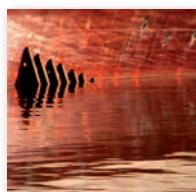


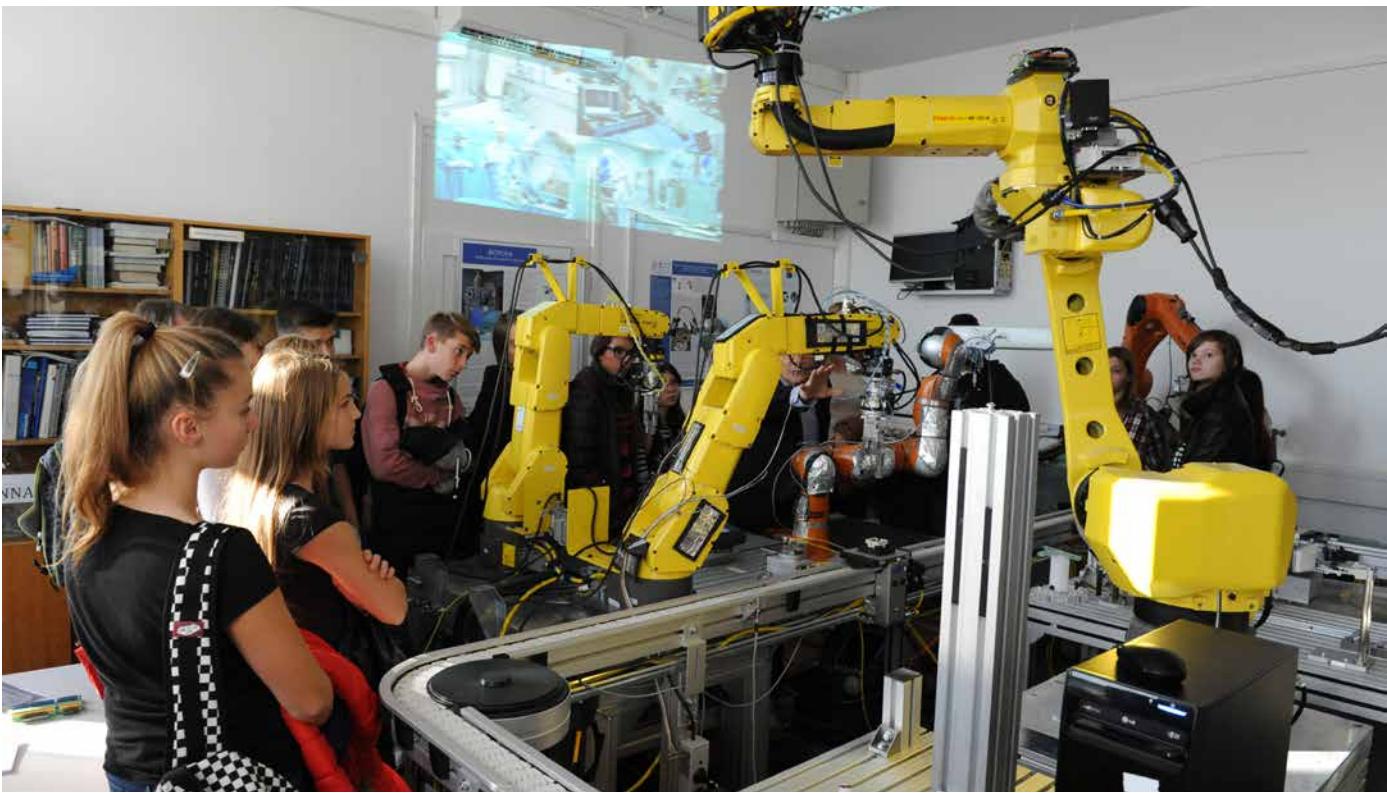
Sveučilište u Zagrebu  
**Fakultet strojarstva i brodogradnje**

University of Zagreb  
**Faculty of Mechanical Engineering and Naval Architecture**





<b>Predgovor</b>		
Foreword		3
<b>O nama</b>		
About us		4
<b>Zavod za konstruiranje</b>		
Department of Design		13
<b>Zavod za tehničku mehaniku</b>		
Department of Applied Mechanics		17
<b>Zavod za termodinamiku, toplinsku i procesnu tehniku</b>		
Department of Thermodynamics and Thermal and Process Engineering		21
<b>Zavod za motore i transportna sredstva</b>		
Department of IC Engines and Transport Systems		25
<b>Zavod za energetska postrojenja, energetiku i ekologiju</b>		
Department of Energy, Power and Environmental Engineering		29
<b>Zavod za brodogradnju i pomorsku tehniku</b>		
Department of Naval Architecture and Offshore Engineering		33
<b>Zavod za industrijsko inženjerstvo</b>		
Department of Industrial Engineering		37
<b>Zavod za kvalitetu</b>		
Department of Quality		41
<b>Zavod za robotiku i automatizaciju proizvodnih sustava</b>		
Department of Robotics and Production System Automation		45
<b>Zavod za materijale</b>		
Department of Materials		49
<b>Zavod za zavarene konstrukcije</b>		
Department of Welded Structures		53
<b>Zavod za tehnologiju</b>		
Department of Technology		57
<b>Zavod za zrakoplovno inženjerstvo</b>		
Department of Aeronautical Engineering		61
<b>Zavod za mehaniku fluida</b>		
Department of Fluid Mechanics		65
<b>Samostalne katedre</b>		
Independent Chairs		68
<b>Studentske udruge</b>		
Student Associations		73
<b>Strukovne udruge</b>		
Professional Associations		76
<b>Knjižnica Fakulteta strojarstva i brodogradnje</b>		
The Faculty of Mechanical Engineering and Naval Architecture Library		77
<b>Časopisi</b>		
Journals		78



## Vizija

Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu dugoročno se želi istaknuti kao jedna od vodećih institucija u području strojarstva, brodogradnje i zrakoplovnog inženjerstva u jugoistočnoj Europi te svojim znanstveno-nastavnim potencijalima osigurati ključnu ulogu u pokretanju razvoja i osiguravanju napretka hrvatskoga gospodarstva temeljenog na inovacijama.

## Misija

Fakultet strojarstva i brodogradnje ima ulogu povezivanja istraživačkoga i nastavnog procesa radi stvaranja inovativne i kreativne društvene elite kao i kreiranja nove vrijednosti transferom rezultata istraživačkog rada za dobrobit gospodarstva i društva u cjelini. Fakultet u svakodnevnom radu slijedi načelo inovativnosti kao bitnog čimbenika znanstvenoistraživačke i nastavne djelatnosti, koja kreira nove znanstvene vrijednosti te obrazuje stručnjake sposobne za aktivno i uspješno cje-loživotno usavršavanje.

## Vision

The Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, aims to position itself as one of the leading institutions in the fields of mechanical engineering, naval architecture and aeronautical engineering in South Eastern Europe. Through research and teaching, it strives to occupy a crucial role in fostering the development and progress in Croatia's economy, based on innovations.

## Mision

The Faculty's mission is to educate innovative and creative leaders by combining research and teaching and to disseminate new scientific knowledge gained through research, all for the benefit of the Croatian economy and society. The Faculty is committed to innovation in research and teaching, creating scientific breakthroughs and educating experts able to actively and effectively pursue lifelong learning and advancement.

## Predgovor

Fakultet strojarstva i brodogradnje (FSB) kao sljedbenik Visoke kraljevske tehničke škole, utemeljene 1919. godine, ima gotovo stoljetnu tradiciju. Tijekom sva ta desetljeća FSB je vodeća institucija u obrazovanju, znanosti i stručnosti u Republici Hrvatskoj, u području strojarstva i brodogradnje, a zadnja dva desetljeća i zrakoplovstva. Kontinuirano i odgovorno obrazuje mlade naraštaje, ali provodi i cje-loživotnu izobrazbu stručnjaka koji su perjanice razvoja velikog dijela gospodarstva te generator ideja njegova razvoja. Surađujući s brojnim akademskim institucijama u Hrvatskoj, ali i izvan nje te s gospodarstvom, uživa visok ugled u međunarodnoj akademskoj zajednici i gospodarstvenim subjektima. Da bi tako i nadalje ostalo te s ciljem ostvarivanja što boljih rezultata u nastavnoj, znanstvenoistraživačkoj i stručnoj djelatnosti, usvojena je Strategija razvoja za sljedeće desetljeće (2014. – 2025.). U nastavne, znanstvene i stručne aktivnosti uključuju se najnovija znanstvena postignuća iz postojećih područja (konstruiranja, brodogradnje, zrakoplovstva, energetike, termotehnike i procesne tehnike, motora i vozila, proizvodnih tehnologija, industrijskog inženjerstva, inženjerstva materijala), a otvaraju se i nova (računalno inženjerstvo i simulacije, mehatronika i robotika, medicinsko inženjerstvo, nanoteknologije, vojne tehnike, mjeriteljstvo, osiguravanje i upravljanje kvalitetom). Znatan dio svojih aktivnosti Fakultet temelji na svojim laboratorijima koji su specijalizirani za različita područja iz svog širokog spektra aktivnosti. Stalnim unaprjeđenjem rada i opremljenosti, 6 laboratorijskih akreditirano je prema EN ISO 17025 i nositelji su državnih etalona. Posebno bogatstvo na Fakultetu su studentske udruge, njih 10. Projekti koji se realiziraju u okviru studentskih udruga, studenti pretazu stečena teorijska znanja u praktičnu primjenu. FSB puno drži do sportskih aktivnosti studenata koje se odvijaju u okviru sportske udruge „Omega“, jer s jedne strane po latinskoj poslovici „Mens sana in corpore sano“ to je dobro za uspješno svladavanje studija, a s druge strane natjecateljski duh snaži osjećaj pripadnosti matičnom Fakultetu. FSB kontinuirano radi na poboljšanju standarda studiranja. Kako bi FSB i nadalje držao korak u istraživačkim i obrazovnim procesima sa suvremenom Europom i ukupnom svjetskom akademskom zajednicom, i u buduće će se baviti sustavnim unaprjeđenjem svih svojih aktivnosti uspostavljenim Sustavom osiguravanja kvalitete.

## Foreword

The Faculty of Mechanical Engineering and Naval Architecture (FAMENA) has an almost century-old tradition – it is the successor to the Royal Technical College founded in 1919. Since then FAMENA has been one of the Croatian leading institutions in education, science and expertise in the fields of mechanical engineering and naval architecture, and for the last two decades in the field of aeronautical engineering too. Generations of engineers have been taught effectively by the Faculty's teaching staff, who are also responsible for carrying out lifelong learning programmes for experts who are in the forefront of the development of economy and can generate ideas for further development. The staff, who collaborate with numerous academic institutions in Croatia and abroad and with the industry, have undoubtedly contributed to a high standing the Faculty has in the international academic community and in the industry. With the aim of maintaining this good reputation and of achieving the best possible results in teaching, research and professional activities the Faculty has adopted its Development Strategy 2014-2025. The teaching, research and professional activities include our recent achievements in the well-established fields (engineering design, naval architecture, aeronautical engineering, energy engineering, thermal and process engineering, IC engines and motor vehicles, manufacturing technologies, industrial engineering, materials engineering), and in the new and emerging fields of science and technology (computer engineering and simulations, mechatronics and robotics, medical engineering, nanotechnologies, military engineering, metrology, quality assurance and management). Many Faculty's activities are carried out in the laboratories that are specialized for various fields. After years of continuous improvement six well-equipped laboratories are accredited to EN ISO and are holders of the Croatian national standards. About ten student associations are the Faculty's valuable asset. Numerous extracurricular activities and projects offer the students the opportunity to apply theoretical fundamentals and academic skills acquired in the classroom in a real-world context. The Faculty supports and encourages students to participate in sports too, in particular within the sports association „Omega“. We firmly believe that „Mens sana in corpore sano“, as the Latin saying goes, means that participating in sports can help academic performance; at the same time, the spirit of competition in sports creates a sense of belonging to the Faculty. The Faculty is continuously improving the quality of teaching and learning. To keep abreast of the research and education processes in modern Europe and the world academic community we are going to secure improvement in all the areas by monitoring the implemented quality assurance system.

Dekan / Dean

  
prof. dr. sc. Zvonimir Guzović

## O nama

Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu najstariji je i najveći od strojarskih fakulteta u Hrvatskoj. Od organizacije prve nastave 1919. godine u okviru Kraljevske visoke tehničke škole Studij strojarstva i Studij brodogradnje, a od 1995. i Studij zrakoplovstva, svojim su sadržajem uvijek bili suvremeni zahvaljujući uspješnoj sintezi temeljnih te općih i stručnih znanja. Razvoj Fakulteta temelji se na razvoju područja konstrukcije, materijala, energetike, proizvodnje i organizacije. Struktura studija i nastavni sadržaji čine nastavni program usporedivim s programima istorodnih studija na uglednim europskim učilištima i time omogućuju da Fakultet strojarstva i brodogradnje zadrži mjesto među vodećim tehničkim fakultetima Sveučilišta u Zagrebu i u zemljama.

Fakultet strojarstva i brodogradnje nositelj je suvremenih studijskih programa iz područja tehničkih znanosti za obrazovanje stručnjaka u svim granama industrije. Danas se na Fakultetu izvode tri sveučilišna preddiplomska i diplomska studija: strojarstva, brodogradnje te zrakoplovstva. Područja stručnoga i znanstvenog rada nakon završetka studija mogu biti: projektiranje, konstruiranje i proizvodnja, vođenje procesa, eksploatacija i održavanje proizvodnih sustava te organizacija rada u njima, i to u svim granama industrije.

Uz teorijske spoznaje, koje prenose vršni nastavnici s ukupno 14 zavoda i 41 katedre, praktična su znanja također bitna sastavnica obrazovanja na Fakultetu što potvrđuju podaci o 51 laboratoriju te intenzivna suradnja s gospodarstvom.

Fakultet strojarstva i brodogradnje trenutno zapošjava oko 400 djelatnika, od kojih 215 čini znanstveno-nastavno osoblje, od profesora do znanstvenih novaka i stručnih suradnika, a ukupno upisanih studenata je više od 2300.

Prednosti studiranja na Fakultetu strojarstva i brodogradnje su:

- održavanje predavanja i vježbi u suvremeno opremljenim dvoranama, učionicama i laboratorijima
- mogućnost rada na računalima s modernim inženjerskim programima, umreženim u gigabitnu mrežu u jednoj od 15 računalnih učionica s približno 300 radnih mjesta, koje su na raspolaganju studentima od 8 do 21 sat
- fakultetska knjižnica dostupna studentima od 8 do 18 sati
- implementirano e-učenje, već i za kolegije na prvoj godini
- Fakultet raspolaže s modernim restoranom studentske prehrane koji posluje u sklopu Studentskog centra
- program mentora – studentima prve godine dodjeljuje se mentor koji pomaže savjetima u vezi sa studijem
- studentske međunarodne razmjene

## About us

The Faculty of Mechanical Engineering and Naval Architecture is the oldest and the largest faculty in the field of mechanical engineering in Croatia. Since the first lectures held at the Royal Technical College in 1919 the Faculty has been providing state-of-the-art education in its mechanical engineering and naval architecture courses and then since 1995 in the aeronautical engineering course too, successfully combining general and expert knowledge. The development of the Faculty is based on the developments in the fields of design, materials, energy engineering, production and organization. The concept of the studies and the designed course syllabi are similar to the curricula of such studies at the prestigious European universities, which contributed directly to the fact that the Faculty is one of the leading engineering faculties both of the University of Zagreb and in Croatia.

The Faculty provides teaching excellence in engineering sciences educating future engineers for different industries. It offers undergraduate and graduate programmes in three courses of study: mechanical engineering, naval architecture and aeronautical engineering. Graduate students may pursue a professional or scientific career in many areas, such as design and production, process management, exploitation and maintenance of production systems and design and operation of manufacturing systems across industries.

In addition to theoretical knowledge, taught by highly qualified teachers from 14 departments and 41 chairs, practical knowledge is an important component of the education at the Faculty and it can be acquired both in 51 laboratories and through intensive collaboration with industry. Numerous elective courses offer plenty of opportunity for professional training in all the courses of study.

The Faculty has approximately 400 staff, 215 of them are teaching and research staff, from full professors to junior researchers and research assistants. There are now over 2300 students enrolled in the study programmes.

The Faculty of Mechanical Engineering and Naval Architecture offers

- lectures and practical exercises held in modern halls, classrooms and laboratories
- the use of modern engineering software tools and applications on computers, connected in a gigabit network, in 15 classrooms with approximately 300 seats, open to students from 8 am to 9 pm
- the Faculty library open to students from 8 am to 6 pm
- e-learning starting with the 1st year courses
- a modern canteen
- a mentoring programme – each 1st year student is paired with one exclusive mentor to get the study-related information, advice and guidance

- industrijske prakse u tvrtkama u Hrvatskoj i inozemstvu
- diploma koja je prepoznata diljem Europe
- velika mogućnost zapošljavanja nakon završetka sveučilišnih studija.

Istraživačka djelatnost Fakulteta strojarstva i brodogradnje vrlo je opsežna, a ostvaruje se putem nacionalnih i međunarodnih znanstveno-istraživačkih i stručnih projekata te projekata s gospodarstvom.

Na Studiju strojarstva obrazuju se stručnjaci za rad na razvoju, konstruiranju, gradnji, uporabi i održavanju postrojenja, strojeva, alata, uređaja i opreme te projektiraju i vođenju toplinskih, energetskih i proizvodnih procesa. Osim toga, stječu se znanja iz područja materijala, automatizacije, robotike, osiguranja kvalitete, mjerena te unapređenja proizvodnje i organizacije rada. Ovako široko područje obrazovanja i mogućnost prilagođavanja studija željama i ambicijama studenata osigurano je, uz temeljno obrazovanje struke, putem devet smjerova, 19 usmjerenja i nizom izbornih kolegija.

Na Studiju brodogradnje školju se stručnjaci za rad i poslove osnivanja i konstrukcije broda, tehnologije gradnje i organizacije u brodogradilištima te eksperti klasifikacije i nadzora, gradnje broda, upravljanja, održavanja i iskorištavanja broda, studijskih i modelskih ispitivanja, u konzultantskim organizacijama, državnim nadzornim ustanovama, i to za sve tipove i veličine brodova i pomorskih objekata.

Na Studiju zrakoplovstva studiraju budući stručnjaci za rad i poslove održavanja konstrukcije i opreme zrakoplova i helikoptera kao i za njihove modifikacije, projektiranje i dokumentaciju, koji se provode u državnim agencijama i ustanovama. Na temeljna tehnička znanja strojarske struke nadograđuju se specijalistička znanja iz područja konstrukcije, pogona, aerodinamike, mehanike leta i upravljanja te projektiranja letjelica, iz područja opreme i uređaja zrakoplova kao i područja tehnologije i organizacije gradnje i održavanja zrakoplova.

#### Smjerovi Studija strojarstva (s usmjerenjima):

- konstrukcijski (dizajn medicinskih konstrukcija, konstruiranje i razvoj proizvoda, mehanizmi i roboti, motori i vozila)
- procesno-energetski (termotehnika, procesna tehnika, energetika)
- proizvodno inženjerstvo (automatika u proizvodnji, obradni sustavi, osiguranje kvalitete, preradba i montaža, zavarene konstrukcije)
- brodostrojarski
- inženjersko modeliranje i računalne simulacije
- računalno inženjerstvo (inteligentni montažni sustavi, proizvodnja polimernih tvorevin, računalno modeliranje alata i

- international student exchange programmes
- student training programmes in Croatian companies and abroad
- a diploma recognized throughout Europe
- employability upon graduation.

The researchers of the Faculty undertake comprehensive research in national and international research projects and projects carried out in collaboration with industry.

Students studying mechanical engineering are trained and prepared for a range of careers in the fields of design, construction, operation and maintenance of plants, machines, tools, devices and equipment, as well as design and management of thermal, energy conversion and production processes. They also acquire specialized knowledge of materials, automation, robotics, quality assurance, measurement, and production and work organization development. This comprehensive education and the freedom students have to pursue their interests and fulfil their ambitions are provided first in the courses teaching the fundamentals of mechanical engineering and then by the courses taught in nine specializations, 19 sub-specializations and a number of elective courses.

Students of naval architecture are trained for careers related to ship design, ship structures, ship production engineering and organization of shipbuilding process, for careers in the area of ship classification and survey, in shipbuilding, ship management, maintenance and service, model testing, as well as for jobs in consulting companies and inspection authorities related to all types and sizes of vessels and offshore structures.

Students of aeronautical engineering acquire in the first semesters the basic knowledge in mechanical engineering which is followed by teaching the specialized knowledge in the fields of structures, propulsion, aerodynamics, flight mechanics and control as well as flight vehicle design, equipment and devices, aircraft manufacturing technology and organization, and aircraft maintenance. They are trained for careers in the field of maintenance of aircraft and helicopter structures and equipment as well as their modification and design, and for the preparation of documentation issued by government agencies and institutions.

Specializations and sub-specializations in the mechanical engineering course are:

- Design (Medical Design, Product Design and Development, Mechanisms and Robots, IC Engines and Motor Vehicles)
- Process and Energy Engineering (Thermal Engineering, Process Engineering and Energy Engineering)
- Production Engineering (Production Automation, Machining Systems, Quality Assurance, Manufacture and Assembly, Welded Structures)

kalupa, računalno vođenje sustava, računalom integrirani razvoj proizvoda, suvremeni obradni sustavi i procesi, upravljanje kvalitetom, ljevarstvo)

- industrijsko inženjerstvo i menadžment
- inženjerstvo materijala
- mehatronika i robotika.

Studiji brodogradnje i zrakoplovstva nemaju smjerove.

### **Preddiplomski studij**

Sveučilišni preddiplomski studiji Fakulteta strojarstva i brodogradnje su:

- Studij strojarstva – 210 ECTS bodova, trajanje sedam (7) semestra, titula: sveučilišni prvostupnik/prvostupnica (baccalaureus/baccalaurea) inženjer/inženjerka strojarstva.
- Studij brodogradnje – 210 ECTS bodova, trajanje sedam (7) semestra, titula: sveučilišni prvostupnik/prvostupnica (baccalaureus/baccalaurea) inženjer/inženjerka brodogradnje.
- Studij zrakoplovstva – 210 ECTS bodova, trajanje sedam (7) semestra, titula: sveučilišni prvostupnik/prvostupnica (baccalaureus/baccalaurea) inženjer/inženjerka zrakoplovnog inženjerstva.

### **Diplomski studij**

Sveučilišni diplomski studiji Fakulteta strojarstva i brodogradnje su:

- Studij strojarstva – 90 ECTS bodova, trajanje tri (3) semestra, titula: magistar/magistra inženjer/inženjerka strojarstva.
- Studij brodogradnje – 90 ECTS bodova, trajanje tri (3) semestra, titula: magistar/magistra inženjer/inženjerka brodogradnje.
- Studij zrakoplovstva – 90 ECTS bodova, trajanje tri (3) semestra, titula: magistar/magistra inženjer/inženjerka zrakoplovnog inženjerstva.

Smjerovi studija strojarstva su isti kao i na preddiplomskom studiju.

### **Poslijediplomski studij**

#### ***Poslijediplomski doktorski studij***

Sveučilišni poslijediplomski studiji na Fakultetu strojarstva i brodogradnje ustrojeni su na principima Bolonjske deklaracije te stoga podrazumijevaju i mobilnost studenata i nastavnika. Vrednovanje uspješnosti polaznika temelji se na ECTS sustavu, što je preduvjet za studentsku mobilnost.

Na poslijediplomskom doktorskom studiju stječe se akademski stupanj doktora znanosti. U skladu s Pravilnikom o utvrđivanju znanstvenih područja („Narodne novine“, br. 118/09) doktorski studij Strojarstvo, brodogradnja, zrakoplovstvo, metalurgija pripada znanstvenom području tehničke znanosti. Na studiju su pokrivena sljedeća polja područja tehničkih znanosti u skladu s Pravilnikom o doktorskom studiju:

- Marine Engineering
- Engineering Modelling and Computer Simulation
- Computer Engineering (Intelligent Assembly Systems, Polymer Product Manufacture, Computer Modelling of Tools and Dies, Computer-Based System Management, Computer-Integrated Product Development, Modern Machining Systems and Processes, Quality Management, Foundry)
- Industrial Engineering and Management
- Materials Engineering
- Mechatronics and Robotics.

There are no specializations in the naval architecture and the aeronautical engineering courses.

### **Undergraduate studies**

The undergraduate studies of the Faculty are:

- the Mechanical Engineering course – seven semesters long, the undergraduate degree equates to 210 ECTS credits, the academic title awarded is BEng (mechanical engineering)
- the Naval Architecture course – seven semesters long, the undergraduate degree equates to 210 ECTS credits, the academic title awarded is BEng (naval architecture)
- the Aeronautical Engineering course – seven semesters long, the undergraduate degree equates to 210 ECTS credits, the academic title awarded is BEng (aeronautical engineering)

### **Graduate studies**

The graduate studies of the Faculty are:

- the Mechanical Engineering course – three semesters long, the graduate degree equates to 90 ECTS credits, the academic title awarded is MEng (mechanical engineering)
- the Naval Architecture course – three semesters long, the graduate degree equates to 90 ECTS credits, the academic title awarded is MEng (naval architecture)
- the Aeronautical Engineering course – three semesters long, the graduate degree equates to 90 ECTS credits, the academic title awarded is MEng (aeronautical engineering).

The graduate study in mechanical engineering has the same specializations as the undergraduate study programme.

### **Postgraduate studies**

#### ***Postgraduate doctoral study***

The postgraduate studies are based on the principles of the Bologna Declaration implying staff and student mobility. The assessment of postgraduate students' performance is based on the European Credit Transfer System (ECTS), which is an eligibility requirement for the participation in the student mobility programmes.

strojarstvo, brodogradnja, zrakoplovstvo, raketna i svemirska tehnika, temeljne tehničke znanosti i metalurgija.

Nastava doktorskog studija izvodi se po smjerovima:

- Industrijsko inženjerstvo i menadžment
- Inženjerstvo materijala
- Mehatronika i robotika
- Napredne proizvodne tehnologije
- Numerička mehanika
- Procesno-energetski smjer
- Teorija konstrukcija
- Znanstveno mjeriteljstvo u strojarstvu
- Brodogradnja i pomorska tehnika
- Zrakoplovno inženjerstvo
- Metalurško inženjerstvo.

Daljnje informacije potražite na [doktorski.fsb.hr](http://doktorski.fsb.hr).

#### ***Poslijediplomski specijalistički studij***

Stjecanje zvanja specijalista moguće je iz sljedećih područja:

- industrijskog inženjerstva i menadžmenta
- inženjerstva materijala
- mehaničkog proračuna konstrukcija
- montaže i pakiranja
- naprednih proizvodnih tehnologija
- polimerijskog inženjerstva
- pomorskih konstrukcija
- upravljanja cjeloživotnim ciklusom proizvoda.

Student odabire specijalističko područje prilikom upisa na studij. Studij traje jednu akademsku godinu (2 semestra) s ukupno 210 sati nastave.

Od 1924. godine na Fakultetu strojarstva i brodogradnje Sveučilišta u Zagrebu promovirano je:

- |                             |       |
|-----------------------------|-------|
| • diplomiranih inženjera    | 11851 |
| • magistra inženjera        | 1648  |
| • prvostupnika              | 2199  |
| • magistra znanosti         | 913   |
| • doktora znanosti          | 508   |
| • sveučilišnih specijalista | 26    |

Web adresa: [www.fsb.unizg.hr](http://www.fsb.unizg.hr)

PhD is the academic title awarded by the University of Zagreb upon completion of the doctoral degree. In line with the Regulation on Fields of Science Definition („Official Gazette“, 118/09) the doctoral studies in mechanical engineering, naval architecture, aeronautical engineering and metallurgy belong to the field of engineering sciences. Based on the Ordinance for doctoral studies, the postgraduate doctoral studies of the Faculty are related to the scientific fields of mechanical engineering, naval architecture, aeronautical engineering, rocket and aerospace engineering, fundamental engineering sciences and metallurgy.

The Faculty offers the following doctoral programmes:

- Industrial Engineering and Management
- Materials Engineering
- Mechatronics and Robotics
- Advanced Manufacturing Technologies
- Computational Mechanics
- Process and Energy Engineering
- Design Theory
- Measurement in Mechanical Engineering
- Naval Architecture and Offshore Engineering
- Aeronautical Engineering
- Metallurgical Engineering

Additional information is available online at [doktorski.fsb.hr](http://doktorski.fsb.hr).

#### ***Postgraduate professional study***

The postgraduate professional study lasts one year (two semesters) with an annual total of 210 hours. Upon completion of the study students are awarded a specialist degree.

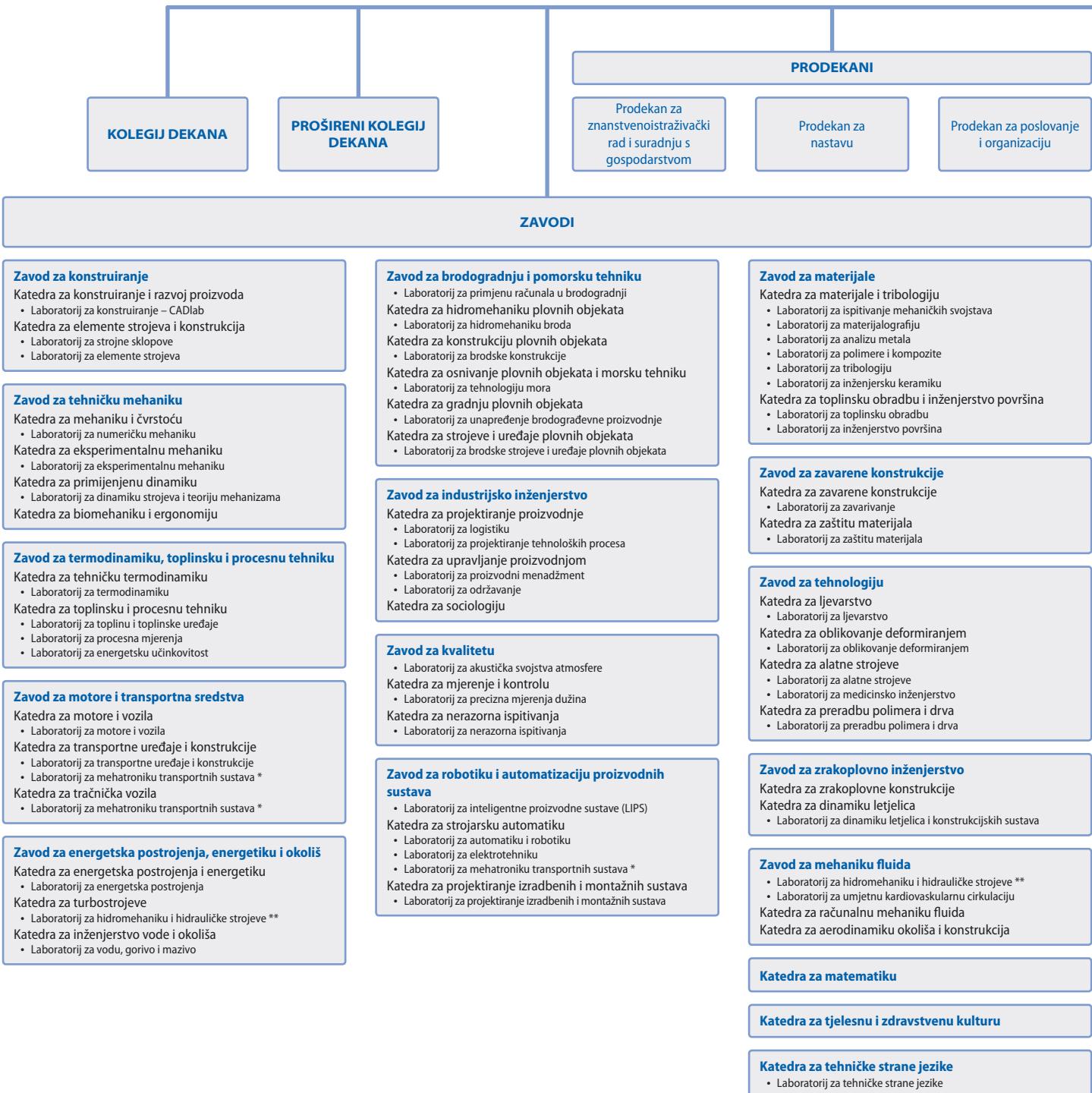
The Faculty offers the following postgraduate professional study programmes:

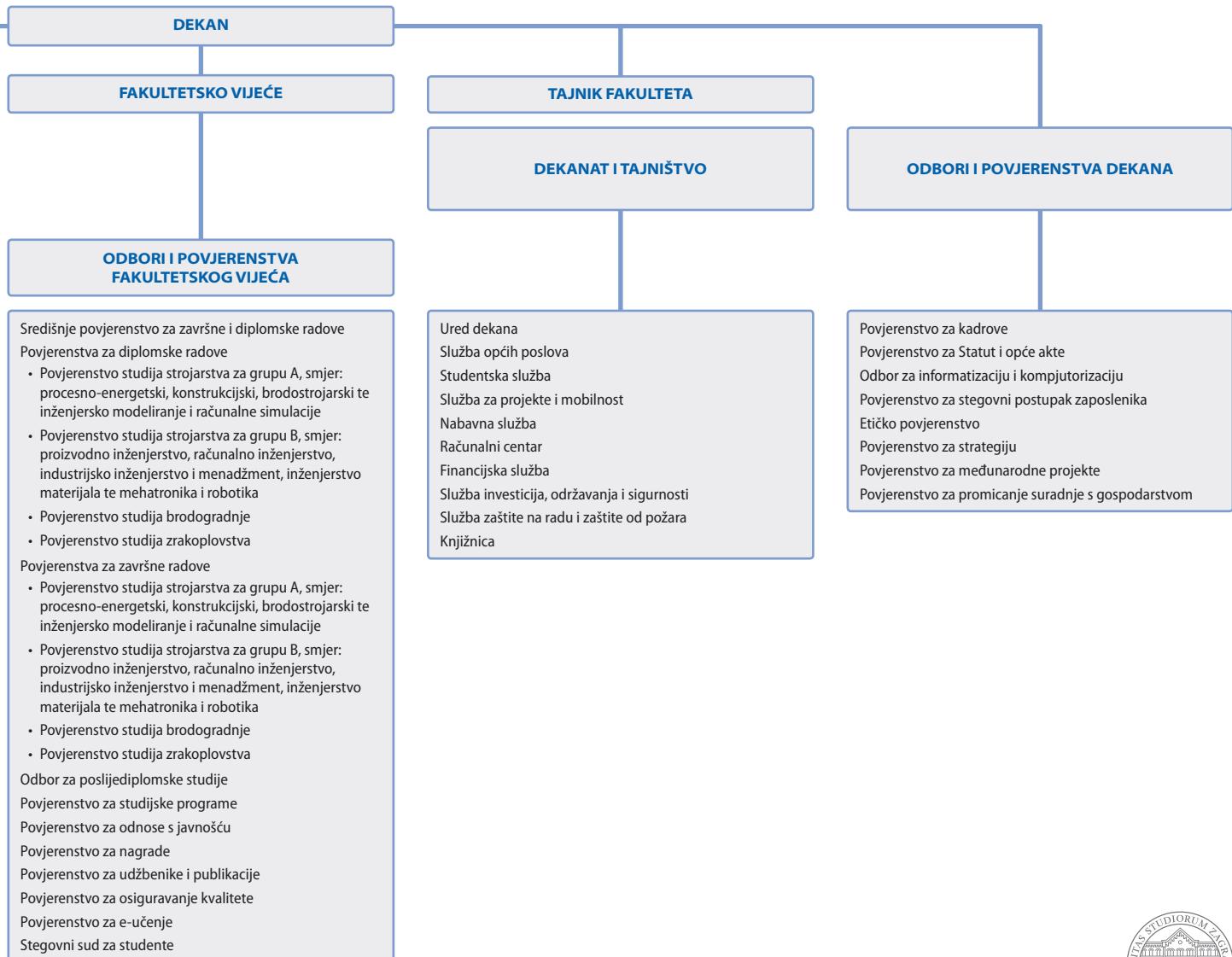
- Industrial Engineering and Management
- Materials Engineering
- Structural analysis and design
- Assembly and Packaging
- Advanced Manufacturing Technologies
- Polymer Engineering
- Offshore Structures
- Product Lifecycle Management

Since 1924 The Faculty of Mechanical Engineering and Naval Architecture has awarded

- 11851 graduate engineer degrees
- 1648 master's degrees
- 2199 bachelor's degrees
- 913 master-of-science degrees
- 508 PhD degrees
- 26 university specialist degrees

Website: [www.fsb.unizg.hr](http://www.fsb.unizg.hr)



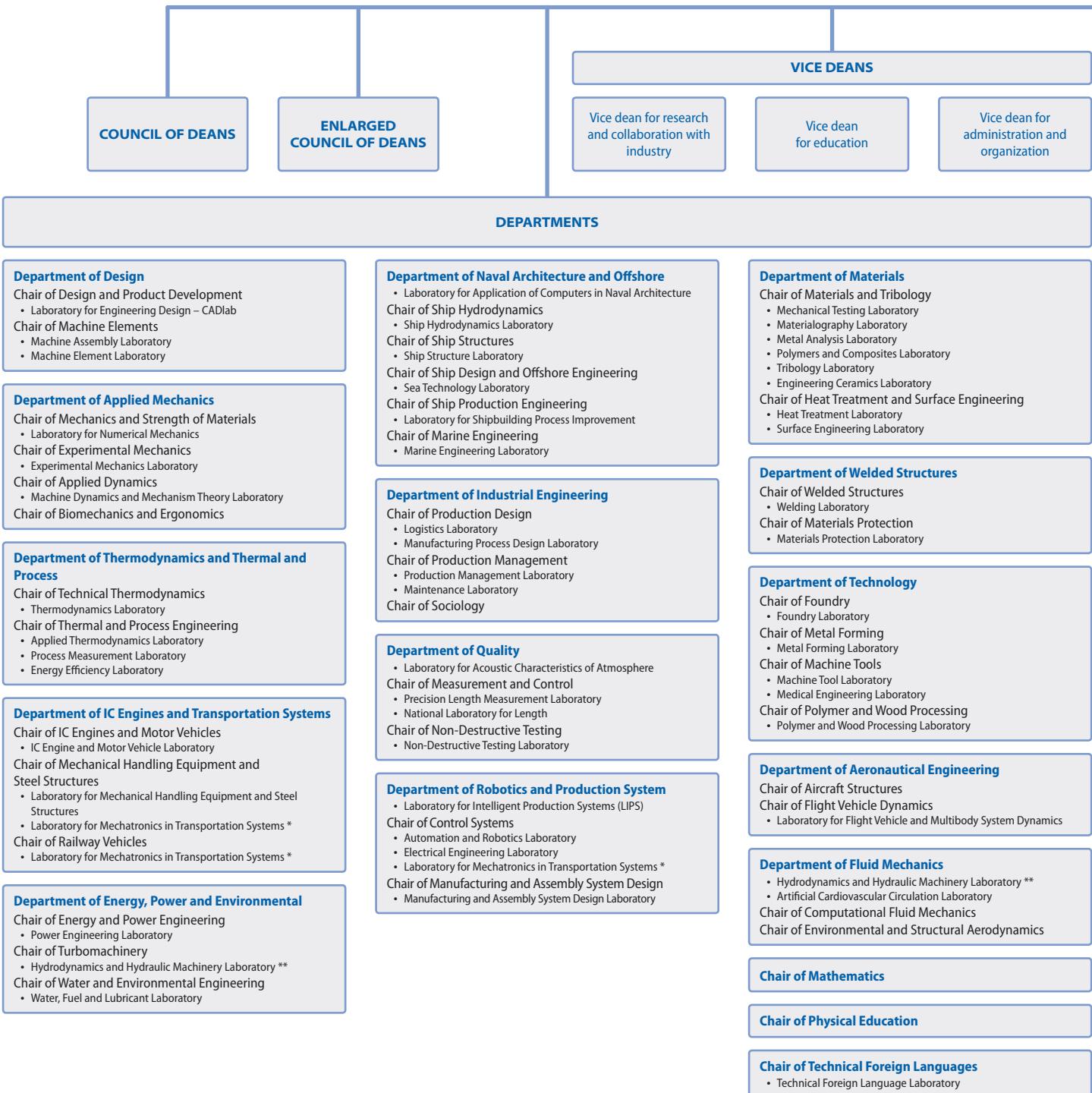


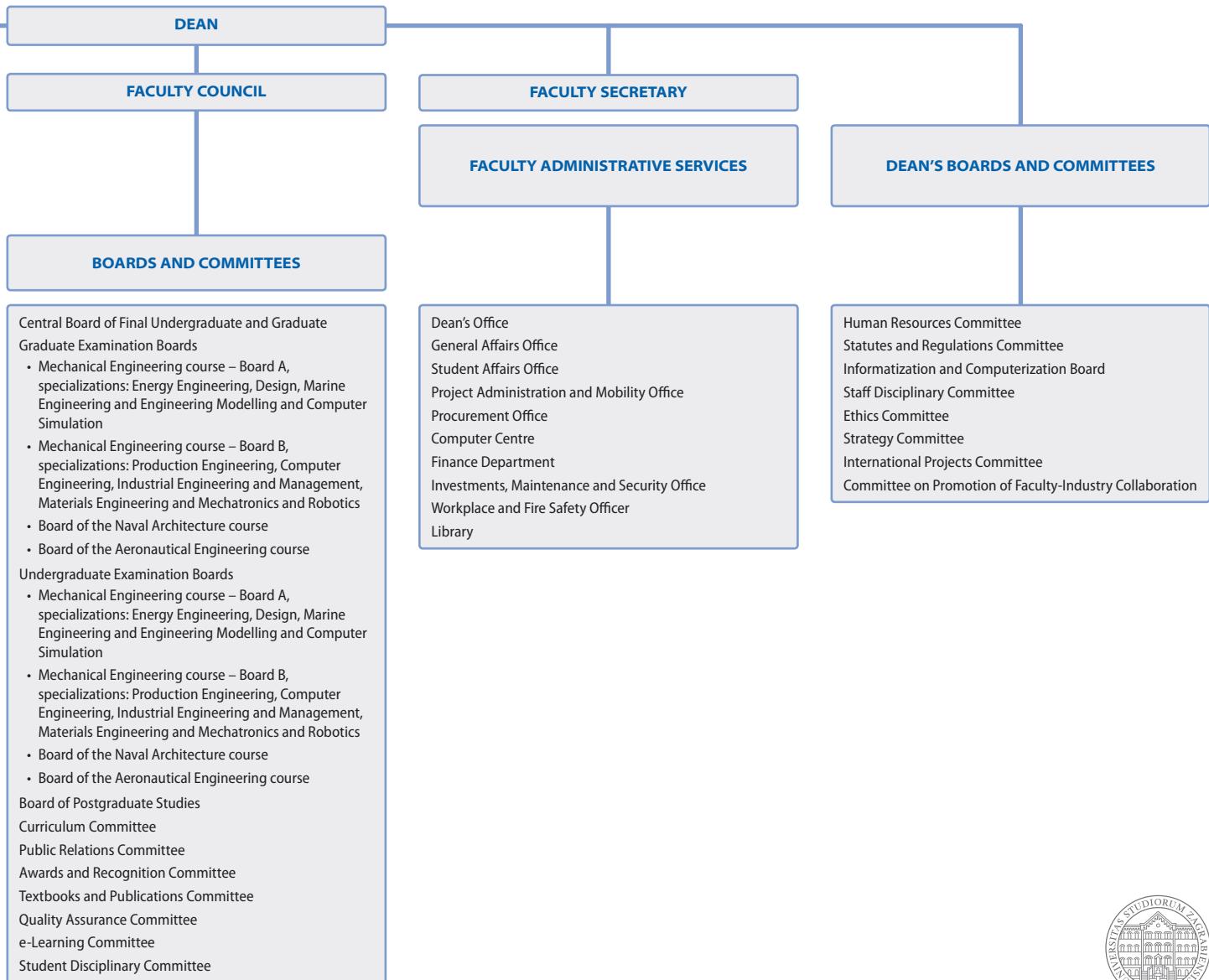
#### Napomena:

- \* Laboratorij za mehatroniku transportnih sustava dijeli Zavod za robotiku i automatizaciju proizvodnih sustava i Zavod za motore i transportna sredstva te sljedeće katedre u okviru navedenih Zavoda: Katedra za strojarsku automatiku, Katedra za transportne uređaje i konstrukcije te Katedra za tračnička i lebdeća pružna vozila
- \*\* Laboratorij za hidromehaniku i hidrauličke strojeve dijeli Zavod za energetska postrojenja, energetiku i okoliš, Katedra za turbostrojeve i Zavod za mehaniku fluida



Organizacijska struktura  
Fakulteta strojarstva i brodogradnje  
Sveučilišta u Zagrebu



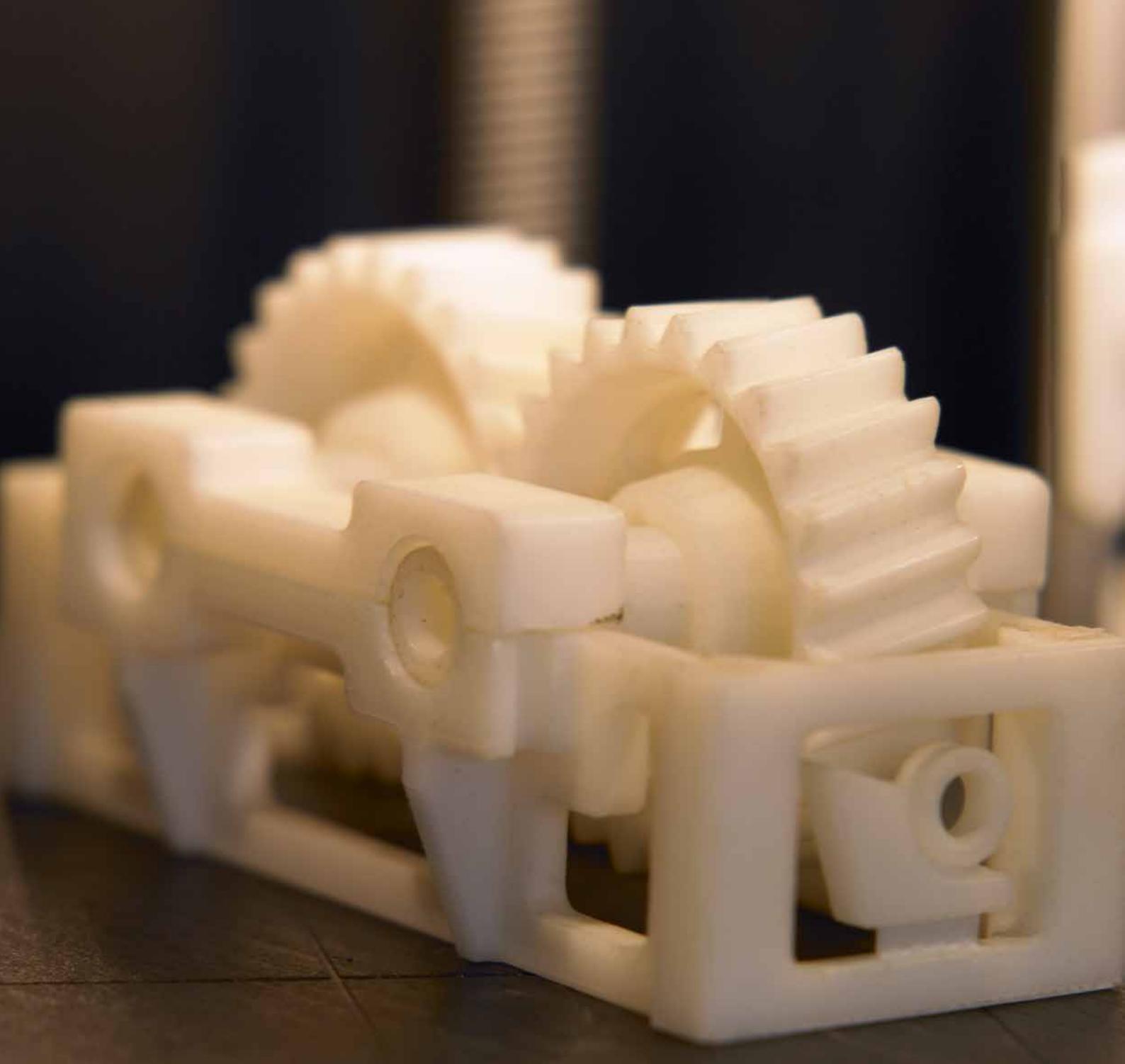


**Note:**

- \* The Laboratory for Mechatronics in Transportation Systems is a joint laboratory including the Department of Robotics and Production System Automation and the Department of IC engines and Transportation Systems as well as the following chairs: the Chair of Control Systems, the Chair of Mechanical Handling Equipment and the Chair of Railway Vehicles.
- \*\* The Hydrodynamics and Hydraulic Machinery Laboratory is a joint laboratory including the Department of Energy, Power and Environmental Engineering, the Chair of Turbomachinery and the Department of Fluid Mechanics



Organizational chart of the  
Faculty of Mechanical Engineering and  
Naval Architecture, University of Zagreb



## Zavod za konstruiranje

Zavod za konstruiranje utemeljen je 1919. godine te od tada kontinuirano podržava edukaciju studenata, istraživanja i industriju. Zavod je nositelj nastave konstrukcijskog smjera na preddiplomskom, diplomskom i doktorskom studiju.

Znanja temeljnih kolegija Zavoda studenti primjenjuju u području elemenata strojeva i konstrukcija gdje proučavaju izvedbe, namjenu i posebnosti proračuna i odabira strojnih dijelova. U višim semestrima preddiplomskog kao i na diplomskom studiju, u okviru specijalističkih i izbornih kolegija, težište nastave je na integraciji stecenih znanja putem kolegija s tematikom razvoja proizvoda i konstruiranja podržanog računalima, a teme završnih i diplomskega radova su mahom realni problemi iz gospodarstva.

Zavod aktivno surađuje sa sličnim zavodima sveučilišta u: Bathu, Bratislavi, Cambridgeu, Mariboru, Ljubljani, Sarajevu, Ecole Centrale Paris, TU Denmark, TU Munich, TU Lulea i Stevens Institute of Technology SAD te sa stručnjacima iz industrije i drugih disciplina.

### Katedra za elemente strojeva i konstrukcija

Kolegiji Katedre usmjereni su na oblikovanje, tehnologičnost te proračun strojnih komponenti i sklopova. Izradom manje složenih projekata studenti se upoznaju s problematikom konstrukcijskog oblikovanja strojnih sklopova. U sastavu Katedre su Laboratorij za elemente strojeva i Laboratorij za strojne sklopove u kojima se izvodi praktična nastava te laboratorijske vježbe.



## Department of Design

Since it was founded in 1919, the Department of Design has always been concerned with the education of students, research and industry. The Department focuses on the Design specializations at undergraduate, graduate and postgraduate studies.

Knowledge gained in basic courses is applied to the field of machine elements where performance, purpose, calculation and selection of machine components are studied. The focus of teaching at undergraduate and graduate studies, within specialized and elective courses, is on the integration of previously acquired knowledge through courses of product development and computer aided design. Real problems from industry are usually subjects of undergraduate and Master's theses.

The Department actively collaborates with similar departments at the faculties in: Bath, Bratislava, Cambridge, Maribor, Ljubljana, Sarajevo, Ecole Centrale Paris, TU Denmark, TU Munich, TU Lulea and Stevens Institute of Technology USA and with experts from industries and other disciplines.

### Chair of Machine Elements

The Chair's courses are directed towards forming, technologicality and calculation of machine elements and assemblies. By carrying out less complex projects students are introduced to the problem of machine assemblies design. The Chair comprises two laboratories: Machine Element Laboratory and Machine Assembly Laboratory. The laboratories are responsible for conducting practical and laboratory exercises.

The research focuses on the basic machine elements, their working methods and types of damage, with the aim to determine damaging mechanism, detect possible improvements and prolong life span. The acknowledged technology projects (Modular system for recycling of secondary raw materials, Development and manufacturing of prototype of measurement line for static torque, Solar dryer for fruits and vegetables with ultrasound preparation etc.) have successfully developed certain products.

Numerous supervisions and expertise have been realised in cooperation with industry, e.g. the revision of the main mechanical engineering project of the mobile roof of the Gruž swimming pools in Dubrovnik, the expertise of damage causes on the ski lift 'Crveni spust' on Zagreb's mountain Medvednica. The Machine Element Laboratory ([www.fsb.unizg.hr/elemstro](http://www.fsb.unizg.hr/elemstro)) is accredited for calibration of the force torque.

Istraživačka djelatnost fokusirana je na temeljne elemente strojnih sustava, izučavanje njihova načina rada i vrsta oštećenja, a s ciljem određivanja mehanizama oštećivanja, možebitnih poboljšanja te produljenja životnog vijeka. Istaknut je i rad na tehnologiskim projektima (Projekt modularnog sustava za recikliranje sekundarnih sirovina, Razvoj i izrada prototipa mjernog lanca za umjeravanje uređaja okretnog momenta, Solarna sušara voća i povrća s ultrazvučnom predobradom itd.) u okviru kojih su realizirani i neki konkretni proizvodi.

Suradnja s gospodarstvom odvija se u okviru projekata nadzora i vještačenja, npr.: Revizija i nadzor glavnoga strojarskog projekta pokretnoga krova bazena Gruž u Dubrovniku, Trosjedežnica 'Crveni spust' na Medvednici (ekspertiza oštećenja glavnoga pogona). Laboratorij za elemente strojeva ([www.fsb.unizg.hr/elemstroj](http://www.fsb.unizg.hr/elemstroj)) akreditiran je za umjerenavanje mjerila momenta sile.

### Katedra za konstruiranje i razvoj proizvoda

Razvoj konkurentnih i inovativnih proizvoda te optimizacija razvojnih procesa središnja su područja djelovanja Katedre.

U 3DEXPERIENCE CADLabu ([www.cadlab.fsb.hr](http://www.cadlab.fsb.hr)) studenti realiziraju projekte u kojima primjenjuju teorijska znanja metodologije razvoja proizvoda uz primjenu računalnih alata. Primarni cilj nastavnih aktivnosti je razvoj kreativnih i inovativnih potencijala studenata, uz razumijevanja cjelokupnoga životnog ciklusa proizvoda. Tijekom nastave u suradnji sa sveučilištima u Ujedinjenom Kraljevstvu, Mađarskoj i Sloveniji, multinacionalni timovi studenata razvijaju funkcionalni prototip proizvoda u suradnji s industrijskim partnerom ([www.city.ac.uk/egpr](http://www.city.ac.uk/egpr)).

Svrha istraživačkih aktivnosti je razvoj i prilagodba metoda i alata koji tvrtkama omogućuju učinkovit razvoj inovativnih proizvoda. Upravljanje inženjerskim znanjem u procesu razvoja proizvoda glavna je tema znanstvenoga rada Katedre. U istraživanjima koja su podržala domaća i međunarodna tijela (npr. [www.trenin.org](http://www.trenin.org), [www.visinev.org](http://www.visinev.org), [www.minmed.org](http://www.minmed.org)), razvijamo metode i alate za upravljanje znanjem i inovacijama u razvoju tehničkih sustava.

Centar za razvoj proizvoda ([www.crp.fsb.hr](http://www.crp.fsb.hr)), pokrenut je 2007. godine radi širenja znanja o novim metodama i alatima za unapređenje razvojnih procesa u tvrtkama te je uspješno suradnju s tvrtkama u regiji u području modularizacije, prilagodbe CAD i PLM sustava kao i u projektima inovativnog razvoja. Katedra je domaćin niza doktorandskih škola „PhD Summerschool on Engineering Design Research“. DESIGN konferencija ([www.designconference.org](http://www.designconference.org)) u organizaciji Katedre referentni je znanstveni događaj za područje razvoja proizvoda i konstruiranja.

### Chair of Design and Product Development

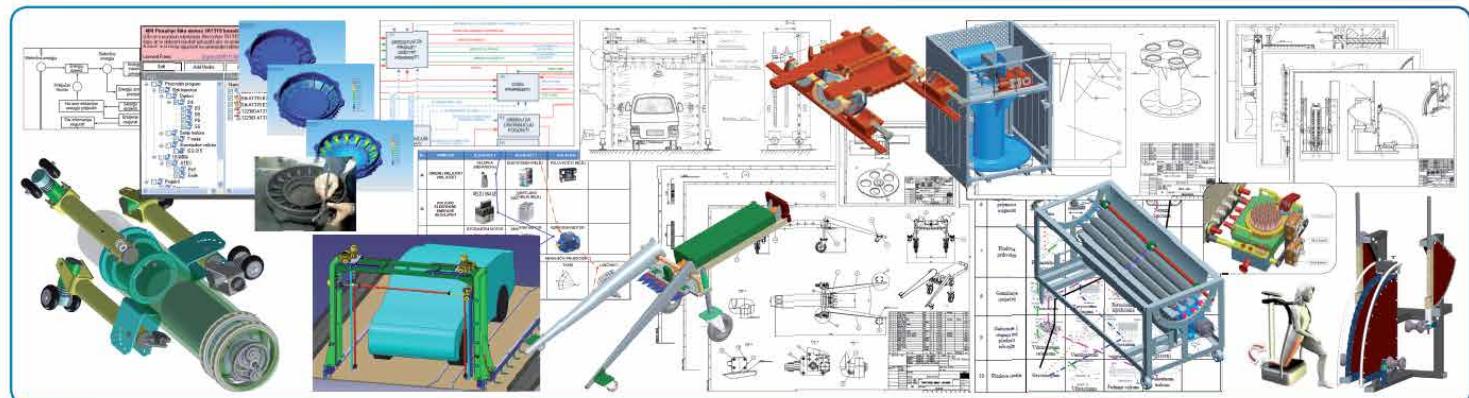
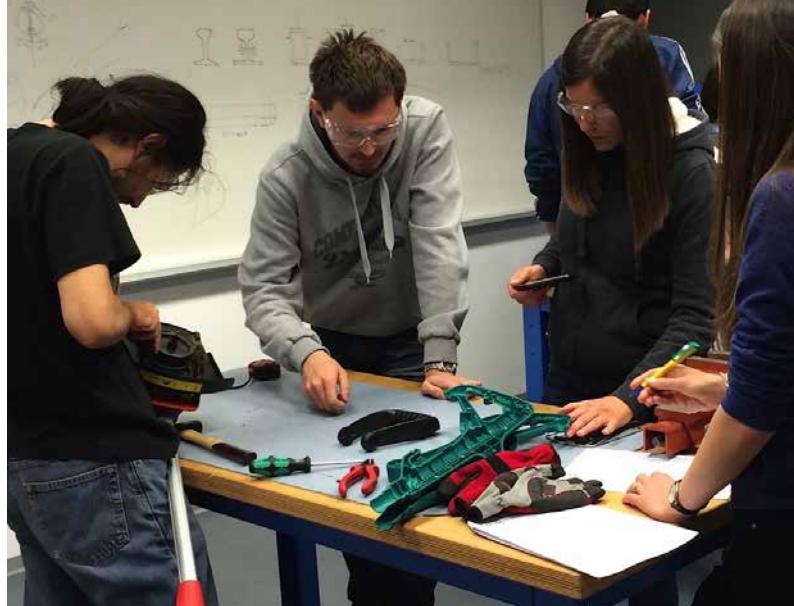
The primary goal of the Chair is developing competitive and innovative products and the optimisation of process development.

Students carry out projects in 3DEXPERIENCE CADLab ([www.cadlab.fsb.hr](http://www.cadlab.fsb.hr)) where they, with the software support, apply theoretical knowledge of product development methodologies. The primary goal of teaching is developing creative and innovative potentials of students with the understanding of the overall life cycle of the product. Multinational student teams develop a functional prototype of a product in cooperation with the universities in the United Kingdom, Hungary and Slovenia and an industrial partner ([www.city.ac.uk/egpr](http://www.city.ac.uk/egpr)).

The research at the Chair deals with the development and adaptation of methods and tools that enable companies to efficiently develop innovative products. The main topic of research is knowledge management in the product development process. Numerous methods and tools for knowledge and innovation management have been developed in researches that have been supported by Croatian and international bodies (e.g. [www.trenin.org](http://www.trenin.org), [www.visinev.org](http://www.visinev.org), [www.minmed.org](http://www.minmed.org)).

In 2007, the Chair started the project 'Centre for Product Development' ([www.crp.fsb.hr](http://www.crp.fsb.hr)) with the goal to spread the knowledge of new methods and tools for improving the development processes in companies in the region. The area of interest is modularization, adaptation of CAD and PLM systems as well as innovative development projects. The Chair has organised a series of postgraduate summer schools under the title 'Engineering Design Research' as well as DESIGN conference ([www.designconference.org](http://www.designconference.org)) which is the reference scientific event for the field of product development and design.







## Zavod za tehničku mehaniku

Zavod održava visokoškolsku nastavu iz temeljnih kolegija na prvoj, drugoj i trećoj godini prediplomskih studija strojarstva, brodogradnje i zrakoplovstva kao i na diplomskom te poslijediplomskom specijalističkom i doktorskom studiju. Tu se razumijevaju kolegiji kao što su: Mechanika I, II i III, Nauka o čvrstoći I i II, Mechanika konstrukcija, Teorija mehanizama, Teorija vibracija, Eksperimentalna mehanika, Metoda konačnih elemenata i Biomehanika. U Zavodu se odvija i intenzivan znanstvenoistraživački rad te suradnja s gospodarstvom. Rezultati istraživanja primjenjuju se na konstrukcije, strojeve i mehanizme. Pri tome se rabe analitičke, numeričke i eksperimentalne metode.

Istraživačka djelatnost Katedre za mehaniku i čvrstoću provodi se u okviru Laboratorija za numeričku mehaniku. Razvijaju se numerički algoritmi za nelinearnu analizu konstrukcija. Tako npr. razvijeni su originalni integracijski postupci za rješavanje problema izotropne i anizotropne plastičnosti uz pretpostavku velikih i malih deformacija. Također, provode se istraživanja i u području numeričkog modeliranja procesa deformiranja bioloških tkiva. Namjera je razviti konstitutivne modele za krvne žile i koštana tkiva. Razvijaju se algoritmi, uglavnom primjenom metode konačnih elemenata, kojima se povezuje analiza na nanorazini s razmatranjima na razini mehanike kontinuma. Zadnjih nekoliko godina počela se razvijati nova numerička bezmrežna metoda. Isto tako, provode se istraživanja na području mehanike loma polimernih materijala te na području modeliranja oštećenja u koštanim tkivima. Na Katedri se kontinuirano njeguje i primjena analitičkih metoda u postavljanju matematičkih modela i rješavanju problema u području teorije plastičnosti, mehanike loma te puzanja i zamora materijala i elemenata konstrukcija. Stručna djelatnost odnosi se na rješavanje visokostručnih problema čvrstoće i stabilnosti konstrukcija za potrebe gospodarstva.

Znanstvenoistraživačka djelatnost Katedre za eksperimentalnu mehaniku usmjerenja je prema razvoju eksperimentalnih metoda u mehaniči deformabilnih tijela, mehaniči oštećenja i mehaniči loma. U Laboratoriju za eksperimentalnu mehaniku, upotreboru odgovarajuće opreme, primjenjuju se, uz klasične metode tenzometrije i fotoelasticimetrije, još i metode kaustike, 3D skeniranja, stereofotogrametrije itd. Primjena rezultata istraživačkog rada vidljiva je u sklopu više stručnih projekata suradnjom s gospodarstvom te u mehaničkom ispitivanju komponenta konstrukcija.

Katedra za primjenjenu dinamiku bavi se istraživanjem nelinearnih problema dinamike, pasivnom i aktivnom regulacijom vibracija, optimizacijom vibracijskih sustava i izolacijom vibracija. S tim ciljevima razvijaju se numerički algoritmi, utemeljeni na optimalnom i robusnom

## Department of Applied Mechanics

The Department teaches basic courses on undergraduate studies (at the first, second and third year of mechanical engineering, naval architecture and aeronautical engineering), as well as on graduate and postgraduate specialized and doctoral studies. The basic courses are: Mechanics I, II and III, Strength of materials I and II, Structural mechanics, Mechanism theory, Vibration theory, Experimental mechanics, Finite element method and Biomechanics. The Department conducts researches and collaborates with industry. The research results are applied to machine elements and mechanisms, whereby analytical, numerical and experimental methods are used.

The Chair of Mechanics and Strength of Materials carries out researches in the Laboratory for Numerical Mechanics. They include the development of numerical algorithms for the nonlinear analysis of structures. Original integration procedures for solving problems of isotropic and anisotropic plasticity under consideration of great and small deformations have been developed. Furthermore, investigations are carried out in the field of numerical modelling of the process of biological tissue deformation. The aim is to develop constitutive models of blood vessels and bone tissues. Algorithms are developed by linking the analyses at the nanolevel with the considerations of continuum mechanics, where mostly the finite element method is applied. A new meshless numerical method has been developed in recent years. In addition, investigations in the field of fracture mechanics of polymeric materials and of modelling damage in bone tissue are conducted. The Chair continuously applies analytical methods in setting mathematical models and solving problems in the field of plasticity theory, fracture mechanics, cracking and fatigue of materials and machine elements. The professional activities include solving complex problems of the strength and stability of the construction for industrial needs.

The research at the Chair of Experimental Mechanics deals with the development of experimental methods in the deformable body mechanics, damage mechanics and fracture mechanics. In the Experimental Mechanics Laboratory, besides the conventional method of tensometry, the optical experimental methods of photoelasticimetry, caustics, 3D-scanning and stereo photogrammetry are applied. The research results are applied in projects run in collaboration with industry in the area of design and mechanical testing of components of structures.

The research at the Chair of Applied Dynamics deals with the problems of dynamics, passive and active regulation of vibrations, optimisation of vibration systems and vibration isolation. Along with the set goals, numerical algorithms based on optimal and robust management, methods for convex optimisation and model order reduction are developed. These re-

upravljanju, metodama konveksne optimizacije, redukcijom reda modela sustava. Ova istraživanja provode se putem nacionalnih i međunarodnih znanstvenih projekata te suradnjom s gospodarstvom.

Katedra za biomehaniku i ergonomiju bavi se istraživanjima u području biomehanike i ergonomije koja obuhvaćaju: analize, simulacije i optimiranje gibanja čovjeka, analize opterećenja mišićno-koštanog sustava, modeliranje, analize i simulacije u dentalnoj biomehanici, razvoj i konstruiranje medicinskih konstrukcija te primjenu ergonomskih načela i razvoj metoda radi integriranja ergonomskih kriterija u razvoj proizvoda i konstruiranje općenito.

#### Katedre

- Katedra za mehaniku i čvrstoću
- Katedra za eksperimentalnu mehaniku
- Katedra za primjenjenu dinamiku
- Katedra za biomehaniku i ergonomiju

#### Laboratorijski

- Laboratorij za numeričku mehaniku
- Laboratorij za eksperimentalnu mehaniku
- Laboratorij za dinamiku strojeva i teoriju mehanizama

searches are conducted through national and international scientific projects and collaboration with industry.

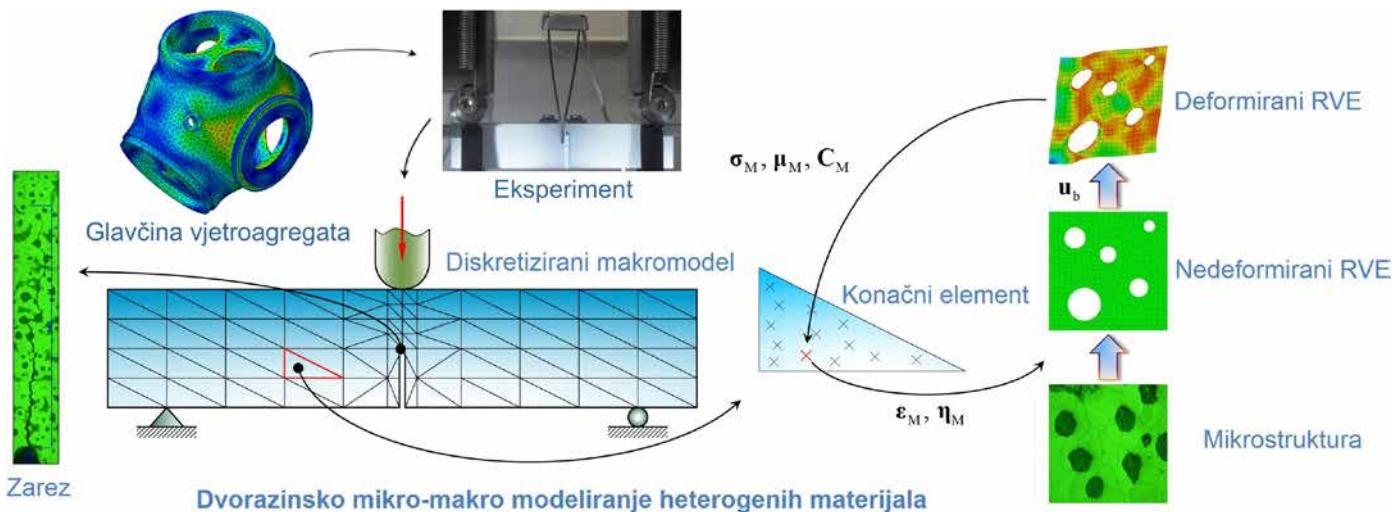
The Chair of Biomechanics and Ergonomics conducts research in the field of biomechanics and ergonomics and include: analysis, simulation and optimisation of human motion, analysis of load on the human musculoskeletal system, modelling, analysis and simulation in dental biomechanics, development of medical design and the application of ergonomic principles and methods development in order to integrate ergonomic criteria in the product development and design in general.

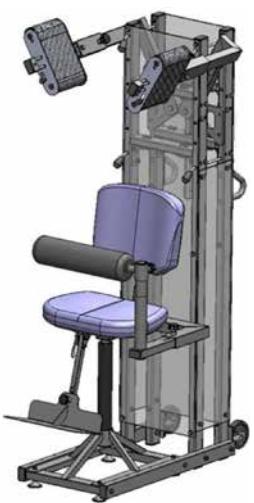
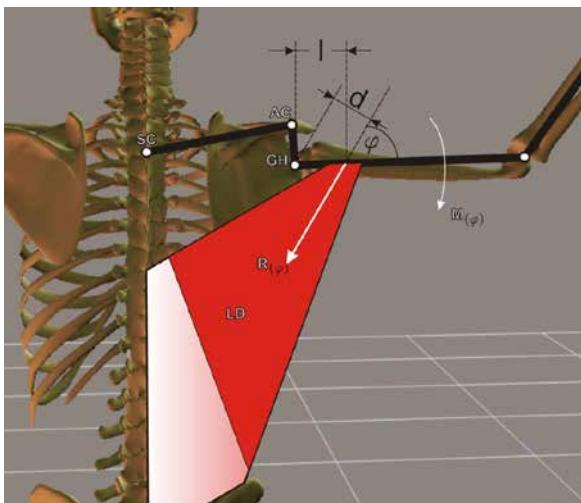
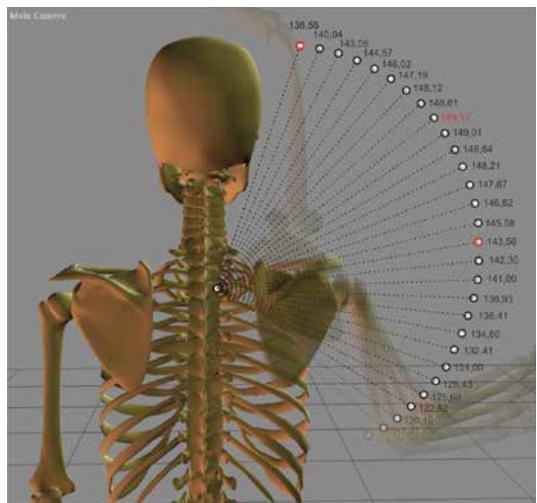
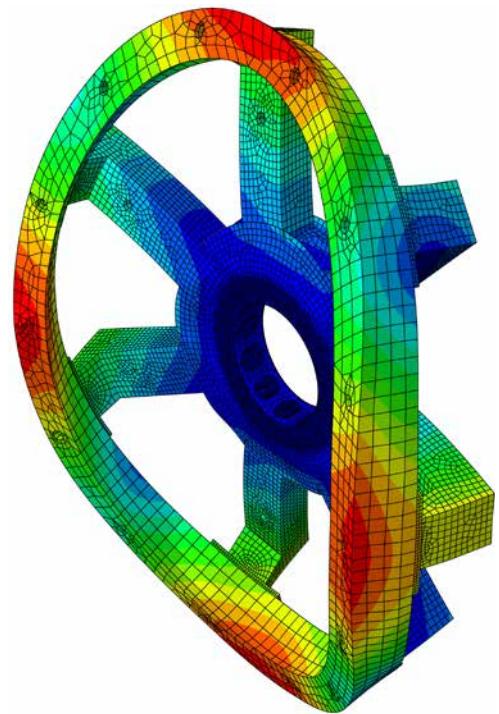
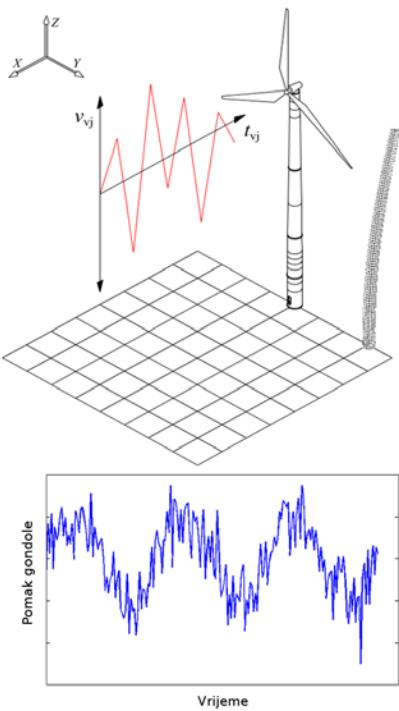
#### Chairs

- Chair of Mechanics and Strength of Materials
- Chair of Experimental Mechanics
- Chair of Applied Dynamics
- Chair of Biomechanics and Ergonomics

#### Laboratories

- Laboratory for Numerical Mechanics
- Experimental Mechanics Laboratory
- Machine Dynamics and Mechanism Theory Laboratory







## Zavod za termodinamiku, toplinsku i procesnu tehniku

Zavod za termodinamiku, toplinsku i procesnu tehniku sastoji se od dvije katedre i četiri laboratorija: Katedre za tehničku termodinamiku i Katedre za toplinsku i procesnu tehniku te Laboratorija za termodinamiku, Laboratorija za procesna mjerena, Laboratorija za toplinu i toplinske uređaje i Laboratorija za energetsku učinkovitost.

Web adresa: [fsb.unizg.hr/ztermo](http://fsb.unizg.hr/ztermo).

Nastavni su sadržaji pretežno na širokom području teorijske i primijenjene termodinamike, što obuhvaća termotehničke sustave grijanja, klimatizacije i ventilacije, dizalice topline, toplinske i mehaničke operacije, gradnju toplinskih aparata, kompresore i vakuumsku tehniku, obnovljive izvore energije, toplinska i procesna mjerena te primjenjene računalne metode. Uz predavanja i vježbe, nastava se odvija i u obliku izradbe konstrukcijskih radova – projekata i laboratorijskih vježbi.

Znanstveni rad Zavoda posvećen je temama racionalne upotrebe energije, obnovljivim izvorima energije, metrologiji procesnih veličina, pametnim zgradama i pametnim mrežama. Aktivni istraživački i tehnologiski projekti svojim naslovima dovoljno govore o svojoj aktualnosti i sadržaju:

- Energijska analiza u procesima izgaranja i otplinjavanja drvne biomase.
- Dizalice topline s korištenjem tla kao obnovljivoga toplinskog spremnika.
- Racionalno gospodarenje energijom optimiranjem sustava grijanja, ventilacije i klimatizacije.
- Izmjena topline i mase u fluidiziranom sloju.
- Toplinski aparati i uređaji za obnovljive izvore energije – biomasa i Sunce.
- Razvoj nacionalnih etalona temperature, tlaka i vlažnosti.
- Međunarodne usporedbe na području mjerena procesnih veličina.
- Istraživanje i promocija plitkih geotermalnih potencijala.
- Modelsko prediktivno upravljanje sustavima u zgradama.
- Sudjelovanje zgrada na pametnim mrežama.
- Akumulacija rashladne i toplinske energije u zgradarstvu.

Stručna djelatnost obuhvaća izradbu idejnih rješenja i sustava, projektiranja, mjerena i ispitivanja te konstrukcije termotehničkih i procesnih uređaja pa do savjetodavnih usluga, organizacije seminara i drugih oblika obrazovanja.

Važan segment u nastavnom, znanstvenom i stručnom radu Zavoda jesu laboratorijski.

## Department of Thermodynamics and Thermal and Process Engineering

The Department of Thermodynamics and Thermal and Process Engineering comprises two chairs and four laboratories: Chair of Technical Thermodynamics and Chair of Thermal and Process Engineering, Thermodynamics Laboratory, Process Measurement Laboratory, Applied Thermodynamics Laboratory and Energy Efficiency Laboratory.

Website: [fsb.unizg.hr/ztermo](http://fsb.unizg.hr/ztermo)

The teaching covers a range of topics in the theoretical and applied thermodynamics, including heating, ventilating and air-conditioning systems, heat pumps, mechanical and thermal process engineering, design of thermal apparatuses, compressors and vacuum technology, renewable energy sources, thermal and process measurements, and applied computational methods. In addition to lectures and exercises, the teachers work with students in laboratories and on design projects.

The research at the Department is carried out mainly within scientific projects dealing with rational energy usage, renewable energy sources, process variable measurement, smart buildings and smart grids. The titles of the running research and technological projects reveal their content and relevance:

- Energy analysis in the processes of combustion and gasification of wood biomass
- Heat pumps using soil as renewable thermal storage
- Rational energy management by optimizing HVAC systems
- Heat and mass transfer in fluidized beds
- Thermal apparatuses for renewable energy sources – biomass and solar
- The development of the national temperature, pressure and humidity standards
- International intercomparisons in the field of process variable measurement
- Research and promotion of shallow geothermal resources
- Model-predictive control for building heating and cooling systems
- The integration of buildings in smart grids
- Thermal energy (heating/cooling) storage in buildings

The members of the Department provide expert services in several areas ranging from system conceptual design, engineering design, measurements and testing, and design of thermal and process devices to consulting, organizing seminars and other forms of training.

The Laboratories have a significant role in teaching, research and expert work of the Department.

Laboratorij za toplinu i toplinske uređaje putem svojih aktivnosti usredotočen je na ispitivanja termotehničkih uređaja kao što su toplovodni kotlovi, izmenjivači topline, klimakomore, radijatori, solarni kolektori i dr.

Također, aktivnosti laboratorija obuhvaćaju i mjerena mikroklimatskih parametara te funkcionalna ispitivanja sustava grijanja i klimatizacije u stambenim, poslovnim i industrijskim objektima. Laboratorij je akreditiran prema HRN EN ISO/IEC 17025 za obavljanje sljedećih poslova: ispitivanje grijalica prostora i štednjaka, ispitivanje sustava klimatizacije i mikroklima, umjeravanje osjetnika temperature.

Posebna djelatnost laboratorija odvija se na području infracrvene termografije za potrebe znanstvenoistraživačkih projekata, energetske certifikacije zgrada i industrijskih postrojenja.

Laboratorij za procesna mjerjenja djeluje na području mjeriteljstva toplinskih i procesnih veličina (temperatura, tlak, protok, vlažnost, toplinska svojstva tvari). Temeljni zadatak laboratorija jest ostvarenje navedenih mjernih jedinica znanstvenim metodama te osiguranje sljedivosti prema međunarodnim etalonima SI sustava. Oprema kojom raspolaže laboratorij omogućuje postizanje mjeriteljskih sposobnosti laboratorija navedenih u bazi podataka o ključnim usporedbama Međunarodnog ureda za utege i mjere (BIPM). Laboratorij je akreditiran prema ISO/IEC 17025 međunarodnoj normi za temperaturu, tlak i vlažnost.

Laboratorij za termodinamiku novijeg je datuma i osnovan je s temeljnom zadaćom provođenja fundamentalnih laboratorijskih ispitivanja u području tehničke termodinamike s posebnim naglaskom na prijenos topline i tvari u svrhu unaprjeđenja laboratorijske nastave, znanstvenoistraživačkog rada kao i suradnje s gospodarstvom. Uspostavljene su mjerne linije za istraživanja u područjima prijenosa topline i tvari u fluidiziranom sloju te prijenosu topline zračenjem.

Najmladi od četiri laboratorija je Laboratorij za energetsku učinkovitost. Laboratorij je opremljen najsvremenijim softverima za računalne simulacije kojima je omogućena analiza dinamike zgrada, optimizacija sustava grijanja, hlađenja, ventilacije, kvalitete zraka i upravljanja te razvoj algoritama za analizu naprednih tehnologija. Među najznačajnijim aktualnim projektima laboratorija su modelsko prediktivno upravljanje u zgradama, sudjelovanje zgrada u sustavima pametnih mreža, eksperimentalna mjerena i obrada podataka u zgradarstvu te pasivne strategije grijanja i hlađenja.

The Applied Thermodynamics Laboratory is focused on the thermal testing of products and systems, such as hot water boilers, heat exchangers, air-conditioning chambers, radiators, solar collectors, etc.

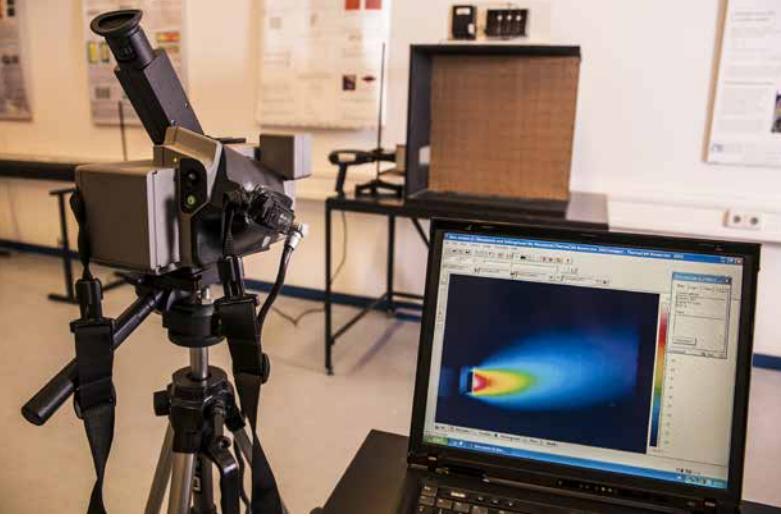
The R&D activities in the Laboratory include the measurements of environmental conditions and testing of HVAC systems in residential, business and industrial premises. The Laboratory is accredited to HRN EN ISO/IEC 17025 for testing space heaters, cookers, air-conditioning systems and microclimate assessment as well as temperature sensor calibration.

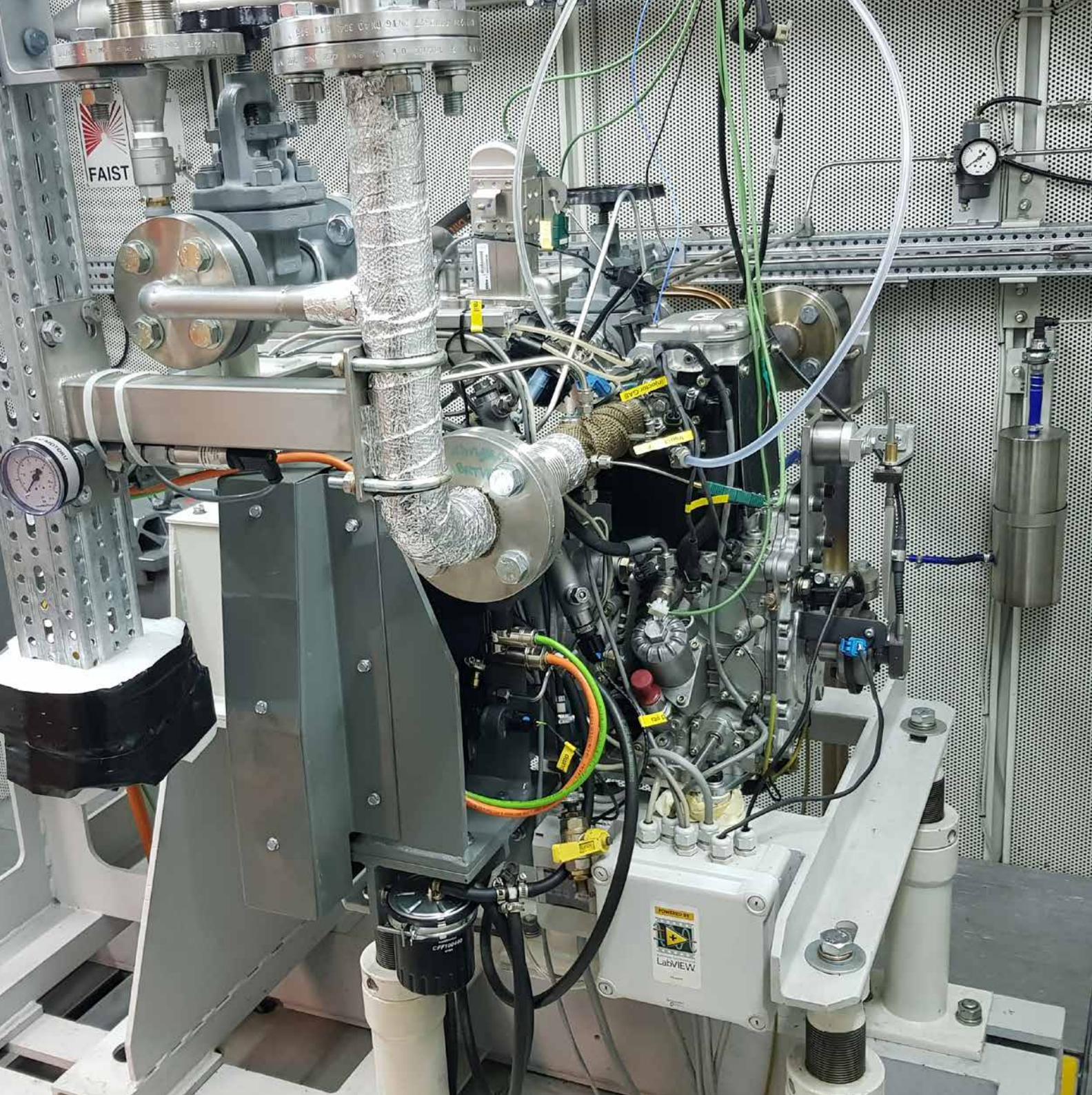
A special part of the Laboratory activities refers to the field of infrared thermography for R&D projects and the energy performance certification of buildings and industrial plants.

The highly specialized Process Measurement Laboratory carries out the measurement of thermal and process variables (temperature, pressure, flow, humidity, thermal properties). The primary task of the Laboratory is to sustain these measurement units by applying scientific methods and to ensure the traceability according to international SI standards. The laboratory equipment guarantees the achievement of measuring capabilities as specified in the key comparison data base of the Bureau International des Poids et Mesures (BIPM). The Laboratory has been accredited to ISO/IEC 17025, the international standard for temperature, pressure and humidity.

The Thermodynamics Laboratory has recently been founded primarily with the task of performing basic laboratory testing in the field of technical thermodynamics with a special focus on heat and mass transfer aiming to improve and upgrade laboratory training, R&D work as well as collaboration with industry. In keeping with that goal, the measurement rigs for the investigation of heat and mass transfer in fluidized beds and heat transfer through radiation have been set-up.

The Energy Efficiency Laboratory, the youngest among the four laboratories, is equipped with the state-of-the-art computer simulation software that provides the analysis of building dynamics, optimization of heating, cooling, ventilation system, air quality and management as well as the development of algorithms for advanced analysis. Among the most important on-going projects of the Laboratory are the model-predictive control for building heating and cooling systems, the integration of buildings in smart grids, the experimental measurements and data processing in buildings and passive heating and cooling strategies.





## Zavod za motore i transportna sredstva

Motori s unutarnjim izgaranjem i transportna sredstva predmet su interesa i središte znanstvenoistraživačkog rada još od samih početaka Fakulteta. Danas Zavod čine tri katedre koje su izravno orijentirane na motore s unutarnjim izgaranjem, cestovna motorna vozila, tračnička, odnosno željeznička vozila te sredstva unutarnjega i vanjskog transporta. Djelatnosti Zavoda obuhvaćaju nastavu, znanstvenoistraživački rad i suradnju s gospodarstvom, pri čemu su te djelatnosti međusobno isprepleteni i teško razdvojive. U okviru nastavne djelatnosti, Zavod je nositelj nastave za studente usmjerjenja Motori i vozila, koja se odvija na trećoj godini preddiplomskog studija i pretežno na diplomskom studiju. Nastava se održava i za brojne studente svih ostalih usmjerjenja, odnosno studija. Između brojnih kolegija, prepoznatljiviji su: Motori s unutarnjim izgaranjem, Konstrukcije motora, Motorna vozila, Željeznička vozila, Konstrukcije pružnih vozila, Hidraulički pogoni, Transportni uređaji i Optimiranje konstrukcija.

Znanstvenoistraživački rad usmijeren je prema užim područjima interesa pojedinih katedri pa je tako znanstvenoistraživačka djelatnost Katedre za motore i vozila usmjerena prema razvoju numeričkih modela procesa izgaranja u motoru s unutarnjim izgaranjem te odgovarajućih (pod)modela raznih fenomena u okviru rada motora s unutarnjim izgaranjem. Posljednjih godina značajan je trud uložen u opremanje Laboratorija za motore i vozila kojem je jedan od ciljeva omogućavanje eksperimentalne provjere numeričkih modela kao i prikupljanje podataka o različitim procesima i fenomenima, čijim se proučavanjem može dodatno unaprijediti numeričke modele. Naravno, rezultati tih aktivnosti povezani su i s projektima i suradnjom s nekoliko vodećih svjetskih sveučilišta i tvrtki kao što su: UC Berkely, SAD i AVL GmbH, Graz, Austrija. Dio aktivnosti Laboratorija za motore i vozila vezan je uz normizaciju motornih vozila koja obuhvaća razna ispitivanja vozila, odnosno njihovih pojedinih sklopova. Posebna se pozornost obraća ekološkim aspektima eksploatacije motornih vozila, tj. emisijama iz motora s unutarnjim izgaranjem u cestovnim motornim vozilima, ali i iz stacionarnih postrojenja kao i iz necestovnih pokretnih strojeva.

Na Katedri za transportne uređaje i konstrukcije naročita pozornost obraća se i razvoju novih konstrukcijskih rješenja transportnih sredstava i njihovom sustavnom istraživanju. Katedra uspješno sudjeluje u radu interdisciplinarnog tima (ACG grupa) na međunarodnim istraživačkim projektima iz područja mehatroničkih sustava za automobilsku industriju kao što su razvoj magnetoreoloških spojki i primjena servo upravljanjih uljnih (aktivni diferencijali) te suhih tarnih spojki (dvostrukе spojke) u suradnji s tvrtkom Ford Motor Co., Dearborn, MI, SAD. Suradnja s gospodarstvom očituje se u opsežnom stručnom radu na razvo-

## Department of IC Engines and Transport Systems

Internal combustion engines and transport machinery have been the subject of interest and the research focus since the very beginning of the Faculty. The area of research and other expert activities of the Department's three chairs are internal combustion engines, road motor vehicles, railway vehicles, and internal and external transport and handling systems. The Department's range of activities includes teaching, research and collaboration with industry, activities that are closely intertwined and difficult to separate. The Department teachers give lectures in the sub-specialization Engines and Vehicles, modules taught in the third year of the undergraduate and mainly in the graduate study. A considerable number of students of other sub-specializations or study programmes also attend lectures given by the Department's staff, including modules on internal combustion engines, engine design, motor vehicles, railway vehicles, rail vehicle design, hydraulic drives, mechanical handling equipment and optimization of constructions.

Research within this Department focuses on the areas of interest of individual chairs. The areas of research that are of special interest to the Chair of IC Engines and Motor Vehicles involve the development of numerical modelling of combustion processes in the internal combustion engine and the appropriate (sub)models of a variety of phenomena within the internal combustion engine. In recent years, a great deal of effort has been devoted to the equipping of the IC Engine and Motor Vehicle Laboratory aiming to enable experimental tests and numerical modelling, and collect data on different processes and phenomena, thus supporting research to further improve numerical models. The results of these activities are also linked to the projects and collaboration with several world leading universities and companies such as UC Berkeley, USA and AVL GmbH, Graz, Austria. The IC Engine and Motor Vehicle Laboratory also deals with the standardization of motor vehicles including testing of vehicles or their components respectively. Special attention has been given to the environmentally unfriendly aspects of motor vehicles; in particular the internal combustion engines emissions in road motor vehicles, but also emissions from stationary plants as well as from non-road mobile machinery.

The Chair of Mechanical Handling Equipment and Steel Structures works on a number of activities among which are the development of new design solutions for transport equipment and their systematic research. As a member of the Interdisciplinary Team (ACG Group), the Chair has successfully participated in the international research projects on automotive industry mechatronic systems such as the development of magnetorheological clutches and the application of servo wet clutches (active differentials) and dry friction clutches (dual clutches) in cooperation with Ford Motor Co., Dearborn, MI, USA. Close collaboration with industry partners in-

ju novih konstrukcija, izradi studija, elaborata i ekspertiza te provedbi nadzora strojarskih postrojenja u graditeljstvu.

S obzirom na to da se jedan od smjerova razvoja prometnog sustava EU-a temelji na željezničkom prometu, na Katedri za tračnička vozila, pored implementacije međugradskoga putničkoga i teretnog prometa, osobita pozornost obraća se tračničkom prigradskom i gradskom prometu. U okviru kolegija Željeznička vozila studente se upoznaje s osnovama tračničkih vozila, dok se na kolegiju Konstrukcije pružnih vozila ulazi u problematiku oblikovanja i proračuna vitalnih dijelova željezničkog vozila. Budućnost razvoja željeznicu velikih brzina i sustava s magnetnom levitacijom – maglev razmatra se u okviru predmeta Lebdeća pružna vozila.

Od listopada 2017. godine u Laboratoriju za motore i vozila provodi se projekt Nacionalni referentni laboratorij za emisije iz motora s unutarnjim izgaranjem za necestovne pokretne strojeve. To je prvi projekt FSB-a kojem su dodijeljena bespovratna sredstava iz europskih strukturnih i investicijskih fondova. Ukupna vrijednost projekta iznosi 57.000.000,00 kuna, što projekt čini najvrjednjim ugovorenim do sada na FSB-u.

## Katedre

- Katedra za motore i vozila  
[www.fsb.unizg.hr/miv/](http://www.fsb.unizg.hr/miv/)
- Katedra za transportne uređaje i konstrukcije  
[www.fsb.unizg.hr/transportni/](http://www.fsb.unizg.hr/transportni/)
- Katedra za tračnička vozila  
[www.fsb.unizg.hr/ktlpv](http://www.fsb.unizg.hr/ktlpv)

## Laboratorijski

- Laboratorij za motore i vozila  
[www.fsb.unizg.hr/lmv/](http://www.fsb.unizg.hr/lmv/)
- Laboratorij za transportne uređaje i konstrukcije

## Posebnosti Zavoda

- nositelj nastave usmjerenja Motori i vozila
- Hrvatsko društvo za motore i vozila
- suvremena programska podrška za proračune motora s unutarnjim izgaranjem i dinamike motornih vozila
- provjera sukladnosti vozila
- ispitivanje sklopova vozila
- brojni zajednički projekti s gospodarstvom
- projekti preinake vozila
- sjedište tima Formula Student

volves the development of new structures, preparing studies, reports and expertises as well as monitoring and special technical inspections.

Since one of the directions of the EU transport system development is based on the railway traffic, in addition to dealing with intercity passenger and freight traffic the Chair of Railway Vehicles is concerned with the suburban and urban traffic. Within the Railway Vehicles module students are taught the fundamentals of rail vehicles, while in the Rail Vehicle Design module the issues of designing and calculating of rail vehicle vital parts are addressed. The future of the development of high-speed railway and magnetic levitation systems, or maglev, is the focus of the Levitated Vehicles module.

Since October 2017, the IC Engine and Motor Vehicle Laboratory has been implementing the project National Reference Laboratory for Emissions from IC Engines for Non-Road Mobile Machinery. This is the first FAMENA project that has been awarded the European Structural and Investment Funds grant. The total value of the project amounts to HRK 57,000,000.00 and makes it the most valuable project contracted by FAMENA so far.

## Chairs

Chair of IC Engines and Motor Vehicles  
[www.fsb.unizg.hr/miv/](http://www.fsb.unizg.hr/miv/)

Chair of Mechanical Handling Equipment and Steel Structures  
[www.fsb.unizg.hr/transportni/](http://www.fsb.unizg.hr/transportni/)

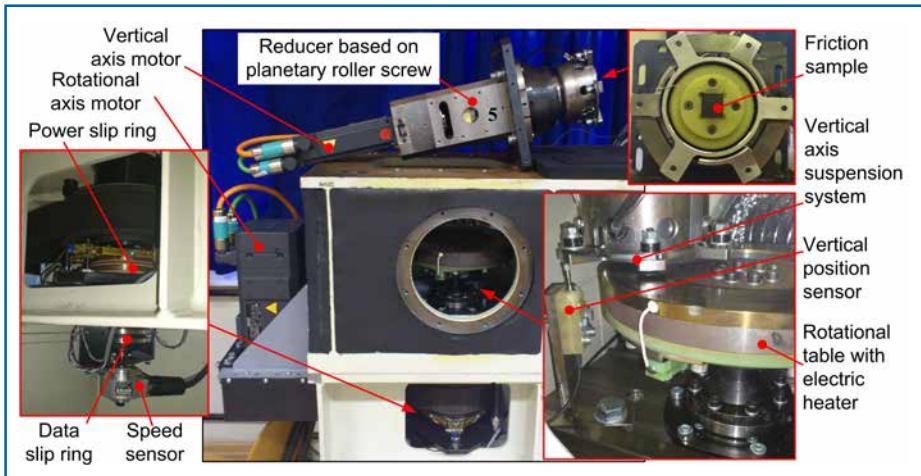
Chair of Railway Vehicles  
[www.fsb.unizg.hr/ktlpv](http://www.fsb.unizg.hr/ktlpv)

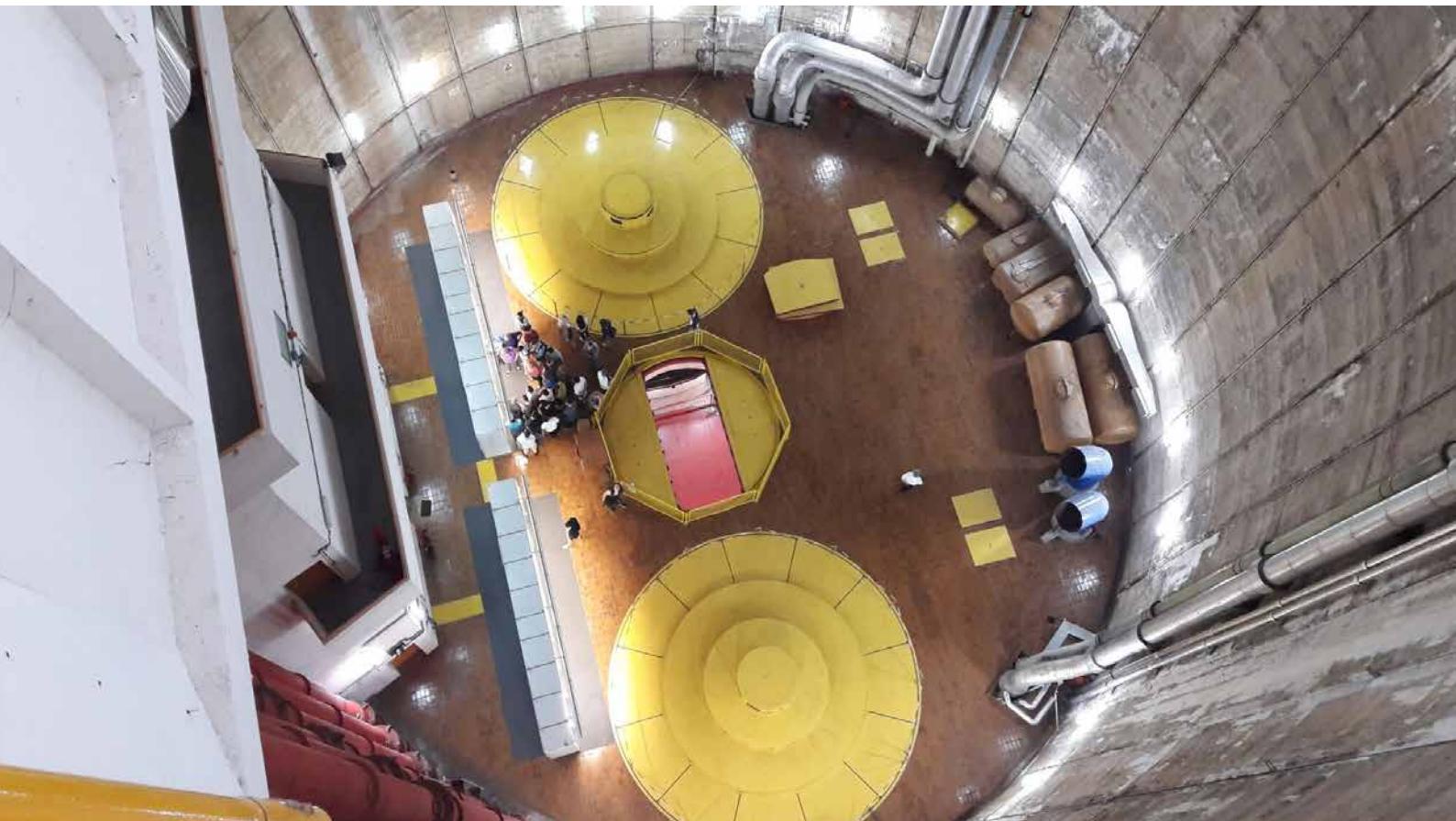
## Laboratories

- IC Engine and Motor Vehicle Laboratory, [www.fsb.unizg.hr/lmv/](http://www.fsb.unizg.hr/lmv/)
- Laboratory for Mechanical Handling Equipment and Steel Structures

## Some distinctive facts

- The key role in the teaching activities within the sub-specialization IC Engines and Motor Vehicles
- Croatian Society for Engines and Vehicles
- State-of-the-art software for the calculation of IC engine and motor vehicles dynamics
- Vehicle conformity certification
- Testing of vehicle components
- A number of projects in close collaboration with industry
- Vehicle conversion projects
- Formula Student team head office





## Zavod za energetska postrojenja, energetiku i ekologiju

Zavod za energetska postrojenja, energetiku i okoliš, osnovan je radi obrazovanja inženjera u području konstrukcije, projektiranja i održavanja energetskih strojeva (parnih kotlova, parnih, plinskih i vodnih turbina, pumpi, ventilatora, kompresora ...) te pružanja stručne i razvojne podrške domaćoj industriji energetske opreme. Zahvaljujući kontinuiranom znanstvenom i stručnom usavršavanju nekoliko generacija zaposlenika i suradnika, u više od četiri desetljeća postojanja, Zavod je nadrastao lokalne okvire i stekao međunarodnu prepoznatljivost koja se danas posebno ističe u području razvoja i primjene računalne mehanike fluida te u području održivog energetskog i ekološkog razvoja.

Zavod čine tri katedre: Katedra za energetska postrojenja i energetiku, Katedra za inženjerstvo vode i okoliša, Katedra za turbostrojeve te tri laboratorijskih: Laboratorij za energetska postrojenja, Laboratorij za hidrodinamiku i hidrauličke strojeve te Laboratorij za vodu, gorivo i mazivo. Do 2017. godine u okviru Zavoda djelovala je i Katedra za mehaniku fluida.

Nastavnici Zavoda sudjeluju u nastavi preddiplomskoga, diplomskoga i poslijediplomskog studija strojarstva, najviše na Procesno-energetskom smjeru. U obrazovnom procesu obuhvaćena su područja energetike, energetskih postrojenja i strojeva, računalne mehanike fluida te inženjerstva voda i okoliša. Uz tradicionalna područja istraživanja i obrazovanja u nastavni program kontinuirano se implementiraju najnovija znanja te razvijaju i primjenjuju suvremene inženjerske metode. Rezultat znanstvenoistraživačkog rada koji se odvija putem nacionalnih i europskih projekata je i velik broj objavljenih radova u priznatim svjetskim časopisima.

U osposobljavanju budućih inženjera za planiranje i vođenje energetskih procesa i sustava, projektiranje energetskih postrojenja te razvoj, konstruiranje i održavanje energetske opreme, osobita pozornost se obraća problematici integracije i korištenja različitih obnovljivih izvora energije, energije vjetra, sunca, biomase i geotermalne energije.

Za poboljšanje značajki postojećih, projektiranje novih te primjenu i održavanje različitih vrsta turbostrojeva, ravnopravno se, uz klasične metode termodinamičkih, hidrauličkih i aerodinamičkih proračuna, koriste i suvremene inženjerske računalne metode i eksperimentalna ispitivanja.

U suradnji s industrijskim partnerima razvijaju se numerički modeli za proračune složenih strujanja fluida, izmjene topline, izgaranja i emisija te čvrstoće materijala.

U području inženjerstva vode i okoliša studenti se obrazuju u okviru više kolegija u kojima se uz teorijske osnove poseban naglasak daje

## Department of Energy, Power and Environmental Engineering

The Department of Energy, Power and Environmental Engineering was founded with the aim to provide engineering education in the field of design, planning and maintenance of power plants (steam boilers, steam, gas and water turbines, pumps, fans, compressors ...) as well as to provide expert support for the development of the Croatian power generation equipment manufacturing. Thanks to the continuous scientific and professional development of several generations of employees and associates, over four decades of its existence, the Department has outgrown the local frameworks and has gained international recognition that is today especially noticeable in the fields of development and application of computational fluid mechanics and sustainable energy and ecological development.

The Department comprises three chairs: Chair of Energy and Power Engineering, Chair of Water and Environmental Engineering, Chair of Turbomachinery, and three laboratories: Power Engineering Laboratory, Hydromechanics and Hydraulic Machinery Laboratory and Water, Fuel and Lubricant Laboratory. Up to 2017 the Fluid Mechanics Chair was also a part of the Department.

The teachers of the Department give lectures in undergraduate, graduate and postgraduate studies in mechanical engineering, for the most part in the specialization programme Process and Energy Engineering. The teaching covers areas of power engineering, power plants and machines, computational fluid mechanics and water and environmental engineering. In addition to fundamental technical knowledge and traditional fields of research, new knowledge is being continually incorporated into the current curriculum and advanced engineering methods are being developed and applied, which keeps teaching up to date. Research work of the Department has been carried out within national and European projects and has resulted in a large number of works published in acknowledged international journals.

In training future engineers for planning and managing energy processes and systems, designing power plants and developing, designing and maintaining energy equipment, special attention has been given to harnessing and integrating different renewable energy sources, wind energy, solar energy, biomass and geothermal energy.

Besides the conventional methods of thermodynamic, hydraulic and aerodynamic calculations, modern calculation tools and experimental tests are used to improve existing features, to design new, and apply and maintain various types of turbomachinery.

Numerical models for complex fluid flow calculations, heat exchanges, combustion, emissions and material strength have been developed in co-operation with industrial partners.

praktičnom i eksperimentalnom radu vezanom uz tehnologije obrade voda, goriva, maziva i zaštite okoliša.

U znanstvenoistraživačkom radu Zavod surađuje sa znatnim brojem svjetskih sveučilišta i organizacija. Suradnja s gospodarstvom, pored stručne podrške, obuhvaća i razvoj novih proizvoda te izradu idejnih projekata postrojenja iz prethodno navedenih područja djelovanja Zavoda.

### Posebnosti Zavoda

U okviru Zavoda djeluje skupina koja je među vodećima u Republici Hrvatskoj po broju odobrenih i izvedenih europskih projekata. Dio zaposlenika Zavoda čine skupinu koja je glavni organizator SDEWES konferencije, jedne od najistaknutijih u svijetu u području održivog razvoja energetike, voda i zaštite okoliša. Više od deset godina skupina zaposlenika surađuje na istraživanjima s vodećim svjetskim institutom za ispitivanje motora s unutarnjim izgaranjem. Na Zavodu se redovito organiziraju i OpenFOAM radionice o razvoju i primjeni ovog računalnog alata za numeričko modeliranje u mehanici kontinuum, koji je međunarodno priznat ne samo u akademskoj zajednici, nego i u industriji i čijem razvoju su u velikoj mjeri pridonijeli zaposlenici Zavoda.

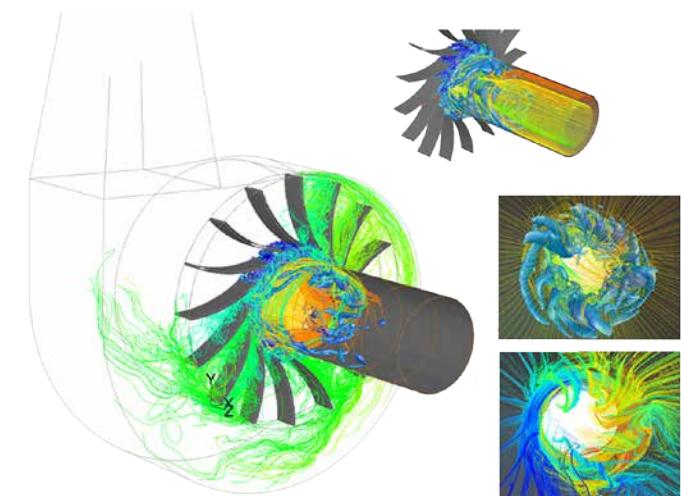


In the field of water and environmental engineering, students are taught several modules in which besides the theoretical fundamentals, special attention has been given to practical and experimental work related to water treatment, fuel, lubricant and environmental protection technology.

In the field of research, the Department collaborates with a significant number of world leading universities and organizations. Collaboration with industry, in addition to professional support, includes the development of new products and conceptual plant designs in the above mentioned Department's areas of expertise.

### Department's distinctive features

Due to their excellence in research, the members of the Department are recognized as the leading group in Croatia regarding the number of the European projects approved, carried out and implemented. The other member group has served as the main organizer of the SDEWES conference, one of the most prominent in the field of sustainable development of energy, water and environment systems worldwide. Over a decade, the Department's staff have been collaborating with the world leading institute for internal combustion engine testing. Furthermore, the Department organizes OpenFOAM workshops on the development and application of this numerical modelling software in continuum mechanics. The software, whose development was largely contributed by the employees of the Department, is internationally recognized not only in academia but also in industry.







## Zavod za brodogradnju i pomorsku tehniku

Cjelokupna djelatnost Zavoda usmjerenja je prema razvoju struke, opstojnosti te povećanju ugleda hrvatske brodogradnje. Djelatniči Zavoda održavaju nastavu iz temeljnih i stručnih kolegija na sve tri razine studija brodogradnje te djelomično na studijima strojarstva i zrakoplovstva, a nastava se prema potrebi drži i na engleskom jeziku. Završnim i diplomskim radovima rješavanju se praktični problemi iz industrije primjenom razrađenih metoda i postupaka.

Web stranica: [www.fsb.unizg.hr/zbrodo](http://www.fsb.unizg.hr/zbrodo)

Aktivnost Zavoda odvija se u okviru pet katedri i šest laboratorijskih članova Zavoda sudjeluju u:

- provedbi međunarodnih, znanstvenih nacionalnih, tehnoloških, industrijskih te obrazovnih projekata
- izdavanju časopisa „Brodogradnja“ ([www.fsb.unizg.hr/brodogradnja](http://www.fsb.unizg.hr/brodogradnja)) koji je indeksiran u svjetskim bibliografskim bazama
- organiziranju brodogađevnog simpozija „Sorta – Teorija i praksa brodogradnje“ s međunarodnim sudjelovanjem
- radu međunarodnih i domaćih institucija i odbora kao što su: IMAM, ISSC, WEGEMT, COREDES, HRB, HAZU, HRZZ i HZN.

Na Katedri za hidromehaniku plovnih objekata znanstvenoistraživački rad usmjeren je prema računalnoj i eksperimentalnoj brodskoj hidromehanici, što uključuje: određivanje otpora neoštećenoga i oštećenog broda u mirnoj vodi i na valovima, gibanja broda, interferencije višetrupnih brodova, opterećenja zbog zalijevanja palube i udaranja pramca o valove, propulzijskih značajki, optimiranje propulzijskih sustava, opis brodske forme, proračun plovnosti, statičkog i dinamičkog stabiliteta, uz razvoj pripadajućih programskih paketa. U okviru Katedre djeluje Laboratorij za hidromehaniku broda te je u tijeku opremanje bazena za modelska ispitivanja koji će omogućiti nastavni i znanstvenoistraživački rad u području eksperimentalne brodske hidromehanike.

Na Katedri za konstrukciju plovnih objekata ([www.fsb.unizg.hr/css](http://www.fsb.unizg.hr/css)) znanstvenoistraživačka aktivnost obuhvaća rad na razvoju i primjeni metode konačnih elemenata i srodnih metoda za proračun čvrstoće, dinamičke izdržljivosti, vibracija, opterećenja, hidroelastičnosti i pouzdanosti brodskih konstrukcija te razvoj racionalnih metoda osnivanja konstrukcija i njihove optimizacije. Katedra ima vrlo dobru suradnju s domaćim i stranim znanstvenoistraživačkim institucijama, klasifikacijskim društvima i subjektima iz gospodarstva. Članovi Katedre sudjeluju u radu Međunarodnoga kongresa za brodske i pomorske konstrukcije (ISSC). U okviru Katedre djeluje Laboratorij za brodske konstrukcije unutar kojeg se studenti upoznaju sa zadacima mjerena

## Department of Naval Architecture and Offshore Engineering

The key activities of the Department are aimed at developing the profession as well as maintaining and increasing the prestige of the Croatian shipbuilding industry. The department staff teach the fundamental and specialized courses in all three studies of naval architecture (undergraduate, graduate and doctoral) as well as some courses in the mechanical engineering and aeronautical engineering courses. Some courses are taught in the English language. In their undergraduate and graduate theses students focus on practical problems in the industry applying scientific methods and tools.

Website: [www.fsb.unizg.hr/zbrodo](http://www.fsb.unizg.hr/zbrodo)

The Department consists of five chairs and six laboratories. The staff participates in

- international and national research projects, technology, industrial and educational projects
- the publication of the journal „Brodogradnja“ ([www.fsb.unizg.hr/brodogradnja](http://www.fsb.unizg.hr/brodogradnja)), whose articles are indexed in the world's largest abstract and citation databases of peer-reviewed literature
- the organization of the international naval architecture symposium „Sorta – Theory and Practice of Shipbuilding“
- the activities of international and Croatian institutions and boards, such as IMAM, ISSC, WEGEMT, COREDES, HRB, HAZU, HRZZ and HZN.

Research at the Chair of Ship Hydrodynamics deals with computational and experimental ship hydrodynamics which includes determining the resistance of an intact and damaged ship in calm water and waves, ship motions, multihull interferences, wave-in-deck loading and bow-flare slamming loads, propulsion characteristics, propulsion system optimization, description of hull forms, buoyancy assessment, static and dynamic stability, as well as software development. Currently, the Chair's Ship Hydrodynamics Laboratory is undertaking the activities on the completion of the towing tank, which will, once in operation, improve teaching quality and research in the area of experimental ship hydrodynamics.

At the Chair of Ship Structures ([www.fsb.unizg.hr/css](http://www.fsb.unizg.hr/css)) research activities include the development and the application of the finite element method and allied methods for the analysis of strength, fatigue reliability, vibration, load, hydro elasticity and reliability of ship structures as well as the development of rational design methods and their optimisation. The Chair cooperates closely with the Croatian and foreign research institutions, classification societies and companies. The staff actively participate in the activities of the International Ship and Offshore Structures Congress (ISSC). In the Chair's Ship Structure Laboratory students are introduced to the tasks of measuring stress and vibrations on models and full-scale ships.

naprezanja i vibracija na modelima i u naravi. Aktualna istraživanja obuhvaćaju simulacije sudara/nasukavanja, graničnu čvrstoću oštećenog broda, propagaciju zamornih pukotina te razvoj projektnih metoda nove generacije.

Na Katedri za osnivanje plovnih objekata i morsku tehniku ([www.fsb.unizg.hr/ship-design](http://www.fsb.unizg.hr/ship-design)) znanstveni rad posvećen je projektiranju specijaliziranih i sofisticiranih brodova te upravljalivosti i ponašanju broda na valovima. Aktivnost Katedre ogleda se u projektima morske tehnike te je ostvarena uspješna suradnja s naftnim tvrtkama na rekonstrukciji i osvremenjivanju platformi i u izobrazbi i specijalizaciji njihovih inženjera. U okviru Katedre djeluje Laboratorij za tehnologiju mora koji je opremljen programskim paketima za analizu i projektiranje objekata morske tehnike, što uključuje procjenu hidrodinamičkih značajki i strukturnog integriteta.

Na Katedri za gradnju plovnih objekata znanstvena istraživanja teku u dva smjera: proučavanje novih oblika organizacije tržišno usmjerene proizvodnje u brodogradilištima primjerenih novoj tehnologiji i automatizaciji te razvoj novih načina proizvodnje. U okviru Katedre djeluje Laboratorij za unapređenje brodograđevne proizvodnje opremljen programskim paketima za analizu i projektiranje brodograđevnog proizvodnog procesa koji predstavljaju važan element u rješavaju problemu upravljanja tehnološkog procesa i osnivanja brodogradilišta.

Na Katedri za strojeve i uređaje plovnih objekata ([www.fsb.unizg.hr/mareng](http://www.fsb.unizg.hr/mareng)) znanstveni je rad usmjerjen na energetsku učinkovitost, pouzdanost i ekološku prihvatljivost brodskih energetskih sustava te buku i vibracije zbog rada brodskih strojeva i uređaja. U okviru Katedre djeluje Laboratorij za strojeve i uređaje plovnih objekata u kojemu se provode ispitivanja radnih značajki parnoga kotla, crpke, ventilatora i motora s unutarnjim izgaranjem kao i istraživačka suradnja s vodećim svjetskim brodogradilištem Hyundai Heavy Industries na problemima buke i vibracija na brodovima.

Laboratorij za primjenu računala u brodogradnji primjerno je tehnički i programski opremljen te pruža podršku svim katedrama u korištenju računalnih programa: GHS, LS-Dyna, MAESTRO, FEMAP/Nx Nastran, Ship Right, VeriSTAR, HydroSTAR.

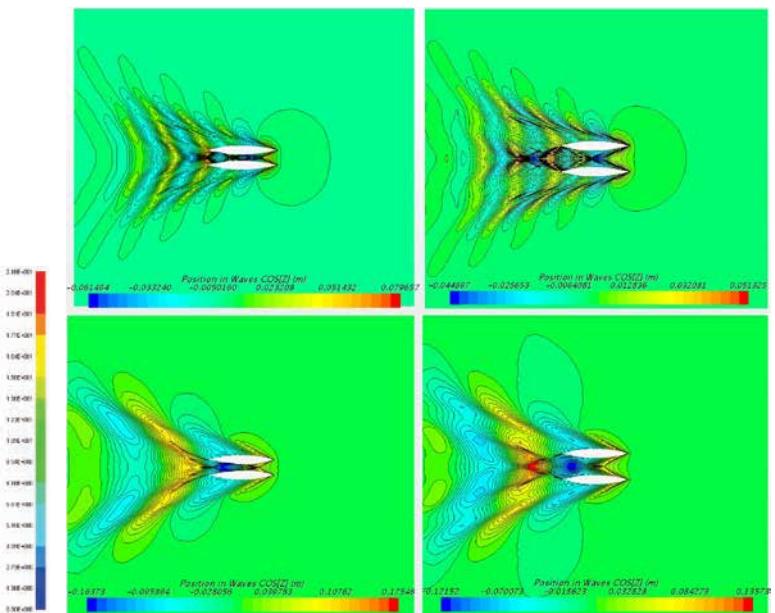
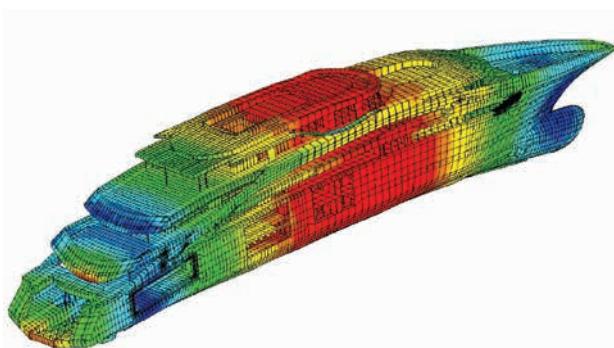
Recent research includes simulations of ship collision/grounding, ultimate strength of a damaged ship, fatigue crack propagation and development of new generation design methods.

The staff of the Chair of Ship Design and Offshore Engineering ([www.fsb.unizg.hr/ship-design](http://www.fsb.unizg.hr/ship-design)) is involved in the research on the design of specialized and sophisticated vessels and on manoeuvrability and behaviour of a ship in a seaway. There are also projects running in the field of offshore engineering. The Chair cooperates successfully with oil companies in retrofitting and upgrading rigs as well as in providing engineering training for rigs. In the Chair's Sea Technology Laboratory software applications for the analysis and design of offshore structures, including the assessment of hydrodynamic properties and structural integrity are used.

The staff of the Chair of Ship Production Engineering undertake research in two areas: the new organization forms of the market-oriented shipyard operation with respect to the new technology and automation, and the development of new production methods. In the Chair's Laboratory for Shipbuilding Process Improvement software applications for the analysis and design of shipbuilding production processes are used as an important tool for solving problems in process management and establishment of shipyards.

The research of the staff of the Chair of Marine Engineering ([www.fsb.unizg.hr/mareng](http://www.fsb.unizg.hr/mareng)) deals with energy efficiency, reliability and environmental acceptability of ship power systems, as well as noise and vibrations generated by engines and ancillary machinery. In the Chair's Marine Engineering Laboratory the performance of marine steam boilers, pumps, fans and internal combustion engines is tested. The Laboratory collaborates with the largest shipyard in the world, Hyundai Heavy Industries, on the research into noise and vibration on ships.

The Laboratory for Application of Computers in Naval Architecture provides support to the staff in the department who use a variety of software programs, e.g. GHS, LS-Dyna, MAESTRO, FEMAP/Nx Nastran, Ship Right, VeriSTAR and HydroSTAR.





## Zavod za industrijsko inženjerstvo

Područje industrijskoga inženjerstva obuhvaća oblikovanje proizvodnih i poslovnih procesa gospodarskih subjekata, integraciju tokova materijala, proizvoda, informacija i ljudskih resursa, upravljanje svim čimbenicima proizvodnje i poslovanja uza stalna nastojanja da se poboljša proces i sustav optimizacijom tih procesa. To se ostvaruje projektiranjem proizvodnje, upravljanjem proizvodnjom, upravljanjem procesima održavanja te definiranjem socijalnih odnosa, ponajviše korištenjem metoda i alata operacijskih istraživanja, statističkih metoda, simulacija te suvremenih koncepta kao što su Industrija 4.0, Lean menadžment, Six sigma, Product Lifecycle Management, Green Supply Chain Management, korporativna društvena odgovornost ...

Uz obrazovanje budućih inženjera, specijalista i doktora znanosti putem diplomskih i poslijediplomskih studija, Zavod u suradnji s CTT-om i LEAN menadžment inicijativnom, Hrvatskom udružom za PLM te ICIL-om (International Centre for Innovation and Industrial Logistics) organizira seminare i savjetovanja poput međunarodne konferencije Management of Technology – Step to Sustainable Production (MOTSP) i International Conference on Industrial Logistics (ICIL).

Strateški ciljevi Zavoda su praćenje i razvoj novih modela projektiranja, upravljanja i kontrole proizvodnih i uslužnih procesa te njihova implementacija u poslovne sustave sa svrhom poboljšanja njihova poslovanja i jačanja konkurentnosti.

Djelatnici Zavoda prenose svoja znanja i hrvatskom gospodarstvu, ali i javnom sektoru u cilju racionalnijega poslovanja uvođenjem lean menadžmenta, pri čemu se lean principi unose u brojne hrvatske tvrtke, ali i javne institucije – npr. KBC Rebro. Znanja se koriste i za poboljšanje života i rada na Fakultetu – projekt digitalizacije fakultetske infrastrukture te osvremenjivanje sustava održavanja FSB-a.

Djelatnici Zavoda sudjeluju na projektima EU-a te surađuju s inozemnim znanstvenim institucijama gdje je započela intenzivnija razmjena putem programa Erasmus.

Uz tradicionalni moto područja industrijskog inženjerstva – *mi rješavamo probleme* – konačni nam je cilj stvaranje i prenošenje znanja koja će pomoći unapređenju sadašnjosti i oblikovanju budućnosti.

Web stranica zavoda: [zind.fsb.hr](http://zind.fsb.hr)

### Katedre

- Katedra za upravljanje proizvodnjom
- Katedra za projektiranje proizvodnje
- Katedra za sociologiju

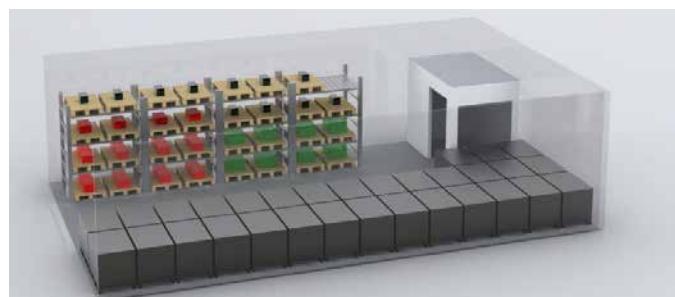
## Department of Industrial Engineering

The work of the Department is carried out in the area of the design of production and business processes of companies, integration of the flow of material, products, information and human resources, and management of all production and business factors, continuously striving to improve the processes and systems through their optimisation. This is achieved by using knowledge in production design, production management, maintenance management and defining social relationships, mostly using operation research methods and tools, statistical methods, simulations and modern concepts such as: Industry 4.0; Lean Management, Six sigma, Product Lifecycle Management, Green Supply Chain Management, corporate social responsibility...

At graduate and postgraduate studies the Department educates future engineers, specialists and doctoral students. Moreover, the Department organises seminars and counselling such as: International Conference Management of Technology – Step to Sustainable Production (MOTSP) and International Conference on Industrial Logistics (ICIL) in cooperation with CTT and LEAN management initiative, Croatian Association for PLM, and ICIL (International Centre for Innovation and Industrial Logistics).

Strategic goals of the Department are to monitor and develop new design models, manage and plan the production and service processes and implement them in business systems with the aim of improving their business and enhancing their competitiveness.

For the purpose of more rationale business, the members of the Department transfer their knowledge to the Croatian economy as well as to the public sector by introducing lean management. By doing so, lean principles are introduced into numerous Croatian companies as well as public institutions such as KBC Rebro. The knowledge is also used to improve life and work at the Faculty – the project of digitalisation of the Faculty infrastructure and upgrading the maintenance system at the Faculty of Mechanical Engineering and Naval Architecture.

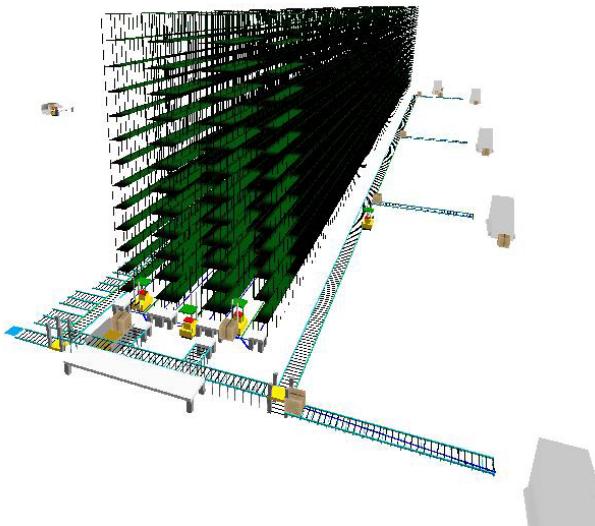


## Laboratori

- Laboratorij za proizvodni menadžment
- Laboratorij za projektiranje tehnoloških procesa
- Laboratorij za logistiku
- Laboratorij za održavanje

## Posebnosti Zavoda

- poslijediplomski specijalistički studij Industrijsko inženjerstvo i menadžment
- poslijediplomski doktorski studij Industrijsko inženjerstvo i menadžment
- međunarodna konferencija MOTSP – Management of Technology Step to Sustainable Production
- međunarodna konferencija ICIL – International Conference on Industrial Logistics
- međunarodna konferencija GALP – Green and Lean production
- LEAN menadžment inicijativa
- Hrvatska udruga za PLM
- Siemens PLM programska podrška
- uvođenje lean menadžmenta u privredne subjekte i javni sektor
- digitalizacija fakultetske infrastrukture
- osuvremenjivanje održavanja na FSB-u
- ERASMUS razmjena nastavnika



The members of the Department actively participate in EU projects and collaborate with foreign scientific institutions where more intensive exchange through the Erasmus program began.

Along with the traditional motto of industrial engineering – we solve problems – our ultimate goal is to create and transfer knowledge which will help to advance the present and shape the future.

Website of the Department: [zind.fsb.hr](http://zind.fsb.hr)

## Chairs

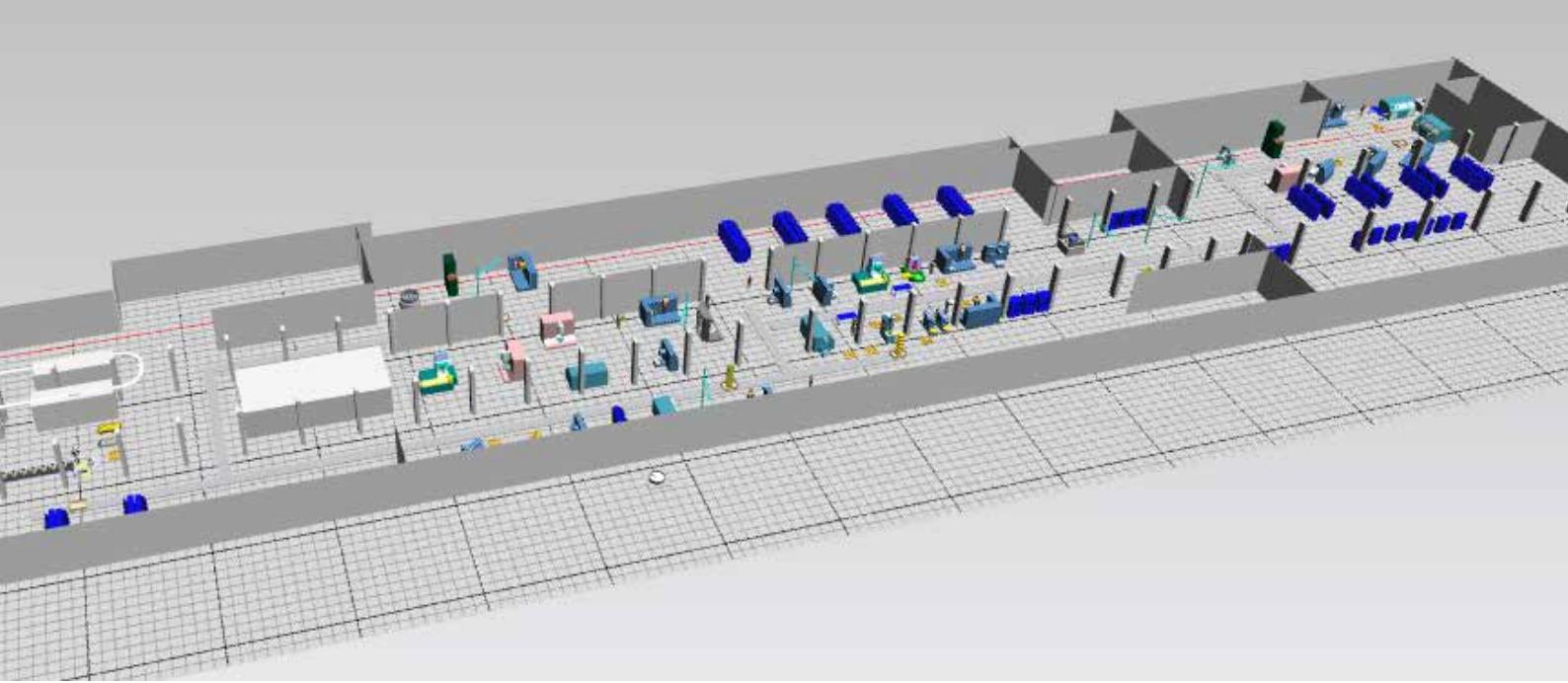
- Chair of Production Management
- Chair of Production Design
- Chair of Sociology

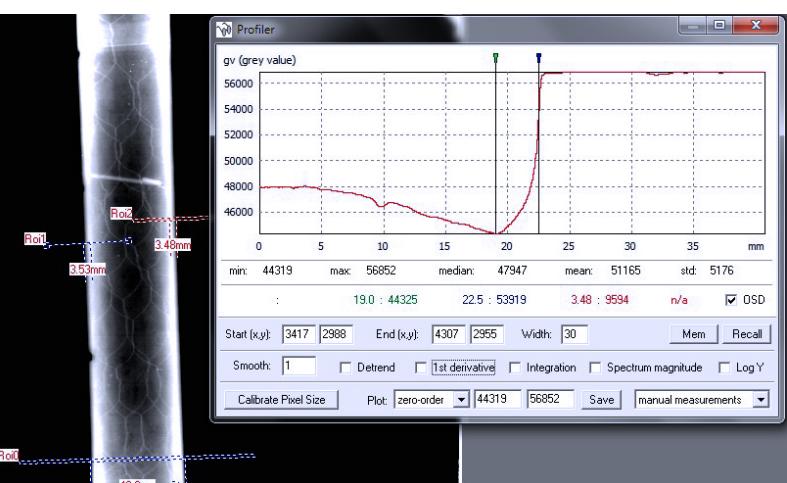
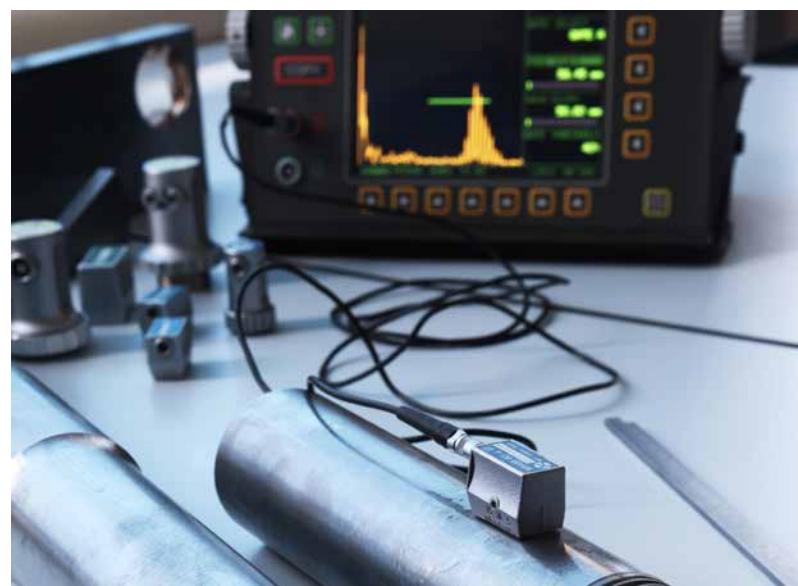
## Laboratories

- Production Management Laboratory
- Manufacturing Process Design Laboratory
- Logistics Laboratory
- Maintenance Laboratory

## The Department's distinctive features:

- Postgraduate professional study – Industrial Engineering and Management
- Postgraduate doctoral study – Industrial Engineering and Management
- International conference MOTSP – Management of Technology Step to Sustainable Production
- International conference ICIL – International Conference on Industrial Logistics
- International conference GALP – Green and Lean production
- LEAN management initiative
- Croatian association for PLM
- Siemens PLM program support
- introducing lean management into companies and public sector
- digitalisation of the Faculty infrastructure
- upgrading maintenance at the Faculty of Mechanical Engineering and Naval Architecture
- teacher exchange within ERASMUS program





## Zavod za kvalitetu

Zavod za kvalitetu utemeljen je godine 1998. Aktivnosti Zavoda odvijaju se u okviru dvije katedre i tri laboratorija: Katedra za mjerjenje i kontrolu, Katedra za nerazorna ispitivanja, Laboratorij za precizna mjerjenja dužina koji je ujedno i Nacionalni laboratorij za duljinu, Laboratorij za nerazorna ispitivanja i Laboratorij za akustička ispitivanja atmosfere. Osnovne zadaće Zavoda su: obrazovanje, znanstvenoistraživačka djelatnost i suradnja s gospodarstvom na području mjeriteljstva, ispitivanja te upravljanje, osiguravanje i kontrola kvalitete.

Djelatnici Zavoda održavaju nastavu iz četrdesetak temeljnih i izbornih kolegija na sve tri razine studija strojarstva te na drugim studijima unutar matičnog Fakulteta i Sveučilišta. Najveći dio nastave na poslijediplomskom doktorskom studiju Strojarstvo, brodogradnja, zrakoplovstvo, metalurgija, nastavnici Zavoda izvode u okviru smjera Znanstveno mjeriteljstvo u strojarstvu.

U sadržaje kolegija, uz tradicionalna područja mjeriteljstva, nerazornih ispitivanja, zrakoplovnih sustava te područja upravljanja kvalitetom, kontinuirano se implementiraju nova znanja prijeko potrebna za mjeriteljstvo i kvalitetu budućnosti.

Istraživačka djelatnost i suradnja s gospodarstvom provode se djelovanjem katedri i laboratorija. Djelatnici Katedre za mjerjenje i kontrolu i Katedre za nerazorna ispitivanja sudjeluju u znanstvenoistraživačkim projektima te na seminarima i radionicama kontinuirano prenose znanja hrvatskim gospodarstvenicima na području: implementacije sustava upravljanja kvalitetom, nerazornih ispitivanja i zrakoplovnih sustava, statističkog modeliranja, umjeravanja mjernih sredstava, procjene mjerne nesigurnosti i međulaboratorijskih usporedbenih mjerjenja.

Laboratorij za precizna mjerjenja dužine, koji je ujedno i Nacionalni laboratorij za duljinu u Republici Hrvatskoj, nositelj je primarnog etalona duljine (jodom stabilizirani He-Ne laser) te državnih etalona za duljinu i hrapavost. Laboratorij je preuzeo odgovornost i obvezu osiguravanja sljedivosti u RH do međunarodnih etalona za duljinu, kut i parametre hrapavosti površina, akreditiran je sukladno međunarodnoj normi ISO 17025 te provodi umjeravanja etalona i mjernih sredstava duljine za brojne hrvatske tvrtke.

Laboratorij za nerazorna ispitivanja posjeduje značajno iskustvo, posebice u području ultrazvučnih i radiografskih metoda ispitivanja. Istraživački rad je usmjeren na poboljšanje pouzdanosti ispitnih metoda. Laboratorij također pruža usluge karakterizacije materijala, stručnih analiza te razrade i provedbe nerazornih ispitivanja komponenti u energetskim i procesnim postrojenjima, pomorskim konstrukcijama, posudama pod tlakom kao i ispitivanja umjetničkih artefakata.

## Department of Quality

The Department of Quality was founded in 1998. The Department has been performing its activities through two chairs and three laboratories: Chair of Measurement and Control, Chair of Non-destructive Testing, Precision Length Measurement Laboratory, being also the National Laboratory for Length, Non-destructive Testing Laboratory and Laboratory for Acoustic Characteristics of Atmosphere. The Department's main tasks are: education, research activities and collaboration with economy in the field of metrology, testing and control, quality assurance and quality control.

The Department staff give lectures in about forty basic and elective courses at all three levels of studies in mechanical engineering and in other studies at the Faculty and the University. Most of the teaching in the postgraduate doctoral studies in mechanical engineering, naval architecture, aeronautical engineering and metallurgy are provided by the Department teachers within the doctoral programme Measurement in Mechanical Engineering.

In addition to courses in traditional fields of metrology, non-destructive testing, aeronautical systems and quality management, new knowledge needed for metrology and the quality of the future has been incorporated into the existing courses.

The activities of the Department chairs and laboratories include both research and collaboration with industry. In order to put research and knowledge to work for industrial needs and requirements, the staff of the Chair of Measurement and Control and of the Chair of Non-destructive Testing participate in research projects and disseminate knowledge through seminars and workshops addressing: the implementation of quality management system, the non-destructive testing and aeronautical systems, the statistical modelling, the calibration of measurement devices, the validation of measurement uncertainties and the inter-laboratory comparisons.

The Precision Length Measurement Laboratory, being also the National Laboratory for Length in the Republic of Croatia, is an accredited holder of the primary standard of length (Iodine-stabilized He-Ne laser) and of the national standards of length and surface roughness. The Laboratory assumed responsibility and obligation to ensure traceability in the Republic of Croatia to international standards of length, angle and surface roughness parameters. It has been accredited to the international standard ISO 17025 and has been providing services of the calibration of standards and measurement devices for length to many Croatian companies.

The Non-destructive Testing Laboratory has considerable and extensive experience, particularly in the field of ultrasound and radiographic testing methods. Its research activities are focused on the improvement of reliability of test methods. The Laboratory also provides services in materials characterisation, expert analyses and the development and implemen-

Laboratorij za akustička ispitivanja atmosfere posjeduje senzore i bes-pilotne letjelice za određivanje akustičkih svojstava atmosfere pri tlu ili na manjim visinama.

#### **Posebnosti Zavoda**

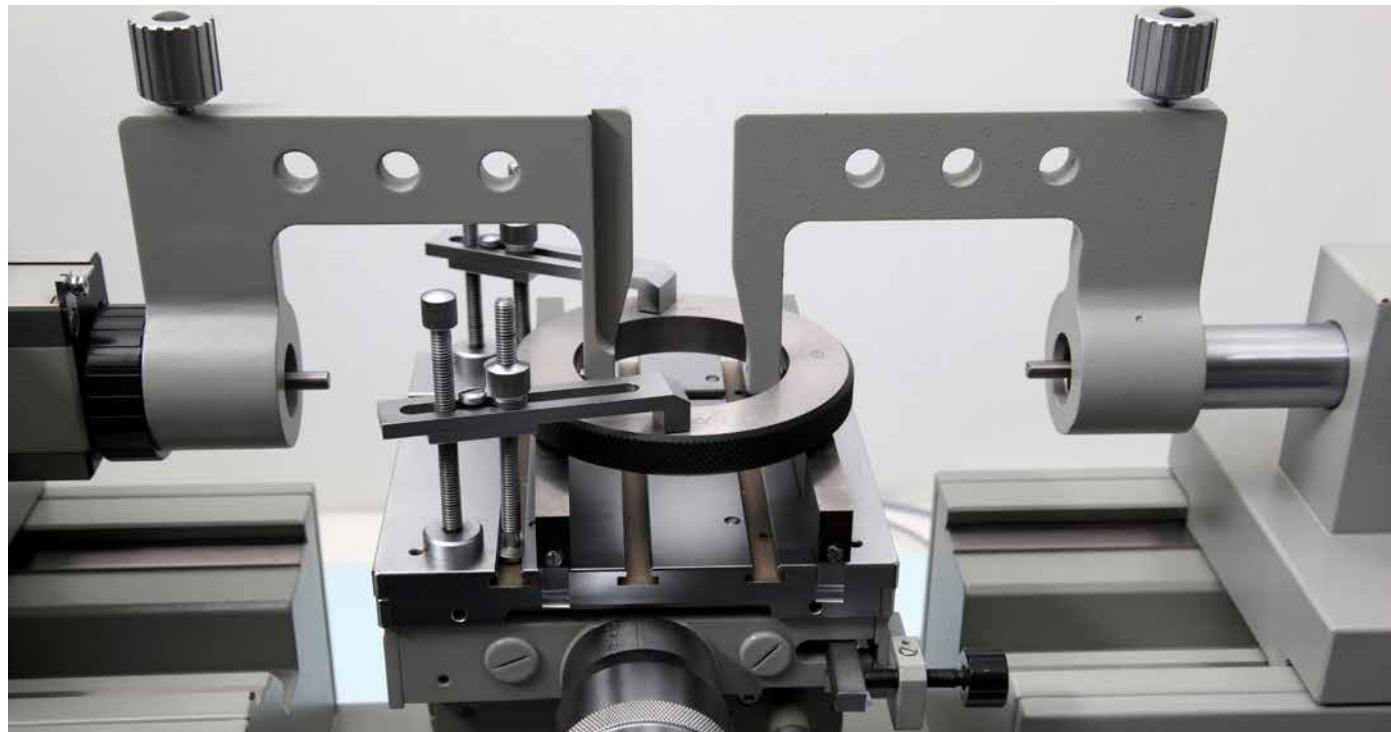
- implementacija sustava upravljanja, osiguravanja i kontrole kvalitete u brojnim tvrtkama
- dimenzionalna, ultrazvučna i radiografska kontrola kompleksnih dijelova i proizvoda
- sustav za računalnu radiografiju
- zrakoplovni sustavi
- suradnja s tvrtkama na razvoju novih proizvoda
- sudjelovanje u međunarodnim međulaboratorijskim usporedbama

tation of non-destructive testing of components in power and process plants, off-shore structures, pressure vessels as well as testing of artefacts.

The Laboratory for Acoustic Characteristics of Atmosphere uses sensors and unmanned aircrafts for determining the acoustic characteristics of atmosphere slightly above the ground or at lower altitudes.

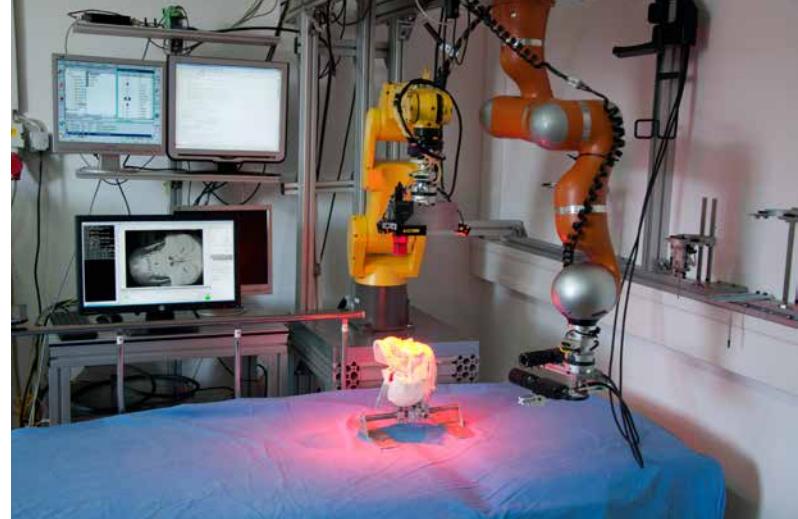
#### **The Department's distinctive activities include:**

- control system implementation, quality assurance and control in companies
- dimensional, ultrasound and radiographic control of complex compounds and products
- computed radiography system
- aeronautical systems
- collaboration with companies to develop new products
- participation in international intercomparisons





FERRANTI  
Metrology Systems  
MERLIN



## **Zavod za robotiku i automatizaciju proizvodnih sustava**

U Zavodu za robotiku i automatizaciju proizvodnih sustava obavlja se opsežna znanstvenoistraživačka djelatnost i obrazovanje na području strojarstva, elektrotehnike i računarstva, kojima su obuhvaćena područja: automatika; robotika; mehatronika i biomehatronika; neuroprotetika; elektronika; elektrostrojarstvo; hidraulika i pneumatika; obradba informacija, programiranje i umjetna inteligencija; projektiranje proizvodnih sustava i sustava montaže, pakiranja i demontaže te brza izradba prototipova.

Znanstvena i stručna djelatnost Zavoda usmjeren je razvoju naprednih i inovativnih koncepata u upravljanju industrijskim, energetskim i transportnim procesima, slijednim sustavima, robotima, kao i primjeni energetski učinkovitih uređaja i postrojenja te visokoautomatiziranih – intelligentnih i autonomnih sustava u proizvodnji materijalnih dobara, ali i u drugim gospodarstvenim djelatnostima.



## **Department of Robotics and Production System Automation**

The Department of Robotics and Production System Automation is involved in extensive research and teaching activities in a wide variety of fields such as mechanical engineering, electrical engineering, and computer science, which include automation, robotics, mechatronics and biomechatronics, neuroprosthetics, electronics, electromechanical engineering, hydraulics and pneumatics, data processing, computer programming and artificial intelligence, production and assembly system design, packaging and disassembly as well as rapid prototyping.

Research and teaching at the Department seek to develop advanced and innovative concepts in control of industrial, power and transport processes, sequential control systems, robots, as well as to apply energy-efficient devices and plants and highly-automated, intelligent and autonomous systems in the production of material goods and in other economy sectors. Projects are carried out by implementing concurrent engineering, which encompasses integrated application of advanced approaches, methods and the CAD/CAE/CAM tools. They are used for a wide range of tasks: from product design and analysis, process design to system specification -engineering solution, including its control and programming, even to a detailed alignment of machines and equipment at the factory floor.

### **Chairs**

- Chair of Control Systems
- Chair of Manufacturing and Assembly System Design

### **Laboratories**

- Laboratory for Intelligent Production Systems (LIPS)
- Automation and Robotics Laboratory
- Electrical Engineering Laboratory
- Manufacturing and Assembly System Design Laboratory

### **Distinctive features**

The Department has always been the leader in the field of robotics in the Republic of Croatia, both in education and research. It conducts a number of courses at the Faculty and is in charge of two specialization programmes in the undergraduate and graduate studies, i.e. Mechatronics and Robotics and Computer Engineering, that sixty students choose to enrol in every year. It is also in charge of the Mechatronics and Robotics postgraduate doctoral study as well as of the Assembly and Packaging professional specialization programme. In addition to fundamental theoretical knowledge and conventional programmes that they acquire and master through these courses, the students gain hand-on experiences in modern and comprehensively equipped laboratories, working together

U rješavanju projektnih zadaća pristupa se po načelu istodobnog inženjerstva, što podrazumijeva integriranu primjenu naprednih pristupa, metoda i CAD/CAE/CAM alata, i to: od oblikovanja i analize proizvoda, oblikovanja procesa do specifikacije sustava – tehničkog rješenja, uključujući i njegovo upravljanje i programiranje, a moguće i sve do detaljnog razmještanja strojeva i opreme u proizvodnim dvoranama.

#### Katedre

- Katedra za strojarsku automatiku
- Katedra za projektiranje izradbenih i montažnih sustava

#### Laboratorijski

- Laboratorij za inteligentne proizvodne sustave
- Laboratorij za automatiku i robotiku
- Laboratorij za elektrotehniku
- Laboratorij za projektiranje izradbenih i montažnih sustava

#### Posebnosti Zavoda

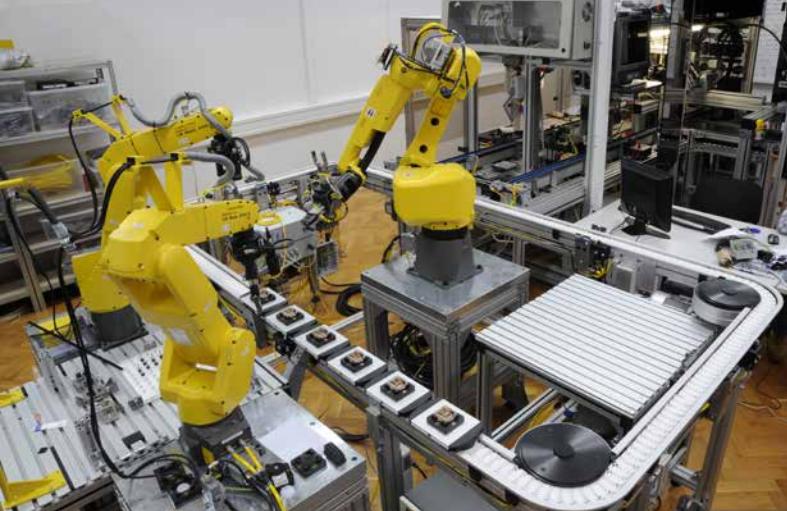
Zavod se odvijek isticao na području robotike u Republici Hrvatskoj, i u edukaciji i u istraživačkom smislu. Zavod sudjeluje u nastavnom procesu Fakulteta s velikim brojem kolegija, pri čemu je nositelj dvaju smjera preddiplomskog i diplomskog studija: Mehatronika i robotika i Računalno inženjerstvo, koje na godinu upiše 60 studenata; a na poslijediplomskom studiju doktorskog smjera Mehatronika i robotika te specijalističkog smjera Montaža i pakiranje. Tijekom pohađanja nastave, osim teorijskih spoznaja i konvencionalne nastave, studenti stječu i neposredna praktična iskustva u suvremeno opremljenim laboratorijskim, u kojima rade zajedno s osobljem Zavoda. Posebna se pozornost obraća uključenju studenata u znanstvenoistraživački rad.

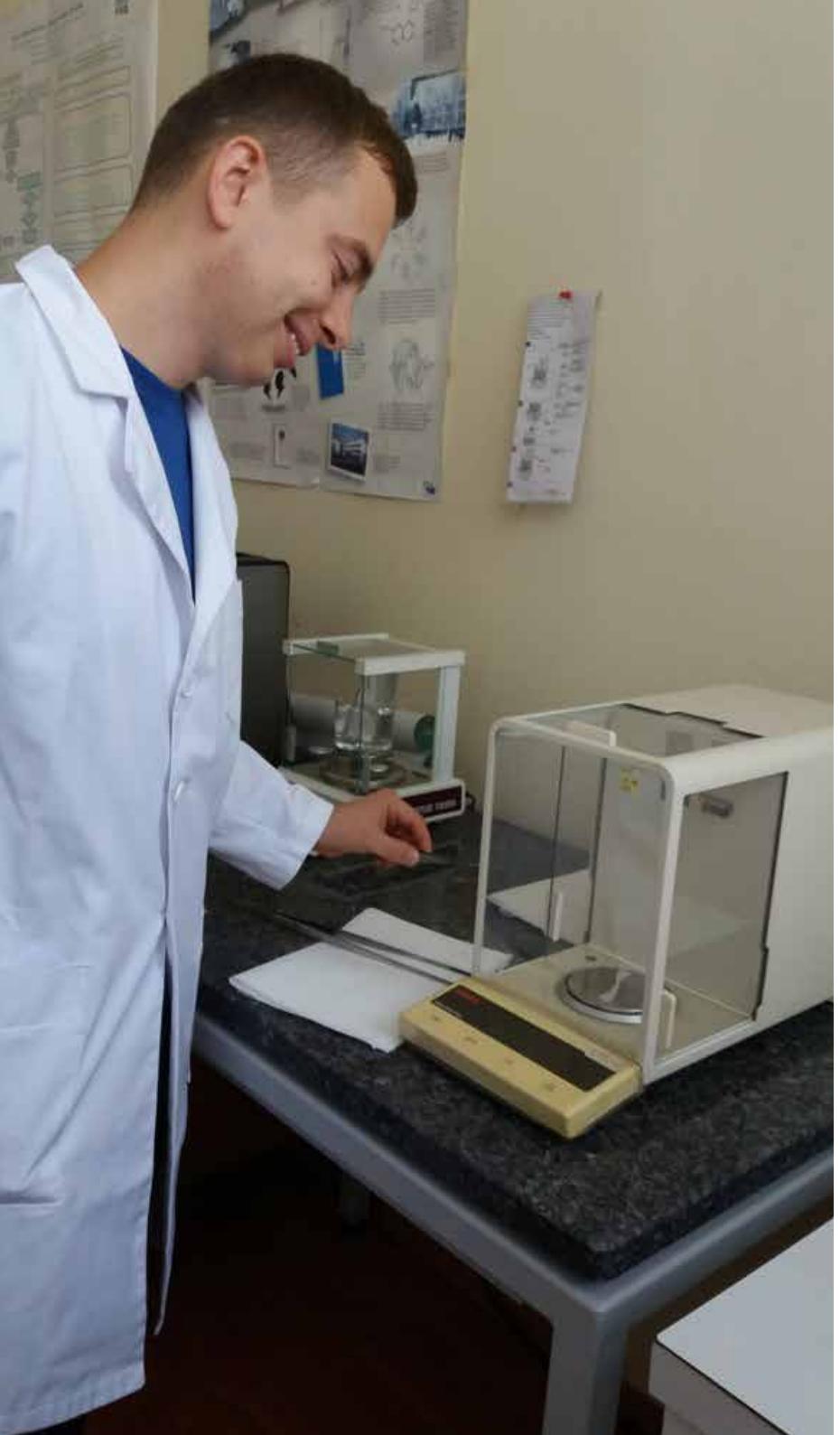
Na Zavodu se odvija veći broj znanstvenoistraživačkih projekata koje financiraju državne institucije, Evropska unija i privreda. Djelatnici Zavoda nosioci su više patenata. Suradnja s gospodarstvom ostvarena je putem stručnih i istraživačkih projekata na područjima projektiranja proizvoda, procesa, uređaja i sustava; primjene i programiranja CA alata; programiranja automata, robotike, vizujskih i haptičkih sustava te izobrazbe inženjera. U suradnji djelatnika Zavoda i istraživača sa Zavoda za neurokirurgiju KB Dubrava razvijen je robotski sustav RONNA za assistiranje pri izvedbi neurokhirurških zahvata. Godine 2015. izведен je prvi klinički zahvat u RH primjenom ovog sustava.

with the Department's staff. The Department's continually encourages and enables the students to get involved in research.

A great number of research projects, funded by the government institutions, the European Union and industry, are conducted at the Department. A number of the Department's members have been granted patents. The Department has been successfully collaborating with industry through professional and research projects in numerous fields, such as the design of products, processes, devices and systems, application and programming of the CA tools, programming of automatic devices, robotics, vision and haptic systems as well as in educating and training engineers. RONNA, a robotic system for assisting neurosurgeries , has been developed through a collaboration with the researchers at the Department of Neurosurgery, University Hospital Dubrava. In 2015 a surgery assisted with this system was performed for the first time in Croatia.







## Zavod za materijale

Zavod za materijale s tridesetak nastavnika, suradnika i tehničkog odeljivača, predstavlja značajan potencijal i ima vodeće mjesto u stručnoj i znanstvenoistraživačkoj djelatnosti te sveučilišnoj nastavi u znanstvenoj grani temeljnih tehničkih znanosti „Materijali“ te grani „Proizvodno strojarstvo“ iz polja strojarstvo, područja tehničkih znanosti. Znanost i inženjerstvo materijala smatra se jednom od temeljnih (generičkih) grana, čiji rezultati pokreću inovativan razvoj novih proizvoda i procesa u nizu drugih grana znanosti i tehnike – strojarstvu, brodogradnji, zrakoplovstvu, elektronici, optici, graditeljstvu, medicini i drugim područjima.

Područje rada Zavoda čine: ispitivanja metalnih, polimernih, keramičkih, kompozitnih materijala, poboljšavanje svojstava postojećih materijala, istraživanje i primjena novih materijala (pametne legure s prisjetljivošću oblika, nanostrukturirani materijali i filmovi, kompozitna keramika, metalne pjene, ...) te razvoj i primjena postupaka toplinske obradbe, modificiranja i prevlačenja površina (inženjerstvo površina).

Praćenjem teorijskih osnova dolazi se do tumačenja mikrostrukture, svojstava i ponašanja materijala kao podloge za njihovu optimalnu primjenu. Primjenom suvremenih laboratorijskih tehnika i opreme za ispitivanje mikrostrukture i svojstava materijala dobivaju se podaci koji uz pomoć računala omogućuju rješavanje različitih problema u istraživanju i primjeni. Uspješno se primjenjuju metode umjetne inteligencije (umjetne neuronske mreže) u predviđanju svojstava materijala i parametara toplinske ili toplinsko-kemijske obrade.

Unutar nastavnog programa, prema načelima bolonjskog procesa, Zavod za materijale započeo je u akademskoj godini 2004./2005. s nastavom smjera Inženjerstvo materijala, prvim studijem takve vrste na



## Department of Materials

The Department of Materials, that employs 30 academic lecturers, associates, and technical staff, has an enormous potential and is the leader in research and teaching in the field of materials science, one of the fundamental engineering sciences, as well as in production engineering, a field of mechanical engineering.

Research in materials science and engineering, which is critical to all other fields of engineering, has always given an impetus to innovative development of new products and processes in many other scientific and engineering fields, such as mechanical engineering, naval architecture, aeronautical engineering, electronics, optics, civil engineering, medicine etc.

Major areas of interest of the Department are: testing of metal, polymer, ceramic and composite materials, improvements in existing material properties, research and application of new materials (shape memory alloys, nanostructured materials and films, composite ceramics, metal foams, etc.) as well as the development and application of heat treatment processes, surface modification and coating (surface engineering).

Keeping up-to-date with the theories in the field allows for accurate interpretations of microstructure, properties and behaviour of materials as the basis for their optimal application. The data obtained by implementing cutting-edge laboratory techniques and equipment for testing material microstructure and properties is then used to solve various problems in research and application of materials by using computer methods. Artificial intelligence methods (artificial neural networks) are successfully applied in predicting material properties and heat or heat-chemical treatment processes.

As part of the curriculum, designed in accordance with the Bologna Process guidelines, the Department initiated the Materials Engineering specialization, the first of its kind in this region, in the 2004/2005 academic year. This enhanced the education in the field of materials development and application, following the proclaimed development priorities in the Republic of Croatia. The Department's staff teach the undergraduate and graduate studies as well as the postgraduate, both doctoral and professional studies. It comprises eight laboratories and one research centre that are involved in research, teaching and collaboration with industry.

### Chairs

- Chair of Materials and Tribology
- Chair of Heat Treatment and Surface Engineering

### Materialography Laboratory

- microstructure analysis
- fracture cause analysis



ovim prostorima. Time se produbilo obrazovanje na području razvoja i primjene materijala u skladu s proklamiranim prioritetima razvoja Republike Hrvatske. Na Zavodu za materijale izvodi se nastava (smjer Inženjerstvo materijala) na preddiplomskom, diplomskom, poslijediplomskom specijalističkom i poslijediplomskom doktorskom studiju. Unutar osam laboratorija i jednog istraživačkog centra provodi se znanstveni rad, nastava i suradnja s gospodarstvom.

#### Katedre

- Katedra za materijale i tribologiju
- Katedra za toplinsku obradbu i inženjerstvo površina

#### Laboratorij za materijalografiju

- analiza mikrostrukture
- analiza uzroka loma
- kvalitativna i kvantitativna analiza slike uzorka materijala
- optička mikroskopija
- skenirajuća elektronska mikroskopija (SEM)
- energijski razlučujuća rendgenska spektrometrija (EDS)

- qualitative and quantitative analysis of material sample image
- optical microscopy
- scanning electron microscopy (SEM)
- energy dispersive X-ray spectrometry (EDS)

#### Mechanical Testing Laboratory

- accredited laboratory for the calibration of force measurement devices
- holder of the national standard of force
- hardness tester calibration and impact-fracture work
- all types of mechanical testing

#### Metal Analysis Laboratory

- instrumental methods: optical emission spectrometry (GDOS); atomic absorption spectrophotometry; UV/VIS spectrophotometry; polarographic and voltametric testing; conductometry
- conventional methods: gravimetry, titrimetry, volumetry, electrogravimetry

### **Laboratorij za ispitivanje mehaničkih svojstava**

- ovlašteni laboratorij za umjeravanje uređaja za mjerjenje sile
- nositelj državnog etalona za silu
- umjeravanje mjerila tvrdoće i udarnog rada loma
- sve vrste ispitivanja mehaničkih svojstava materijala

### **Laboratorij za analizu metala**

- instrumentalne metode: optička emisijska spektrometrija (GDOS); atomska apsorpcijska spektrofotometrija; UV/VIS spektrofotometrija; polarografsko-voltametrijska ispitivanja; konduktometrija
- klasične metode: gravimetrija, titrimetrija, volumetrija, elektrogravimetrija

### **Laboratorij za polimere i kompozite**

- karakterizacija polimernih materijala
- kemijska otpornost
- mehanička svojstva (čvrstoća, tvrdoća, žilavost, dinamičko-mehanička svojstva)
- tehnološka i toplinska svojstva
- morfologija i struktura polimera

### **Laboratorij za tribologiju**

- otpornost na abrazijsko trošenje
- otpornost na erozijsko trošenje
- otpornost na adhezijsko trošenje
- otpornost na umor površine
- ferografska analiza

### **Laboratorij za toplinsku obradbu**

- toplinska obrada u vakuumskoj peći
- postupci žarenja i kaljenja (površine i cijelog volumena)
- nitriranje (solna kupka, plinska atmosfera, plazma)
- cementiranje
- boriranje
- vanadiranje
- PACVD prevlačenje (TiN, TiCN, TiBN)

### **Laboratorij za inženjersku keramiku**

### **Laboratorij za inženjerstvo površina**

### **Istraživački centar za modeliranja u toplinskoj obradi metala (QRC)**

- istraživanje i razvoj novih sredstava za gašenje i novih tehnologija ohlađivanja
- matematičko modeliranje i simulacije procesa u toplinskoj obradi



### **Polymers and Composites Laboratory**

- characterisation of polymer materials
- chemical resistance
- mechanical properties (strength, hardness, toughness, dynamic-mechanical properties)
- technological and thermal properties
- polymer morphology and structure

### **Tribology Laboratory**

- abrasive wear resistance
- erosive wear resistance
- adhesive wear resistance
- surface fatigue resistance
- ferrographic analysis

### **Heat Treatment Laboratory**

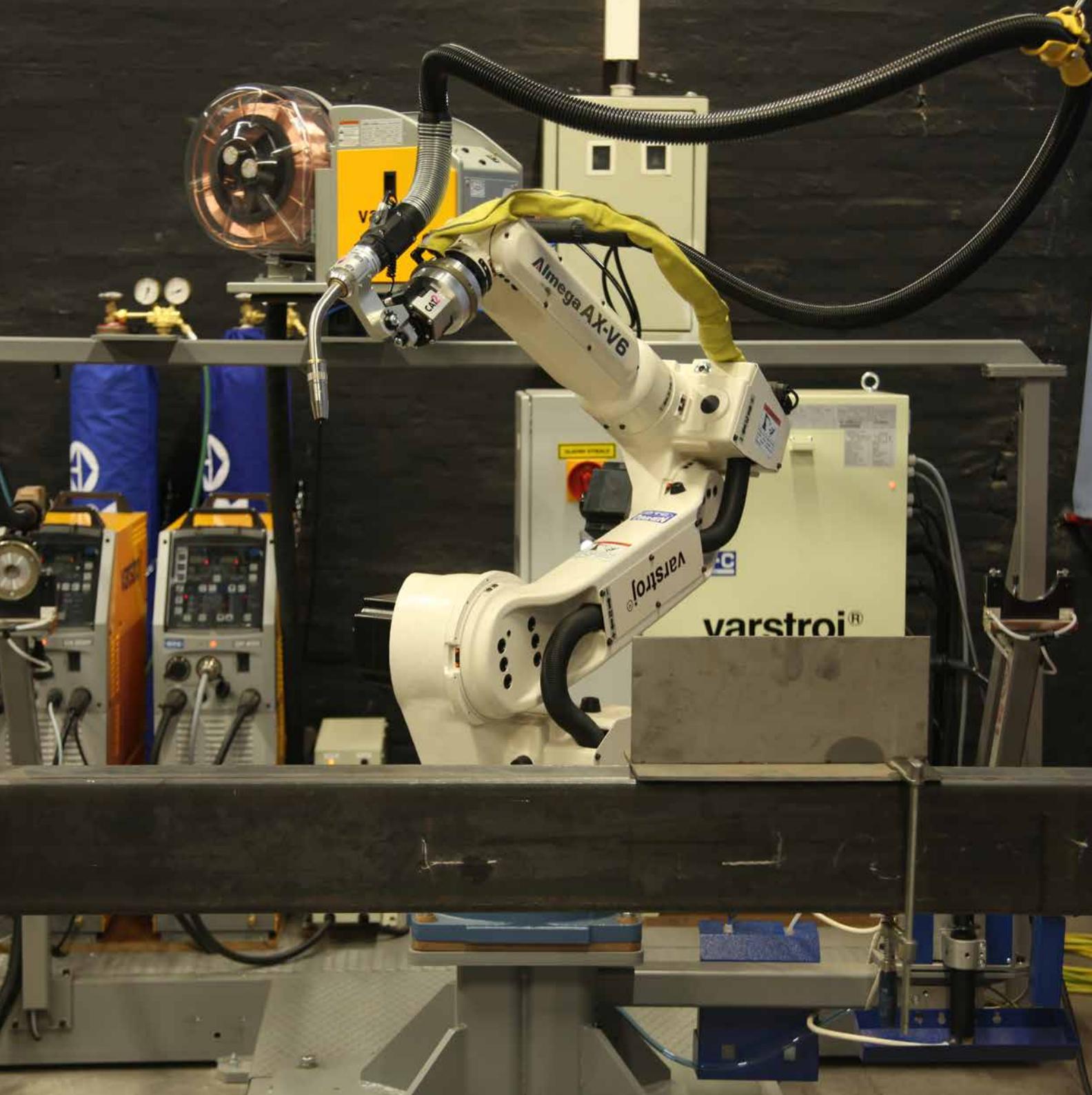
- vacuum furnace heat treatment
- annealing and hardening (of the surface and the entire volume)
- nitriding (salt bath, gaseous atmosphere, plasma)
- cementing
- boriding
- vanadium coating process
- PACVD coating (TiN, TiCN, TiBN)

### **Engineering Ceramics Laboratory**

### **Surface Engineering Laboratory**

### **Research Centre for Metal Heat Treatment Modelling (QRC)**

- research and development of new quenching tools and new cooling technologies
- mathematical modelling and process simulation in heat treatment



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# Zavod za zavarene konstrukcije

Zavod za zavarene konstrukcije nastao je iz Zavoda za mehaničku tehnologiju koji je osnovan 1922. na Tehničkoj visokoj školi. Prvi predstojnik Zavoda za zavarene konstrukcije, osnovanog 1958. god., bio je prof. Drago Kunstelj. Od 1997. Zavod za zavarene konstrukcije čine Katedra za zavarene konstrukcije i Katedra za zaštitu materijala. U Zavodu se odvija nastava u sklopu preddiplomskoga, diplomskoga i poslijediplomskog studija i znanstvenoistraživački rad. U Zavodu, odnosno na katedrama diplomiralo je nekoliko stotina inženjera, znanstveni magisterij steklo je nekoliko desetaka polaznika, a doktorat je obranilo petnaestak znanstvenika. Teorijska nastava i praktični dio u dobro organiziranom Laboratoriju za zavarivanje i Laboratoriju za zaštitu materijala na visokoj su razini.

## Katedra za zavarene konstrukcije

Katedra za zavarene konstrukcije uz edukaciju studenata sudjeluje i u ospozobljavanju EWE, EWT, EWS kadra prema programu EWF. U suradnji s privredom ostvareni su mnogi značajni projekti i provedena unapređenja u izradbi konstrukcija zavarivanjem i srodnim tehnologijama. Od 1974. godine do danas Katedra za zavarene konstrukcije (u okviru Fakulteta) ovlaštena je institucija za ocjenu sposobnosti pogona za izradbu konstrukcija zavarivanjem prema usvojenim normama. Na Katedri je zaposleno 10 djelatnika, znanstvenika, suradnika i drugog tehničkog osoblja.

Katedra za zavarene konstrukcije dugi niz godina njeguje suradnju s privredom koja obuhvaća:

- certifikaciju postupaka zavarivanja
- certificiranje zavarivača
- ispitivanje zavarljivosti i razvoj tehnologija zavarivanja različitih proizvoda i objekata
- zavarivački nadzor nad izgradnjom različitih objekata (mostovi, spremnici, cjevovodi, nosive konstrukcije)
- certificiranje tvrtki shodno nizu normi HRN EN ISO 3834:2007, certifikaciju tvorničke kontrole proizvodnje shodno HRN EN 1090-1:2012 normi, certifikaciju shodno HRN EN 15085-2:2008 normi
- ospozobljavanje zavarivača prema programu EWF kojim se stječe kvalifikacija europskog zavarivača u suradnji s Hrvatskim društvom za tehniku zavarivanja.

Od 2015. god. osnivanjem odjela FSB-ZK Cert Katedra za zavarene konstrukcije postaje tijelo za ocjenu sukladnosti za građevne proizvode (čelične i aluminijuske konstrukcije).

# Department of Welded Structures

The Department of Welded Structures was developed from the Department of Mechanical Technology, founded at High Technical School in the academic year 1922. The first head of the Department of Welded Structures, founded in 1958, was Professor Drago Kunstelj. Since 1997 the Department consists of two chairs: Chair of Welded Structures and Chair of Materials Protection. The Department is concerned with the education of students at undergraduate, graduate and postgraduate studies. It is also involved in research. Several hundreds of students have obtained a Bachelor's degree; while several dozen have won their Master's and about fifteen of them have been awarded their doctor's degree at the Department. High level of theoretical teaching and practical part are conducted at well organised Welding Laboratory and Materials Protection Laboratory.

## The Chair of Welded Structures

The Chair of Welded Structures is concerned with the students' education and training for the EWE, EWT, EWS qualifications according to EWF programme. A number of significant projects have been carried out in cooperation with industry, as well as advancements made in the fabrication of structures using welding and related technologies. Since 1974 the Chair has been accredited for carrying out the assessment of plants' competence to fabricate welded structures in compliance with the established norms and standards. It employs 10 people, including researches, research associates and technical staff.

The Chair of Welded Structures for many years fosters collaboration with industry which includes:

- certification of welding procedure
- certification of welders
- testing weldability and development of welding technologies of different products and objects
- supervision of welding operations in the fabrication of structures, such as bridges, storage tanks, pipelines, supporting structures
- certification of the number of companies according to the HRN EN ISO 3834:2007, certification of plant production control according to the HRN EN 1090-1:2012 standard, certification according to the HRN EN 15085-2:2008 standard
- education of welders, according to EWF programme, for the qualification of European welders in collaboration with Croatian Welding Society.

After the FSB-ZK Cert was founded in 2015, the Chair of Welded Structures becomes the body for Conformity Assessment of Construction Products (steel and aluminium structures).

## Katedra za zaštitu materijala

Katedra za zaštitu materijala proistekla je iz Laboratorija za zaštitu materijala osnovanog 1961. godine, čije osnivanje je inicirao i više desetljeća vodio prof. dr. sc. Ivan Esih. Nastavna i znanstvenoistraživačka djelatnost Katedre usmjerena je k izučavanju složenih korozijskih fenomena na metalnim materijalima te mogućnosti njihova izbjegavanja.

Osim toga, razvijaju se znanja iz područja metoda zaštite od korozije, a posebno zaštite industrijskim premazima nove generacije i smanjenja njihovoga štetnog utjecaja na okoliš.

Na Katedri za zaštitu materijala uz nastavne aktivnosti provode se znanstvena istraživanja i suradnja s privredom u okviru koje su riješeni mnogobrojni problemi koji su uzrokovali korozijska razaranja, a rezultati provedenih ispitivanja i ekspertiza priznati su u praksi. Za stručnjake iz gospodarstva Katedra kontinuirano organizira seminare i radionice u okviru cjeloživotnog obrazovanja.

Znanstveni i stručni rad Katedre potvrđuju i djela – radovi nastali istraživanjima, od kojih valja posebno istaknuti jedno od kapitalnih izdanja svjetskog izdavaštva na ovom području – Corrosion Atlas, koji uključuje i radove nastale na Katedri za zaštitu materijala s područja određivanja uzroka nastanka korozijskih oštećenja u području zavarenih spojeva konstrukcija od nehrđajućih čelika.

U okviru Katedre djeluje Laboratorij za zaštitu materijala, koji je u proteklih deset godina osjetno osvremenjen novom ispitnom opremom. Komora za ispitivanje u slanoj atmosferi, vlažna komora, UV komora, uređaj za ispitivanje naizmjeničnim uranjanjem, stereomikroskop, prijenosni uređaj za XRF kemijsku analizu metala i polimera, stanica za elektrokemijska korozijska ispitivanja, što sve omogućuje, uz ostalu opremu, provedbu raznovrsnih korozijskih ispitivanja. Karakterizacija korozijskih procesa na granicama faza metal/elektrolit provodi se elektrokemijskom impedancijskom spektroskopijom. Laboratorij je opremljen i opremom za fizikalna ispitivanja zaštitnih premaza u laboratoriju i na terenu.

## Katedre

- Katedra za zavarene konstrukcije  
[www.fsb.unizg.hr/zavarivanje/](http://www.fsb.unizg.hr/zavarivanje/)
- Katedra za zaštitu materijala  
[www.fsb.unizg.hr/korozija/](http://www.fsb.unizg.hr/korozija/)

## Chair of Materials Protection

The Chair of Materials Protection, founded in 1961, has developed from the Welded Structures Laboratory. Professor Ivan Esih, PhD, was the initiator and was appointed the first head of the Chair for several decades. Both, the teaching and research activities are targeted at the study of complex corrosion phenomena on metals and the methods for reducing the danger of corrosion damage.

Besides, the Chair develops new knowledge in the areas of corrosion protection, and in particular in the areas of a new generation of industrial protective coatings and the reduction of their adverse environmental impact.

Besides teaching, the Chair conducts researches and successfully cooperates with industry within which many issues that have caused corrosion destruction have been solved and the validity of the research results have been proven in practice.

Scientific and professional activities of the Chair have been confirmed by numerous contributions the experts of the Chair have made in this field. However, a special emphasis should be placed on the works in the analysis of corrosion damage causes in stainless welds, included in Corrosion Atlas, a seminal work in the field.

In the past ten years, the Materials Protection Laboratory has been significantly upgraded through the acquisition of new testing equipment such as a chamber for testing in salt atmosphere, a humidity chamber, a UV chamber, a device for alternating submerging, stereo-microscope, portable XRF analyser of metals and polymers, a station for electrochemical corrosion testing. This equipment, along with the hardware, allows for a wide range of corrosion testing. The characterisation of corrosion processes at metal / electrolyte phase boundaries is performed by electrochemical impedance spectroscopy. The Laboratory is also equipped with the equipment for testing protective coatings in the laboratory and the field.

## Chairs

- Chair of Welded Structures  
[www.fsb.unizg.hr/zavarivanje/](http://www.fsb.unizg.hr/zavarivanje/)
- Chair of Materials Protection  
[www.fsb.unizg.hr/korozija/](http://www.fsb.unizg.hr/korozija/)



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## Zavod za tehnologiju

Zavod za tehnologiju sljednik je Zavoda za mehaničku tehnologiju osnovanoga godine 1922. pri Tehničkoj visokoj školi. Današnju strukturu stekao je 1997.

Sa svoje četiri katedre sudjeluje u nastavnom programu sveučilišnoga preddiplomskog studija strojarstva u svih devet smjerova te studiju zrakoplovstva.

Glavnina nastave na diplomskom studiju izvodi se na smjerovima Proizvodno inženjerstvo i Računalno inženjerstvo, a u manjoj mjeri i na Konstrukcijskom smjeru. Nastava se provodi i na Studiju dizajna na Arhitektonskom fakultetu u Zagrebu.

Zavod sudjeluje i na poslijediplomskom doktorskom studiju i poslijediplomskom specijalističkom studiju Fakulteta strojarstva i brodogradnje na smjeru Napredne proizvodne tehnologije.

Na Katedri za ljevarstvo provodi se nastava, izrada završnih i diplomskih radova, znanstvenoistraživački rad te suradnja s privredom. Rad Katedre usmjeren je na izučavanje ljevačkih svojstava materijala, probleme degeneracije tvorbe grafita nodularnog lijeva te primjenu računalnog paketa u predviđanju tijeka lijevanja, skrućivanja i dobivanja odljevaka bez grešaka. U radu znanstvenih djelatnika Katedre te studenata, neizostavan je Laboratorij za ljevarstvo koji omogućuje praktični rad u rješavanju problema s kojima se susrećemo u tehnologiji lijevanja, opremljen induktijskom i elektrotopornom peći, mješalicom i opremom za ručno kalupljenje te softverom za simulacije lijevanja, skrućivanja i predviđanja poroznosti QuikCAST.

Katedra za oblikovanje deformiranjem osnovana je prije približno četrdeset pet godina kao prva katedra takve djelatnosti u ovom dijelu Europe. Znanstvena djelatnost odnosi se na istraživanje ponašanja metala u deformacijskim postupcima te na građu i značajke strojeva i alata za oblikovanje deformiranjem. Istraživanja su teorijska, model-ska i prototipna, a mogućnosti eksperimentalnog rada na osnovnim deformacijskim strojevima i uređajima, kao što su eksperimentalni gravitacijski bat, laboratorijske hidraulične preše i posebno prilagođeni uređaji, pruža Laboratorij za oblikovanje deformiranjem. Suradnja s industrijom odnosi se na zadatke manjeg opsega vezane uz tekuću proizvodnju, ali i na veće stručne zadatke u obliku ekspertiza za novu proizvodnju ili idejnu razradbu parametara za novi stroj.

Katedra za alatne strojeve osnovana je 1920. godine u sklopu Tehničkog fakulteta u Zagrebu. U sastavu Katedre su Laboratorij za alatne strojeve i Laboratorij za medicinsko inženjerstvo.

Laboratorijski su opremljeni klasičnim i CNC strojevima, sustavima za digitalizaciju i mjernom opremom što pruža dobre uvjete za nastavu,

## Department of Technology

The Department of Technology, began in 1922 as the Institute of Mechanical Technology at the Technical College. Its present-day organizational structure was created in 1997.

The Department comprises four chairs that are involved in teaching the undergraduate studies of the mechanical engineering course, all nine specializations, as well as of the aeronautical engineering course.

The majority of the graduate study programmes are taught in the specializations of Production Engineering and Computer Engineering while others are taught in the Engineering Design specialization.

The staff teach at the School of Design, Faculty of Architecture, and in the postgraduate doctoral study in the Advanced Production Technologies specialization at the Faculty of Mechanical Engineering and Naval Architecture.

The Foundry Chair is engaged in teaching, auditing students in writing their undergraduate and Master's theses, research and collaboration with industry. The research is focused on studying material castability, issues related to the degeneration of nodular cast iron graphite formation and application of computer software for the prediction of casting processes, solidification and fabrication of defect-free castings. The Foundry Laboratory, equipped with an induction and resistance furnace, mixing and manual moulding equipment as well as with software for casting simulation, solidification and prediction of QuikCAST porosity, enables both the researchers and the students to find solutions for problems occurring in casting technology.

The Chair of Metal Forming, founded around forty years ago, was, at that time, the first of its kind in this part of Europe. It is focused on doing research on metal behaviour in metal forming processes and the design and characteristics of metal forming machines and tools. The research is aimed at developing theories, models and prototypes. The Metal Forming Laboratory supports experimental work done on basic metal forming machines and devices, such as experimental gravity hammer, laboratory hydraulic press and other specially modified devices. The Chair has been collaborating with industry on both minor tasks related to current production and on major tasks which require specialist expertise in innovative production or conceptual development of basic parameters for new machines.

The Chair of Machine Tools was founded at the Technical College in 1920. It comprises the Machine Tool Laboratory and the Medical Engineering Laboratory.

The Laboratories are equipped with conventional machines and the CNC machines, digitalization systems and measuring equipment which pro-

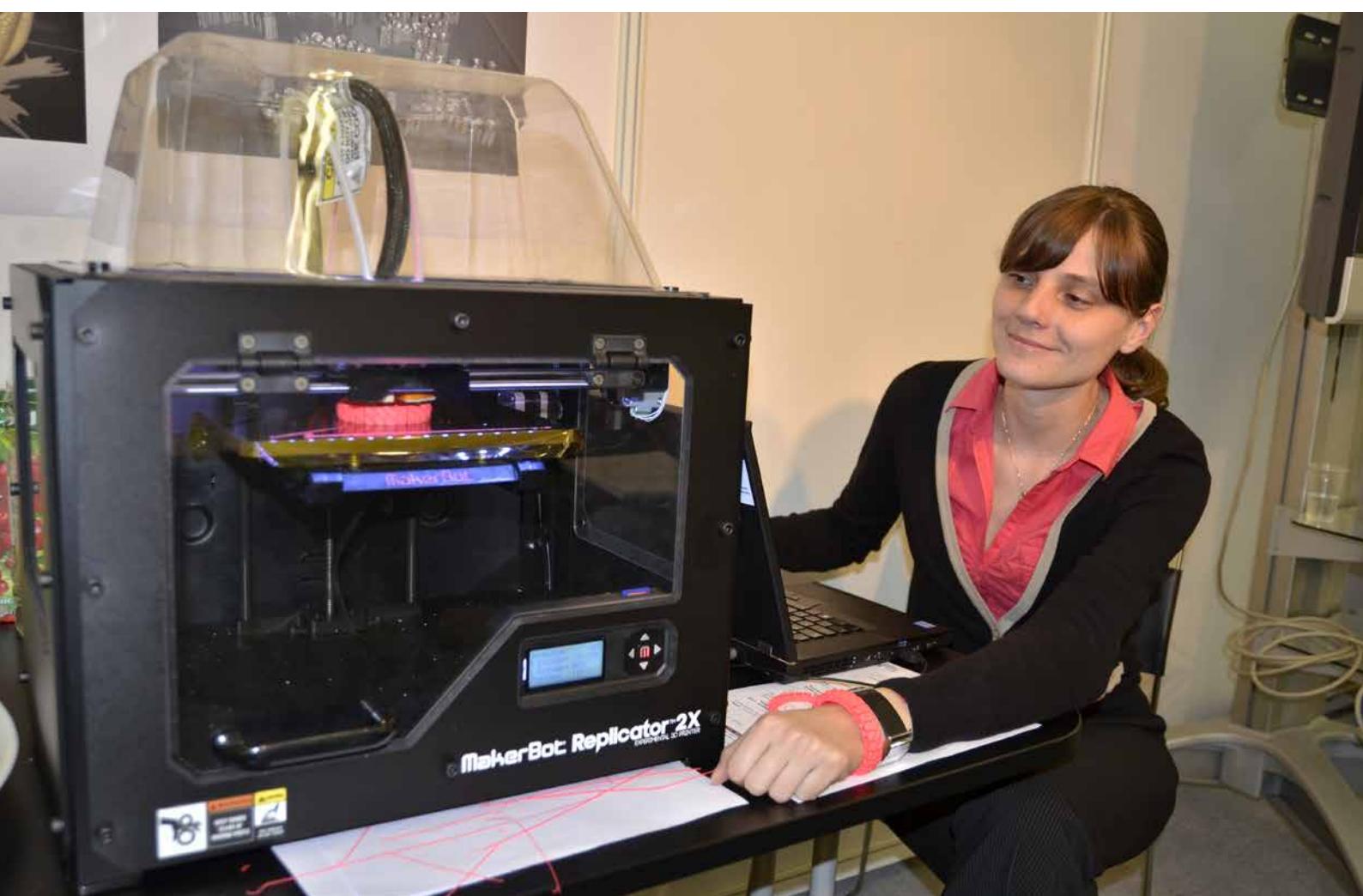
istraživački rad i suradnju s gospodarstvom. U okviru Katedre ostvareni su brojni istraživački i tehnologički projekti, a velika podrška daje se realizaciji projekata studentskih udruga našega Fakulteta. Posljednjih godina intenzivno se radi na istraživanjima u području autonomnosti obradnih sustava i u medicinskom inženjerstvu, uza suradnju s istraživačima s drugih zavoda, liječnicima i tvrtkama iz gospodarstva Republike Hrvatske. Katedra je nositelj organizacije CIM savjetovanja i Hrvatske udruge proizvodnoga strojarstva.

O polimerima i njihovoj preradi podučava se na ovom fakultetu već više od šezdeset godina, a u tom razdoblju načinjeno je više od petsto diplomskih i završnih radova. U sklopu Katedre za preradbu polimera i drva djeluje Laboratorij za preradbu polimera i drva koji je uključen u rješavanje praktičnih problema s područja preradbe polimera. Godine 2013. osnovan je Centar za aditivne tehnologije u kojem su smještene tri stroja za aditivnu proizvodnju i kidalica za ispitivanje mehaničkih svojstava polimernih proizvoda. Djelatnici Katedre surađuju u uređivanju znanstvenih i stručnih časopisa s područja polimerstva i aktivno sudjeluju na mnogobrojnim savjetovanjima u zemlji i inozemstvu, a trajni društveni zadatak je suradnja s nizom tvrtki.

vide for teaching activities, research and collaboration with industry. A large number of research and technology projects have been carried out at the Chair. In addition, the Chair has been supporting the projects run by student associations at the Faculty. In collaboration with researchers from other departments, doctors and companies across the Republic of Croatia, extensive research on manufacturing systems autonomy and medical engineering has been done at the Chair in recent years.

Polymers and polymer processing have been studied at the Faculty of Mechanical Engineering and Naval Architecture for over sixty years. More than five hundred undergraduate and Master's theses have been completed during that period. The Polymer and Wood Processing Laboratory, which is part of the Chair of Polymer and Wood Processing, deals with practical issues in polymer processing. The Centre for Additive Technologies, which houses three machines for additive manufacturing and a universal tester for testing mechanical properties of polymer products, was established in 2013. The teaching staff collaborate with editorial boards of scientific and professional journals in the field of polymer processing and they actively participate in numerous conferences in the country and internationally. The Chair's permanent social mission is to achieve successful collaboration with industry.







# Zavod za zrakoplovno inženjerstvo

## Opis i strategija Zavoda za zrakoplovno inženjerstvo

Jedna od primarnih zadaća Zavoda za zrakoplovno inženjerstvo je koordinacija Studija zrakoplovstva na Fakultetu strojarstva i brodogradnje, izvođenje nastave tog Studija te općenito briga o djelatnostima studenata zrakoplovstva na Fakultetu.

Nastavnici i asistenti Zavoda izvode nastavu u okviru niza predmeta preddiplomskoga i diplomskog dijela Studija zrakoplovstva u više nastavnih cjelina: aerodinamika i mehanika leta, konstrukcija letjelica, vođenje i upravljanje letjelicama, dinamička i statička analiza zrakoplovnih konstrukcija, numeričke metode u analizi zrakoplovnih i svemirskih konstrukcija te drugim područjima.

Objekti analize u nastavi Studija zrakoplovstva, jedinog studija zrakoplovnog inženjerstva u Republici Hrvatskoj, su zrakoplovi, helikopteri, projektili i svemirske letjelice. Značajan korak Zavoda u smjeru unaprjeđenja znanstvenog polja zrakoplovstva, raketne i svemirske tehnike je pokretanje smjera Zrakoplovnog inženjerstva u okviru novoga poslijediplomskoga doktorskog studija na Fakultetu čime se, po prvi put u RH, omogućuje stjecanje znanstvenog stupnja doktora znanosti u području zrakoplovnog inženjerstva.

U okviru znanstvenoistraživačkih i stručnih aktivnosti na Zavodu provode se znanstveni i stručni projekti u području dinamike zrakoplovnih i svemirskih konstrukcija i dinamike letjelica i numeričkih algoritama mehanike više tijela, kao i novih računalnih i eksperimentalnih metoda u aerodinamici.

Nadalje, znanstvene i stručne aktivnosti obuhvaćaju analizu konstruktivnih elemenata zrakoplovnih konstrukcija s naglaskom na mehanički kompozitnih i drugih naprednih materijala te istraživanju životnog vijeka i integriteta konstrukcija uz upotrebu numeričkih metoda mehaničke analize konstrukcija. Pokretanje novih projekata, daljnje unaprjeđenje nastave te općenito razvoj područja zrakoplovnog inženjerstva dugo-ročna je strategija Zavoda.

Web-stranica Zavoda:

[www.fsb.unizg.hr/aero](http://www.fsb.unizg.hr/aero)

Portal za sadašnje, buduće i bivše studente zrakoplovstva:

[www.fsb.unizg.hr/zrakoploving](http://www.fsb.unizg.hr/zrakoploving)

# Department of Aeronautical Engineering

## About the Department of Aeronautical Engineering and its strategy

The Department of Aeronautical Engineering is involved in the coordination of the Aeronautical Engineering course at the Faculty of Mechanical Engineering and Naval Architecture, teaching in this course and it caters for various students' activities at the Faculty.

The Department's teaching staff and assistants teach a number of undergraduate and graduate study programmes in the Aeronautical Engineering course, such as aerodynamics and flight mechanics, flight vehicle design, flight vehicle guidance and control, dynamic and static analysis of aircraft structures, numerical methods in the analysis of aircraft and spacecraft structures, etc.

In the Aeronautical Engineering course, one of its kind in the Republic of Croatia, analyses of aircraft, helicopters, missiles and spacecraft are carried out.

The Department has significantly contributed to improvements in the scientific field of aeronautical, rocket and aerospace engineering by having initiated a new postgraduate doctoral study programme within the Aeronautical Engineering course at the Faculty. For the first time in Croatia, students are given an opportunity to gain a PhD title upon completion of the doctoral degree.

The Department is also involved in scientific and professional projects in aircraft and spacecraft structure dynamics, flight vehicle dynamics, numerical algorithms of multibody mechanics as well as in new computational and experimental methods in aerodynamics.

It is also engaged in the analysis of aircraft structure design components. Special emphasis is put on mechanics of composites and other advanced materials and research on structural health and design life of aircraft structures, using numerical methods in mechanical analysis of structures. In the long term, the Department's mission is to initiate new projects, further improve teaching and, generally, contribute to further progress in the field of aeronautical engineering.

Department's website:

[www.fsb.unizg.hr/aero](http://www.fsb.unizg.hr/aero)

Portal for current and future students and alumni:

[www.fsb.unizg.hr/zrakoploving](http://www.fsb.unizg.hr/zrakoploving)

## **Popis katedri i laboratoriјa**

- Katedra za zrakoplovne konstrukcije  
[www.fsb.unizg.hr/aero/kated\\_aerodin.html](http://www.fsb.unizg.hr/aero/kated_aerodin.html)
- Katedra za dinamiku letjelica  
[www.fsb.unizg.hr/aero/kated\\_dinletjel.html](http://www.fsb.unizg.hr/aero/kated_dinletjel.html)
- Laboratorij za dinamiku letjelica i konstrukcijskih sustava  
[www.fsb.unizg.hr/aero/kated\\_dinletjel\\_lab.htm](http://www.fsb.unizg.hr/aero/kated_dinletjel_lab.htm)

## **Posebnosti Zavoda za zrakoplovno inženjerstvo**

Kao jedini sveučilišni zavod u RH u području zrakoplovnog inženjerstva, Zavod za zrakoplovno inženjerstvo intenzivno promiče znanstveni i stručni rad u suradnji s relevantnim zrakoplovnim i znanstvenostručnim partnerima (MZOŠ, MORH, CA, Agencija za istraživanje zrakoplovnih nesreća, Hrvatska agencija za civilno zrakoplovstvo i dr.).

U tom je smislu pokrenuto više znanstveno-tehnologičkih projekata te su izvršene brojne stručne studije. Zavod se ističe u međunarodnim istraživanjima, pri čemu je uspostavljena znanstvena suradnja s najznačajnijim institutima EU-a i SAD-a u zrakoplovnom inženjerstvu i računalnoj mehanici.

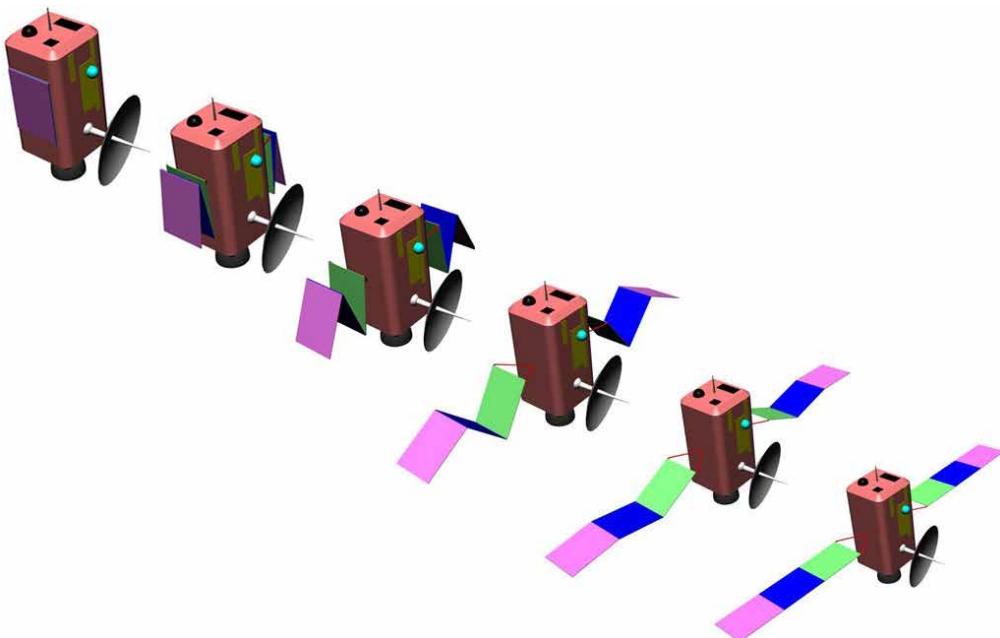
## **Chairs and laboratories**

- Chair of Aircraft Structures  
[www.fsb.unizg.hr/aero/kated\\_aerodin.html](http://www.fsb.unizg.hr/aero/kated_aerodin.html)
- Chair of Flight Vehicle Dynamics  
[www.fsb.unizg.hr/aero/kated\\_dinletjel.html](http://www.fsb.unizg.hr/aero/kated_dinletjel.html)
- Laboratory for Flight Vehicle and Multibody System Dynamics  
[www.fsb.unizg.hr/aero/kated\\_dinletjel\\_lab.htm](http://www.fsb.unizg.hr/aero/kated_dinletjel_lab.htm)

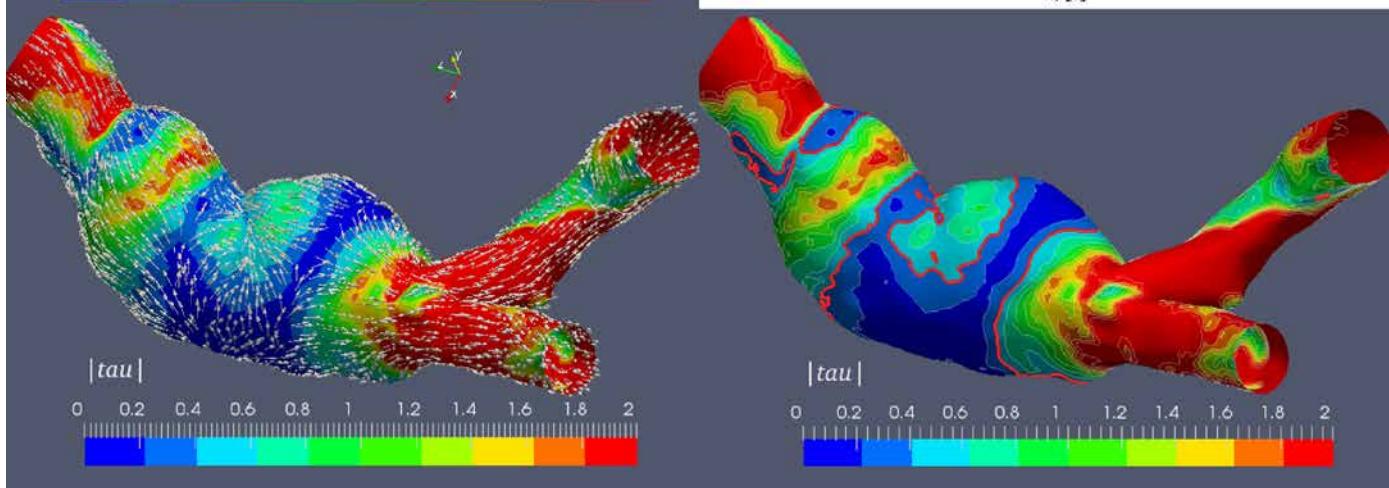
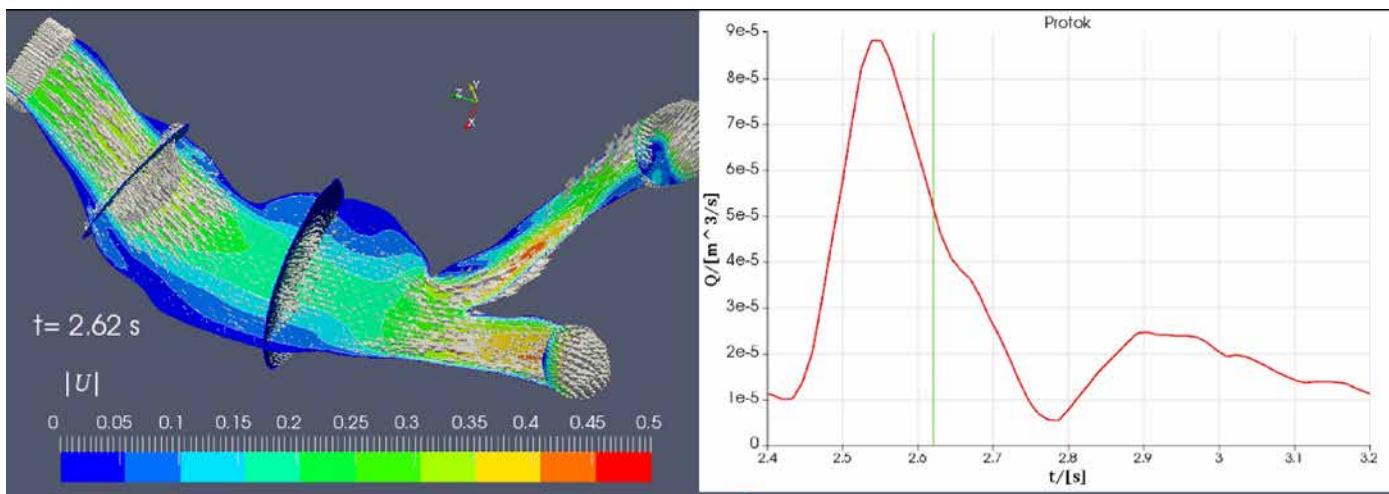
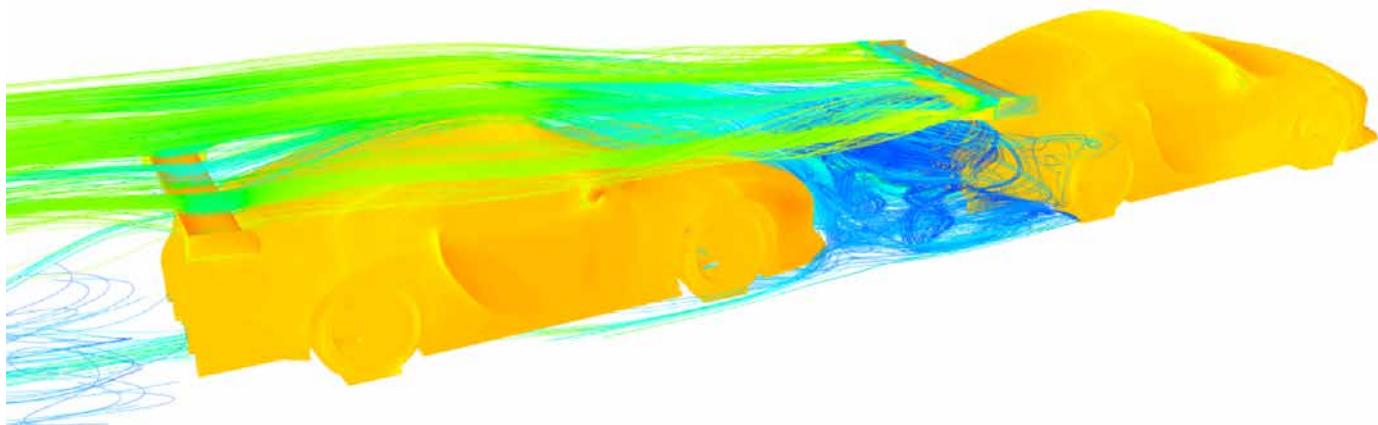
## **Distinctive features**

Being the only university department of aeronautical engineering in the Republic of Croatia, the Department strongly promotes research and teaching in collaboration with the key partners in the field – the Ministry of Science, Education and Sport, the Ministry of Defence, Croatia Airlines, the Air Accidents Investigation Agency, Croatian Civil Aviation Agency, etc.

In doing so, the Department has initiated a number of research and technology projects and carried out numerous professional studies. The Department, as an academic institution well-known for its excellence in international research, collaborates with the most important institutes in the European Union and the USA in the fields of aeronautical engineering and computational mechanics.







## Zavod za mehaniku fluida

Mehanika fluida je grana fizike koja je temeljna za studije strojarstva, brodogradnje, građevinarstva i zrakoplovнog inženjerstva. Težište aktivnosti Zavoda za mehaniku fluida je u teorijskom, eksperimentalnom i računalnom pristupu mehanici fluida, što uključuje modeliranje turbulentcije i rješavanje stacionarnoga i nestacionarnog strujanja kapljevinu i plinova uz izmjenu topline i promjenu agregatnog stanja u tehničkim, prirodnim i biomedicalnim znanostima. Pri tome se u računalnom pristupu koriste vlastito razvijeni i komercijalni računalni programi.

U okviru nastavne djelatnosti Zavod izvodi temeljnu nastavu iz mehanike fluida za sve smjerove studija strojarstva i zrakoplovнog inženjerstva te sudjeluje u stručnim kolegijima Procesno-energetskog smjera i smjera Inženjersko modeliranje i računalne simulacije, u kojem je Zavod jedan od glavnih nositelja.

Istraživačka i stručna djelatnost te dio stručne nastave odvija se u okviru dvije katedre. Aktivnosti Katedre za računalnu mehaniku fluida obuhvaćaju primjenu mehanike fluida:

- u analizi stacionarnoga i nestacionarnog strujanja kapljevinu i plinova u složenim cjevnim mrežama (vodovodima, plinovodima, naftovodima, toplovodima, ...), što uključuje dimenzioniranje mreža, analizu njihovih transportnih mogućnosti, projektiranje pumpne stanice i zaštitu od hidrauličkog udara
- u modeliranju srčane cirkulacije (analizi širenja valova tlaka i protoka u velikim arterijama) i primjenu računalne dinamike fluida u razvoju umjetne srčane pumpe
- u matematičkom modeliranju i simulaciji različitih problema sa strujanjem fluida i izmjenom topline.

Aktivnosti Katedre za aerodinamiku okoliša i konstrukcija usmjereni su na karakterizaciju strujanja vjetra u donjim slojevima atmosfere, dje-lovanje vjetra na konstrukcije i vozila, iskorištanje energije vjetra i drugih obnovljivih izvora energije te širenje plinova i disperziju čestica u urbanim sredinama. Aktivnosti se provode mjerjenjima u prirodi i modelskim ispitivanjima u zračnim tunelima i drugim tipovima laboratorijskih te razvojem računalnih modela. Uza skupine sa Sveučilišta u Zagrebu, npr. Geofizički odsjek Prirodoslovno-matematičkog fakulteta, aktivnosti se provode u suradnji s relevantnim inozemnim sveučilištima i istraživačkim institutima, uključujući:

- Sveučilište u Firenci, Italija
- Sveučilište Notre Dame, SAD
- Institut za teorijsku i primjenjenu mehaniku u Pragu, Česka
- Sveučilište Newcastle, Velika Britanija
- Tehničko sveučilište u Münchenu, Njemačka.

## Department of Fluid Mechanics

Fluid mechanics, a branch of physics, is fundamental to studying mechanical engineering, naval architecture, civil engineering and aeronautical engineering. The Department of Fluid Mechanics is focused on theoretical, experimental and computational approaches to fluid mechanics, including turbulent flow modelling and finding solutions for steady and unsteady flow of liquids and gases which involve heat exchange and phase change, in engineering, natural and biomedical sciences. In doing so, both the Department's in-house software programs and commercial packages are used.

The Department is involved in teaching the fundamental programmes in fluid mechanics for all specializations in the mechanical engineering and aeronautical engineering courses. It also takes part in teaching professional programmes of the specializations Process and Energy Engineering and Engineering Modelling and Computer Simulation, as one of the departments in charge.

It comprises two chairs dedicated to research and teaching. The Chair of Computational Fluid Mechanics is involved in the application of fluid mechanics in:

- analysis of steady and unsteady flow of liquids and gases in complex networks of piping (water piping, gas piping, oil piping, hot water systems...), including network sizing, analysis of their transfer capacities, pumping station design and hydraulic impact protection
- cardiovascular circulation modelling (analysis of pressure and flow waveform propagation in large arteries) and application of computational fluid dynamics in the development of artificial heart pump
- mathematical modelling and simulation of various problems related to fluid flow and heat exchange.

The Chair of Environmental and Structural Aerodynamics is engaged in wind flow characterization in lower atmospheric layers, wind impact on structures and vehicles, application of wind energy and other renewable energy sources as well as gas expansion and particle dispersion in urban areas. The research includes measurements done in nature, model testing done in wind tunnels and other types of laboratories as well as developing computational models. Besides the collaboration with other faculties and their departments within the University of Zagreb, e.g. the Department of Geophysics at the Faculty of Natural Sciences and Mathematics, our Department also collaborates with eminent universities and research institutes internationally, including the following ones:

- University of Florence, Italy
- University of Notre Dame, USA
- Institute for Theoretical and Applied Mechanics, Prague, Czech Republic

Najnovija saznanja prikupljena istraživačkim radom izravno se uključuju u nastavne sadržaje i primjenjuju u praksi.

#### Katedre

- Katedra za računalnu mehaniku fluida
- Katedra za aerodinamiku okoliša i konstrukcija

#### Laboratorijski

- Laboratorij za hidromehaniku i hidrauličke strojeve (zajednički laboratorij s Katedrom za turbostrojeve Zavoda za energetska postrojenja, energetiku i ekologiju)
- Laboratorij za umjetnu kardiovaskularnu cirkulaciju

#### Posebnosti Zavoda

Nastavnici Zavoda su vodeći stručnjaci u područjima računalne i eksperimentalne dinamike fluida te su putem nastave na diplomskom i doktorskom studiju obrazovali generacije vrsnih stručnjaka. Primjeri projekata izvedenih uz pomoć računalnog pristupa na Zavodu su: optimizacija bubregrana na autocesti Rijeka-Zagreb, simulacija gašenja električnog luka u visokonaponskim prekidačima, simulacija procesa kontinuiranog lijevanja, simulacija utjecaja toplovoda na zagrijavanje električnih kabela položenih paralelno s toplovodom, simulacija strujanja dimnih plinova u ispuhu plinske turbine itd.). U okviru Zavoda sustavno se istražuju i rješavaju problemi aerodinamike okoliša i konstrukcija, uključujući: sigurnost i zaštitu cestovnih vozila i vlakova zbog djelovanja bočnog vjetra; optimiranje pozicije i opterećenje vjetroturbina, zgrada i drugih građevinskih objekata složene arhitekture u terenima složene topografije; disperziju štetnih čestica u urbanim okružjima; aerodinamička i aeroelastična opterećenja visećih i ovješenih mostova s pripadajućom nosivom užadi.

Zavod nudi industrijskim klijentima pomoć u razvoju, unaprjeđenju i optimizaciji njihovih proizvoda (povezano sa strujanjem fluida i izmjenom topline) kao i u stručnim vještacanjima i analizi kvarova.

Zavod nudi eksperimentalna ispitivanja ventila i hidrauličkih strojeva u vlastitom laboratoriju kao i računalne simulacije i ekspertizu uz primjenu vlastito razvijenih računalnih programa LIQNET i GASNET za analizu strujanja u složenim cijevnim mrežama.

- Newcastle University, United Kingdom
- Technical University in München, Germany

The state-of-the-art knowledge gained through research is directly introduced into teaching and it is applied in the real-life context.

#### Chairs

- Chair of Computational Fluid Mechanics
- Chair of Environmental and Structural Aerodynamics

#### Laboratories

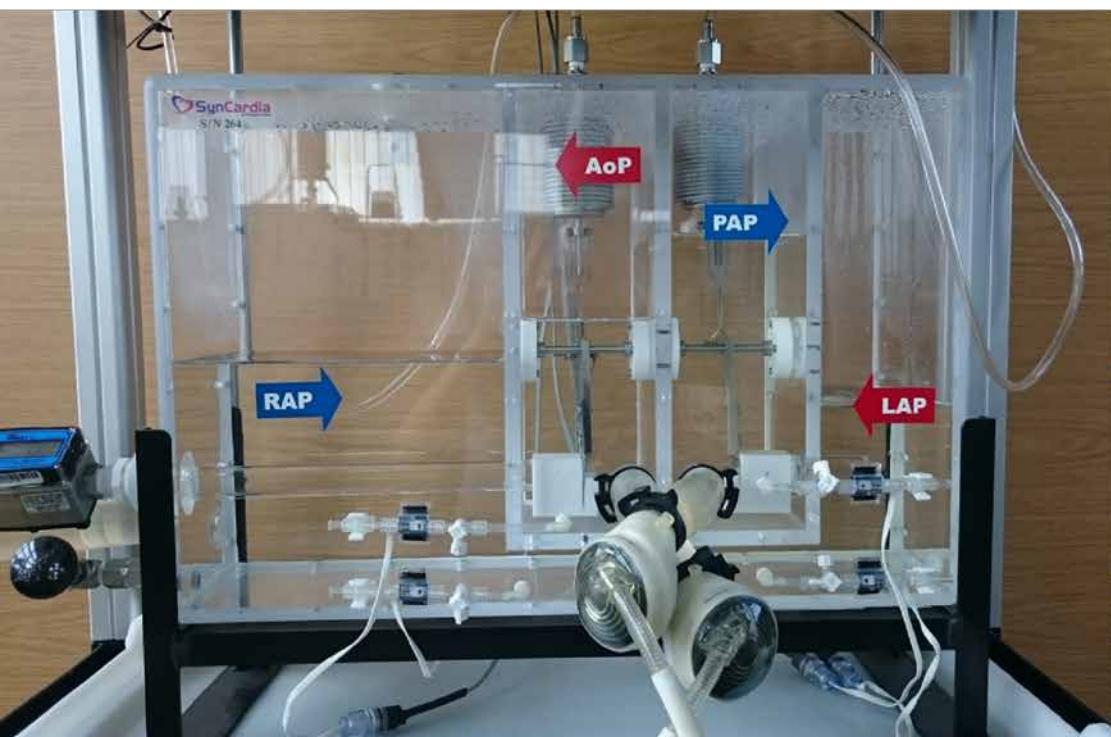
- Hydrodynamics and Hydraulic Machinery Laboratory (a joint laboratory including the Department of Energy, Power and Environmental Engineering, The Chair of Turbomachinery and the Department of Fluid Mechanics)
- Artificial Cardiovascular Circulation Laboratory

#### Dinstinctive features

The Department is the leader in the fields of computational and experimental fluid dynamics. As outstanding teachers and researchers, the Department's staff have educated generations of experts in the field. Some of the projects carried out at the Department are: optimization of the Rijeka-Zagreb motorway wind barriers, simulation of electric arc quenching in high-voltage circuit breakers, simulation of continuous casting process, simulation of water system effect on electrical cables laid on parallel with these systems, simulation of exhaust gases flow at the gas turbine exhaust etc. The Department is dedicated to research and systematically seeks solutions to the problems related to environmental and structural aerodynamics, including road and rail vehicle safety and protection from cross-wind impact, optimization of the positioning and loading of wind turbines, buildings and other structures with complex geometry whose surroundings include complex topography, dispersion of harmful particles in urban surroundings, aerodynamic and aeroelastic loading of suspension and cable-stayed bridges along with their load-bearing stay cables.

The Department collaborates with industry and offers its clients support in the development, improvement and optimization of the products that involve fluid flow and heat exchange. It also offers its expertise and failure analysis assistance.

In addition, it conducts experimental testing of valves and hydraulic machinery in its laboratory and it offers expertise and computational simulations of complex piping network analysis, using the LIQNET and GASNET software which was developed at the Department.



## Samostalne katedre

### Katedra za tehničke strane jezike

Na Katedri za tehničke strane jezike zaposlene su Brankica Bošnjak Terzić, profesorica engleskoga jezika i književnosti i informatologije, dr. sc. Olinka Breka, profesorica engleskoga jezika i sociologije, mr. sc. Vesna Cigan, profesorica engleskoga jezika i književnosti te njemačkoga jezika i književnosti i dr. sc. Snježana Kereković, također profesorica engleskoga jezika i književnosti te njemačkoga jezika i književnosti.

Primarna je djelatnost ove katedre poučavanje pa su nastavnice odgovorne za nastavu tehničkih i poslovnih (engleski, njemački) stranih jezika. Na preddiplomskome studiju predaju obvezne kolegije *Tehnički engleski/njemački jezik* studentima strojarstva koji mogu birati jedan od dvaju navedenih stranih jezika u struci, dok je za studente brodogradnje i zrakoplovstva obvezan kolegij iz tehničkoga engleskog jezika. Poslovni strani jezici predaju se na preddiplomskome odnosno diplomskom studiju kao izborni netehnički kolegiji.

U sklopu kolegija naglasak je stavljen ne samo na lingvističku komponentu stranoga jezika struke već i na specifične jezične vještine potrebne budućem inženjeru u suvremenome poslovnom okružju (npr. prezentiranje sadržaja, kritičko promišljanje sadržaja, argumentiranje, rješavanje problema, pisanje sažetaka i životopisa). Za nastavu su nastavnice izradile materijale s radnim listovima koji se redovito osuvremenuju, a u izradi je i novi udžbenik iz tehničkoga engleskog jezika za studente strojarstva. Nastavu dopunjaju i materijali koje nastavnice kontinuirano pripremaju za portal za e-učenje i koji su na taj način dostupni studentima u svako doba i na svakome mjestu.

Stručni i znanstveni rad odvija se u području jezika strukâ strojarstva, brodogradnje i zrakoplovstva, pri čemu se posebna pozornost obraća metodici nastave tehničkih stranih jezika, strukovnome nazivlju te osobitostima tehničkoga teksta na stranome jeziku. Ostala važna područja stručnoga i znanstvenoga interesa su jezično usvajanje te interkulturna i komunikacijska kompetencija studenata.

Katedra surađuje s više fakulteta, institucija i udruženja u Hrvatskoj. Studenti anglistike Filozofskoga fakulteta u Zagrebu pribivaju nastavi iz tehničkoga engleskog jezika u okviru svojega kolegija metodike engleskoga jezika. Surađnja s izdavačkom kućom Školska knjiga odvija se organiziranjem i održavanjem pozvanih predavanja i radionica. Radionice su u prvoj redu namijenjene kontinuiranoj metodičkoj izobrazbi nastavnika engleskoga jezika. Nastavnice s izdavačkim kućama surađuju i kao recenzentice, autorice su udžbenika i tehničkih rječnika, te prevode i lektoriraju knjige, monografije, rječnike, znanstvene i stručne članke kao i sažetke za niz časopisa (*Transactions of FAMENA, IRT 3000, Hrvatske vode*).

## Independent Chairs

### Chair of Technical Foreign Languages

The teachers of the Chair of Technical Foreign Languages are: BA Brankica Bošnjak Terzić, senior lecturer (English and Information Science), PhD Olinka Breka, senior lecturer (English and Sociology), MSc Vesna Cigan, senior lecturer (English and German) and PhD Snježana Kereković, senior lecturer (English and German).

The teachers are responsible for teaching technical and business foreign languages (English and German). In their undergraduate study students of mechanical engineering choose between the courses in *Technical English or German*, while all students of naval architecture and aeronautical engineering enrol on a course in technical English. Business foreign languages are offered by the Chair as an elective non-technical courses.

The courses focus equally on the linguistic aspect of the foreign technical language and on specific language skills which future engineer will need in the modern business environment (e.g. presenting a project or product, developing critical thinking, outlining the case, problem solving, writing summaries or CVs). The teachers have also compiled course materials and workbooks that are continuously being updated. In addition, the teachers are working on a new English textbook for students of mechanical engineering. Teaching activities are also supplemented by the materials that teachers continually prepare for the e-learning portal and are thus accessible to students at all times and at every place.

Professional activities and research are carried out in the field of the foreign language of each particular profession (mechanical engineering, naval architecture and aeronautical engineering), where special attention is paid to the methods of teaching technical foreign languages, terminology and characteristics of technical texts in the foreign language. Other important fields of interest are language acquisition and student's competence in communication skills.

The teachers cooperate with other faculties, institutions and organisations in Croatia. Students of English at the Faculty of Humanities and Social Sciences in Zagreb attend the lectures of technical English language as a part of their English language methodology course. The cooperation with the publishing house Školska knjiga is realized by organizing and holding invited lectures and workshops. Workshops primarily offer continuous training to teachers of English. The teachers collaborate also with publishers as reviewers and authors of textbooks and technical dictionaries. They also translate and proofread books, monographs, dictionaries, scientific and professional papers as well as summaries for several journals (*Transactions of FAMENA, IRT 3000, Hrvatske vode*).

Website of the Chair: [www.fsb.unizg.hr/tehnicki\\_strani\\_jezici/](http://www.fsb.unizg.hr/tehnicki_strani_jezici/)



## Katedra za matematiku

Katedra za matematiku jedna je od tri samostalne katedre na Fakultetu strojarstva i brodogradnje. Trenutno su na Katedri zaposleni: prof. dr. sc. Sanja Singer, izv. prof. dr. sc. Jadranka Mićić Hot, doc. dr. sc. Julije Jakšetić, mr. sc. Petar Gregorek, pred., dr. sc. Paola Glavan, Iva Kasum, mag. mat., Ana Klobučar, mag. rač. i mat., Neven Krajina, mag. rač. i mat., Ivana Radišić, mag. mat. i Saša Stanko, mag. rač. i mat. Nastavna djelatnost zaposlenika Katedre vezana je uz temeljne matematičke kolegije bitne za razvoj i razumijevanje tehnike i izvodi se na preddiplomskoj, diplomskoj i poslijediplomskoj razini. U preddiplomskom studiju matematika je zastupljena kolegijima na prve dvije godine studija, gdje se predaju osnove diferencijalnoga i integralnog računa, linearne algebre, vjerojatnosti i statistike, vektorske analize, numeričke matematike i kompleksne analize. U okviru diplomskog studija djelatnici Katedre nositelji su dvaju kolegija – Matematike IX. i Teorije odlučivanja. Na poslijediplomskom studiju članovi Katedre izvode nastavu iz kolegija Numerička linearna algebra koji doktorandima daje uvid u moderne metode znanstvenoga, uglavnom matričnog, računanja.

Znanstvena djelatnost Katedre je vrlo široka. Vezana je uz matematičku logiku, teorijsko računarstvo, funkcionalnu analizu, nejednakosti, algebru, primjenjenu matematiku te numeričku matematiku i parallelno računanje. Djelatnici Katedre članovi su više znanstvenih seminara na PMF–Matematičkom odsjeku. Znanstveni projekti na kojima sudjeluju članovi Katedre su: HRZZ projekt 5435 (2014.–2018.) „Nejednakosti i primjene“ (članovi projekta J. Mićić Hot, J. Jakšetić) te HRZZ projekt IP–2014–09–3670 (2015.–2019.) „Matrične faktorizacije i blok dijagonalizacijski algoritmi“ (članovi projekta S. Singer, N. Krajina i S. Stanko). S. Singer i N. Krajina sudjeluju još i u radu njemačko-hrvatskoga bilateralnog projekta „High-performance tensor contraction“ (2016.–2017.).

## Chair of Mathematics

The Chair of Mathematics is one of three independent chairs at the Faculty of Mechanical Engineering and Naval Architecture. The Chair staff are PhD Sanja Singer, full professor, PhD Jadranka Mićić Hot, associate professor, PhD Julije Jakšetić, assistant professor, MSc Petar Gregorek, lecturer, PhD Paola Glavan, Iva Kasum, mag.math., Ana Klobučar, mag.inf.et math., Neven Krajina, mag.inf.et math., Ivana Radišić, mag.math. and Saša Stanko, mag.inf.et math. Teaching activities of the Chair are related to basic courses in mathematics which are of vital importance for good understanding of engineering and are held at the undergraduate, graduate and postgraduate studies. At the undergraduate study, mathematics is represented by the first and second-year courses in which the essentials of differential and integral calculus, linear algebra, probability and statistics, vector analysis, numerical mathematics and complex analysis are taught. At the graduate study the Chair holds two courses (Mathematics IX and Decision Theory) and the course in Numerical linear algebra at the postgraduate study, which gives PhD candidates better insight into modern methods of scientific, mostly matrix, computing.

Research activities of the Chair are broad. They deal with mathematical logic, theoretical computer science, functional analysis, non-equivalencies, algebra, applied mathematics and numerical mathematics and parallel processing. Members of the Chair are the members of many scientific seminars at PMF- Department of Mathematics. Members of the Chair are the members on the following research projects: HRZZ project 5435 (2014.–2018.) ‘Non-equivalencies and Applications’ (project members: J. Mićić Hot, J. Jakšetić) and HRZZ project IP–2014–09–3670 (2015.–2019.) ‘Factorisation of matrices and block-diagonal algorithms’ (project members: S. Singer, N. Krajina and S. Stanko). S. Singer and N. Krajina also collaborate on the bilateral German-Croatian research project ‘High-performance tensor contraction’ (2016–2017).





### Katedra za tjelesnu i zdravstvenu kulturu

Nastava tjelesne i zdravstvene kulture na Fakultetu strojarstva i brodogradnje organizirano se provodi od 1982. godine. Trenutno su zaposlena dva predavača, Željko Lukenda, prof. i Nenad Zvonarek, prof. Nastava je organizirana u okviru osnovnoga, posebnoga i izbornog programa. Ovi programi provode se u dvorani, na vanjskim terenima i na bazenu. Programi nastave tjelesne i zdravstvene kulture nastali su na osnovi interesa studenata i materijalno-kadrovske uvjeta Fakulteta strojarstva i brodogradnje.

**Osnovni program** nastave tjelesne i zdravstvene kulture izvodi se dva-put na tjedan u trajanju 45-60 minuta. Studenti odabiru jedan program ili više ponuđenih programa kojima će zadovoljiti svoje potrebe za tjelesnom aktivnosti, a ujedno ispuniti i normu od 60 sati nastave tjelesne i zdravstvene kulture u akademskoj godini.

**Izborni program** namijenjen je studentima viših godina studija koji prema vlastitu interesu upisuju predmet Tjelesne i zdravstvene kulture kao izborni predmet i time nastavljaju organizirano vježbanje tijekom studija.

**Posebni programi** namijenjeni su studentima svih godina studija koji pokazuju posebne interese, a koji imaju više znanja i sposobnosti u pojedinim kineziološkim aktivnostima. Ovim programom obuhvaćeni su i studenti koji predstavljaju FSB na različitim sveučilišnim natjecanjima.

### Chair of Physical Education

Teaching activities at the Faculty of Mechanical Engineering and Naval Architecture have continuously been organized since 1982. The Chair staff are BA Željko Lukenda, senior lecturer and BA Nenad Zvonarek, senior lecturer. Teaching activities are organized in three programmes: basic, specialized and elective programmes. The programmes are conducted in a gym, outdoor facilities, and a swimming pool. The programmes have been devised as a result of students' interests, existing facilities and the staff at the Faculty of Mechanical Engineering and Naval Architecture.

**Basic programme** of physical education is carried out twice a week. It lasts 45-60 minutes. The students elect one or more offered programmes in order to meet their needs for physical activities and by doing so they also fill the required 60-hour-quote in an academic year.

**Elective programme** of physical education is intended for senior students who, according to their own interest, select the course of Physical education as an elective subject, thus continuing the organized practice during their studies.

**Specialized programmes** are intended for students who show special interests, and have more knowledge and skills in particular kinesiological activities. These programmes also involve students representing the Faculty at various university competitions.



## **Studentske udruge**

### **Hrvatska studentska asocijacija strojarskih fakulteta (HSA SF)**

HSA SF je studentska udruga koja se bavi projektima tehničke prirode čiji članovi nastoje stići znanje i iskustvo prijeko potrebito za rad nakon završenog fakulteta. Ciljevi udruge jesu povezivanje studenata s profesorima i gospodarstvenicima te povezivanje studenata međusobno. Udruga je osnovana 1995. godine na Fakultetu strojarstva i brodogradnje u Zagrebu te danas okuplja 60-ak članova sa šest fakulteta Sveučilišta u Zagrebu. Projekti HSA SF jesu FSB Karting kup te FSB Racing team, tim studenata koji se bavi konstrukcijom i proizvodnjom bolida za inženjersko natjecanje Formula Student.

### **Hrvatska udruga studenata brodogradnje (HUSB)**

HUSB okuplja sve studente brodogradnje i brodostrojarstva na FSB-u i trenutno broji 32 aktivna člana. Udruga je osnovana 1996. godine radi organiziranja raznih sportsko-društvenih događanja poput Pivskoga kupa te rada na projektima (Brodocikl) s kojima nastupaju na međunarodnom studentskom natjecanju International Waterbike Regatta.

### **Udruga I3**

Osnovana je 2007. godine sa svrhom da informira studente FSB-a o novostima na području strojarstva i njegovih grana. U projektu se izdaju dva časopisa na godinu, odnosno ovisno o tome koliko ima novitet u volontera za rad na časopisu. Osim strojarske tematike pokriva također i sportske događaje te razne evenete.

### **Udruga mehatroničara**

Udruga mehatroničara je neprofitna studentska udruga koja je započela s djelovanjem 2011. godine na Fakultetu strojarstva i brodogradnje u Zagrebu. Udruga okuplja oko 30 mladih i starijih članova. Udruga mehatroničara studentima pruža mjesto i alate za rad te priliku za razvoj vještina sudjelovanjem na projektima tehničke prirode. Tako studenti ispunjavaju svoje potrebe za kreativnošću zabavom i timskim radom te time unaprjeđuju svoja znanja i vještine.

### **UIFSB**

Udruga je osnovana 2006. godine te, a pod paskom Saveza inovatora Zagreba i Hrvatskog saveza inovatora, okuplja studente različitih profila i interesa. Uloga Udruge je približiti pitanje inventivnog rada i zaštite inovacija članovima Fakulteta te im pomoći u koracima zaštite inovacije i njezine realizacije kao komercijalnog proizvoda. Pritom, UIFSB pomaže u pravnoj zaštiti inovacija, organizira dodatno poduzetničko obrazovanje te počne osigurati proračunska sredstva potpore inovatorima članovima.

## **Student Associations**

### **Croatian Student Association of Faculties of Mechanical Engineering (HSA SF)**

HSA SF is a student association that deals with projects of a technical nature. Its members endeavour to acquire knowledge and gain valuable experience useful for performing tasks in the workplace after graduating from the Faculty. The Association aims to facilitate the continuing communication among students and connect them with professors and entrepreneurs. The Association was founded in 1995 at the Faculty of Mechanical Engineering and Naval Architecture in Zagreb and today it brings together about sixty members from six faculties of the University of Zagreb. The projects the HSA SF is particularly proud of are FSB Carting Cup and FSB Racing Team, engaging a team of students in the engineering design and production of a car for Formula Student engineering competition.

### **Croatian Association of Students of Naval Architecture (HUSB)**

HUSB brings together all students of naval architecture and naval mechanical engineering at the Faculty of Mechanical Engineering and Naval Architecture and has today a membership of 32 active members. The Association was founded in 1996 with the aim to organize various sport and social events like Pivski kup (Beer Cup) and other projects (Waterbike) with which they participate in the international student competition International Waterbike Regatta.

### **Association I3**

The Association I3 was founded in 2007 with the aim to inform the students of the Faculty of Mechanical Engineering and Naval Architecture about the latest developments in the mechanical engineering and its branches. Two journals are issued annually, depending on the number of volunteers and how much novelty needs to be published. In addition to topics in mechanical engineering, sport and other events are also reported.

### **Association of Students of Mechatronics**

The Association of Students of Mechatronics is a non-profit organisation founded in 2011 at the Faculty of Mechanical Engineering and Naval Architecture in Zagreb. The Association brings together about thirty younger and older members. The Association provides students with a platform and various tools that allow them the opportunity to develop skills by participating in projects of a technical nature. Students engage in creative activities, entertain themselves and work in teams, thus improving their knowledge and skills.

## **FOS FSB**

Fakultetska organizacija studenata Fakulteta strojarstva i brodogradnje, FOS FSB, najstarija je udruga FSB-a, započinje s radom 70-ih godina prošlog stoljeća kako bi ispunila studentske potrebe za izvannastavnim aktivnostima. Od šahovskoga kluba, časopisa Naša nova tribina, organiziranja kino projekcija pa do biblioteke, klub je također bio mjesto dobre zabave gdje se rado svraćalo na šalicu kave. Godine 1996. udruga osniva SRL, Studentski računski laboratorij, koji i danas mogu koristiti svi studenti, bilo za izradu diplomskih ili seminarских radova i programa ili kao mjesto za učenje i druženje.

### **FSB Student Sailing Team**

Studentska jedriličarska posada Fakulteta strojarstva i brodogradnje jedina je posada takve vrste na našem Sveučilištu. Udrugu je 2011. godine osnovalo šest studenata, a danas broji više od trideset članova. Članstvo je vrlo neobavezujuće i slobodno. U posadu se može učlaniti bilo koji student FSB-a, bez obzira na godinu i smjer studija te iskustva u jedrenju i plovidbi. Aktivnosti posade su odlasci na domaće i međunarodne regate.

## **HUSZ**

Hrvatska udruga studenata zrakoplovstva neprofitna je udruga koja djeli na FSB-u. Osnovana je 1999. godine radi povezivanja svih studenata zrakoplovstva u jednu skupinu. Članica je EUROAVIA-e, međunarodnog udruženja studenata zrakoplovstva. Od projekata najbitniji je Air Cargo Challenge, gdje je cilj izraditi bespilotnu radio upravljalu letjelicu najveće moguće nosivosti prema pravilniku. Tu je i FSB-X koji je stručno obrazovno putovanje u svrhu uvida u europsku zrakoplovnu industriju.

## **SIIM**

Udruga SIIM osnovana je 2009. godine na inicijativu studenata smjera Industrijskog menadžmenta s FSB-a. Cilj udruge je unaprjeđenje kvalitete znanja putem raznih seminara, kongresa, radionica te organizacija natjecanja TIMES. Natjecanje TIMES odvija se na području industrijskog inženjerstva u kojem se dobiva konkretni problem te skupina studenata mora predložiti realno rješenje.

## **OMEGA**

Sportska udruga studenata OMEGA osnovana je 1990. godine. Sudjeli u organizaciji tradicionalnih godišnjih sportskih natjecanja: Regate osmeraca strojarskih fakulteta RH, Studenskog relija, Karting kupa FSB-a, Pivskoga kupa, malonogometnog turnira, raftinga te mnogih drugih.

## **UIFSB**

The Association was founded in 2006 under the auspices of the Zagreb Association of Innovators and the Croatian Association of Innovators and serves as a gathering place for students with different preferences, skills and interests. The role of the Association is to familiarize the Faculty members with the inventive work and the protection of innovations, assist them in deciding on the innovation protection methods and in making it commercially available. Furthermore, the UIFSB provides member innovators with the assistance in legal protection issues related to innovations, offers entrepreneurial training and helps in raising budget support funds.

## **FOS FSB**

The Faculty Organisation of Students of the Faculty of Mechanical Engineering and Naval Architecture, FOS FSB, the oldest FAMENA association, has been working since the 70s of the last century to meet student needs for extracurricular activities. With its activities ranging from the chess club, the journal Naša nova tribina (Our New Forum), the organisation of film screening to the library, the club has always been a place of good entertainment students tend to drop into for a nice cup of coffee. In 1996 the Association established the Student Computer Laboratory (SRL) that has been used by students when writing their seminar papers and theses or as a place for studying and meeting other students.

### **FSB Student Sailing Team**

The student sailboat crew of the Faculty of Mechanical Engineering and Naval Architecture is the only crew of this kind at our University. The Association was founded in 2011 by a group of six students, and today it has more than thirty members. The membership is non-binding and entirely free. Any FAMENA student can become a crew member regardless of the year or course of studies and the experience in sailing and navigation. The crew has participated in a number of national and international regattas.

## **HUSZ**

The Croatian Association of Students of Aeronautical Engineering (HUSZ) is a non-profit association active at the Faculty of Mechanical Engineering and Naval Architecture since 1999, when it was established to connect students who share a common interest in aeronautical engineering. The Association is a member of the European Association of Aerospace Students (EUROAVIA). The most important project of the Association is the Air Cargo Challenge, a competition whose objective is to build a radio-controlled unmanned aircraft with the maximum possible payload. Another project is FSB-X, a study tour whose aim is to gain insight into the European aeronautics industry.

## SOME

SOME je udruga studenata inženjerstva materijala, osnovana 2016. godine radi povezivanja svih koji se u svom stručnom, znanstvenom i akademskom radu bave problematikom ispitivanja i razvoja materijala u različitim granama industrije. Iako relativno mlada, udruga uz pomoć fakulteta i studentskog zbora do kraja 2017. godine ima odobreno pet projekta s područja izbora i uporabe materijala.



## SIIM

SIIM Association was founded in 2009 on the initiative of the students of Industrial Management at FAMENA. The aim of the Association is to improve the knowledge quality by organizing seminars, congresses, workshops and TIMES competitions. Tournament in Management and Engineering Skills, TIMES, is a prestigious industrial engineering competition in which student teams work on a particular problem, prepare a case and present an oral solution to the case.

## OMEGA

The Student Sports Association called OMEGA was founded in 1990. It has participated in organisation of traditional annual student competitions: student rowing regattas featuring eights coming from Croatian faculties of mechanical engineering, student rally, FSB Carting Cup, Pivski kup (Beer Cup), indoor football tournament, rafting and many other activities.

## SOME

SOME is the association of students of materials engineering founded in 2016 for the purpose of connecting all who in their professional, scientific or academic field work on the issues of materials testing and development in different branches of industry. This year, five projects in the fields of selection and use of materials prepared by the association with the help of the Faculty and the Student Council have been approved.





## Strukovne udruge

1. Hrvatska udruga inženjera Fakulteta strojarstva i brodogradnje Sveučilišta u Zagrebu, [www.amac.fsb.hr](http://www.amac.fsb.hr)
2. Centar za nerazorna ispitivanja, [ceni.hr](http://ceni.hr)
3. Hrvatsko društvo za tehniku zavarivanja, [www.fsb.unizg.hr/hdtz/](http://www.fsb.unizg.hr/hdtz/)
4. Hrvatsko društvo za mehaniku, [www.csm.hr](http://www.csm.hr)
5. Lean menadžment inicijativa
6. Međunarodni centar za održivi razvoj energetike, voda i okoliša, [www.sdewes.org](http://www.sdewes.org)
7. Hrvatska sekcija instituta za izgaranje, [adriacombustioninstitute.org](http://adriacombustioninstitute.org)
8. Hrvatsko društvo za teoriju strojeva i mehanizama, [www.fsb.unizg.hr/CroFToMM/](http://www.fsb.unizg.hr/CroFToMM/)
9. Udruga tajnika i pravnika u sustavu visokog obrazovanja i znanosti Zagreb
10. Hrvatsko društvo za zaštitu materijala, [www.fsb.unizg.hr/hdzama/](http://www.fsb.unizg.hr/hdzama/)
11. Hrvatsko društvo za toplinsku obradu i inženjerstvo površina, [www.hdtoip.hr](http://www.hdtoip.hr)
12. Hrvatski DAAD klub, [www.fsb.unizg.hr/daad-klub/](http://www.fsb.unizg.hr/daad-klub/)
13. Hrvatsko društvo za elemente strojeva i konstrukcije, [www.hdesk.fsb.hr](http://www.hdesk.fsb.hr)
14. Društvo za gumu i plastiku, [www.fsb.unizg.hr/polimeri/](http://www.fsb.unizg.hr/polimeri/)
15. Hrvatsko društvo za materijale i tribologiju (HDMT), [www.hdmt.hr](http://www.hdmt.hr)
16. Nautički klub FSB, [www.fsb.unizg.hr/nauticki-klub/](http://www.fsb.unizg.hr/nauticki-klub/)
17. Hrvatska udruga proizvodnog strojarstva, [www.fsb.unizg.hr/cim2007/](http://www.fsb.unizg.hr/cim2007/)
18. Centar za inovacije u maloj brodogradnji, [www.fsb.unizg.hr/cimb/](http://www.fsb.unizg.hr/cimb/)
19. Udruga za rashladnu tehniku i dizalice topline, [www.hurkt.hr](http://www.hurkt.hr)
20. Hrvatska udruga za PLM

## Professional Associations

1. Croatian Association of Engineers of the Faculty of Mechanical Engineering and Naval Architecture of the University of Zagreb, [www.amac.fsb.hr](http://www.amac.fsb.hr)
2. Centre for Non-destructive Testing, [ceni.hr](http://ceni.hr)
3. Croatian Welding Society, [www.fsb.unizg.hr/hdtz/](http://www.fsb.unizg.hr/hdtz/)
4. Croatian Society of Mechanics, [www.csm.hr](http://www.csm.hr)
5. Lean management initiative
6. International Centre for Sustainable Development of Energy, Water and Environment Systems, [www.sdewes.org](http://www.sdewes.org)
7. Croatian Section of the Combustion Institute, [adriacombustioninstitute.org](http://adriacombustioninstitute.org)
8. Croatian Society of Mechanism and Machine Theory, [www.fsb.unizg.hr/CroFToMM/](http://www.fsb.unizg.hr/CroFToMM/)
9. Zagreb Association of Secretaries and In-house Lawyers of the Higher Education System and Science
10. Croatian Society for Materials Protection, [www.fsb.unizg.hr/hdzama/](http://www.fsb.unizg.hr/hdzama/)
11. Croatian Association for Thermal Treatment and Surface Engineering, [www.hdtoip.hr](http://www.hdtoip.hr)
12. Croatian DAAD Club, [www.fsb.unizg.hr/daad-klub/](http://www.fsb.unizg.hr/daad-klub/)
13. Croatian Society for Machine Elements and Design, [www.hdesk.fsb.hr](http://www.hdesk.fsb.hr)
14. Society for Plastics and Rubber, [www.fsb.unizg.hr/polimeri/](http://www.fsb.unizg.hr/polimeri/)
15. Croatian Association for Materials and Tribology (HDMT), [www.hdmt.hr](http://www.hdmt.hr)
16. FSB Nautical Club, [www.fsb.unizg.hr/nauticki-klub/](http://www.fsb.unizg.hr/nauticki-klub/)
17. Croatian Association of Production Engineering, [www.fsb.unizg.hr/cim2007/](http://www.fsb.unizg.hr/cim2007/)
18. Centre for Innovations in Small Shipyards, [www.fsb.unizg.hr/cimb/](http://www.fsb.unizg.hr/cimb/)
19. Association of Refrigeration Systems and Heat Pumps, [www.hurkt.hr](http://www.hurkt.hr)
20. Croatian Association for Product Lifecycle Management

## Knjižnica Fakulteta strojarstva i brodogradnje

Knjižnica Fakulteta strojarstva i brodogradnje Sveučilišta u Zagrebu je visokoškolska knjižnica koja svojim zbirkama i uslugama pruža informacijsku i komunikacijsku potporu znanstvenoj i nastavnoj djelatnosti svoje matične ustanove.

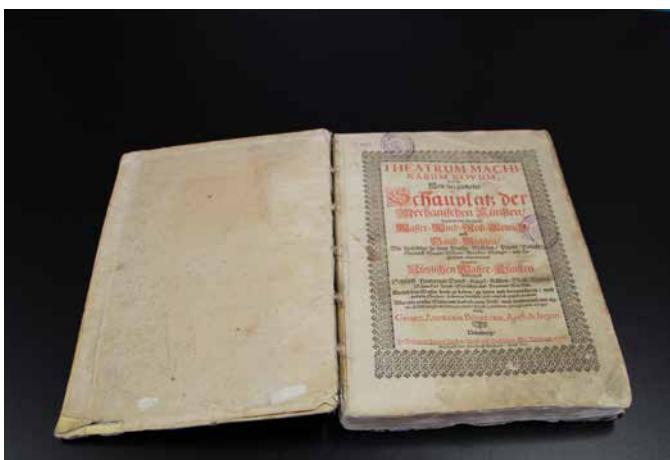
Kao visokoškolska knjižnica otvorenog tipa Knjižnica je namijenjena prvenstveno djelatnicima i studentima Fakulteta, ali je također otvorena i svim vanjskim korisnicima kojima je potrebna literatura ili bilo koja vrsta informacija iz područja strojarstva, brodogradnje i zrakoplovstva.

Uz standardnu referentnu literaturu (rječnici, enciklopedije, priručnici, leksikoni...), najveći dio fonda čine znanstvene i stručne publikacije koje pokrivaju šire područje tehničkih znanosti, a posebno znanstvena područja strojarstva, brodogradnje i zrakoplovstva. Osim toga, tu je i stručna i ispitna literatura iz ostalih područja koja su uvrštena u kurikulum Fakulteta (matematika, fizika, kemija, marketing, ekologija, strani jezici...). Kontinuiranom nabavom nove stručne i znanstvene literature nastoji se što više osvremeniti knjižnični fond.

Osim knjiga, omogućen je pristup različitim digitalnim bazama podataka, primjerice katalogu i repozitoriju Fakulteta, Ebsco database, Web of Science, Scopus... Također, u prostoru Knjižnice studentima su na raspolaganju računala. Prostor Knjižnice je uređen za ugodan i nesmetan rad studenata.

Najstarija knjiga koju Knjižnica posjeduje rijetko je djelo iz područja tehničke mehanike. Riječ je o knjizi autora G. A. Böcklera, *Theatrum machinarum novum*, izdane u Nürnbergu 1673. godine. Knjiga ima 44 stranice teksta (gotika) i 154 stranica grafičke (bakroreza). Uvezana je u pergamenu od svinjske kože.

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## The Faculty of Mechanical Engineering and Naval Architecture Library

The Faculty of Mechanical Engineering and Naval Architecture Library, is an academic library whose primary purpose is to serve the Faculty's educational and research goals providing IT and communication support through its collections of various resources and services.

Although primarily intended for the use of students and faculty, an open access is granted to visitors in search of specific literature or information related to the fields of mechanical engineering, naval architecture and aeronautical engineering.

Along with standard editions and reference resources, such as dictionaries, encyclopaedias, textbooks, lexicons etc, the Library holds principal collections of scientific and professional publications in technical sciences and comprehensive collections in the fields of mechanical engineering, naval architecture and aeronautical engineering.

It also provides the recommended subject specific reading and exam literature for other courses and study programmes taught at the Faculty, e.g. mathematics, physics, marketing, ecology, foreign languages etc. The Library is dedicated to continually growing and updating its collections.

Apart from book collections, the Library also provides access to various online databases, such as the Faculty's catalogue and repository, Ebsco database, Web of Science, Scopus etc. In the Library students can find study spaces conducive to academic work.

The oldest book that the Library holds is a rare edition in engineering mechanics, *Theatrum machinarum novum*, written by G.A. Böckler and published in Nürnberg in 1673. It is a book bound in pigskin parchment that comprises 44 pages of the text written in Gothic script and 154 pages of prints (copper-plate engravings).

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# Časopisi

## Transactions of FAMENA

Međunarodni znanstveni časopis *Transactions of FAMENA* prvi put je tiskan 2000. godine u izdanju FSB-a. No kako taj časopis nastavlja tradiciju *Zbornika radova FSB-a* koji je izlazio od 1970., nosio je oznaku Svezak XXIV. (Volumen XXIV.). Naziv FAMENA je skraćenica od FAculty of Mechanical Engineering and Naval Architecture. Može se shvatiti i kao skraćenica od Faculty of Aerospace, Mechanical Engineering and Naval Architecture, budući da časopis objavljuje radove iz područja strojarstva, brodogradnje i zrakoplovstva. Glavni urednik je profesor emeritus Ivo Alfirević. Od broja XXXIV-2 FAMENA izlazi isključivo na engleskom jeziku. Trećine objavljenih radova autori su s FSB-a, oko polovine je iz Hrvatske, a ostali iz inozemstva. FAMENA je indeksirana između ostalih baza i u Science Citation Index Expanded (Sci Search) i SCOPUSU, a danas izlazi četiri puta na godinu.

## Brodogradnja

Časopis Brodogradnja/Shipbuilding utemeljen je 1950. godine, a od 2014. izlazi u digitalnom obliku otvorenog pristupa, u izdanju FSB-a. Brodogradnja je međunarodni recenzirani znanstveni časopis posvećen multidisciplinarnim istraživanjima u područjima teorijske i eksperimentalne brodogradnje i oceanologije kao i izazovnim problemima pomorstva, gradnje broda, pomorskim tehnologijama i industrijskim pitanjima diljem svijeta. Cilj je časopisa integrirati interes u brodogradnji, pomorskom inženjerstvu, pomorstvu, unutarnjoj plovidbi, intermodalnom transportu kao i zaštiti okoliša, sveukupnoj sigurnosti, hidrokinetičkim obnovljivim izvorima energije vjetra i valova te održivom razvoju prometa na rijekama, jezerima, morima i oceanima. Časopis je usredotočen na hidrodinamiku, konstrukciju, pouzdanost, materijale, projektiranje, optimizaciju, gradnju, vođenje projekata, popravke i planiranje održavanja, informacijske sustave u brodogradnji i brodogradilištima, osiguranje kvalitete kao i opremanje, pogon, pogonske uređaje i opremu na brodovima. Indeksiran je u svjetskim bibliografskim bazama kao što su Web of Science Core Collection (SCIE), Scopus i Ebsco te je uvršten u kategoriju A prema Ministarstvu znanosti i obrazovanja Republike Hrvatske.

## Polimeri (časopis za plastiku i gumu)

Polimeri – znanstveni, stručni, obrazovni i poslovni časopis koji u svakom broju donosi mnoštvo informacija o najnovijim dostignućima na područjima plastike i gume te potrebne opreme. Jedino je izdanje ove vrste u Republici Hrvatskoj. Referiraju ga sekundarne publikacije, npr. SCOPUS. Namijenjen je zainteresiranom rukovodnom osoblju, tehničkim stručnjacima, ekonomistima, pravnicima i ostalim zaintere-

# Journals

## Transactions of FAMENA

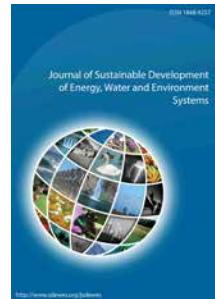
The Faculty of Mechanical Engineering and Naval Architecture published the first issue of the international scientific journal *Transactions of FAMENA* in 2000. This issue was listed as Volume XXIV as it continued the tradition of the *Proceedings* of the Faculty that were first published in 1970. The acronym FAMENA stands for both the FAculty of Mechanical Engineering and Naval Architecture or the Faculty of Aeronautical (Engineering), Mechanical Engineering and Naval Architecture, and it publishes papers related to this three fields: mechanical engineering, naval architecture and aeronautical engineering. From Volume XXXIV-2 FAMENA is published in the English language. A third of the published papers are authored by the staff of the Faculty of Mechanical Engineering and Naval Architecture, a half by scientists from Croatia and a half by foreign scientists. The articles are indexed in abstract and citation databases of peer-reviewed literature, such as Science Citation Index Expanded (Sci Search) and SCOPUS. The editor of this quarterly publication is Professor Emeritus Ivo Alfirević.

## Brodogradnja

The journal *Brodogradnja (Shipbuilding)* was established by the Faculty of Mechanical Engineering and Naval Architecture in 1950, and in 2014 it became an electronic, open access journal. It is an international peer-reviewed scientific journal encompassing the multidisciplinary research in the fields of naval architecture and oceanography, as well as challenging problems in maritime affairs, shipbuilding, maritime technologies and other industrial issues worldwide. The aim of the journal is to include not only issues of shipbuilding, offshore engineering, inland navigation, intermodal transport but also issues of environmental protection, safety, renewable sources of wind and wave energy, and sustainable development of transport on rivers, lakes, seas and oceans. The journal focuses on hydrodynamics, structures, reliability, materials, design, optimization, construction, project management, repair and maintenance planning, information systems in shipbuilding and shipyards, quality assurance, outfitting, powering, and ship power plants and equipment. Its articles are indexed in abstract and citation databases of peer-reviewed literature, such as Web of Science Core Collection (SCIE), SCOPUS and Ebsco. The journal is assigned to the highest quality category (A) by the Croatian Ministry of Science and Education.

## Polimeri – the journal of plastics and rubber

*Polimeri* is a scientific, professional, educational and business journal which provides its readers with information on the recent developments in the fields of plastics and rubber including the information on the relevant equipment. It is the only journal of its kind in Croatia. Its articles are indexed in abstract and citation databases of peer-reviewed literature, such as SCO-



siranim stručnjacima koji rade kod proizvođača polimernih sirovina i dodataka, polimernih materijala, opreme, plastičnih i gumenih dijelova, znanstvenicima, nastavnicima te ostalima koje zanima ovo područje ljudskog djelovanja. Izdavač časopisa *Polimeri* je Društvo za plastiku i gumu. Izlazi od 1980., a na izdavanju su angažirani najvećim dijelom djelatnici FSB-a i FKIT-a.

### Zavarivanje

Časopis *Zavarivanje* počeo je izlaziti još 1958. godine i pripada među najstarije stručne časopise iz područja tehnike u Hrvatskoj. Vrlo je cijenjena i rado korištena znanstvena i stručna literatura u zavarivanju. U časopisu se objavljaju znanstveni i stručni članci iz područja zavarivanja i srodnih tehnologija, a poseban dio čine novosti iz industrije sajmova i radionica. Izuzetno je važan kao medij prenošenja znanja. Nakladnik je *Hrvatsko društvo za tehniku zavarivanja*, a u rad na izdavanju uključeni su djelatnici FSB-a.

### JSDEWES

„Journal of Sustainable Development of Energy, Water and Environment Systems“ – JSDEWES je časopis otvorenog pristupa pokrenut 2013. godine inicijativom glavnog urednika, prof. dr. sc. Nevena Duića te urednika prof. dr. sc. Zvonimira Guzovića, a izdavač časopisa je SDEWES Centre. Časopis objavljuje volumen godišnje u četiri sveštičića, s po 12 radova u svakom sveštičiću. Časopis je u vrlo kratkom roku uvršten u baze SCOPUS, Inspec, Directory of Open Access Journals (DOAJ) i Hrcak te druge baze, a od nedavno je uvršten i u bazu Web of Science Core CollectionTM – Emerging Sources Citation Index (ESCI). Prema izvještaju SCImago za 2016., JSDEWES se nalazi u Q2 u područjima „Energy Engineering and Power Technology“, „Environmental Science“ te „Water Science Technology“. SCImago Journal Rank (SJR) časopisa JSDEWES je 0,367, a h-indeks 6. Časopis ima CiteScore 1,03, a Source Normalized Impact per Paper (SNIP) mu je 0,438. Više informacija o časopisu dostupno je na [www.sdwes.org/jsdewes](http://www.sdwes.org/jsdewes).

*PUS. Polimeri* is read by managers, engineers, economists, lawyers and other interested professionals who work in companies producing polymer raw materials and additives, polymeric materials, equipment, plastic and rubber parts, as well as by scientists, teachers and others interested in this field of work. The journal is published by the Croatian Society of Plastics and Rubber Engineers. It was first published in 1980. The Faculty of Mechanical Engineering and Naval Architecture and the Faculty of Chemical Engineering and Technology are jointly engaged in its publication.

### Zavarivanje (Welding)

The first issue of *Zavarivanje* was published as early as 1958. The journal is one of the oldest specialist journals in the field of engineering in Croatia. It is a highly regarded journal that has many regular readers among scientists and professionals engaged in welding. The journal publishes scientific and professional papers related to the field of welding and allied processes, and brings news from the industry sector, fairs and workshops. It plays a major role in facilitating knowledge transfer. It is published by the Croatian Welding Society including the staff of the Faculty of Mechanical Engineering and Naval Architecture.

### JSDEWES

*Journal of Sustainable Development of Energy, Water and Environment Systems – JSDEWES* is an open access journal, set up on the initiative of its editor-in-chief Professor Neven Duić, PhD and its editor Professor Zvonimir Guzović, PhD, and published by SDEWES Centre. It is a quarterly journal publishing 12 papers in each issue. Shortly upon its publication the journal was indexed by the databases, such as SCOPUS, Inspec, Directory of Open Access Journals (DOAJ), Hrcak and some other, and recently it has been also included in the database Web of Science Core CollectionTM – Emerging Sources Citation Index (ESCI). According to the 2016 SCImago Journal and Country Ranking JSDEWES is categorized as Q2 in the fields of Energy Engineering and Power Technology, Environmental Science and Water Science Technology. It has achieved SRJ 0.367, H-index 6, CiteScore 1.03 and Source Normalized Impact per Paper (SNIP) 0,438. Additional information about the journal is available online at [www.sdwes.org/jsdewes](http://www.sdwes.org/jsdewes).

**Nakladnik:**

Fakultet strojarstva i brodogradnje  
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**Za nakladnika:**

prof. dr. sc. Zvonimir Guzović

**Urednik:**

doc. dr. sc. Ivan Stojanović

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Olinka Breka (engleski jezik)  
Vesna Cigan (engleski jezik)  
Snježana Kereković (engleski jezik)  
Brankica Bošnjak Terzić (engleski jezik)

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Fakultet strojarstva i brodogradnje / Faculty of Mechanical Engineering and Naval Architecture  
Ivana Lučića 5 • 10002 Zagreb • Croatia  
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