance	2.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	3.5	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity/participation, mid-term exams, and written and/or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Kreyszig, E.: Advanced Engineering Mathematics, John Wiley & Sons, Inc., 1993
Štefan Trubić M., Črnjarić-Žic N., Maćešić S., Mathematics for engineers, course material (on-line available on e-course)
Pavčević M.: Vector Analysis, (FER) Biblioteka Bolonja, Element, 2007. (In Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Farlow J. S., Partial differential equations for scientists and engineers, Dover publication Inc., 1993

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Kreyszig, E.: Advanced Engineering Mathematics, John Wiley & Sons, Inc., 1993	3	120
Štefan Trubić M., Črnjarić-Žic N., Maćešić S., Mathematics for engineers, course material (on-line available on e-course)	150	120
Pavčević M.: Vector Analysis, (FER) Biblioteka Bolonja, Element, 2007. (In Croatian)	2	120

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Mechanical Behaviour and Selection of Materials**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Groups of materials. Properties, features and parameters of material behaviour. Understanding the connection between the microstructure and the mechanical behaviour of materials. Understanding of the mechanisms of strengthening, fatigue, creep and the occurrence of residual stresses. Developing the ability to choose an appropriate criterion of failure. Introduction to the constitutive models of materials. Developing the ability to choose an appropriate criterion of fatigue failure. Understanding and application of methodology of materials selection in the design process.		
1.2. Course enrolment requirements		
Working knowledge of mechanics, strength of materials, metallic and non-metallic materials.		
1.3. Expected course learning outcomes		
Ability to define the type of atomic bonding and the microstructure and relate them to mechanical behaviour of different materials subjected to various loading conditions. Ability to explain the mechanisms of strengthening, fatigue, creep of materials and the occurrence of residual stresses, to select and apply an appropriate criterion of failure for the calculation of strength. Ability to distinguish the mechanisms of ductile and brittle failure. Ability to select and apply criterion of fatigue crack initiation. Ability to interpret and use the data about the mechanical properties of materials. Ability to differentiate between various types of constitutive material models. Ability to analyze design, technological, economical and other requirements and set up proper criteria for materials selection. Ability to apply and use (Ashby) materials selection charts.		
1.4. Course content		
Properties, behaviour and selection of materials in the context of the product development. Physical phenomena and processes, especially those at the microscopic, molecular and atomic scale, determining and explaining the macroscopic behaviour of various kinds of design-relevant materials (metals, polymers, composites, ceramics) under different types and modes of loading: kinds and mechanisms of deformation, alterations of mechanical properties, fatiguing, damaging, and failure. Yield and failure criteria. Phenomenological characterisation and classification of mechanical behaviour and performance of materials. Constitutive models. Material fatigue. Requirements and criteria for materials selection. Materials selection charts. Computer-aided materials selection.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		

Course attendance, program assignments, individual studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Homework assignment		Program assignments	1		

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, program assignments, sustained knowledge check, combined written and oral exam

1.10. Assigned reading (at the time of the submission of study programme proposal)

Teaching materials and lecture notes.
Dowling, N. E., Mechanical Behavior of Materials : Engineering Methods for Deformation, Fracture, and Fatigue, 3rd ed., Pearson Education, Upper Saddle River (NJ), 2007.
Ashby, M. F., Materials Selection in Mechanical Design, 3rd ed., Butterworth-Heinemann, Oxford, 2005.
Filetin, T., Materials Selection in Product Development, FSB, Zagreb, 2000. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Roesler, J., Harders, H., Baeker, M., Mechanical Behaviour of Engineering Materials : Metals, Ceramics, Polymers, and Composites, Springer, Berlin, 2007.
Meyers, M. A., Chawla, K. K., Mechanical Behavior of Materials, Prentice-Hall, Upper Saddle River, NJ, 1999.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Dowling, N. E., Mechanical Behavior of Materials : Engineering Methods for Deformation, Fracture, and Fatigue, 3rd ed., Pearson Education, Upper Saddle River (NJ), 2007.	1	12
Ashby, M. F., Materials Selection in Mechanical Design, 3rd ed., Butterworth-Heinemann, Oxford, 2005.	1	12
Filetin, T., Materials Selection in Product Development, FSB, Zagreb, 2000. (in Croatian)	4	12

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Mechanical Design of Machine Components**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+45+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Acquiring theoretical knowledge and skills development in order to understand the application of simple and complex machine elements in complex mechanical machine components. Analysis of given problems and methodological solution of project tasks related to power transmissions, with regards to the standard guidelines and with the application of suitable software solutions.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Choose the criteria for dimensioning and design of in complex mechanical machine components. Apply modern standard procedures for the assessment of load capacity of simple and complex machine elements. Optimally dimension and design gear transmission. Recommend and interpret the achieved results by sharing information, through presentations and technical documentation.							
1.4. Course content							
Complex mechanical machine components. Elements of power transmissions. Gear transmissions. Spur gears. Involute gearing. Contact of solids (Hertzian contact). Gear design. Law of gearing. Gears dimensioning. Bevel gears. Standard procedures for the evaluation of load capacity and durability of gears. Elastohydrodynamic lubrication. Stresses in gears teeth. Load capacity of gears. Calculation and design of a gear transmission, including concept sketches and required technical drawings. Application of software packages for the geometry and strength control of machine elements and components.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, homework, project tasks, studying.							
1.8. Evaluation of student's work							
Course attendance	2.5	Activity/Participation		Seminar paper	0.5	Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project	1	Sustained knowledge	0.5	Report		Practice	

		check					
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance. Oral examination through mid-term exams. Evaluation of independent work and presentation skills through seminars. Continuous evaluation of accuracy, precision, completeness and creativity in solving the problem assignment. Written verification of acquired knowledge on the final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Obsieger, B., Gear Transmissions (In Croatian), Faculty of Engineering, Rijeka, 2012.
Kraut's Mechanical Manual (In Croatian), Axiom, Zagreb, 1997., 2009.

1.11. Optional / additional reading (at the time of proposing study programme)

Orlić, Ž., Gear Reducer (In Croatian), Tehnički fakultet u Rijeci, Rijeka, 2001.
Oberšmit, E., Gears and Gearing (In Croatian), SNL, 1982.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Obsieger, B., Gear Transmissions (In Croatian), Faculty of Engineering, Rijeka, 2012.	5	16
Kraut's Mechanical Manual (In Croatian), Axiom, Zagreb, 1997., 2009.	16	16

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Mechanics of Composites**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Obtaining theoretical knowledge and develop skills to solve practical problems in the field of mechanics of composite structures.							
1.2. Course enrolment requirements							
Basic knowledge of solid mechanics.							
1.3. Expected course learning outcomes							
Define the main composite constituents. Highlight the features and benefits of the use of composite materials. Define the constitutive equations of anisotropic materials. Describe the change in elastic constants due to the change of fibre orientation. Define the rule of mixture. Calculate the mechanical properties of composites using the rule of mixture. Establish a connection between engineering constants of elasticity tensor and compliance tensor. Analyze a lamina mechanical behaviour. Establish the constitutive equations of multilayer laminates. Determine the stress and strain distribution over the composite lamina. Define the composite failure criteria. Define the thermal and moisture effects on composite mechanics. Analyze the laminated composite cross section beams. Explain the basic experimental testing procedures for determining the mechanical properties of composite materials.							
1.4. Course content							
Introduction. Constitutive equations of anisotropic materials. Macromechanics of composites. Micromechanics of composites. Mechanics of laminated composites. Hydrothermal effects on mechanical behaviour of composites. Interlaminar stresses. Failure criteria. Composite beam-type structure analysis. Basic experimental testing of composites.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ Individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, project, studying.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper	0.5	Experimental work	
Written exam	1	Oral exam	1	Essay		Research	

Project	0.5	Sustained knowledge check		Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, project, written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

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1.11. Optional / additional reading (at the time of proposing study programme)

Agarwal, D. B., et. al.: "Analysis and performance of fiber composites", John Wiley & Sons, New Jersey, 2006.
Barbero, E. J.: "Finite element analysis of composite materials", CRC Press, Boca Raton, 2008.
Jones, R. M.: "Mechanics of composite materials", Taylor & Francis, Philadelphia, 1999.
Reddy, J. N.: "Mechanics of laminated composite plates and shells", CRC Press, Boca Raton, 2004.
Kollar, L. P., Springer, G. S.: "Mechanics of composite structures", Cambrige University Press, Cambridge, 2003.
Christensen, R. M.: "Mechanics of composite materials", Dover Publications inc., New York, 2005.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
-	-	-

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Metal Materials**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Student will get the knowledge of metal materials, their classification, properties, microstructure and application.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Define equilibrium and non-equilibrium microstructure transformation in steel. Analyse the effects of microstructure on the mechanical properties of steel. Analyse properties and applicability of construction and special kinds of steels. Analyse properties and applicability of cast irons and other metal alloys. Analyse properties and applicability of special metal materials. Select appropriate material on the basis of construction and technological requirements.							
1.4. Course content							
Equilibrium and non-equilibrium microstructure transformation in steel. Microstructure and mechanical properties of steel. TTT-diagrams. Types of steel. Properties and application of structural steels and high strength steels. Microstructure, properties and application of corrosion and chemical resistant steels. Tool steels. Cast irons. Microstructure and properties of cast irons. Application of cast irons. Aluminium alloys. Microstructure and properties of aluminium alloys. Application of aluminium alloys. Magnesium alloys. Microstructure and properties of magnesium alloys. Application of magnesium alloys. Properties and application trends of alloys formed in semi-solid state. Copper alloys. Classification, properties and applications of copper alloys. Classification, properties and application of nickel and cobalt alloys. Super alloys. Classification, properties and applications of titanium alloys. Lead alloys. Tin alloys. Hard metals.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, preparation of seminars, studying.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	

Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, sustained knowledge check, seminar papers, written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Novosel, M., Krumens, D., Ferrous materials. II part: Construction steels, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod, 1995. (in Croatian)
De ferri metallographia I, II, III, Bruxelles ...[etc.]: Presses Academiques ...[etc.], 1966-1967.
Hertzberg, R. W., Deformation and Fracture Mechanics of Engineering Materials, Wiley, 1996.

1.11. Optional / additional reading (at the time of proposing study programme)

Heat Treating, ASM Handbook Vol. 4, ASM International, Materials Park, OH, 1991.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Novosel, M., Krumens, D., Ferrous materials. II part: Construction steels, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod, 1995. (in Croatian)	1	12
De ferri metallographia I, II, III, Bruxelles ...[etc.]: Presses Academiques ...[etc.], 1966-1967.	1	12
Hertzberg, R. W., Deformation and Fracture Mechanics of Engineering Materials, Wiley, 1996.	1	12

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Micro- and Nanoelectromechanical Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+15+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Competences in appropriate modelling, design, construction, production and usage of micro- and nanoelectromechanical systems. Team work and capability to communicate with experts.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Explain the terminology and notions related to MEMS and NEMS systems. Distinguish and characterise the scaling laws in various fields. Distinguish and characterise the relevant production technologies. Distinguish the materials used in this field. Distinguish and characterise innovative materials and technological processes. Explain and summarise the principles of modelling and simulation of systems. Explain occurrences and terminology related to micro- and nanotribology as well as the microfluidic systems. Explain the basics of measurement of mechanical entities in MEMS and NEMS elements and systems. Explain the ethical and societal aspects of the usage of the nanotechnologies. Teamwork and written and oral communication with experts in this and other fields.							
1.4. Course content							
Definition of micro- and nanoelectromechanical systems (MEMS & NEMS). Basic terminology. Scaling laws in miniaturisation. Production technologies for MEMS & NEMS. Used materials (especially carbon nanotubes and graphene). Usage of biological, therapeutics and other innovative materials and technological processes. Design and integration of systems. Modelling of systems. Basics of micro- and nanotribology. Basics of lab-on-a-chip systems and of microfluidics. Applications of MEMS & NEMS systems. Calculation, modelling and measurements in the field of micro- and nanoelectromechanical elements and systems. Ethical and social aspects of the usage of the nanotechnologies.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork			☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other			
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, activity, homework assignments (seminar papers) and autonomous study.							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper	1.5	Experimental work	

Written exam		Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Active participation to classes and homework assignments (seminar papers). Knowledge review via quizzes and on final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

***: „Springer Handbook of Nanotechnology“ - 3rd ed., ed. Bh. Bushan, Springer Verlag, Berlin (D), 2010.
T.-R. Hsu: „MEMS & MICROSYSTEMS – Design and Manufacture“, McGraw Hill, Boston (MA, USA), 2002.
M. J. Madou: „Fundamentals of Microfabrication“, CRC Press, Boca Raton (FL, USA), 2002.
S. Zelenika, E. Kamenar: „Precision Engineering and Micro- and Nanosystems Technologies – Precision Engineering“, University of Rijeka – Faculty of Engineering, Rijeka (HR), 2015. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

N. Maluf and K. Willimas: „An Introduction to Microelectromechanical Systems Engineering“ - 2nd ed., Artech House, Boston (MA, USA), 2004.
***: „Microsystems Mechanical Design“ – CISM Courses and Lectures No. 478, Springer Verlag, Wien (A), 2006.
K. K. Jain: „The Handbook of Nanomedicine“ - 3rd ed., Humana Press (Springer), New York (NY, USA), 2017.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
***: „Springer Handbook of Nanotechnology“ - 3rd ed., ed. Bh. Bushan, Springer Verlag, Berlin (D), 2010.	1	10
T.-R. Hsu: „MEMS & MICROSYSTEMS – Design and Manufacture“, McGraw Hill, Boston (MA, USA), 2002.	1	10
M. J. Madou: „Fundamentals of Microfabrication“, CRC Press, Boca Raton (FL, USA), 2002.	1	10
S. Zelenika, E. Kamenar: „ Precision Engineering and Micro- and Nanosystems Technologies – Precision Engineering“, University of Rijeka – Faculty of Engineering, Rijeka (HR), 2015. (in Croatian)	5	10
N. Maluf and K. Willimas: „An Introduction to Microelectromechanical Systems Engineering“ - 2nd ed., Artech House, Boston (MA, USA), 2004.	1	10
***: „Microsystems Mechanical Design“ – CISM Courses and Lectures No. 478, Springer Verlag, Wien (A), 2006.	1	10
K. K. Jain: „The Handbook of Nanomedicine“ - 3rd ed., Humana Press (Springer), New York (NY, USA), 2017.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Via the institutionalised quality assurance system of the Faculty of Engineering. Constant interaction and work with the students with the aim of improving the quality of teaching.

Basic description		
Course title	**Modelling in Engineering**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**			
1.1. Course objectives			
Define mathematical models in engineering practice. Apply mathematical models in typical engineering problems and solve them. Use of the appropriate methods for solving specific problems. Use of the specialized software packages.			
1.2. Course enrolment requirements			
None.			
1.3. Expected course learning outcomes			
Recognize appropriate mathematical model for some physical problems. Differentiate models which are based on ordinary differential equations and models based on partial differential equations. Differentiate initial and boundary value problems. Formulate correctly appropriate mathematical model of physical problem. Explain correctly fundamental ideas and properties of different numerical approaches and methods for solving differential equations; explain correctly advantages and disadvantages of particular computational methods. Solve mathematical model with appropriate numerical method with the aid of existing or homemade software. Evaluate results of applied methods.			
1.4. Course content			
Introduction to mathematical modelling of technical systems. Models based on ordinary differential equations (ODE). Solving of initial problems and boundary value problems. Dynamical systems. Methods for solving dynamical systems. Models based on partial differential equations (PDE). Applications to viscous fluid flow, stationary heat transport, conservation laws, gas flow, shallow water.			
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other	
1.6. Comments	-		
1.7. Student's obligations			
Course attendance, activity, solving and presentation of project tasks, studying.			
1.8. Evaluation of student's work			

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project	1.5	Sustained knowledge	1	Report		Practice	

		check					
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam
Sustained knowledge check, solving and presentation of project tasks, oral exam.
1.10. Assigned reading (at the time of the submission of study programme proposal)
Chapra S. C., Channale R. P., Numerical methods for engineers, McGrowHill Inc., 2003
1.11. Optional / additional reading (at the time of proposing study programme)
Strang G., Computational Science & Engineering, Wellesley-Cambridge Press, 2007.
1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Chapra S. C., Channale R. P., Numerical methods for engineers, McGrowHill Inc., 2003	10	15

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences
Through the Institution's quality assurance system.

Basic description		
Course title	**Modelling of Hydraulics and Pneumatics Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Acquisition of knowledge of hydraulic and pneumatic systems as parts of mechatronic systems and methodology and tools for their design.							
1.2. Course enrolment requirements							
Attended: Power Transmissions.							
1.3. Expected course learning outcomes							
Distinguish systems for fluid power. Define el.-hydraulic and el.-pneumatic systems. Apply automation on fluid power systems. To analyze the complex structure of the mobile and industrial systems. Select the available software tools for modeling and simulation as part of solving complex design tasks. Explain and present the solution of the project task.							
1.4. Course content							
Mathematical modelling of hydraulics and pneumatics systems. Control systems. Hydraulics and pneumatics proportional and servo systems. Hydraulic hybrid technologies. Design of ALC systems: MPL and fluidic. Modelling of complex hydraulics systems using a simulation software. Modelling of pneumatics systems using a pneumatic laboratory system.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, the application of knowledge for solving project task using appropriatly software for simulation of hydraulic and pneumatic systems.							
1.8. Evaluation of student's work							
Course attendance	2.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project	1	Sustained knowledge check		Report		Practice	0.5
Portfolio		Homework					
1.9. Procedure and examples of learning outcome assessment in class and at the final exam							

Course attendance, activity, making project task, project presentation, written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Siminiati, D.: Oil hydraulic, Tehnički fakultet Sveučilišta u Rijeci, Rijeka, 2012. (In Croatian)
Jelali, K., Kroll, A.: Hydraulic Servo-systems, Springer, 2008.
Beater, P.: Pneumatic drives: System Design, Modelling and Control, Springer, 2006.
J. Petrić: Automation, Fakultet strojarstva i brodogradnje, Sveučilište u Zagrebu, 2012. (In Croatian)
Costa, G. K., Sepheri. N.: Hydrostatic transmision and actuators, Wiley, 2014.

1.11. Optional / additional reading (at the time of proposing study programme)

H. E. Merritt: ''Hydrauilc Control Systems'', John Wilez&Sons, 1967
Bishop, R. H., The Mechatronics Handbook, CRC Press, Boca Raton, 2002.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Siminiati, D.: Uljna hidraulika, Tehnički fakultet Sveučilišta u Rijeci, Rijeka, 2012.	13	20
Jelali, K., Kroll, A.: Hydraulic Servo-systems, Springer, 2008.	1	20
Beater, P.: Pneumatic drives: System Design, Modelling and Control, Springer, 2006.	1	20
J. Petrić: ''Automatska regulacija: uvod u analizu i sintezu'', Fakultet strojarstva i brodogradnje, Sveučilište u Zagrebu, 2012.	available online	20
Costa, G. K., Sepheri. N.: Hydrostatic transmision and actuators, Wiley, 2014.	1	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Non Conventional and Additive Manufacturing Processes**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION		
1.1. Course objectives		
Acquisition of theoretical knowledge and training for modeling and optimization of non conventional and additive manufacturing processes, independent selection of the most appropriate process with regard to economic aspects and the quality of the finished product, and calculation of technological parameters.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
To identify and to describe the non conventional and additive manufacturing processes and their application. To interpret the physical fundamentals of non conventional and additive manufacturing processes. To apply the basic calculations of the most important technological parameters. To analyze the characteristics of different non conventional and additive manufacturing processes. To assess the advantages and limitations of applying non conventional and additive manufacturing processes compared to conventional processes and with each other. To select the most appropriate process with regard to economic aspects and the quality of the finished product. To apply experimental modeling and optimization of non conventional and additive manufacturing processes.		
1.4. Course content		
Classification and development of manufacturing technologies. Non conventional machining processes: ultrasonic machining, abrasive jet machining, water jet machining, abrasive water jet machining, ice jet machining, chemical machining, photochemical machining, electrochemical machining, shaped tube electrolytic machining, electrochemical jet machining, electrical discharge machining, laser beam machining, electron beam machining, plasma beam machining, ion beam machining and hybrid machining processes. Additive manufacturing processes: vat photopolymerisation, material jetting, material extrusion, powder bed fusion, binder jetting, sheet lamination and directed energy deposition. Experimental modeling and optimization of non conventional and additive manufacturing processes.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☒ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		
Course attendance, control tasks, project, independent learning.		
1.8. Evaluation of student's work		

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project	1	Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, sustained knowledge check, project, written and / or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Cukor, G.: Non-conventional Machining Processes, internal script, Tehnički fakultet Sveučilišta u Rijeci, 2011. (in Croatian)
Cukor, G.: Hybrid Machining Processes, internal script, Tehnički fakultet Sveučilišta u Rijeci, 2011. (in Croatian)
Cukor, G.: Additive Manufacturings, internal script, Tehnički fakultet Sveučilišta u Rijeci, 2011. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Krar, S., Gill, A.: Exploring Advanced Manufacturing Technologies, Industrial Press, 2003.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Cukor, G.: Non-conventional Machining Processes, internal script, Tehnički fakultet Sveučilišta u Rijeci, 2011. (in Croatian)	50	46
Cukor, G.: Hybrid Machining Processes, internal script, Tehnički fakultet Sveučilišta u Rijeci, 2011. (in Croatian)	50	46
Cukor, G.: Additive Manufacturings, internal script, Tehnički fakultet Sveučilišta u Rijeci, 2011. (in Croatian)	50	46

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Non-Metal Materials**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	4
	Number of hours (L+E+S)	30+15+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Students will gain knowledge about the types and properties of non-metallic materials.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Define and explain polymers, polymerization reactions and different classifications of polymeric materials. Analyze the differences in the structure of the macromolecules of thermoplastics, thermosets and elastomers and the influence of the structure on the properties of the polymer. Analyze the influence of temperature and loading time on mechanical properties of polymer, their processing and use. Explain the relaxation phenomena in polymers. Analyze the thermal, electrical and optical properties of the polymer. Compare different methods of processing the polymer in the same finished product and explain the constraints in the choice of process with respect to the type of polymer. Compare the physical and mechanical properties of wood with the properties of other constructional materials. Define ceramic materials and their classification into traditional and technical ceramics. Explain the influence of chemical composition and structure on mechanical, thermal and electrical properties of ceramic materials. Compare the basic steps of obtaining finished products from traditional and technical ceramics as well as obtaining finished glass products. Define composite materials and their classification according to the type of reinforcement or type of matrix. Explain properties and areas of application of composites with polymer, metal and ceramic matrices.		
1.4. Course content		
Types of nonmetallic materials. Structure and classification of polymeric materials. Additives for polymers. Mechanical properties of polymeric materials. Thermal properties. Electrical properties. Optical properties. Aging of polymeric materials. Processing of polymeric materials into finished products. Application of polymers. Composition, structure, properties and application of wood. Structure and classification of ceramic materials. Mechanical properties. Thermal properties. Electrical properties of ceramic materials. Application of ceramics in the engineering. Properties, manufacturing and application of glass. Structure, properties and classification of composite materials. Processes for manufacturing composite materials and their application.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		

Course attendance, homework, preparation for participation in classes, seminar paper, independent learning.

1.8. Evaluation of student's work

Course attendance	1.5	Activity/Participation		Seminar paper	0.5	Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, sustained knowledge check, seminar paper, written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Smokvina Hanza, S., E-Lectures: Non-metal materials, RITEH, Rijeka, 2020. (in Croatian)
Katavić, I., Introduction to materials, RITEH, Rijeka, 2008. (in Croatian)
Filetin, T., Kovačiček, F., Indolf, J., Properties and application of materials, FSB, Zagreb, 2011. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Raos, P., Šercer, M., Theoretical bases of polymer production, Strojarski fakultet, Slavonski Brod, 2010. (in Croatian)
Filetin, T., Kramer, I., Technical ceramics, FSB, Zagreb, 2005. (in Croatian)
Askeland, D. R., Wright, W. J., The science and engineering of materials, Boston [etc.]: Cengage Learning, cop. 2016.
Callister, W. D., Jr., Materials science and engineering: An Introduction, John Wiley & Sons, New York, Chichester, etc., 1996.
Schwartz, M., Encyclopedia of Materials, Part and Finishes, second edition, CRC Press, 2002.
Strong, A. B., Plastics Materials and Processing, second edition, Prentice Hall, Columbus, Ohio, 2000.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Katavić, I., Introduction to materials, RITEH, Rijeka, 2008. (in Croatian)	22	12
Filetin, T., Kovačiček, F., Indolf, J., Properties and application of materials, FSB, Zagreb, 2011.	5	12
Smokvina Hanza, S., E-Lectures: Non-metal materials, RITEH, Rijeka, 2020. (in Croatian)	available on Merlin	12

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Numerical Methods in Design**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Development of theoretical knowledge and skills required to solve practical engineering problems by applying modern numerical methods.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Applying interpolation and error estimation. Describe orthogonal and shape functions. Describe the most important partial differential equations (PDE). Applying finite difference and finite element methods. Applying the Gauss and Green theorems.Describe Green functions and general solutions of PDE. Solving PDE by FEM. Compare direct and numerical integration on elements. Compare methods of solving linear equation systems. Apply the acquired knowledge to concrete machine design problems. Numerically determine equation solutions. Numerically determine optimal solutions for engineering problems. Numerically solve ordinary differential equations.							
1.4. Course content							
Error and uncertainty. Error propagation. Approximation and interpolation. Orthogonal coordinate functions. Shape functions. The most important PDEs in heat conduction, elasto-mechanics, fluid mechanics and lubrication. Boundary conditions. Finite difference method and finite volume method. Frontal integration. Gauss and Green theorems. Fundamental solutions (Green functions) of PDEs. Solving PDE by FEM. Direct and numerical integration on finite elements. Strategies for the solving of linear equation systems. Comparison of different method for solving PDEs on the same examples. Procedures for the numerical solution of equations. Finding of optimal solutions for engineering problems. Methods for the solution of differential equations. Application of the Boundary Element Method. Application of the Genethic Algorithm in engineering problems.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, homework, project tasks, studying.							
1.8. Evaluation of student's work							
Course	2	Activity/Participation		Seminar paper	1	Experimental	

attendance						work	
Written exam		Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Homeworks	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance. Oral examination through two mid-term exams. Evaluation of presentation skills through two seminars. Continuous evaluation of accuracy, precision, completeness and creativity in solving the problem assignment. Written verification of acquired knowledge on the final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Chapra, S. C.; Canale, R. P.: Numerical methods for engineers, McGraw-Hill Book Company, New York, 1990.
Obsieger, B.: Numerical Methods I – Basis and Fundamentals, Tehnički fakultet, Rijeka, 2012.
Obsieger, B.: Numerical Methods II – Roots and Equations Systems, Tehnički fakultet, Rijeka, 2012.
Obsieger, B.: Numerical Methods III – Approximation of Functions, Tehnički fakultet, Rijeka, 2011.
Obsieger, B.: Numerical Methods IV – Interpolation and Shape Functions, Tehnički fakultet, Rijeka, 2014.

1.11. Optional / additional reading (at the time of proposing study programme)

Alfirević, I.: Uvod u tenzore i mehaniku kontinuuma, Golden marketing–Tehnička knjiga, Zagreb, 2000.
Esfandiari, R. S.: Numerical methods for engineerins and scientists using MATLAB, CRC Press, Boca Raton, 2013.
Jović, V.: Uvod u inženjersko numeričko modeliranje, Aquarius Engineering, Split, 1993.
Langtangen, H. P.: Python scripting for computational science, Springer-Verlag, Berlin, 2008.
Obsieger, B.: Metoda rubnih elemenata I, ISBN 953-98862-4-4, Zigo Rijeka, 2003.
Obsieger, B.: Metoda rubnih elemenata II, ISBN 953-98862-9-5, Zigo Rijeka, 2003.
Press, W. H.; Teukolsky, S. A.; Vetterling, W. T.; Flannery, B. P.: Numerical Recipes 3rd Edition, Cambridge University Press, New York NY, 2007.
Šribar, J.; Motik, Boris.; Motik, Bruno.: Demistificirani C++, Element, Zagreb, 2006.
Zienkiewicz, O.C., Taylor, R.L., ZHU, J.Z.: The Finite Element Method, its Basis and Fundamentals, Elsevier, London, 2006.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Obsieger, B.: Numerical Methods I – Basis and Fundamentals, ISBN 978-953-6326-66-2, Faculty of Engineering, Rijeka, 2014.	2	16
Obsieger, B.: Numerical Methods II – Roots and Equations Systems, ISBN 978-953-6326-67-9, Faculty of Engineering, Rijeka, 2012.	2	16
Obsieger, B.: Numerical Methods III – Approximation of Functions, ISBN 978-953-6326-68-6, Faculty of Engineering, Rijeka, 2011.	4	16
Obsieger, B.: Numerical Methods IV – Interpolation and Shape Functions, Tehnički fakultet, Rijeka, 2014.	1	16
Chapra, S. C.; Canale, R. P.: Numerical methods for engineers, McGraw-Hill Book Company, New York, 1990.	6	16

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's system of quality control.

Basic description		
Course title	**Numerical Modelling in Thermodynamics**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Obtaining theoretical knowledge in fields of mathematical modelling and numerical solving, as well as training of skills for solving practical numerical problems in fields of thermodynamics.		
1.2. Course enrolment requirements		
Basic knowledge of thermodynamics.		
1.3. Expected course learning outcomes		
Define and mathematically describe mass, momentum and energy conservation laws in vector and differential form. Describe and analyze differential and integral forms of the general transport equation. Define and compare numerical methods for solving of heat transfer problems. Define and describe the discretisation equations using control volume method for steady and unsteady heat conduction. Define and describe the discretisation equations using control volume method for steady and unsteady convection-diffusion problems. Describe and compare solution algorithms for pressure-velocity coupling. Define and describe methods of discretised equation systems solving. Apply acquired knowledge on the numerical calculations of temperature, velocity and pressure fields. Apply acquired knowledge on the mathematical model, initial and boundary conditions defining as well as on the results interpretation in use of software for numerical simulations of heat transfer.		
1.4. Course content		
Mathematical description of thermodynamic processes. Mass, momentum and energy conservation laws. Vector forms of the continuity, Navier-Stokes and energy equations. Differential equations setting. Initial and boundary conditions. Differential and integral forms of the general transport equation. Numerical methods for solving of heat transfer problems. Control volume method. Temperature fields calculation during steady and unsteady heat conduction. Control volume method for convection-diffusion problems. Solution algorithms for pressure-velocity coupling. Temperature fields calculation for convection-diffusion problems. Laminar boundary layer. Calculation of unsteady problems. Initial and boundary conditions treatment. Solution of discretised equation systems. Computer codes for numerical simulations of heat transfer processes.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		
Course attendance, activity, homework, seminar work, studying.		

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper	0.5	Experimental work	
Written exam		Oral exam	1	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, seminar work, continuous knowledge testing (two mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Versteeg,H.K., Malalasekera,W.: An Introduction to CFD:The Finite Volume Method, L. S&T, Essex, 1995.
Welty, J. R., Wicks, C. E., Wilson, R. E.: Fundamentals of Momentum, Heat and Mass Transfer, John Wiley & Sons Inc., New York, 1984.
Patankar, S. W.: Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corp., NY, 1980.

1.11. Optional / additional reading (at the time of proposing study programme)

Bošnjaković, F.: Thermodynamics, Vol. I, II and III (reprint editions of 1978, 1976 and 1986), Graphis d.o.o., Zagreb, 2012. (in Croatian)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Versteeg,H.K., Malalasekera,W.: An Introduction to CFD:The Finite Volume Method, L. S&T, Essex, 1995.	1	20
Welty, J. R., Wicks, C. E., Wilson, R. E.: Fundamentals of Momentum, Heat and Mass Transfer, John Wiley & Sons Inc., New York, 1984.	2	20
Patankar, S. W.: Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corp., NY, 1980.	1	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Numerical Modelling of Hydraulic Machines**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Identifying computational problems in engineering practice; understanding and application of computer environment for turbomachine geometry creation. Automatic creation of 2D and 3D geometry of hydraulic machines; application of commercial software for fluid flow simulation and turbomachine performance assessment.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Indicate and correctly interpret 2D numerical fluid flow analysis of axial and radial turbo machinery. Develop tools for effective blade design for hydraulic machines: apply different spline curves for blade shape design: using NACA profiles, using pressure and suction side curves and using profile camber and thickness curves. Develop a computer program in Fortran or C / C+ + and apply it to create geometry of wicket gate, stay vanes and runner blades. Apply a commercial computer program for simulation of 3D flow in the axial, radial and axial-radial turbines and determine machine performance and efficiency. Define geometric parameters for shape optimization and perform an optimization based on fluid flow simulation results.							
1.4. Course content							
Problem formulation. 2D numerical fluid flow analysis of axial and radial turbines. Development of tools for efficient blade design using different spline curves. Blade design using NACA profiles, pressure and suction side curves and camber and thickness curve distribution. Computer programs in Fortran, C, C+ +. Applications for creation of geometry of stay vanes, wicket gate and rotor blades. Finite volume discretization and numerical fluid flow simulation. 3D fluid flow simulation in the axial, radial and axial-radial turbines. Machine performance assessment . Definition of geometric parameters for blade shape optimization.							
1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, homework, independent studying.							
1.8. Evaluation of student's work							
Course	2	Activity/Participation		Seminar paper		Experimental	

attendance						work	
Written exam	0.5	Oral exam		Essay		Research	
Project	1.5	Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, project.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Krivchenko, G., Hydraulic Machines: Turbines and Pumps, ISBN 1-56670-001-9, CRC Press, 1994.
Horvat, D., Water turbines, Tehnička knjiga, 1955., (in Croatian)
Tuzson, J., Centrifugal Pump Design, ISBN 0-471-36100-3, John Wiley & Sons, 2000.

1.11. Optional / additional reading (at the time of proposing study programme)

Ferziger, J.H., Peric, M., Computational Methods For Fluid Dynamics, ISBN: 3540420746, Springer-Verlag, 1996.
W.Press et al: Numerical Recipes for C/C++/Pascal/fortran, Cambridge University Press, 1992

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Krivchenko, G., Hydraulic Machines: Turbines and Pumps, ISBN 1-56670-001-9, CRC Press, 1994.	1	15
Horvat, D., Vodne turbine, Tehnička knjiga, 1955., (in Croatian)	1	15
Tuzson, J., Centrifugal Pump Design, ISBN 0-471-36100-3, John Wiley & Sons, 2000.	1	15

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Offshore Operations**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Creating preconditions for complex analysis of the scope and specificities of marine operations in offshore industry. Acquiring specific competencies in complex offshore operations. Ability to carry out appropriate analysis and assessment of corresponding requirements during planning and performing offshore operations. Acquiring specific knowledge in risk analysis of marine and offshore operations.		
1.2. Course enrolment requirements		
Attended course Offshore Structures and Vessels.		
1.3. Expected course learning outcomes		
To define and distinguish marine operations in offshore industry. To describe how weather windows can be determined according to weather forecasts and environmental loads. To have knowledge and competences about selected marine operations. To describe and analyze marine and offshore operations like station keeping, path following, heavy object lifting, pipe playing, tandem loading and off-loading, heave compensation. To be able to quantitatively and qualitatively analyze risks during marine and offshore operations.		
1.4. Course content		
Introduction in marine and offshore operations. Weather windows and uncertainties in weather forecasts. Marine and offshore operations: installation and operation of offshore oil and gas fields, towing and transportation of offshore structures, lifting and landing of large and heavy objects, mooring, pipe and cable laying, offshore loading and off-loading, heave compensation, subsea operations, remotely operated and autonomous operations. Analysis and assessment of requirements during planning and performing of offshore operations. Operational profiles. Risk analysis in marine and offshore operations. Qualitative and quantitative risk analysis. Safety of operations. Cost benefit analysis.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		
Attendance, participation, seminar paper, self-study.		
1.8. Evaluation of student's work		

Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	
Written exam		Oral exam	1	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance, activity, individual assignments, continuous assessment (2 mid-term exams), oral examination.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Nielsen, F.G. (2007). Marine Operations. Lecture Notes, Department of Marine Technology, Faculty of Engineering, Norwegian University of Science and Technology, Trondheim/Bergen, Norway.
Gudmestad, O.T. (2015). Marine Technology and Operations: Theory & Practice. WIT Press, UK.
DNV GL (2017). Environmental conditions and environmental loads. Report DNVGL-RP-C205, DNV GL AS, Norway. [Online]. Available: https://www.dnvgl.com/rules-standards/
DNV GL (2017). Modelling and analysis of marine operations. Report DNVGL-RP-N103, DNV GL AS, Norway. [Online]. Available: https://www.dnvgl.com/rules-standards/
DNV GL (2017). Risk management in marine and subsea operations. Report DNVGL-RP-N101, DNV GL AS, Norway. [Online]. Available: https://www.dnvgl.com/rules-standards/

1.11. Optional / additional reading (at the time of proposing study programme)

Carlton, J., Jukes, P., Choo, Y.-S., Eds. (2018). Encyclopedia of Maritime and Offshore Engineering. John Wiley & Sons, Inc., Hoboken, USA.
Dhanak, M.R., Xiros, N.I., Eds. (2016). Springer Handbook of Ocean Engineering. Springer, Germany.
Chakrabarti, S.K. (2005). Handbook of Offshore Engineering, Vol. 2. Elsevier, Oxford, UK.
Fossen, T.I.(2011).Handbook of Marine Craft Hydrodynamics and Motion Control. John Wiley & Sons, Ltd.,UK
Vinnem, J.-E. (2014). Offshore Risk Assessment - Principles, Modelling and Applications of QRA Studies - Vol. 1 & 2, 3rd Ed. Springer-Verlag, London, UK.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Nielsen, F.G. (2007). Marine Operations. Lecture Notes, Department of Marine Technology, Faculty of Engineering, Norwegian University of Science and Technology, Trondheim/Bergen, Norway.	1	20
Gudmestad, O.T. (2015). Marine Technology and Operations: Theory & Practice. WIT Press, UK.	1	20
DNV GL (2017). Environmental conditions and environmental loads. Report DNVGL-RP-C205, DNV GL AS, Norway. [Online]. Available: https://www.dnvgl.com/rules-standards/	available online	20
DNV GL (2017). Modelling and analysis of marine operations. Report DNVGL-RP-N103, DNV GL AS, Norway. [Online]. Available: https://www.dnvgl.com/rules-standards/	available online	20
DNV GL (2017). Risk management in marine and subsea operations. Report DNVGL-RP-N101, DNV GL AS, Norway. [Online]. Available: https://www.dnvgl.com/rules-standards/	available online	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through a structured system of quality assurance of the Faculty.

Basic description		
Course title	**Offshore Structures and Vessels**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1.COURSE DESCRIPTION							
1.1. Course objectives							
Creating preconditions for complex analysis of the scope and specifics of maritime technology. Based on the basic knowledge of the technical requirements, and how to achieve compliance with the broader basis for understanding the essential factors in the design, construction and operation in the maritime technology.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
To distinguish offshore structures and vessels and to describe their characteristics. To estimate environmental and other loads and their impact on offshore structures and vessels. To perform static analysis of mooring lines. To describe construction and installation requirements for selected offshore structures and vehicles. To describe and perform capability analysis of dynamic positioning system. To distinguish special purpose vessels and to describe their characteristics. To distinguish other floating units and subsea structures and objects and to describe their characteristics. To analyse and elaborate environmental and ecological impact of offshore structures and vessels.							
1.4. Course content							
Classification of offshore structures and vessels. Fixed platforms. Compliant platforms. Jacket platforms. Jack-up platforms. Tension-leg platforms. Mooring systems. Static analysis of mooring lines. Semi-submersible rigs and ships. Dynamic positioning systems. Environmental loads. Other loads. Construction and installation requirements. Special purpose vessels: tugs, offshore supply vessels, cable-laying vessels, pipe-laying vessels, dredgers, drilling ships, heavy cargo vessels. Floating, production, storage and offloading units. Offshore wind farms and other offshore renewable energy systems. Offshore aquaculture structures. Offshore mobile bases. Subsea systems, structures and objects. Environmental and ecological aspects of offshore structures and vessels.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Attendance, participation, seminar paper, self-study.							
1.8. Evaluation of student's work							
Course	2	Activity/Participation		Seminar paper	1	Experimental	

attendance						work	
Written exam		Oral exam	1	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance, activity, individual assignments, continuous assessment (2 mid-term exams), oral examination.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Reddy, D.V., Swamidas, A.S.J. (2014). Essentials of Offshore Structures - Framed and Gravity Platforms. CRC Press, Taylor & Francis Group, LLC, Boca Raton, FL, USA.
Wilson, J.F., Ed. (2003). Dynamics of Offshore Structures. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
Chakrabarti, S.K. (2005). Handbook of Offshore Engineering, Vol. 1 & 2. Elsevier, Oxford, UK.
DNV GL (2017). DNV GL rules for classification: Ships (RU-SHIP), Underwater technology (RU-UWT), Offshore units (RU-OU), Offshore standards (OS). [Online]. Available: https://www.dnvgl.com/rules-standards/

1.11. Optional / additional reading (at the time of proposing study programme)

El-Reedy, M.A. (2012). Offshore Structures - Design, Construction and Maintenance. Elsevier, USA.
McCormick, M.E. (2010). Ocean Engineering Mechanics with Applications. Cambridge University Press, New York, USA.
Faltinsen, O.M. (1990). Sea Loads on Ships and Offshore Structures. Cambridge University Press, Cambridge, UK.
Karimirad, M. (2014). Offshore Energy Structures - For Wind Power, Wave Energy and Hybrid Marine Platforms. Springer International Publishing, Switzerland.
Carlton, J., Jukes, P., Choo, Y.-S., Eds. (2018). Encyclopedia of Maritime and Offshore Engineering. John Wiley & Sons, Inc., Hoboken, USA.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Reddy, D.V., Swamidas, A.S.J. (2014). Essentials of Offshore Structures - Framed and Gravity Platforms. CRC Press, Taylor & Francis Group, LLC, Boca Raton, FL, USA.	1	20
Wilson, J.F., Ed. (2003). Dynamics of Offshore Structures. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.	1	20
Chakrabarti, S.K. (2005). Handbook of Offshore Engineering, Vol. 1 & 2. Elsevier, Oxford, UK.	1	20
DNV GL (2017). DNV GL rules for classification: Ships (RU-SHIP), Underwater technology (RU-UWT), Offshore units (RU-OU), Offshore standards (OS). [Online]. Available: https://www.dnvgl.com/rules-standards/	Available online	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through a structured system of quality assurance of the Faculty.

Basic description		
Course title	**Polymer Processing**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+15+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Acquisition of theoretical and practical knowledge from the production and processing of polymeric materials. Developing skills of apply numerical simulations in the injection molding process for the injection mold design.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Describe the method of polymeric materials production. Explain the structural characteristics of polymers. Classify polymeric materials. State and explain the mechanical, rheological, thermal, electrical, and chemical properties of polymers. List and explain the procedures of primary shaping and forming. Analyze the cycle of the thermoplastic injection molding process. State and explain the function of the basic elements of an injection mold. Analyze key process parameters. List the shortcomings of the molded part. Analyze the obtained results of numerical simulations of mold filling in injection molding.							
1.4. Course content							
Development and significance of polymer application. Production of polymeric materials. Structural characteristics of polymers. Division of polymers and polymeric materials, their labeling, and classification. Mechanical, rheological, and thermal properties of polymers. Energy and heat balance in polymer processing. Primary and forming polymer processing. Production of polymeric foam and composite polymers. Machining and joining of polymer products. Management of plastic products. Numerical flow simulation in the injection molding process. Injection mold design. Design of cooling channel-conformal cooling system.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Class attendance and activity, solving assigned project work, and independent learning.							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	

Project	1	Sustained knowledge check	2	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Class attendance, project work, continuous knowledge assessment, and written and/or oral examination.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Čatić, I.: *Proizvodnja polimernih tvorevina*, ISBN: 953-97450-4-7, Društvo za plastiku i gumu, Zagreb, 2006. (in Croatian)
Rogić, A., Čatić, I., Godec, D.: *Polimeri i polimerne tvorevine*, ISBN-13: 978-953-97450-6-4, Društvo za plastiku i gumu, Zagreb, 2008. (in Croatian)
Raos, P., Šercer, M.: *Teorijske osnove proizvodnje polimernih tvorevina*, ISBN-13: 978-953-6048-57-1, Strojarski fakultet u Slavonskom Brodu i Fakultet strojarstva i brodogradnje u Zagrebu, 2010. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Dangel, R.: *Injection Molds for Beginners*, 2nd edition, eBook ISBN-13: 978-1-56990-819-8, Hanser Publications, 2020.
Baur, E., Osswald, T.A., Rudolph, N.: *Plastics Handbook - The Resource for Plastics Engineers*, 5th edition, Hardcover ISBN-13: 978-1569905593, eBook ISBN: 978-1-56990-560-9, Hanser Publications, 2019.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Čatić, I.: *Proizvodnja polimernih tvorevina*, ISBN 953-97450-4-7, Društvo za plastiku i gumu, Zagreb, 2006. (in Croatian)	8	20
Rogić, A., Čatić, I., Godec, D.: *Polimeri i polimerne tvorevine*, ISBN 978-953-97450-6-4, Društvo za plastiku i gumu, Zagreb, 2008. (in Croatian)	5	20
Raos, P., Šercer, M.: *Teorijske osnove proizvodnje polimernih tvorevina*, ISBN 978-953-6048-57-1, Strojarski fakultet u Slavonskom Brodu i Fakultet strojarstva i brodogradnje u Zagrebu, 2010. (in Croatian)	1	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Power Transmissions**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student ‘s workload coefficient	5
	Number of hours (L+E+S)	45+45+0

1. COURSE DESCRIPTION

1.1. Course objectives

Acquiring knowledge and skills about topics related to power transmissions. Mastering the basis hydrostatic and pneumatic power transmissions, the application of knowledge to constructional compiling of assembly and simulations on computer software solutions. The development of the ability to calculate, design and apply complex power transmissions in industrial praxis, taking into consideration demands regarding safety, ecology, ergonomics, engineering ethics, etc.

1.2. Course enrolment requirements

None.

1.3. Expected course learning outcomes

Explain the term, classification and application of power transmissions. Explain the ways of transmission power in mechanical, hydraulic and pneumatic systems. Define the sources of hydraulic energy and compressed air energy. Distinguish the components for control in hydraulic and pneumatic systems. Describe auxiliary devices. Connecting hydraulic and pneumatic elements into simple circuit. Implement knowledge onto complex systems of power transmissions. Modelling of basic pneumatics systems using a laboratory pneumatic system. Define classification, application, calculation and design of planetary (epicyclic) gears, worm gears, frictional transmissions, conventional and automated gear-boxes. Explain and define application of power transmissions in cars, trucks, tractors, ships, airplanes, helicopters, wind turbines, hoisting devices, etc. Understand the importance of using ecology, ergonomics and engineering ethics in design and maintenance of power transmissions. Apply acquired knowledge in design and application of complex power transmissions, using computer software solutions.

1.4. Course content

Fundamental of power transmissions, principal features, classification, application. Development and application of hydraulic and pneumatic devices and systems. Standardized symbols of the hydraulic and pneumatic elements. Working fluids. Energy and power in hydraulic and pneumatic systems. Sources of the hydraulic and compressed air energy (pumps and compressors). Actuators (motors and cylinders). Components for control in hydraulic and pneumatic systems (valves). Auxiliary devices. Hydro-pneumatic devices. Vacuum devices. Designing of fluid power systems and their combinations with mechanical transmissions. Planetary (epicyclic) gears: fundamentals of the theory and the operation, types, purpose, calculation of the planetary gear's geometry and transmission ratio. Wolfram's planetary gear. Analysis of the forces and torques. Power branching. Design and application of conventional and automated gear-boxes. Worm gears: fundamentals of the theory and the operation, geometry, materials, lubrication, efficiency, design of worms and wheels, intermittent and short duration running, calculation of load capacity and safety factors. Frictional transmissions: types, purpose, design, calculation of the contact pressure, durability. Continuously variable transmissions. Modern vehicle transmissions. Application of power transmissions in cars, trucks, tractors, ships, airplanes, helicopters, wind turbines, hoisting devices, etc. Analysis of the importance of using ecology, ergonomics and engineering ethics in design and maintenance of power

transmissions. Application of computer software solutions for calculation, analysis and optimization of power transmissions.

1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Course attendance, activity, solving assigned project work, studying.

1.8. Evaluation of student's work

Course attendance	3	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.25	Oral exam	0.25	Essay		Research	
Project	0.5	Sustained knowledge check	0.5	Report		Practice	0.5
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, assembling circuits in laboratory, continuous knowledge testing (two mid-term exams), project work, final written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Siminiati, D.: Oil Hydraulics, Tehnički fakultet Sveučilišta u Rijeci, Rijeka, 2012. (in Croatian)
Nikolić. J.: Pneumatic Control, Zagreb, 1976. (in Croatian)
Orlić, Ž., Orlić, G.: Planetary Transmissions, Zigo, Rijeka, 2006. (in Croatian)
Opalić, M.: Power and Motion Transmissions, HDESK, Zagreb, 1998. (in Croatian)
Oberšmit, E.: Gearing and Gears, Sveučilišna naknada Liber, Zagreb, 1982. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Krist, T.: Hydraulik, Fluidtechnik, Vogel Buchverlag, 1997.
Haug, R.: Pneumatische Steuerungstechik, Teubner, Stuttgart, 1991.
Lechner, G., Naunheimer, H.: Automotive Transmissions, Springer-Verlag Berlin Heidelberg, 1999.
Decker, K.H.: Machine Elements, Golden marketing-Tehnička knjiga, Zagreb, 2007. (in Croatian)
Dudas, I.: Worm Gear Drives, Penton Press, London, 2000.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Siminiati, D.: Oil Hydraulics, Tehnički fakultet Sveučilišta u Rijeci, Rijeka, 2012. (in Croatian)	13	20
Nikolić. J.: Pneumatic Control, Zagreb, 1976. (in Croatian)	3	20
Orlić, Ž., Orlić, G.: Planetary Transmissions, Zigo, Rijeka, 2006. (in Croatian)	4	20
Opalić, M.: Power Transmissions, HDESK, Zagreb, 1998. (in Croatian)	2	20
Oberšmit, E.: Gearing and Gears, Sveučilišna naknada Liber, Zagreb, 1982. (in Croatian)	7	20

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Precision Engineering and Microsystems Technologies**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	6
	Number of hours (L+E+S)	45+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Competences in appropriate design, construction, production and usage of elements of precision and micromechanical components as well as in their integration into devices. Team work and capability to communicate with experts.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Explain the terminology and notions as well as the specificities and advantages of precision and microsystems. Explain and implement resolution, accuracy and precision. Distinguish and characterise the elements of precision devices. Evaluate the elements of precision devices. Explain the characteristics, the reliability and the specificities of the design of microsystems. Distinguish and characterise precision production technologies. Distinguish and characterise microsystems' production technologies. Explain the fundamentals of vacuum technologies. Recall the basic characteristics of the materials used in this field. Explain the procedures of handling and assembly of precision and microsystems. Teamwork and written and oral communication with experts in this and other fields. Implement the acquired knowledge in the solution of concrete tasks.		
1.4. Course content		
Introduction to precision engineering. Emergence and role of precision engineering and microsystems. Orders of magnitude. Basic terminology in precision engineering. Micro- and nanotechnologies basics. Main characteristics of precision mechanical components and devices. Elements of precision devices. Experimental validation of performances of high precision mechanical devices. Compliant elements and their properties. Microsystems technologies. Production technologies of high precision devices and microsystems. Handling and assembly of elements of precision and microsystems. Integration of mechanical components with actuating and measuring devices: micro-(opto)-electro-mechanical systems. Examples of high precision and microsystems designs. Properties of used materials.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	-	
1.7. Student's obligations		
Course attendance, activity, homework assignments and autonomous study.		

1.8. Evaluation of student's work

Course attendance	2.5	Activity/Participation	1.5	Seminar paper		Experimental work	
Written exam		Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Active participation to classes and homework assignments. Knowledge review via quizzes and on final exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

J. J. Allen: „Micro Electro Mechanical System Design", CRC Press, Boca Raton (FL, USA), 2005.
M. J. Madou: „Fundamentals of Microfabrication – The Science of Miniaturisation", CRC Press, Boca Raton (FL, USA), 2002.
H. Slocum: „Precision Machine Design, Society of Manufacturing Engineers", Dearborn (MI, USA), 1992.
S. Zelenika, E. Kamenar: „Precision Engineering and Micro- and Nanosystems Technologies – Precision Engineering", University of Rijeka – Faculty of Engineering, Rijeka (HR), 2015. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

***: „Springer Handbook of Nanotechnology" - 3rd ed., ed. Bh. Bushan, Springer Verlag, Berlin (D), 2010.
S. D. Senturia: „Microsystems Design", Kluwer Academic Publishers, Doddrecht (NL), 2000.
S. T. Smith: „Flexures - Elements of Elastic Mechanisms", Gordon and Breach Science Publishers, Amsterdam (NL), 2000.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
J. J. Allen: „Micro Electro Mechanical System Design", CRC Press, Boca Raton (FL, USA), 2005.	1	15
M. J. Madou: „Fundamentals of Microfabrication – The Science of Miniaturisation", CRC Press, Boca Raton (FL, USA), 2002.	1	15
H. Slocum: „Precision Machine Design, Society of Manufacturing Engineers", Dearborn (MI, USA), 1992.	1	15
S. Zelenika, E. Kamenar: „Precision Engineering and Micro- and Nanosystems Technologies – Precision Engineering", University of Rijeka – Faculty of Engineering, Rijeka (HR), 2015. (in Croatian)	5	15
***: „Springer Handbook of Nanotechnology" - 3rd ed., ed. Bh. Bushan, Springer Verlag, Berlin (D), 2010.	1	15
S. D. Senturia: „Microsystems Design", Kluwer Academic Publishers, Doddrecht (NL), 2000.	1	15
S. T. Smith: „Flexures - Elements of Elastic Mechanisms", Gordon and Breach Science Publishers, Amsterdam (NL), 2000.	1	15

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Via the institutionalised quality assurance system of the Faculty of Engineering. Constant interaction and work with the students with the aim of improving the quality of teaching.

Basic description		
Course title	**Process Plants' Equipment**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Assuming theoretical knowledge and development of skills for practical solving of problems in design and application of process equipment.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Classification and description of processes in process industry and gas liquefaction. Definition and description of main process equipment. Classification, description of regulation and application, interpretation of calculation of process tanks and pressure equipment in process plants. Description of design, and presentation of basic calculations for destillation equipment. Description of application of process furnaces, their components, design characteristics and controls. Description of types, construction parts and features with interpretation of design and selection procedures of reactors, separators, filters and mixing equipment. Demonstration of selection procedures and application of pumps and fans in process plants. Selection, calculation and design of pipelines, selection ad calculation of pipeline supports, joints and bellows for compensation of thermal dilatation of pipelines. Description of types and applications of pipe fittings and valves. Definition and specification of process equipment security requirements. Selection of safety equipment in process industry. Description of properties, choice of types and performance of calculation for thermal insulation of piping, tanks and process equipment.		
1.4. Course content		
Process plants in oil, petrochemical, chemical and other process industries. Introduction about processes. Basic physical and chemical processes. Classification, design and protection of tanks. Classification of pressure vessels. Process columns. Process furnaces. Reactors, separators, filters and mixers. Applications of pumps and fans in process plants. Pipelines: design, selection of materials, compensation of thermal dilatations, mechanical design. Pipe supports and hangers. Valves and fittings. Safety of process plants. Types, design and specification of safety devices. Characteristics, selection, thickness calculation and mounting of thermal insulation.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	-	
1.7. Student's obligations		

Course attendance, activity, studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, continuous knowledge testing (two mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Pavković, B.: Process plants equipment, (lectures), https://moodle.srce.hr

1.11. Optional / additional reading (at the time of proposing study programme)

Cheremisnof, N. P.: Handbook of Chemical Processing Equipment, (book), Butterworth & Heinemann, Boston, Oxford 2000.
Mullinger, P., Jenkins, B: Industrial and process furnaces, (book), Butterworth – Heinemann, 2008.

Širola, D.: Machines and equipment in the oil and petrochemical industry, (book), Školska knjiga Zagreb, 1986. (in Croatian)

Ludwig, E.E.: Applied Process design for Chemical and Petrochemical Plants, (book), Volume I, II and III, Gulf Publishing Company, Houston 1984.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Pavković, B.: Process plants equipment, (lectures), https://moodle.srce.hr	unlimited	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Processes Planning**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Introduction to the influential elements on the production process and its results. Mastering the knowledge, techniques and methods of process planning and its improvement. Basics of programming NC machines and using computers in programming. Understanding trends in the development of manufacturing techniques and production organizations, the impact of production process features.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Indicate technological background of process planning, and interpret their impact on the results and the setting process. Specify and analyse technological measures to increase productivity. Define the order of tasks of process planning and an integral technological process and interpret the objectives pursued. Explain interdependence structure of the technological process and the features of the models of the production system. Define group technology and explain the effects of the areas of product design and special tools and processes planning. Explain the specifics technological preparations for NC machines. Explain the principles of computer use in the design process. Develop NC program with the help of computers and the finished computer program and simulate the machining process.		
1.4. Course content		
Introduction to the technological processes of manufacture. Technological background. Technological base. Fixed and freeform treatment. Influence rigidity, vibration and temperature of the machining system and the results of the setting process. The influence of residual stresses on setting process. Accuracy of the work piece, systemic and random effects. Technological measures to increase productivity. Access process planning, process variant. Computer aided process planning - CAPP. Effect of NC – machines features of the process. Classification NC - system. Technological preparation for NC - machines. The coordinate system. NC - program and its structure. Specific technological documents for NC - machines. Different sorts of making NC - program. The introduction and optimization NC - program.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		
Course attendance, class participation, homework, self-learning.		

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance and activity on teaching, continuous knowledge check, homework and written and/or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Gačnik, V., Vodenik, F.: Technological Processes Design, Zagreb 1990. (in Croatian)
Curis, M.A.: Process Planning, New York, 1988.
Jurković, M., Tufekčić, D.: Tehnological Processes, Design and Modelling, Tuzla, 2000. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Mueler, G.: Technologische Fertigungsvorbereitung/Maschinenbau. VEB Verlag, Berlin 1975.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Gačnik, V., Vodenik, F.: Technological Processes Design, Zagreb 1990. (in Croatian)	4	10
Curis, M.A.: Process Planning, New York, 1988.	1	10
Jurković, M., Tufekčić, D.: Tehnological Processes, Design and Modelling, Tuzla, 2000. (in Croatian)	3	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Production Management**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Master the principles of strategic planning and operations management. Be able to analyze the influencing factors on the planning and management of production. Be able to propose and evaluate improvement projects in the production environment.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Managinig the production facilities. Categorize the dominant production paradigms. Ability of calculating the production costs. Knowledge of planning and production control principles. Specify value stream map for each product. Planning of lean process improvement. Evaluate known methods of managing production resources and stock.							
1.4. Course content							
Production function within organization - operations and processes. Competitiveness - development strategy. New product development process and strategy. Development of dominant production paradigms. Influencing factors on the organization of the production function. Production capacity and quality management. Demand and supply management. Departments of technology and operative preparation. Structure of production cost. Managing individual and recurring production processes. Inventory management. Production resource management. Lean manufacturing, value flow analysis and continuous improvement. Time and motion study. Ergonomics and design of work environment.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☐ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Attendance, class participation, independent learning.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	

Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance and activity on lessons, continuous assessment, written and/or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Mikac, T.; Ljubetić, J.: Organization and Control of Production, Graphis, Zagreb; Tehnički fakultet Rijeka, Rijeka, 2009. (in Croatian)
Slack, N.; Brandon-Jones, A.: Operations and Process Management – Principles and practice for strategic impact, 5th edition, Paerson, 2018.

1.11. Optional / additional reading (at the time of proposing study programme)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Mikac, T.; Ljubetić, J.: Organization and Control of Production, Graphis, Zagreb; Tehnički fakultet Rijeka, Rijeka, 2009. (in Croatian)	1	29
Slack, N.; Brandon-Jones, Alistair: Operations and Process Management – Principles and practice for strategic impact, 5th edition, Paerson, 2018.	1	29

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Professional Practice II**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	compulsory	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	-

1. COURSE DESCRIPTION							
1.1. Course objectives							
Student verifies and complements his own expertise, along with a comprehensive view of the work process.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Apply acquired knowledge and skills from studied courses professional content. Gain working process experience. Develop and further improve competence for solving specific professional engineering problems.							
1.4. Course content							
Industrial practice within Graduate University Study of Naval Architecture is carried out individually in work organization that is engaged in the student's field of study, and with activities in accordance with the Industrial Practice Rules and Study Program curriculum. Within such practice, student is familiarized with the corresponding jobs that are studied through programs of education, with the task of verifying and complementing their own expertise, along with a comprehensive view of the work process.							
1.5. Teaching methods	☐ lectures ☐ seminars and workshops ☐ exercises ☐ long distance education ☒ fieldwork		☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Conducting professional practice in duration of 15 working days, or 120 hours, and writing the corresponding report.							
1.8. Evaluation of student's work							
Course attendance		Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Sustained knowledge check		Report	1	Practice	4
Portfolio							
1.9. Procedure and examples of learning outcome assessment in class and at the final exam							
Assesses and evaluates student work and dedication, and written report.							

1.10. Assigned reading (at the time of the submission of study programme proposal)		
1.11. Optional / additional reading (at the time of proposing study programme)		
1.12. Number of assigned reading copies with regard to the number of students currently attending the course		
Title	*Number of copies*	*Number of students*
1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences		
Through the Institution's quality assurance system.		

Basic description		
Course title	**Programming of Engineering Applications**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Basic knowledge of C++ programming language. Skills: to independently write simpler console and Windows applications with significant technical content.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Writing computer programs using functions written in more than one file. To define and apply pointers and properly use dynamic memory. To define and apply lightweight abstractions in computer code. Proper interpretation of classes and inheritance. Create computer programs with significant technical content.							
1.4. Course content							
Use of Python programming language and basic use of C++ computer language. Code organization by using functions written in more than one file. Modules, Classes and inheritance. Solving problems with significant technical content.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork			☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other			
1.6. Comments							
1.7. Student's obligations							
Course attendace, individual assignements and exercises.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio		Homework	2				
1.9. Procedure and examples of learning outcome assessment in class and at the final exam							
1.10. Assigned reading (at the time of the submission of study programme proposal)							

B. Eckel, Thinking in C++, 2000

1.11. Optional / additional reading (at the time of proposing study programme)

B. Eckel, Thinking in C++, 2000

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
B. Eckel, Thinking in C++		10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Programming: Scripting Languages**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	6
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
The aim of this course is familiarization with the concept of scripting languages, their historical development, initial use (command interpreters, shells, report generation) and evolution into their current state. Along with the application of programming language concepts in the domain of scripting (i.e. declaring variables), this course references capabilities rarely present in classical programming languages. A series of short programming assignments familiarizes students with the capabilities of various scripting languages and teaches them flexibility in approaches to learning new computer languages. Course contents include the most relevant scripting languages in various areas of application: extending OS capabilities through Unix and Windows shell scripts, server-side web scripting, scripts for scientific computing and data processing.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Classifiy computer languages into programming and scripting languages, understand their advantages and disadvantages. Analyze different real-world programming challenges and: devise an optimum solution path, apply scripting languages to create the solution, analyze and substantiate the applicability and quality of the solution. Use scripting languages to create: web applications, computer process automation scripts, data processing, scientific computing. Aalyze and explain the advantages and disadvantages of particular scripting languages in different areas of application.		
1.4. Course content		
Scripting languages: historical development, similarities and differences regarding programming languages, areas of application. Data management: regular expressions, string interpolation (Python). Web programming: web applications, PHP, database connectivity (MySQL), Ruby on Rails, CGI services. Computer process automation ("pasting"): Windows Script Engine – Jscript; Bash; Windows PowerShell; Scientific computing: Python. Overview of other languages: Perl, Ruby, VBScript, Javascript, Actionscript.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		
Course attendance (lectures, exercises), activity, homework, remote coursework, formal written exam, independent studying.		

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation	1	Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance (lectures, exercises), activity, independent programming of scripting solutions, homework, continual knowledge testing (mid-term), final exam

1.10. Assigned reading (at the time of the submission of study programme proposal)

Pilgrim Mark: Dive Into Python 3, Apress, New York, SAD, 2009. –available at http://diveintopython3.org/ (downloaded 16.4.10.)
Cooper, Mendel: Advanced Bash-Scripting Guide, 2009. available at http://tldp.org/LDP/abs/html/ (downloaded 16.4.10.)
Getting Started With Windows PowerShell, available at http://technet.microsoft.com/hr-hr/library/ee177003%28en-us%29.aspx (http://bit.ly/avxQqJ) (downloaded 16.4.10.)
Getting Started with Rails, available at http://guides.rubyonrails.org/getting_started.html (downloaded 16.4.10.)
PHP 101: PHP For the Absolute Beginner, available at http://devzone.zend.com/article/627 (downloaded 16.4.10.)
Beginner's Introduction to Perl, available at http://www.perl.com/pub/a/2000/10/begperl1.html (downloaded 16.4.10.)

1.11. Optional / additional reading (at the time of proposing study programme)

Scott, Michael: Programming Language Pragmatics, 3rd edition, Morgan Kaufman, San Francisco, USA, 2009.
Model, M. L.: Bioinformatics Programming Using Python, O'Reilly Media, Sebastopol, USA, 2009.
Taylor, Dave: Wicked Cool Shell Scripts, No Starch Press, San Francisco, USA, 2004.
Schwartz, R. L. et. al.: Learning Perl (5th edition), O'Reilly Media, Sebastopol, USA, 2008.
Tate, B. A. et. al.: Ruby on Rails: Up and Running, 1st Edition, Sebastopol , USA, 2006.
Beighley, L. et al.: Head First PHP & MySQL, O'Reilly Media, Sebastopol , USA, 2008.
Wilson, Ed: Microsoft Windows PowerShell Step by Step, Microsoft Press, Redmond, USA 2007.
Langtangen, H.P.: Python Scripting for Computational Science, Springer-Verlag, Berlin, Germany 2004.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Pilgrim Mark: Dive Into Python 3, Apress, New York, SAD, 2009.	freely available	-
Cooper, Mendel: Advanced Bash-Scripting Guide, 2009	freely available	-
Getting Started With Windows PowerShell	freely available	-
Getting Started with Rails	freely available	-
PHP 101: PHP For the Absolute Beginner	freely available	-
Beginner's Introduction to Perl	freely available	-

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Project I**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	compulsory	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	0+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Application of acquired knowledge and skills to solve practical problems in the field of associated course from which the Project I is elected.							
1.2. Course enrolment requirements							
Enrolled course from which the Project I is elected.							
1.3. Expected course learning outcomes							
Apply the knowledge and skills from professional content of the associated course. Solve practical task. Acquire competence for individually solving specific professional tasks.							
1.4. Course content							
Chosen chapter of associated course from which the project was elected.							
1.5. Teaching methods	☐ lectures ☐ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☒ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Attending the consultation, individually solving task and writing the project report.							
1.8. Evaluation of student's work							
Course attendance		Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam		Essay		Research	
Project	2	Sustained knowledge check		Report		Practice	
Portfolio		Individual task solving	3				
1.9. Procedure and examples of learning outcome assessment in class and at the final exam							
Assesses and evaluates the accuracy and completeness of the project task solution and its presentation.							
1.10. Assigned reading (at the time of the submission of study programme proposal)							
References listed for the associated course from which the Project I is elected.							

1.11. Optional / additional reading (at the time of proposing study programme)		
References listed for the associated course from which the Project I is elected.		
1.12. Number of assigned reading copies with regard to the number of students currently attending the course		
Title	*Number of copies*	*Number of students*
1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences		
Through the Institution's quality assurance system.		

Basic description		
Course title	**Project II**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	compulsory	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	0+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Application of acquired knowledge and skills to solve practical problems in the field of associated course from which the Project II is elected.							
1.2. Course enrolment requirements							
Enrolled course from which the Project II is elected.							
1.3. Expected course learning outcomes							
Apply the knowledge and skills from professional content of the associated course. Solve practical task. Acquire competence for individually solving specific professional tasks.							
1.4. Course content							
Chosen chapter of associated course from which the project was elected.							
1.5. Teaching methods	☐ lectures ☐ seminars and workshops ☐ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☒ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Attending the consultation, individually solving task and writing the project report.							
1.8. Evaluation of student's work							
Course attendance		Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam		Essay		Research	
Project	2	Sustained knowledge check		Report		Practice	
Portfolio		Individual task solving	3				
1.9. Procedure and examples of learning outcome assessment in class and at the final exam							
Assesses and evaluates the accuracy and completeness of the project task solution and its presentation.							
1.10. Assigned reading (at the time of the submission of study programme proposal)							
References listed for the associated course from which the Project II is elected.							

1.11. Optional / additional reading (at the time of proposing study programme)		
References listed for the associated course from which the Project II is elected.		
1.12. Number of assigned reading copies with regard to the number of students currently attending the course		
Title	*Number of copies*	*Number of students*
1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences		
Through the Institution's quality assurance system.		

Basic description		
Course title	**Project Management**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+15+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Knowledge of project management principles. Understanding project planning methods. Knowledge of the basics of project management software.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Explain the basic concepts of project management. Compare the vision, strategy and goals when designing a project. Explain what project management is, the tasks of a project manager, the work of project teams and the relationship between project management and organizational structures. Know the models of the project management process. Explain the basic organizational structures of project organizations. Describe the organization of the project. Distinguish methods for project planning by time and/or capacity planning - Gantt charts, network planning techniques. Know the basics of computer project planning.							
1.4. Course content							
Introduction and basic concepts of project management. Projects - vision, strategy, goals. Project management. Project managers. Project teams. Project management and organizational structures. Project management models. HBS model. Project phases: project definitions and organization, project planning and project monitoring and management. Project planning techniques by time and / or capacity planning - Gantt charts, network planning techniques. Cost management project planning. Human resource management. Communication management. Computer project planning.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Attendance, control assignments, final exam.							
1.8. Evaluation of student's work							
Course attendance	1.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	1.5	Oral exam		Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	

Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Attendance, class participation, continuous assessment, written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Ikonić, M., Vuković, A.: *Project Management,* Tehnički fakultet, Rijeka, 2011. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Quality Management and Metrology**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
The course is designed to provide the student with basic knowledge in quality management and metrology topics. Through individual projects, students are introduced with practical application of several course objectives.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Compare different approaches to quality management. Specify implementation of quality management system and international quality standards ISO 90001. Compare models of excellence. Differentiate methods for quality improvement. Assess capability of measurement system. Interpret advanced metrology concepts. Assess quality by statistical process control. Asses risk.							
1.4. Course content							
History and characteristics of quality management. Strategies of quality management. Total quality management. Quality planning methods. Quality management system. Methods for quality improvement. Basic and advanced continuous quality improvement tools.. Statistical process control. Control charts. Process capability analysis. Measurement system capability analysis. Reliability and risk management. Quality management in projects. Process improvement with designed experiments. Full factorial experiments. Fractional factorial experiments.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork		☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, active participation in the course, attendance at exercises and fieldwork, seminar paper and independent learning.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper	0.75	Experimental work	
Written exam	0.5	Oral exam		Essay		Research	

Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio		Fieldwork	0.25				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Sustained knowledge check and final written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1.11. Optional / additional reading (at the time of proposing study programme)

Montgomery, D. C.: Introduction to statistical quality control, 8th ed., J. Wiley & Sons, New York, 2019.
Montgomery, D.C., Jennings, C. L., Pfund, M. E.: Managing, controlling, and improving quality, John Wiley & Sons Wiley, 2011.
Bilić, B.: Kvaliteta-planiranje, analiza i upravljanje, FESB, 2016.
Kondić, Ž., Maglić, L., Pavletić, D.: Kvaliteta 1, 2, 3, Sveučilište Sjever, Strojarski fakultet Slavonski Brod, Tehnički fakultet Sveučilišta u Rijeci, 2018
Jay L. Bucher: The Metrology Handbook, ASQ Quality Press, 2004.
Smith, G. T.: Industrial Metrology, Springer, 2002.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Refrigeration**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Assuming theoretical knowledge and development of skills for practical solving of problems in design and application of refrigeration equipment and systems.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Analyze and calculate thermodynamic processes, distinguish and describe different designs of compression and sorption cooling devices. Describe the properties of refrigerants and heat transfer substances in refrigeration, compare methods of their application and environmental impact. Interpret the thermodynamic basics of refrigeration compressors, describe specific properties important for the application and control of compressors in refrigeration systems. Describe the design features and interpret the role, method of regulation and application of evaporators and condensers. Describe the design featurs and interpret the application of control devices, expansion devices, fittings and pipelines in refrigeration. Describe processes and devices with jet blowers, thermoelectric cooling, cooling with dry ice and application of cooling mixtures. Describe the performance, analyze and calculate the processes of gas liquefaction devices. Describe the method of construction and design of thermal insulation of cold stores, and calculate the required cooling effect for the cold store. Describe the integration of refrigeration units and heat pumps into heating, cooling and air conditioning systems.		
1.4. Course content		
Refrigeration applications. Processes, thermodynamic basic calculations and performance of compression and absorption refrigeration devices. Direct cooling systems and heat transfer medium systems. Refrigerants. Thermodynamic basics of refrigeration compressors operation, application and control in refrigeration systems. Performances, application and calculation of heat exchangers in refrigeration equipment. Design, application and calculation of expansion devices, fittings and pipelines for the refrigerant. Operating characteristics and control of refrigeration systems. Coolers with jet blowers. Thermoelectric cooling. Cooling mixtures. Liquefaction of gases. Construction, thermal insulation and calculation of cooling capacity of cold stores. Integration of cooling devices and heat pumps into heating, cooling and air conditioning systems. An elective project from the course content is planned.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☐ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments	-	

1.7. Student's obligations

Course attendance, activity, studying.

1.8. Evaluation of student's work

Course attendance	2.5	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Activity, continuous knowledge testing (two mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Pavković, B.: Refrigeration, (lectures), https://moodle.srce.hr
Bošnjaković, F.: Thermodynamics I, (book), Tehnička knjiga, Zagreb, 1970. (in Croatian)
Bošnjaković, F.: Thermodynamics II, (book), Tehnička knjiga, Zagreb, 1976. (in Croatian)
Bošnjaković, F.: Thermodynamics III, (book), Tehnička knjiga, Zagreb, 1986. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

H. L. von Cube et al.: Lehrbuch der Kältetechnik, Bd. 1, 2, 3, (book) C. F. Müller Verlag, Heidelberg, 1997.
ASHRAE: 2018 ASHRAE HANDBOOK- REFRIGERATION, (book) ASHRAE Atlanta, 2018.
Ciconkov, R.: Refrigeration :solved examples, (book), Faculty of Mechanical Engineering, Skopje, 2004.
Vujić, S.: Rashladni uređaji, (book), Mašinski fakultet Beograd 2000.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Pavković, B.: Refrigeration, (lectures), https://moodle.srce.hr	unlimited	
Bošnjaković, F.: Thermodynamics I, (book), Tehnička knjiga, Zagreb, 1970. (in Croatian)	20	
Bošnjaković, F.: Thermodynamics II, (book), Tehnička knjiga, Zagreb 1976. (in Croatian)	11	
Bošnjaković, F.: Thermodynamics III, (book), Tehnička knjiga, Zagreb, 1986. (in Croatian)	10	

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Renewable Energy Sources**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Within the course students acquire theoretical knowledge and skills that are required to solve practical problems related to the design and use of renewable energy systems.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Explain current knowledge of the impact of energy processes on the Earth's ecosystem. Comment the measures and actions for pollution reduction and environmental protection, consistent with the objectives of international climate protection initiatives. Discuss the energy potential and economics of application of renewable energy sources. Interpret designs, construction and principle of operation of solar thermal collectors, photovoltaic modules, heat pumps, fuel cells, wind turbines / power plants, geothermal and hydroelectric power plants. Differentiate active and passive solar energy systems. Explain the characteristics of passive solar architecture. Apply acquired knowledge to calculate and select the basic elements of active solar systems and systems with heat pumps. Describe designs of biomass energy systems. Analyze the feasibility of application of renewable energy sources. Apply acquired knowledge to solve practical problems.							
1.4. Course content							
Sources and forms of energy. Earth's ecosystems. Ecological footprint. Ozone depletion. Global warming. Measures and actions for pollution reduction and environmental protection. Montreal and Kyoto protocol. Characteristics of renewable energy sources. Energy potential and economics of renewable energy use. Solar energy. Active and passive solar systems. Solar thermal collectors. Solar concentrators. Photovoltaic systems. Passive solar architecture. Heat pumps. Geothermal energy. Wind energy. Biomass. Hydrogen as a potential fuel of the future. Fuel cells. Hydro energy. Combined use of conventional and renewable energy sources. Calculations and sizing of renewable energy systems.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, homework, studying.							
1.8. Evaluation of student's work							
Course	2.5	Activity/Participation		Seminar paper		Experimental	

attendance						work	
Written exam		Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, continuous knowledge testing (two mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

1.11. Optional / additional reading (at the time of proposing study programme)

Group of authors: Buildings Energy Certification Handbook, UNDP, 2010. (in Croatian)
Majdandžić, Lj.: Solar Systems, Graphis d.o.o., Zagreb, 2010. (in Croatian)
Labudović, B. et al.: Fundamentals of Photovoltaic Systems, Energetika marketing, Zagreb, 2011. (in Croatian)
Labudović, B. et al.: Fundamentals of Heat Pumps Application, Energetika marketing, Zagreb, 2009. (in Croatian)
Labudović, B. et al.: Fundamentals of Biomass Aplication, Energetika marketing, Zagreb, 2012. (in Croatian)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Robot Elements Design**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Introduction to main parts of robots and manipulators, their construction, design and dimensioning.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Robot workspace and degrees of freedom of movement analysis. Dimensioning the main parts of robots and manipulators (selection criteria and dimensioning of drives, gears, guidance, workspace design, motion planning…).							
1.4. Course content							
Types of industrial robots and manipulators. Pedestal, guidance, turning units drive, mechanism for straight and parallel guidance. Turning arm drives. Joints and workspace. Drives of robots and manipulators. Power and cinematic transmissions in robots and manipulators. Bearings and couplings. Gripers.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork			☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other			
1.6. Comments							
1.7. Student's obligations							
Course attendance, constructive work and seminars, continuous knowledge testing.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper	0.5	Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project	1	Sustained knowledge check	1	Report		Practice	
Portfolio							
1.9. Procedure and examples of learning outcome assessment in class and at the final exam							
Constructive work and seminars, continuous knowledge testing, written exam.							
1.10. Assigned reading (at the time of the submission of study programme proposal)							

Paul E. Sandin: Robot Mechanisms and Mechanical Devices Illustrated, McGraw-Hill, 2003.
John J. Craig: Introduction to robotics mechanics and control second edition, Pearson Education International, 2005.
Bruno Siciliano, Oussama Khatib: Springer Handbook of Robotics, Springer 2008.
Lecture materials

1.11. Optional / additional reading (at the time of proposing study programme)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Paul E. Sandin: Robot Mechanisms and Mechanical Devices Illustrated, McGraw-Hill, 2003.	1	15
John J. Craig: Introduction to robotics mechanics and control second edition, Pearson Education International, 2005.	1	15
Bruno Siciliano, Oussama Khatib: Springer Handbook of Robotics, Springer 2008.	1	15
Lecture materials	web	15

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Ship Outfitting and Repair**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+15+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Introduction to documentation and procedures of fabrication and installation of the ship equipment, as well as to monitoring work execution, quality control, testing and monitoring ship outfitting costs in accordance with defined learning outcomes.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Explain and interpret the significance and complexity of ship outfitting and its structure and sequence. Apply the breakdown of the ship and the basic tenets of the ship outfitting process. Argue the benefits of outfitting ship sections and modular outfitting. Use adequate documentation in the process of ship outfitting. Analyze technological solutions for ship outfitting, outfitting process, quality control, testing procedures and costs. Develop a basic scheduler of outfitting works, estimate required man hours, and the calculation of the required workforce by profession and a list and plan of outfitting activities. Describe the technological process of ship outfitting regarding ship piping workers, mechanics, electricians, locksmiths, metalworkers, insulation workers and painters. Interpret and use curriculum of ship trial process. Define and describe the repair works and services. Describe the technological processes of ship repair. Distinguish types of docks and docking procedures.		
1.4. Course content		
Meaning and scope of ship outfitting. Product work breakdown structure. Basic scheme of ship outfitting process. Technological solutions and improvement of ship outfitting. Modular and advance ship outfitting. Structure, division and sequences of outfitting. Making a list and a plan of outfitting works. Monitoring the execution of works, quality, testing and direct costs. Piping works. Pipe blocks Installation of ship main engine, shaft and other machinery and equipment. Processing and installation of propeller shaft and rudder bearing. Installation of ship electrical equipment. Installation of ship cables. Description of metalwork, carpenter works, insulation and painting works. Monitoring the outfitting works and repairs, inspections, tests and ship trial. The purpose and reasons for the ship repair. Breakdown and description of ship repair. Repair facilities capacities and their utilization. Docks. Works and services in docking and ship repair. Ship Demolition and Recycling activities.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☒ long distance education ☒ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☒ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Course attendance, activity, sustained knowledge check, seminar paper, studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity at lectures and laboratory practice, sustained knowledge check (two mid-term exams), seminar paper, written and oral exam or their combination.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Matulja, T.: Teaching material published on e-learning course Skip Outfitting and Repair, 2021.
Butler, D., Guide to Ship Repair Estimates, Butterworth Heinemann, Oxford, 2000.
House, D.J., Dry Docking and Shipboard Maintenance, Witherby & Co. Ltd., London, 2003.

1.11. Optional / additional reading (at the time of proposing study programme)

Marušić, I.: Piping in Shipbuilding, Školska knjiga, Zagreb, 1983. (in Croatian)
Čujić, M.: Metalworks in Shipbuilding, Školska knjiga, Zagreb, 1984. (in Croatian)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Matulja, T.: Teaching material published on e-learning course Skip Outfitting and Repair, 2021.		
Butler, D., Guide to Ship Repair Estimates, Butterworth Heinemann, Oxford, 2000.	1	26
House, D.J., Dry Docking and Shipboard Maintenance, Witherby & Co. Ltd., London, 2003.	1	26

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Ship Propulsion Devices**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
The acquisition of specific competencies dealing with the ship propulsion devices. Ability to solve a given problem in order to determine the required required ship's main engine power and the propeller characteristics.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Describe the phenomena in the water flow around the ship's hull. Distinguish components of ship resistance. Describe the main characteristics of screw propellers and explain the theory of propeller action. Describe the propeller model tests. Explain the interaction of the main engine and propeller, and analyze the relationship between ship resistance and propulsion. Preliminary calculation of the ship screw propeller of a chosen ship. Describe the impact of the propulsion engine and the srew propeller characteristics on the requirements for the energy efficiency of the ship.							
1.4. Course content							
Ship resistance. Flow past ship hull. Displacement, semi-displacement and planing regimes. Components of ship resistance. Methods for determining ship resistance. Model tests. Ship propulsion. Ship propulsion devices. Ship screw propeller. Geometry of the screw propeller. Theory of propeller action. Interaction between hull and propeller. Components of propulsive efficiency. Propeller model tests. Propeller cavitation. Matching the propeller and engine. Propeller design. Propeller manufacturing. Propeller materials. Propeller blade strength. Propeller blade vibrations. Propeller operational problems. Special types of propellers: ducted propellers, controllable pitch propeller, tandem and contra-rotating propellers. Other types of propulsion devices: oar, sail, paddle wheel, vertical-axis propellers, waterjets, transverse and azimuthing thrusters, podded propellers. Energy efficiency of the ship.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Attendance at lectures, activity in class, project assignment, self learning.							
1.8. Evaluation of student's work							
Course	2	Activity/Participation	0.5	Seminar paper		Experimental	

attendance						work	
Written exam	0.5	Oral exam	0.5	Essay		Research	
Project	0.5	Sustained knowledge check	1	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Class attendance, class activity, prject assignment, continuous knowledge assessment (mid-term exams), written and oral examination.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Carlton, J. S., Marine Propellers and Propulsion, Butterworth - Heinemann, Oxford, 2007.
Molland, A.F., Turnock, S.R., Hudson, D.A.: Ship Resistance and Propulsion - Practical Estimation of Propulsive Power, Cambrodge University Press, New York, 2011.
Birk, L., Funfdamentasls of Ship Hydrodynamics: Fluid Mechanics, Ship Resistance and Propulsion, John Wiley & Sons Ltd., Hoboken, 2019.
Lewis, E. V., (ed.), Principles of Naval Architecture, Vol. II - Resistance, Propulsion and Vibration, The Society of Naval Architects and Marine Engineers, Jersey City, 1988.

1.11. Optional / additional reading (at the time of proposing study programme)

Allison, J., Marine Waterjet Propulsion, SNAME Transactions, Vol. 101, 1993.
Sentić, A., Fancev, M., Ship Resistance and Propulsion Problems, Brodogradnja, Zagreb, 1956. (in Croatian)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Carlton, J. S., Marine Propellers and Propulsion, Butterworth - Heinemann, Oxford, 2007.	1	7
Molland, A.F., Turnock, S.R., Hudson, D.A.: Ship Resistance and Propulsion - Practical Estimation of Propulsive Power, Cambrodge University Press, New York, 2011.	1	7
Lewis, E. V., (ed.), Principles of Naval Architecture, Vol. II - Resistance, Propulsion and Vibration, The Society of Naval Architects and Marine Engineers, Jersey City, 1988.	1	7
Birk, L., Funfdamentasls of Ship Hydrodynamics: Fluid Mechanics, Ship Resistance and Propulsion, John Wiley & Sons Ltd., Hoboken, 2019.	1	7

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Ship Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+15+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Obtaining theoretical knowledge and develop skills to solve practical problems in the field of ship systems and design of ship systems.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Define and analyze ship propulsion systems of ships with diesel engine propulsion plants. Describe ship propulsion systems of ships with turbine propulsion. Describe and analyze ship ballast and bilge systems. Describe ship sanitary systems and fresh water systems. Describe and compare systems for cargo loading and unloading. Describe and analyze ship systems for cargo heating. Describe and compare ship fire fighting systems. Describe ship systems on LNG tankers.							
1.4. Course content							
Generally on ship systems. Rules for design, building and maintenance of ship systems. Fuel oil systems. Ship cooling systems. Compressed air systems. Lubrication oil systems. Other ship engine systems. Ballast systems. Bilge systems. Sanitary systems. Fire fighting systems. Other ship common systems. Systems for cargo loading and unloading. Inert gas systems. Tank cleaning systems. Special systems on chemical tankers. Special systems on LNG and LPG ships. Ship control systems.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, homework, studying.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper	0.25	Experimental work	
Written exam		Oral exam	0.75	Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, seminar paper, continuous knowledge testing (two mid-term exams), oral or written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Ozretić, V.: Marine Auxiliary Machinery and Devices, Dalmacijapapir, Split, 1996. (in Croatian)
Martinović, D.: Marine Machinery Systems, Digital point, Rijeka, 2005. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Smith, D. W.: Marine Auxiliary Machinery, Butterworths, London, 1988.
Knak, C.: Diesel Motor Ships, Engines and Machinery, Institute of Marine Engineers, 1990.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Ozretić, V.: Marine Auxiliary Machinery and Devices, Dalmacijapapir, Split, 1996. (in Croatian)	8	30
Martinović, D.: Marine Machinery Systems, Digital point, Rijeka, 2005. (in Croatian)	3	30

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Stability of Structures**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Developing knowledge and skills for autonomous assessing of external load levels at which structural deformation forms become unstable.							
1.2. Course enrolment requirements							
Basic knowledge of solid mechanics.							
1.3. Expected course learning outcomes							
Define structural stability problems. Describe goals of linear and nonlinear stability. Define global and local stabilities of structures. Analyse flexural, torsional and torsional-flexural stability of columns. Analyse lateral-torsional stability of beams. Calculate the critical buckling load of columns and beams. Design of structures according to the Eurocode.							
1.4. Course content							
Classification of structural stability problems. Linear and nonlinear stability analysis. Global and local instabilities. Flexural, torsional and torsional-flexural buckling of columns. Lateral-torsional buckling of beams. Stability of frames. Stability of arches and rings. Stability of rods under varying load. Stability of thin plates. Application of approximate methods. Application of finite element method and computer applications.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork			☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other			
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, activity, homework, studying.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	0.5
Written exam	1	Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Homeworks and seminars. Written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

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1.11. Optional / additional reading (at the time of proposing study programme)

Simitses, G. J., Hodges, D. H.: "Fundamentals of Structural Stability", Butterworth-Heinemann, Amsterdam, 2006.
Trahair, N.S., Bradford, M.A., Nethercot, D.A., Gardner, L.: "The Behaviour and Design of Steel Structures to EC3", Taylor & Francis, London, 2008.
Gambhir, M. L.: "Stability Analysis and Design of Structures", Springer-Verlag, Berlin, 2004.
Chen W. F., Lui, E. M.: "Structural Stability", Prentice Hall, Upper Saddle River, New Jersey, 1987.
Čaušević, M., "Statika i stabilnost konstrukcija", Školska knjiga, Zagreb, 2003.
Mihanović, A.: "Stabilnost konstrukcija", DHGK, Zagreb, 1993.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
-	-	-
-	-	-

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Strength of Materials II**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	compulsory	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	7
	Number of hours (L+E+S)	45+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Developing knowledge and skills for autonomous stress/strain analyses and determining dimensions and materials of load-carrying structures and their components.							
1.2. Course enrolment requirements							
Basic knowledge of solid mechanics.							
1.3. Expected course learning outcomes							
Explain Cauchy stress tenzor. Determine Cauchy's stress equations (Cauchy's formula). Determine static and dynamic equations of equilibrium. Explain displacement gradient tensor and small strain tensor. Define and explain constitutive equations. Eplain generalized Hooke's and Duhamel-Neumann's laws. Define constitutive equations for axisymmetric planar problems. Determine stress and strain at thin- and thick-walled cylinders. Explain energy conservation law. Define strain energy. Explain and apply energy methods: Betti's and Maxwell's reciprocity theorems, virtual work principles, principle of total potential energy, principle of complementar potential energy, Castigliano's theorems, Mohr's theorem. Explain three-moment equation for continuous beams. Determine and analyse distribution of internal forces at continuous beams. Define sources of dynamic stress and characteristcs of a stress cycle. Explain notion of fatigue strength. Explain types of dynamic loads. Explain notions of geometric and material nonlinearities. Define constitutive equations for materially nonlinear problems. Define idealized stress-strain diagrams. Determine ultimate limit-load of structures. Large displacements and finite strains: define stress tensors, deformation gradient, deformation tensors and strain tensors.							
1.4. Course content							
Stress. Strain. Constitutive equations. Energy methods. Continuous beams. Dynamic stresses. Analysis of structures under dynamic loadings. Elastic-plastic analysis of structures. Large displacements and geometric nonlinearity.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☐ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other				
1.6. Comments	-						
1.7. Student's obligations							
Course attendance, laboratory exercises, final exam, self-studying							
1.8. Evaluation of student's work							
Course	2.5	Activity/Participation		Seminar paper		Experimental	0.5

attendance						work	
Written exam	1.5	Oral exam	1	Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance. Continuous knowledge testing. Laboratory exercises. Written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

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1.11. Optional / additional reading (at the time of proposing study programme)

Brnić, J., Turkalj, G.: "Strength of Materials II" (in Croatian), Zigo, Rijeka, 2006.
Brnić, J., Turkalj, G.: "Strength of Materials I" (in Croatian), University of Rijeka, Faculty of Engineering, Rijeka, 2004.
Alfirević, I.: "Strength of Materials II" (in Croatian), Golden marketing, Zagreb, 1999.
Šimić, V.: "Strength of Materials II" (in Croatian), Školska knjiga, Zagreb, 1995.
Reddy, J. N.: "Energy Principles and Variational Methods in Applied Mechanics", John Wiley & Sons, New Jersey, 2002.
Dym, C. L., Shames, I. H.: "Solid Mechanics, A Variational Approach", Springer, New York, 2013

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Systematic Engineering Design and Product Development**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**			
1.1. Course objectives			
Acquiring competence in systematic and methodical approach to products design and development. Developing abilities to apply and implement modern concepts and methods of product design and development. Successful participation in team-based product design. Developing of creativity and criticism.			
1.2. Course enrolment requirements			
None.			
1.3. Expected course learning outcomes			
Define and describe product design process phases and wider concept of product development. Explain the function of a technical product. Differentiate variant, adaptive and new designs. Compare and select methods of searching for solutions. Evaluate design variants. Define and describe size ranges and modular products. Explain design principles on examples. Quote and explain rules of the embodiment design regarding selected criteria. Solve design problem by implementation of acquired knowledge and skills.			
1.4. Course content			
Design theory and modern product development concepts and approaches. Technical systems. Function of a technical system. Types of designs. Product design and development process. Product planning and clarifying the task. Conceptual design. Searching for working principles. Conventional, intuitive and discursive methods of finding design solutions. Embodiment design. Detail design. Evaluation. Size ranges and modular products. Principles of design: clarity, simplicity and safety. Principles of force transmission, division of tasks, self-help and stability. Design rules. Methodical and systematic materials selection. Design for X (environment protection, ergonomy, expenses,...).			
1.5. Teaching methods	X lectures seminars and workshops X exercises long distance education fieldwork	X individual assignment multimedia and network laboratories mentorship X other_teamwork	
1.6. Comments	–		
1.7. Student's obligations			
Course attendance, activity, solving design problems autonomous and in team, studying.			
1.8. Evaluation of student's work			

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project	1.5	Sustained knowledge	1	Report		Practice	

		check					
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, mid-term exams, design project, final written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Course materials and lecture notes.

Križan, B.: Osnove proračuna i oblikovanja konstrukcijskih elemenata, Školska knjiga, Zagreb, 2008.

1.11. Optional / additional reading (at the time of proposing study programme)

Mattson, C.A.; Sorensen, C.D.: Product Development - Principles and Tools for Creating Desirable and Transferable Designs, Springer, Cham, 2020.
Pahl, G.; Beitz, W.: Engineering Design, Springer, London, 1996.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Križan, B.: Fundamentals of Calculation and Design of Machine Elements, Školska knjiga, Zagreb, 2008.	4	16

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Systems and Data Analysis**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION							
1.1. Course objectives							
Developing skills for collecting, recognizing and performing basic analysis and classification of data. Getting acquainted with basic methods for statistical analysis, time-series analysis, and sensitivity analysis. Understanding methods of artificial intelligence such as artificial neural networks and classification methods. Acquiring experience in managing and analyzing large, complex data structures, complex systems and stochastic systems. Adopting the knowledge needed to apply analytical methods to technical systems and data. Understanding the basic ideas of substitute (surrogate) models and mastering the skills required for their implementation and use.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Independently implement a computer program for data collection and filtering. Perform basic statistical data analysis and filter and correct errors in data. Use artificial intelligence (artificial neural networks and classification methods) in data analysis. Create moderately complex computer programs for time-series analysis, complexity and sensitivity analysis and visualization of analytical results. Model and analyze stochastic systems.							
1.4. Course content							
Data collection. Basic statistical analysis. Data errors and data filtering. Interpolation of data by using artificial neural networks. Classification of data. Analysis of time-series and dynamic systems. Methods for analyzing system sensitivity and chaosiness. Complex systems and big data. Probabilistic and stochastic systems. Basic surrogate models and their implementation. Analytical visualization. Examples in engineering.							
1.5. Teaching methods	☒ lectures ☒ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Lectures, practice, homework, seminar, E-learning, consultation.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1.5	Oral exam	0.5	Essay		Research	

Project	1	Sustained knowledge check		Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, continuous knowledge check, making a project, preparing and presenting results, oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Ian H.Witten, Eibe Frank, Mark A. Hall: Data mining: Practical machine learning tools and techniques, Morgan Kaufmann, 2016.
Alexander I.J. Forrester, Andreas Sobester, Andy J. Keane: Engineering design via surrogate modelling: A practical guide, Wiley, 2008.
A. Katok, B. Hasselblatt: Introduction to the Modern Theory of Dynamical Systems, Cambridge University Press, 1995.

1.11. Optional / additional reading (at the time of proposing study programme)

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1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Ian H.Witten, Eibe Frank, Mark A. Hall: Data mining: Practical machine learning tools and techniques, Morgan Kaufmann, 2016.	1	10
Alexander I.J. Forrester, Andreas Sobester, Andy J. Keane: Engineering design via surrogate modelling: A practical guide, Wiley, 2008.	1	10
A. Katok, B. Hasselblatt, ”Introduction to the Modern Theory of Dynamical Systems“, Cambridge University Press, 1995.	1	10

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.

Basic description		
Course title	**Theory of Machines and Mechanisms**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. COURSE DESCRIPTION			
1.1. Course objectives			
The ability of analysis and synthesis of planar and spatial mechanisms. Solving theoretical and practical problems in the field of dynamics of machines and robots.			
1.2. Course enrolment requirements			
None.			
1.3. Expected course learning outcomes			
Make kinematic and dynamic models of simple planar and spatial mechanisms. Explain the basic principles and methods of synthesizing mechanisms. Matematically model and analyze mechanisms of manipulators and robots. Explain the principle of balancing of mechanisms and components of the robot. Differentiate the principles of balancing of mechanisms of engines with one or more cylinders. Explain the basic principles of elastic foundation of machines. Calculate natural frequencies and responses of forced vibrations of a rigid body. Analyze the kinematics and dynamics of rigid and flexible rotors numerically and experimentally. Apply numerical simulation and perform practical balancing of rotor in one or more planes.			
1.4. Course content			
Kinematics and dynamics of planar and spatial mechanisms. Methods of mechanism synthesizing. Analytical methods for the assesment of velocities and accelerations as well as forces of the planar and spatial mechanisms. Analysis of mechanisms of robots and manipulators. Balancing of engine mechanisms with one or more cylinders. Elastic foundation of machines. Natural frequencies and forced vibrations of rigid body. Kinematics and dynamics of rotors. Balancing of rotor in one or more planes. Rigid and elastic rotors.			
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other	
1.6. Comments			
1.7. Student's obligations			
Course attendance, activity, homework, studying.			
1.8. Evaluation of student's work			

Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	
Written exam	1.5	Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	

Portfolio		Excercises	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, 6 constructional exercises, 2 seminars, written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Uicker, J.J. et all: Theory of machines and Mechanisms, Oxford University Press, New York, 2015.
Kovačić, Z. et al.: Basics of robotics, Faculty of Electrical Engineering and Computing, Zagreb, 2000. (in Croatian)
Kumar Mallik, A. Et all: Kinematik Analysis and Synthesis of Mechanisms, CRC Press, 1994.

1.11. Optional / additional reading (at the time of proposing study programme)

Jazar, R.N.: Theory of applied Robotics: Kinematics, Dynamics, and Control, Springer – Verlag, 2007.
Khurmi, R. et al.: Theory of Machines, 14th ed.; S. Chand & Co. Ltd., New Delhi 2005.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Uicker, J.J. et all: Theory of machines and Mechanisms, Oxford University Press, New York, 2015.	1	5
Kovačić, Z. et al.: Basics of robotics, Faculty of Electrical Engineering and Computing, Zagreb, 2000. (in Croatian)	1	5
Kumar Mallik, A. Et all: Kinematik Analysis and Synthesis of Mechanisms, CRC Press, 1994.	1	5

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Thermal Measurements**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Within the course students acquire theoretical knowledge and skills that are required to set up and perform measurements on HVAC systems and present the experimental results.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Compare field and laboratory measuring methods for HVAC and energy systems. Differentiate liquid volume flow rate measuring methods in closed-loop circulation systems, with special application to the hydronic balancing of heating and cooling systems and operation control of the circulation pumps. Describe the methods of air velocity and flow rate measurements in air ducts. Discuss the methods of air flow velocity and temperature distribution measurements in ventilated and air-conditioned spaces. Classify solar irradiance measurements methods, with application to the efficiency estimation of solar thermal collectors or photovoltaic modules. Calculate thermal conductivity of materials and heat transfer coefficients of building elements based on the field results of heat fluxes measurements. Comment the methods of heat exchangers performances measurements. Discuss principles of thermal imaging, with application to the detection of thermal bridges and zones of increased heat fluxes. Interpret results of solid biomass and waste calorific value measurement methods. Apply acquired knowledge in planning, setting up and carrying out practical laboratory and field measurements and presenting obtained results.		
1.4. Course content		
Measurements in thermal engineering, importance and application. Measurement sensors – definition, types, and fundamental characteristics. Measurement errors. Laboratory and field measurements. Liquid volume flow rate measurements in closed-loop systems. Air velocity and flow rate measurements in air ducts. Air distribution, turbulence level and temperature measurements in enclosed spaces. Measurements of specific heat fluxes and determination of heat transfer coefficients and thermal conductivity of materials. Evaluation of heat exchanger performances. Thermal imaging. Determination of calorific value of solid biomass and waste. Solar irradiance measurements. Creating reports and presenting measurement results.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		
Course attendance, activity, writing reports on the measurements performed, studying.		

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam	0.5	Essay		Research	
Project		Sustained knowledge check	1	Report	1.5	Practice	
Portfolio							

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, writing reports on the measurements performed, continuous knowledge testing (three mid-term exams), oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Teaching materials.

1.11. Optional / additional reading (at the time of proposing study programme)

2008 ASHRAE Handbook, ASHRAE Atlanta, 2008.
Recknagel, Sprenger, Schramek: Heitzung und Klimatechnik 05/06, Springer Verlag, München, 2005.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Thermal Power Plants**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+15+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Adoption of the theoretical knowledge and skills for solving technical problems in the field of design, operation and maintenance of thermal power plants.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Describe and analyze the conversion of energy in power plants to produce electricity and heat. Describe and analyze the plant with steam and gas turbines. Develop energy balance and calculating efficiency of thermal power plants with steam and gas process. Analyze and explain the factors influencing efficiency of thermal power plants. Draw the basic scheme of the main types of thermal power plants. Describe and calculate the main components of thermal power plants (steam generators, turbines, condensers, regenerative water heaters, cooling towers, gas turbines, compressors, waste heat boiler). Describe the main influential factors when designing thermal power plant. Indicate and explain the operational problems that may arise in the operation of thermal power plants. Describe the main principles of good maintenance of thermal power plants.		
1.4. Course content		
Introduction to thermal power plants. Steam power plant. Utilization and fuel efficiency of steam power plants. Ways of increasing the efficiency of steam power plants. Steam plant for the combined production of electricity and heat. Steam generators. Heat balance, efficiency and fuel consumption in the steam generators. Steam turbines. The working principle of a steam turbine. Types of steam turbines. Losses and efficiency of steam turbines. Steam condensers. Regenerative water heaters. Cooling towers. Treatment of feed water in steam thermal power plants. Design, modeling and optimization of thermal power plants. Gas fired power plants. The main types of gas thermal power plants. Thermal power plants with a combined gas-steam process. Cogeneration and trigeneration thermal power plants. The main parts of a gas turbine plant. Non-conventional power plants. Hydro-electric power plant.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		

Course attendance, activity, homework, studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam	1	Essay		Research	
Project		Sustained knowledge check	1.5	Report		Practice	
Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, continuous knowledge testing (2 mid-term exams), written or oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Prelec, Z.: Energetics in process industry (in Croatian), Školska knjiga, Zagreb, 1994.

1.11. Optional / additional reading (at the time of proposing study programme)

Požar, H.: Basis of energetics, 1st and 2nd part (in Croatian), Školska knjiga Zagreb, 1976., 1978,
El-Vakil, M.: Power plant technology, Mc Graw Hill Book Company, 2002.
Zhu, F.: Energy and Process Optimization for the Process Industries, Wiley-AIChE, 2013.
Jaluria, Y.: Design and Optimization of Thermal Systems, CRC Press, 2020.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Prelec, Z.: Energetics in process industry (in Croatian), Školska knjiga, Zagreb, 1994.	10	30

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's system of quality control

Basic description		
Course title	**Thermal Processes of Materials**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

2. **COURSE DESCRIPTION**		
1.14. Course objectives		
Understanding of reaction, microstructure transformation and mechanical behaviour of materials during the thermal processes: heat treatment, thermo-mechanical processing, surface engineering, casting and welding. Understanding of behaviour of materials at low and high temperatures.		
1.15. Course enrolment requirements		
Attended courses Metal Materials.		
1.16. Expected course learning outcomes		
Define basic thermal processes: heat treatment, thermos-mechanical processing, surface engineering, casting and welding. Define theoretical findings regarding to thermal processes of materials. Analyse the classical methods of predicting of result of thermal processes of materials. Analyse the possibilities of applications of thermal processes of materials. Analyse behaviour of materials in specific thermal condition, or to analyse application of materials at low and high temperatures.		
1.17. Course content		
Basic thermal processes, heat treatment, thermo-mechanical processing, surface engineering, casting and welding. Equilibrium and non-equilibrium phenomenon microstructure transformations, reaction during the heating, slow cooling and quenching in steel and other metal alloys. Process of melting and crystallization. Possibilities of heat treatment, thermo-mechanical processing, surface engineering, casting and welding of steel and other metal alloys. Application of TTT-diagrams in heat treatment. Designing of mold cavity, risering and gating system. Abilities of heat treatment of cast alloys and welding joints. Chemical and physical vapor deposition. Deposition of thin layers by spraying technologies. Laser surface hardening, structure refinement, melting, alloying and laser fusion of coating. Ion implantation. Failings in thermal processing of materials. Appearance of residual stresses. Appearance of thermal fatigue, thermal shock, creep and thermal destruction of materials. Prediction of results, residual stresses and distortions at thermal processes of materials. Methods of testing and characterization of results of thermal processing of materials.		
1.18. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other
1.19. Comments	-	
1.20. Student's obligations		
Course attendance, preparation of seminars, studying.		
1.21. Evaluation of student's work		

Course attendance	2	Activity/Participation		Seminar paper	1	Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	1	Report		Practice	
Portfolio		Homework					

1.22. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, sustained knowledge check, seminar papers, written exam.

1.23. Assigned reading (at the time of the submission of study programme proposal)

Smoljan, B., Heat treatment of steel, gray and ductile iron castings, Zagreb: Hrvatsko društvo za toplinsku obradbu i inženjerstvo površina, Udžbenici Sveučilišta u Rijeci, 1999. (in Croatian)
Krumes, D., Heat treatment, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod 2000. (in Croatian)
Katavić, I.: Foundry, Sveučilište u Rijeci, 1993. (in Croatian)
Gojić, M., Techniques for materials joining and separation, Sveučilište u Zagrebu, Metalurški fakultet, 2003. (in Croatian)
Duplančić, I.: Metal Forming Processes, Fakultet elektrotehnike, strojarstva i brodogradnje Sveučilišta u Splitu, 2007. (in Croatian)

1.24. Optional / additional reading (at the time of proposing study programme)

Schumann, H., Metallographie, VEB Deutscher Verlag fuer Grundstoffindustrie, Leipzig, 1967.
DeGarmo, Paul E., Materials and processes in manufacturing, Macmillan Publishing Co., Inc., New York, 1974.
Metals engineering – processes, ASME Handbook, McGraw-Hill Book Co., Inc., New York, etc., 1958.

1.25. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Smoljan, B., Heat treatment of steel, gray and ductile iron castings, Zagreb: Hrvatsko društvo za toplinsku obradbu i inženjerstvo površina, Udžbenici Sveučilišta u Rijeci, 1999. (in Croatian)	4	30
Smoljan, B., Fundamentals of heat treatment of steel, Rijeka: Sveučilište u Rijeci, Pedagoški fakultet, 1997. (in Croatian)	6	30
Krumes, D., Heat treatment, Strojarski fakultet u Slavonskom Brodu, Slavonski Brod 2000. (in Croatian)	1	30
Katavić, I.: Foundry, Sveučilište u Rijeci, 1993. (in Croatian)	21	30
Gojić, M., Techniques for materials joining and separation, Sveučilište u Zagrebu, Metalurški fakultet, 2003. (in Croatian)	2	30
Duplančić, I.: Metal Forming Processes, Fakultet elektrotehnike, strojarstva i brodogradnje Sveučilišta u Splitu, 2007. (in Croatian)	2	30

1.26. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Thermodynamics II**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	compulsory	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	7
	Number of hours (L+E+S)	45+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Obtaining theoretical knowledge and develop skills to solve practical problems in the field of thermodynamics. Acquiring the knowledge required for attending lectures in the field of thermal and energy engineering.		
1.2. Course enrolment requirements		
Basic knowledge of thermodynamics.		
1.3. Expected course learning outcomes		
Define and mathematically describe heat conduction. Define and mathematically describe heat transfer by convection. Describe Oberbeck's mathematical model as well as define and describe differential equations of fluid flow and heat transfer in the boundary layer. Interpret analogy theorem and define and describe dimensionless parameters of fluid flow and heat transfer. Describe and compare heat transfer by natural and forced convection. Describe heat transfer in phase change processes. Describe and define the concept of black body and Stefan-Boltzmann's radiation law. Describe thermal radiation properties of natural bodies and gases. Define and describe heat transfer by radiation for special and general plane arrangement. Describe and analyze the gasification process and explain the Mollier-Hofmann's diagram. Describe and analyze the flow process with friction phenomenon. Define and describe reversible and irreversible mixing. Describe and analyze processes with humid air. Apply acquired knowledge to solve thermodynamic tasks (practical problems).		
1.4. Course content		
Heat transfer. Fourier's differential equation of heat conduction. Heat transfer by convection. Boundary layer. Differential equations of fluid flow and heat transfer. Oberbeck's mathematical model. Analogy theorem. Forced and natural convection. Dimensionless parameters. Heat transfer in phase change processes. Overall heat transfer coefficient. Thermal radiation. Black body. Stefan-Boltzmann's law. Radiation in half of area. Properties of thermal radiation. Radiation of natural bodies. Selectively radiation of gases. Heat transfer by radiation for special and general plane arrangement. Gasification. Transformation degree. Mollier-Hofmann's tetragon of generator gas. Flow process with friction phenomenon. Reversible and irreversible mixing. Irreversibility degree. Humid air. Processes with humid air.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		

Course attendance, activity, homework, studying.

1.8. Evaluation of student's work

Course attendance	2.5	Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam	2	Essay		Research	
Project		Sustained knowledge check	2	Report		Practice	
Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, continuous knowledge testing (three mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Bošnjaković, F.: Thermodynamics, Vol. I, II and III (reprint editions of 1978, 1976 and 1986), Graphis d.o.o., Zagreb, 2012. (in Croatian)
Halasz, B, Galović, A., Tadić, M.: Collections of exercises in Thermodynamics, part I, part II, Sveučilišna tiskara, Zagreb, 1993. and 1996. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Galović, A.: Termodynamics I, (book), Fakultet strojarstva i brodogradnje, Zagreb, 2007. (in Croatian)
Galović, A.: Termodynamics II, (book), Fakultet strojarstva i brodogradnje, Zagreb, 2007. (in Croatian)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Bošnjaković, F.: Thermodynamics, Vol. I, II and III (reprint editions of 1978, 1976 and 1986), Graphis d.o.o., Zagreb, 2012. (in Croatian)	38	120
Halasz, B, Galović, A., Tadić, M.: Collections of exercises in Thermodynamics, part I, part II, Sveučilišna tiskara, Zagreb, 1993. and 1996. (in Croatian)	19	120

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Thermodynamics of Mixtures**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	45+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Accepting the theoretical knowledge and training of skills for solving practical problems in field of thermodynamics of mixtures. Accepting knowledge which is needed for attending subjects in fields of thermal systems.							
1.2. Course enrolment requirements							
Attended course Thermodynamics II.							
1.3. Expected course learning outcomes							
Describe the thermal phenomena of mixing, Merkel diagram and explain the rule of mixing. Describe and analyze the process of vaporisation and liquefaction of homogeneous and heterogeneous mixture. Define and describe the process of damping. Define and describe the process of absorption. Define and mathematically describe the processes of distillation deflegmation and rectification. Define and mathematically describe the process of adiabatic evaporation. Define and mathematically describe the process of non-adiabatic evaporation. Describe and analyze the heat and mass transfer in circulating cooling by evaporation. Apply acquired knowledge to solve thermodynamic tasks (practical problems).							
1.4. Course content							
The properties of binary mixtures. Homogeneous and heterogeneous mixtures. Thermal processes with binary mixtures. Vaporisation and liquefaction of binary mixtures. The separation of the mixture. Damping. Absorption. Absorption refrigeration unit. Adiabatic evaporation. Direction of change of state and cooling temperature limit. Non-adiabatic evaporation. Unit size and direction of change of state. Practical applications - cooling tower.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, homework, studying.							
1.8. Evaluation of student's work							
Course attendance	2.5	Activity/Participation		Seminar paper		Experimental work	
Written exam		Oral exam	1	Essay		Research	
Project		Sustained knowledge	1	Report		Practice	

		check					
Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, continuous knowledge testing (three mid-term exams), written and oral exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Bošnjaković, F.: Thermodynamics, Parts I., II. & III. (pretisak izdanja iz 1978., 1976. i 1986.), Graphis d.o.o., Zagreb, 2012. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Bošnjaković, F.: Thermodynamics, Parts I., II. & III. (pretisak izdanja iz 1978., 1976. i 1986.), Graphis d.o.o., Zagreb, 2012. (in Croatian)	38	18

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Thermomechanics**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**			
1.1. Course objectives			
Obtaining theoretical knowledge and develop skills to solve practical problems of thermal stresses.			
1.2. Course enrolment requirements			
None.			
1.3. Expected course learning outcomes			
Define balance laws of continuum mechanics. Describe mechanical behaviour in the elevated temperature conditions. By analytical procedures determine stress and displacements distributions in trusses, beams and plate structures for the nonisothermal environment. Determine stress and displacement distribution for the problems defined in cylindrical and spherical coordinate systems. To solve problems of thermal stresses and dilatations in a pipeline. Define basic equation of a finite element in the variable temperature regime. By the application of finite element method solve time-independent and time-dependent problems.			
1.4. Course content			
Introduction. Basic laws of continuum mechanics. Constitutive equations for elastic and inelastic material is elevated temperature environment. Thermoelasticity. Basic problems of thermal stresses. Thermal stresses in rods, beams and plates – analytical solutions. Numerical determination of thermal stresses in complex structures. Time dependent and time independent problems. Coupled problems in thermomechanics.			
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other	
1.6. Comments	-		
1.7. Student's obligations			
Course attendance, activity, homework, seminar paper, studying.			
1.8. Evaluation of student's work			

Course attendance	2	Activity/Participation		Seminar paper	2	Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project		Sustained knowledge check		Report		Practice	
Portfolio		Homework	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework(2), seminar paper, written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Boley, B. A., Weiner, J. H.: «Theory of Thermal Stresses», Dover Publications, Mineola, 1997.
Brnić, J., Čanađija, M.:"Finite element analysis of solids, Fintrade, Rijeka, 2009. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Salencon, J.: «Handbook of Continuum Mechanics. General Concepts – Thermoelasticity», Springer – Verlag, Wien, 2001.
Maugin, G.: «Thermomechanics of Plasticity and Fracture», Cambridge Univ. Press, 1992.
Bathe, K. J.:»Finite Element Procedures», Prentice Hall, Englewood Cliffs, 1996.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Boley, B. A., Weiner, J. H.: «Theory of Thermal Stresses», Dover Publications, Mineola, 1997.	4	5
Brnić, J., Čanađija, M.:"Finite element analysis of solids, Fintrade, Rijeka, 2009. (in Croatian).	10	5

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Transport Systems**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**2.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Acquiring knowledge and skills about topics related to transport systems. The development of the ability to calculate, design and apply transport systems in industrial praxis, using modern materials and taking into consideration demands regarding reliability, safety, quality, cost, ecology, ergonomics, engineering ethics, etc.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Explain term, purpose, classification, application and historical development of transport systems and transport logistics. Explain and define industrial transport equipment and devices in warehouses. Explain and define hand and motor driven industrial vehicles. Understand the importance of using green transport logistics, transportation ecology and engineering ethics in in design and application of transport systems. Explain and define table top chain conveyors, overhead chain conveyors and bucket elevators. Explain and define unpowered and powered roller conveyers. Explain and define cranes and crane mechanisms, standards and service classes of hoisting appliances. Explain and define lifts, escalators, moving walkways, ropeways and small transport devices. Apply acquired knowledge in design and application of transport systems.		
1.4. Course content		
Introduction. Transport of materials and people. Historical development. The importance and place of transport in the industry. Basic concepts, application, divisions and characteristics of transport systems. Transport logistics. Industrial transport equipment and devices in warehouses. Hand and motor driven industrial vehicles: - types, description, calculation and design. Analysis of using green transport logistics, transportation ecology and engineering ethics in design and application of transport systems. Table top chain conveyors, overhead chain conveyors, bucket elevators: - types, purpose, description and calculation. Unpowered and powered roller conveyors: - types, purpose, description and calculation. Cranes and crane mechanisms, standards and service classes of hoisting appliances: - types, features, purpose, description, calculation and design. Lifts, escalators, moving walkways, ropeways, small transport devices: - types, purpose, description and calculation.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork	☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other
1.6. Comments		

1.7. Student's obligations

Course attendance, activity, solving assigned project work, studying.

1.8. Evaluation of student's work

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	0.5	Oral exam		Essay		Research	
Project	1	Sustained knowledge check	1.5	Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, 2 mid-term exams, project work, final written exam.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Oluić, Č.: Warehousing in Industry, FSB, Zagreb, 1997. (in Croatian)
Piršić, T.: Transport in Industry, FESB, Split, 2005. (in Croatian)
Habus, J., Zlonoga, D.: Applications of Forklifts, Nakladništvo & Marketing, Zagreb, 1997. (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Dundović, Č., Hess, S.: Indoor Transport and Warehousing, Pomorski fakultet, Rijeka, 2007. (in Croatian)
Zlonoga, D., Lukačević, M.: Pallets and Palletisation, August Šenoa, Zagreb, 1993. (in Croatian)
Baura, Gail, D.: *Engineering Ethics: An Industrial Perspective*, Elsevier Academic Press, USA, 2006.
Herold, Z., Ščap, D., Hoić, M.: Lifting and Handling Equipment, Part 1, Fakultet strojarstva i brodogradnje, Zagreb, 2020. (in Croatian)
Herold, Z., Ščap, D., Hoić, M.: Lifting and Handling Equipment, Part 2, Fakultet strojarstva i brodogradnje, Zagreb, 2020. (in Croatian)
Janovsky, L.: Elevator Mechanical Design, Elevator World, Inc., U.S., 2017.
McCain, Z.: Elevators 101, Elevator World, Inc., U.S., 2015.
Abbaspour, B.: Escalator Engineering, Elevator World, Inc., U.S., 2017.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Oluić, Č.: Warehousing in Industry, FSB, Zagreb, 1997. (in Croatian)	5	19
Piršić, T.: Transport in Industry, FESB, Split, 2005. (in Croatian)	1	19
Habus, J., Zlonoga, D.: Applications of Forklifts, Nakladništvo & Marketing, Zagreb, 1997. (in Croatian)	1	19

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Vibrations**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	4
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**		
1.1. Course objectives		
Obtaining theoretical and practical knowledge of mechanical system vibration analysis. To understand the importance of vibration analysis with the goal of reducing its harmful influence on durability of machines and structures.		
1.2. Course enrolment requirements		
None.		
1.3. Expected course learning outcomes		
Explain the basic concepts of kinematics vibrational motion. Distinguish different ways of expressing the amplitude of vibration. Make transformation of nonharmonic periodic functions in Fourier's order. Time and frequency domain representation of the vibration signal. To analyze the problem of free vibration of single degree of freedom–SDOF system. Distinguish undamped from damped vibrations. Harmonic excitation of the SDOF system. Define equations of motion of the single and two DOFs and calculate their natural frequencies and modes of vibrations. Perform reduction of continuous system on a lumped mass system. Specify and describe measuring devices and sensors for vibration measurements. Indicate measures for reduction of vibration, passive and active approach.		
1.4. Course content		
Vibration kinematics. Fourier analysis and frequency spectra. Vibration dynamics of the SDOF system: free and forced vibrations of undamped and damped systems. Different types of excitations: harmonic, rotating unbalance and support excitation. Jeffcott – Laval rotor model. Vibration isolation. System response on general periodic and nonperiodic excitation. System with two (multiple) DOF: free and forced vibration. Lumped mass modelling of distributed masses. Finite element method in vibration problems. Vibration measurements: sensors and equipment. Durability of structure and measures for vibration reduction. Response on seismic excitation.		
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☒ fieldwork	☒ individual assignment ☐ multimedia and network ☒ laboratories ☐ mentorship ☐ other
1.6. Comments		
1.7. Student's obligations		
Course attendance, activity, student laboratory reports, studying		
1.8. Evaluation of student's work		

Course attendance	2	Activity/Participation		Seminar paper		Experimental work	
Written exam	1	Oral exam		Essay		Research	
Project		Sustained knowledge check	0.5	Report		Practice	
Portfolio		Laboratory exercises	0.5				

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, student laboratory reports, written exam. Sustained knowledge check.

1.10. Assigned reading (at the time of the submission of study programme proposal)

Krpan, M., Butković, M., Žigulić, R., Braut, S., Franulović, A.: Dynamics, Theory and application, TFR, Rijeka, 2001. (in Croatian)
Stegić, M.: Theory of vibration, FSB Zagreb, 1996 (in Croatian)

1.11. Optional / additional reading (at the time of proposing study programme)

Žigulić, R., Braut, S.: Kinematika, Tehnički fakultet Sveučilišta u Rijeci, 2012.
Rao, S.S.: Mechanical Vibrations, Pearson, Sixt edition, 2018.
Benaroya, H., Nagurka, M.L.: Mechanical Vibration; Analysis, Uncertanties and Control, 3rd edition, CRC Press, Boca Raton, 2010.

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
Krpan, M., Butković, M., Žigulić, R., Braut, S., Franulović, A.: Dynamics, Theory and application, TFR, Rijeka, 2001. (in Croatian)	16	8
Stegić, M.: Theory of vibration, FSB Zagreb, 1996 (in Croatian)	3	8

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution's quality assurance system.

Basic description		
Course title	**Visualization and Preparation of Computer Simulations**	
Study programme	**Graduate University Study of Mechanical Engineering**	
Course status	optional	
Year	**1.**	
ECTS credits and teaching	ECTS student 's workload coefficient	5
	Number of hours (L+E+S)	30+30+0

1. **COURSE DESCRIPTION**							
1.1. Course objectives							
Assessment and preparation of the computational domain for the numerical simulation. Creating geometry, numerical meshes and various types of visualizations using commercial and free software tools for CAD, meshing and analysis of calculated results.							
1.2. Course enrolment requirements							
None.							
1.3. Expected course learning outcomes							
Define the computational domain for a particular physical problem. Create the computational domain using CAD software. Understand different CAD exchange formats and distinguish their advantages and disadvantages. Indicate and correctly interpret types of numerical meshes. Create and compare numerical meshes of different basic element types, applicable to the same problem. Specify and correctly apply visualization techniques to analyze numerical results. Apply the appropriate visualization techniques for preparation of specific representations of results with complex computational domains.							
1.4. Course content							
Defining physical problem and associated computational domain. Modelling the computational domain with CATIA and ANSYS or any other contemporary software package. Creating specific computational domains. Importing geometry from other CAD tools. Understanding the various CAD file formats. Types of numerical meshes. Structured and unstructured meshes. Building a numerical mesh. Customizing mesh size and type to specific geometric features. Postprocessing of numerical results. Analysis and review of the results of numerical simulations using Fluent, CFX, Ansys software packages. XY graphs, contour plots and vector plots, path lines, 3D isosurfaces. Animating results for unsteady simulation cases. Creating reports.							
1.5. Teaching methods	☒ lectures ☐ seminars and workshops ☒ exercises ☐ long distance education ☐ fieldwork		☒ individual assignment ☐ multimedia and network ☐ laboratories ☐ mentorship ☐ other				
1.6. Comments							
1.7. Student's obligations							
Course attendance, activity, homework, independent studying.							
1.8. Evaluation of student's work							
Course attendance	2	Activity/Participation		Seminar paper		Experimental work	

Written exam		Oral exam		Essay		Research	
Project	3	Sustained knowledge check		Report		Practice	
Portfolio		Homework					

1.9. Procedure and examples of learning outcome assessment in class and at the final exam

Course attendance, activity, homework, project work.

1.10. Assigned reading (at the time of the submission of study programme proposal)

User guides and Tutorials (Catia, Ansys)
Ferziger J.H. & Peric M. (1999) Computational Methods for Fluid Dynamics, Springer, Berlin, Germany.
Zikanov O. (2010) Essential Computational Fluid Dynamic, John Wiley & Sons Inc., ISBN 978-0-470-42329-5

1.11. Optional / additional reading (at the time of proposing study programme)

1.12. Number of assigned reading copies with regard to the number of students currently attending the course

Title	*Number of copies*	*Number of students*
User guides and Tutorials (Catia, Ansys)	e-copies	30
Ferziger J.H. & Peric M. (1999) Computational Methods for Fluid Dynamics, Springer, Berlin, Germany.	1	30
Zikanov O. (2010) Essential Computational Fluid Dynamic, John Wiley & Sons Inc., ISBN 978-0-470-42329-5	1	30

1.13. Quality monitoring methods which ensure acquirement of output knowledge, skills and competences

Through the Institution’s quality assurance system.