



SVEUČILIŠTE U ZAGREBU
METALURŠKI FAKULTET

UNIVERSITY OF ZAGREB
FACULTY OF METALLURGY

SELF-EVALUATION REPORT OF THE FACULTY OF METALLURGY

Sisak, December 14th, 2011

The Self-evaluation report of the Faculty of Metallurgy has been conducted by members of work groups appointed to produce the Self-evaluation, the constitution of which has been the following:

1. Management of the higher education institution and quality assurance (element 1) and Resources: Administrative and technical services, facilities, equipment and finances (element 7):
 1. Assistant Professor Stjepan Kožuh – head of the working group,
 2. Lana Vanić, L.L.B., secretary of the Faculty
 3. Professor Ankica Rađenović,
 4. Natalija Dolić, senior assistant,
 5. Sonja Kraker Zednik, head of Accounting Office.
2. Study programs (element 2) and Students (element 3):
 1. Professor Mirko Gojić – head of the working group,
 2. Assistant Professor Robert Pezer,
 3. Tahir Sofilić, PhD, CMC Sisak d.o.o.,
 4. Assistant Professor Ljerka Slokar,
 5. Tin Brić, student.
3. Teachers (element 4):
 1. Assistant Professor Anita Štrkalj – head of the working group,
 2. Professor Faruk Unkić,
 3. Professor Tanja Matković,
 4. Assistant Professor Ivan Brnardić,
 5. Anita Begić Hadžipašić, senior assistant.
4. Scientific, artistic and professional activities (element 5) and Mobility and international co-operation (element 6):
 1. Assistant Professor Tamara Holjevac Grgurić– head of the working group,
 2. Professor Jadranka Malina,
 3. Krunoslava Kosina Milutinović, BSc., Poslovne zone Sisak d.o.o.,
 4. Professor Ladislav Lazić,
 5. Assistant Professor Zoran Glavaš

with the participation of the members of the Commission for the quality assurance and improvement of the Faculty of Metallurgy:

- Lana Vanić, L.L.B. – president of the Commission, secretary of the Faculty,
- Professor Faruk Unkić, dean,
- Assistant Professor Robert Pezer, vice dean for education,
- Professor Jadranka Malina, vice dean for science and finance,
- Tahir Sofilić, PhD, CMC Sisak d.o.o., representative of the external stakeholders,
- Assistant Professor Zdenka Zovko Brodarac, representative of teaching staff,
- Sanja Vujnović, head of the Library, representative of non-teaching staff,
- Tomislav Rupčić, representative of the students.

The Self-evaluation report of the Faculty of Metallurgy has been approved on the Faculty Council 4th regular session held on December 14th, 2011.

SELF-EVALUATION REPORT

Faculty of Metallurgy
University of Zagreb

Year of foundation: 1960

Address: Aleja narodnih heroja 3, 44103 Sisak

Phone: 044 533 379

Fax: 044 533 378

Web site: www.simet.unizg.hr

E-mail: dekanat@simet.hr

Title, name and surname of the of the higher education institution: Faruk Unkić,
PhD, full professor

Bank and account number via which the higher education institution conducts
business: Privredna banka d.d. Zagreb, 2340009-1110015835

December, 14th, 2011

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1 Management of the higher education institution and quality assurance

1a)

A short description of the development of the higher education institution concerned as well as significant events in the past ten years (organizational changes, change of location, important problems in everyday activities).

The economic development of the mid-20th century created the need for rapid education of experts and specialists in the Republic of Croatia in technical areas, including metallurgy. The first activities were started in the summer of 1958 with efforts regarding the foundation of the Technical higher education school, which had metallurgy and technical areas of expertise. However, this solution was abandoned, and instead of that the Faculty of Technology in Sisak was founded, containing the Department of Metallurgy and the Department of Oil Technology and Industry. Instruction at both mentioned departments of the Faculty of Technology started in Sisak with the academic year 1969/1961, when 89 students enrolled (49 students of metallurgy and 40 at the oil industry and technology). The mother Faculty of Technology in Zagreb provided a great deal of support during the foundation and development of the said institution by participating in instruction directly, organizing and building laboratories, as well as further education of the teaching staff.

In 1963, the Faculty of Technology in Zagreb went through a restructuring, after which the higher education instruction in Sisak was separated into two departments: the Department of Metallurgy and Chemical-technological oil department. In the late 1960s, there arose a problem with facilities, i.e. lack thereof, due to an increased number of students as a result of instruction in all three levels, which was resolved by awarding new facilities (around 620m²) of The Institute of Metallurgy within the company Željezara Sisak.

The Faculty of Technology in Zagreb experienced another restructuring in 1974, when the existing departments in Sisak were abolished and the Faculty of Metallurgy transformed into a Basic organization of joint labour Metallurgy Engineering, as one of six such organizations with the Faculty of Technology. The primary activities of the Basic organization of joint labour Metallurgy Engineering consisted of scientific and educational activities from the field of metallurgic engineering and similar disciplines.

Another restructuring, which occurred as a result of social changes with the goal of finding an organizational structure of connecting higher education in the field of metallurgy and scientific and research programs, followed in 1979, when the Basic organization of joint labour Metallurgy Engineering and the Institute of Metallurgy were joined into a Labour organization Institute of Metallurgy Sisak within a Complex organization of joint labour of the Metallurgy Combine of Željezara Sisak. This meant that the Labour organization Institute of Metallurgy Sisak consisted of two basic organizations of joint labour (Faculty of Metallurgy and Technical and Administrative Services), as well as a Labour community for general affairs. Due to this integration, the institution received an increased support in organizing and financing education, scientific and specialist projects. Thus, the Faculty of Metallurgy gained more qualified teaching and scientific staff, more laboratories at its disposal, procurement of new equipment was simplified, etc.

The result of integrating the Institute of Metallurgy and the Basic organization of joint labour Metallurgy Engineering into the Labour organization Institute of Metallurgy Sisak was an increase in the number of specialist in staff who did not participate in instruction. Of the total number of 107 employees during the academic year 1979/1980, only 57 of them worked as teachers.

The Scientific and Educational Committee of the Faculty of Metallurgy was founded on the 3rd of November 1978.

Pursuant to the Act on Higher Education, on the 1st of February 1979, the Faculty of Metallurgy became one of 56 independent members of the University of Zagreb.

In 1979, the Faculty of Metallurgy had 14 PhDs, six of them in the field of metallurgy. Because the Scientific and Educational Committee of the Faculty of Metallurgy at that time still did not fulfil legal requirements which would enable selection to academic ranks and procedures for acquisition of the titles of MSc and PhD, in 1981 the University of Zagreb reached a decision on the foundation of a joint Scientific and Educational Committee of the Faculty of Metallurgy and the Mining-geological-petroleum engineering Faculty in Zagreb in view of conducting the said procedures.

On the 14th of September 1987, a new Scientific and Educational Committee of the Faculty of Metallurgy was founded. Since then, the Faculty of Metallurgy fulfils all the prescribed requirements and conditions for the procedure of acquiring a PhD title and has the permission to implement the said procedure for the scientific field of metallurgy within the expertise of technical sciences, as well as the procedure of selection to scientific and research ranks in the same area of expertise and provides opinions on the procedures of selection to scientific and educational ranks in the same scientific area of expertise.

In 1989, the Act on businesses started being implemented, after which the Complex organization of joint labour of the Metallurgy Combine of Željezara Sisak was transformed in a way that the Labour organization Institute of Metallurgy became Institute for Research and Development (IRI d.o.o.), and the Faculty of Metallurgy a sector of that business (1989-1991), at the same time remaining within the University of Zagreb.

From late 1978 to 1991, the organization and management of the Faculty of Metallurgy took place at three structural levels: scientific, research-developmental and business.

During the academic year 1990/1991, the Faculty of Metallurgy separated itself from the Complex organization of joint labour of the Metallurgy Combine of Željezara Sisak and on the 1st of June 1991 became an independent scientific and educational institution of the University of Zagreb for the following activities:

- Scientific and educational activities in the field of technical sciences (metallurgy);
- Scientific and research activities in the field of metallurgy, chemical engineering and other technical and technological areas relevant to the field of metallurgy;
- Auxiliary scientific and research activities.

By becoming independent, after almost 31 years of conducting higher education instruction in the field of metallurgy in Sisak, and following numerous organizational changes, The Faculty of Metallurgy (hereinafter: Faculty, FM) remained an independent constituent of the University of Zagreb in its own right. At that time, the Faculty of Metallurgy had 119 students, of which 61 in the first year of studies. In 1991, the internal organization of the Faculty of Metallurgy was changed in a way that operations were organized into Department of Materials and Department of Metallurgy. The main managing body was an expert committee consisting of the Dean, Vice-Dean, Secretary and Chiefs of Departments. Furthermore, the Scientific and Educational Committee of the Faculty of Metallurgy was established, in which the Dean had the presiding role.

During the development of the Department of Metallurgy, Metallurgy engineering, i.e. Faculty of Metallurgy, the number of departments and chairs changed a number of times (consequently, their names changed as well) in line with the number of courses, teachers and associates. Based on the Regulations on determining scientific fields and areas of the Ministry of Science and Technology of the Republic of Croatia (Official Gazette, 29/97) and the Statute of the Faculty of Metallurgy dating from the 28th of February 1997, from the 1st of October the Faculty of Metallurgy consists of three departments: Department of Process Metallurgy, Department of Mechanical Metallurgy and Department of Physical Metallurgy.

Today teaching and research of the Faculty is conducted at the same place (in two buildings at the same location), which contributes to significantly lower utilities expenses, as well as faster and better communication between members of the faculty, but also teachers and students. While the Faculty of Metallurgy functioned within the Institute of Metallurgy (1979-1989), i.e. Institute for Research and Development of Željezara Sisak(1989-1991), the Faculty conducted its activities at the same location and in the same facilities.

In the last decade the instructional practice at the Faculty of Metallurgy has experienced significant transformations with the goal of further improvements. Together with the Faculty of Graphic Arts in Zagreb, the Faculty of Metallurgy has introduced ECTS system (as second, i.e. third of all the faculties within the jurisdiction of the University of Zagreb). The renewed curriculum of the undergraduate four-year study in the field of metallurgy started being implemented in the academic year 2000/2001. It was approved by the University of Zagreb Senate Decision dating from the 13th of February 2001, after previously having acquired positive review of the National Council for Higher Education of the Republic of Croatia. The studies were conducted through common program foundations during seven semesters, with the possibility of choosing one of three optional groups of subjects (process metallurgy, casting, metal processing) in the eighth semester. Upon the completion of undergraduate studies students are awarded the academic title of Bachelor of Science in Metallurgy, irrespective of the optional group of subjects.

A year later, starting from the academic year 2001/2002, the renewed curriculum of the graduate study in the field of metallurgy started being implemented, which was approved by the University of Zagreb Senate Decision dating from the 10th of July 2001, after previously having acquired positive review of the National Council for Higher Education of the Republic of Croatia. The duration of the graduate studies is four semesters. Upon the completion of graduate studies students are awarded the academic title of Master in Metallurgy.

The Scientific Activity and Higher Education Act from 2003 rests upon the principles of Bologna. In accordance with the said Act, in the academic year 2005/2006 new curricula of three-year undergraduate and two-year graduate studies were introduced for the university study in metallurgy. The conduction of the said studies is founded on the permits issued by the Ministry of Science, Education and Sports of the Republic of Croatia dating from the 16th of June 2005. Upon the completion of undergraduate studies students are awarded the academic title of Bachelor of Science in Metallurgy (univ.bacc.ing.met.). Upon the completion of graduate studies students are awarded the academic title of Master in Metallurgy (mag.ing.met.).

The new curricula of undergraduate and graduate studies, in accordance with the Bologna Process, indicated the need for introducing a new postgraduate doctoral

study in metallurgy, constituted in a way that it can also represent a continuation of the study of metallurgy and/or a similar graduate study in a related field. The program of the said studies was approved by the University of Zagreb Senate Decision dating from the 15th of December 2007, and started being implemented from the academic year 2007/2008 with the permit issued by the Ministry of Science, Education and Sports. The duration of the doctoral studies is six semesters, and it is completed upon a public viva to an expert committee, after the procedure proscribed by the Regulations on postgraduate doctoral studies in metallurgy. The acquired academic title is PhD in technical sciences, field of metallurgy.

Pursuant to the University of Zagreb Senate Decision dating from the 14th of July 2009, the undergraduate and graduate studies of metallurgy are conducted according to the revised curricula for 2009/2010.

Pursuant to the University of Zagreb Senate Decision dating from the 15th of March 2011, a new undergraduate specialized study-as-you-work course of Casting is introduced and implemented. Courses started in the academic year 2011/2012 in the duration of five semesters, and upon completion candidates are awarded the academic title Bachelor of Casting.

1b)

Display the diagram of the organizational structure of the higher education institution (council, departments, chairs, etc.). Include the number of full-time employees in every organizational unit. In addition, summarize the compositions and functions of respective organizational elements. List the elements of the governing structure in with other participants are included (students, employers, etc.) and comment on their roles and contributions.

Internal organizational structure of the Faculty as shown in Figure 1b1.

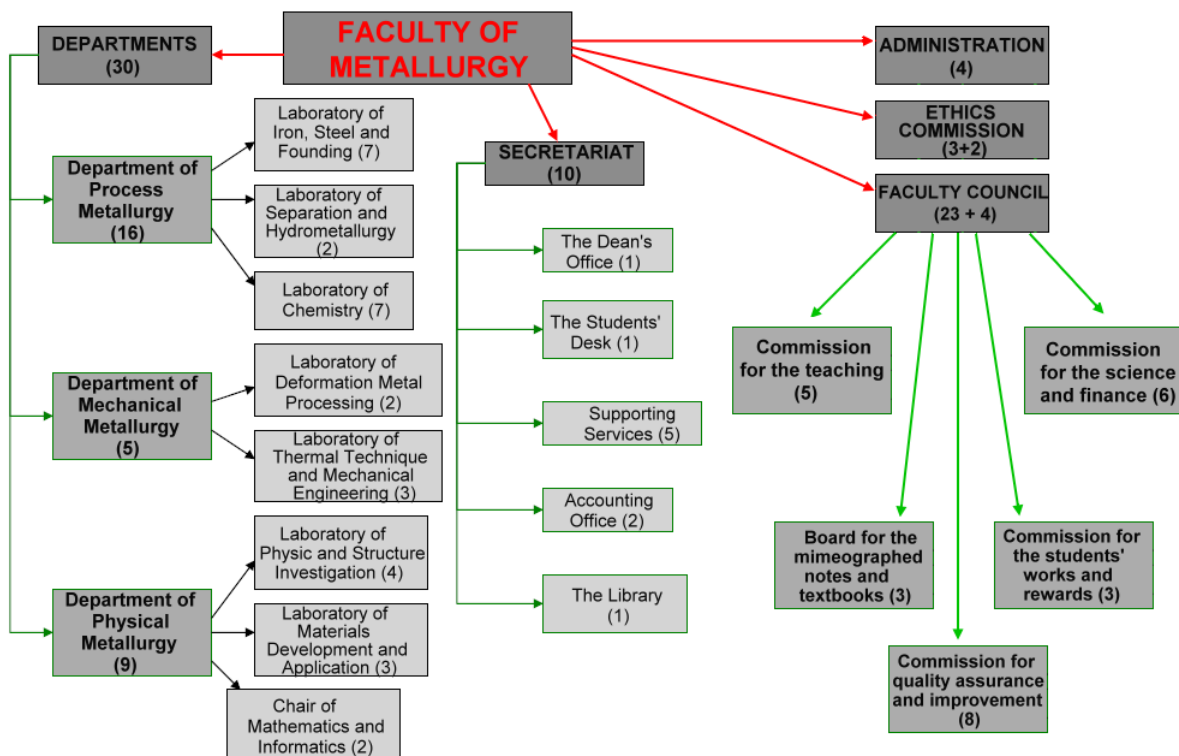


Figure 1b1. Internal organizational structure of the Faculty of Metallurgy

The activities of the Faculty of Metallurgy are conducted in three Departments consisting of the total of seven Laboratories and one Chair, as well as the Secretariat. (Figure 1b1.)

A **Department** is an organizational unit consisting of Laboratories and/or Chairs. It is managed by a Chief who is responsible to the Dean.

A **Laboratory** is an organizational unit within the Department. It is managed by a Head who is responsible to the Chief of Department.

A **Chair** is an organizational unit within the Department. It is managed by a Head appointed by the Chief of Department. The Head is responsible to the Chief of Department.

Instruction of the **Department of Process Metallurgy** includes courses in technical chemistry, theoretical courses relevant to the field of metallurgy (e.g. Theory of metallurgical processes) and a series of specialist courses from the field of metallurgy, such as Metallurgy of iron and steel, Metals founding, etc. Scientific and research expertise includes the production of raw iron and steel, metal processing via founding, resistance of metals to various forms of corrosion, structure and properties of carbon material, extraction of metals from depleted raw materials and usage of waste and secondary products of metallurgical processes. An integral part of activities is related to specialist activities, especially in the field of metallographic testing for the needs of businesses.

The constituent organizational units of the Department of Process Metallurgy are:

- Laboratory of Iron, Steel and Founding,
- Laboratory of Separation and Hydrometallurgy,
- Laboratory of Chemistry (basic, inorganic, physical).

Instruction of **the Department of Mechanical Metallurgy** includes courses in mechanical engineering, courses related to thermal technical processes, industrial equipment and furnaces, as well as courses from the field of metals processing via deformation, testing and control of metals materials. Scientific and research expertise includes research of heat transfer, testing of deformability of metals materials, numerical analyses, material testing, etc.

The constituent organizational units of the Department of Mechanical Metallurgy are:

- Laboratory of Deformation Metal Processing,
- Laboratory of Thermal Technique and Mechanical Engineering

Instruction of **the Department of Physical Metallurgy** is related to courses in physics and mathematics, as well as subjects from the field of physical metallurgy (e.g. Physical Metallurgy, Thermal Dynamics of Alloys, Surface Processing, Techniques of Melding and Separation, etc.). Scientific and research expertise includes research of constitution and structure of alloys, production of complex alloys in the controlled laboratory conditions, testing of crystal structure of alloys by standard methods, thermal processing of metals materials, testing of hardenability by the Jominy method, thermal analyses (DTA, DSC, TGA), welding of metals by various procedures, etc.

The constituent organizational units of the Department of Physical Metallurgy are:

- Laboratory of Physics and Structure Investigation
- Laboratory of Materials Development and Application
- Chair of Mathematics and Information Technology

The **Secretariat** conducts organizational, legal and personnel-related activities, activities related to students and public procurement, and coordinates the activities of its own organizational units. The activities and tasks of respective organizational units are listed in the Rules on internal organization and structure of positions at the Faculty of Metallurgy.

The constituent organizational units of the Secretariat are:

- The Secretariat of the Faculty,
- The Dean's Office,
- The Students' Desk,
- Accounting Office,
- The Library,
- General and Technical Services.

The activities of students at the Faculty of Metallurgy are conducted via the Student's Assembly as a representative body which presents the students' interests (connected to the studies themselves, students' standard, etc.), participated in various activities of bodies of the Faculty of Metallurgy and represents students in the higher education system of the University of Zagreb. The Students' Assembly participates actively with elected representatives (one student from each year of study) in the activities of the Faculty Council, Commission for teaching, Commission for quality assurance and improvement and the Ethical Committee. The students are equal to other members of the Faculty Council in its operations. Students have the right to veto decisions on issues of special interest. Furthermore, students participate in the activities of commissions and work groups *ad hoc*, following the Dean's decision. Students also participate in reviewing teachers via student polls with the purpose of obtaining information on the quality of teaching concerning professors and assistants of respective courses.

Students' participation in the activities of the Faculty of Metallurgy is represented also in operations concerning "Technology Games", organization and participation at International Foundrymen Conference, "Freshmen's Party", University of Zagreb Fair, Open Day at the Faculty of Metallurgy, etc.

External participants are not included in formal governing structures, however their opinions, suggestions and viewpoints on the development of the Faculty are regularly gathered in various informal ways (panels, polls, topical meetings, Alumni activities, etc.). Moreover, they are included in the operations of the Faculty of Metallurgy by participating in work groups in regards to life-long education in the field, changes and revisions of curricula as well as scientific research. External participants are members of the Commission for quality assurance and improvement and special work groups of the said Commission.

1c)

Describe the governing structure of the higher education institution (dean, vice-deans, chiefs of departments, etc.) and their roles and election regulations.

Pursuant to the Statute of the Faculty of Metallurgy, the Faculty is governed by the Dean and the Faculty Council. The Dean's Collegium helps and advises the Dean. The members of the Dean's Collegium are Vice-Deans, Chiefs of Departments, Faculty Secretary and Head of Accounting Office.

The **Dean** of the Faculty is an employee with special authorities elected in a manner prescribed by the Scientific Activities and Higher Education Act, the Statute of the University of Zagreb and the Statute of the Faculty.

The Dean governs the Faculty and is its head and leader. The insignia of the Dean's authority is the chain of the Dean. The Dean's authorities and responsibilities are prescribed by Article 15 of the Statute of the Faculty of Metallurgy:

- represents the Faculty and act on behalf thereof,
- makes business decisions in accordance with the regulations,
- presides over the Faculty Council and proposes the agenda for its sessions,
- is a member of the Technical Field Council as of duty,
- proposes to Faculty Council measures for improvement of the Faculty operation,
- implements the decisions of the Faculty Council and the decisions of the Senate and Technical Field Council related to the Faculty,
- appoints regular and ad hoc commissions for the tasks of Dean's jurisdiction,
- ensures conditions for legal business and work and takes care of fulfilling all obligations prescribed by the Act,
- approves official domestic and abroad travels,
- ascertains periodical and final budget,
- decides on founding and terminating of employment contracts,
- appoints and relief of chief of departments,
- approves staying expenses for foreign experts on the Faculty based on signed protocols,
- approves conduction of scientific-educational work in other scientific-educational or scientific and other domestic and foreign organizations,
- appoints the examination commission in the case when student takes the examination from the same subject for the fourth time,
- looks after the quality notifying of the employees,
- issue final resolution on all administrative causes on the Faculty,
- performs other duties provided by the law, Statute of the University, other regulations and this Statute.

The Dean shall have the right to make business decisions on behalf and expense of the Faculty in the value up to one million Kuna. For legal transactions of up to three million Kuna the Dean shall need approval of the Faculty Council and of the Senate for transactions of the value over three million Kuna.

The Dean is responsible to the Faculty Council and the Rector and annually submits the report to them on operations and businesses of the Faculty, as well as a report on his or her work, including the report on the budget proposal and its execution.

The Dean may be elected from among the educators of the Faculty, with the title of full or associate professor. The Dean shall be elected for a two-year term and may be re-elected once. The election procedure of the Dean commences by an invitation of the Faculty Council for submission of candidacies. Candidates submit their curricula vitae and work programs which they present orally before the Faculty Council. Proposals approved by the Faculty Council shall be sent to the Senate, which shall, at the proposal of the Rector, decide during one-month term whether to give consent to the appropriately addressed proposal. If consent is denied, the decision of the Rector and the Senate thereupon must be explained. The Faculty Council shall elect the Dean by a secret ballot from among the candidates approved by the Senate. The candidate who, in the final ballot, obtains a majority of votes of all the members of the Faculty Council shall be elected the Dean. If no candidate obtains such a majority in the first election, at the same session of the Faculty Council, after the break, the second election shall be held, whereas the two candidates who have obtained the largest number of votes in the first election shall have the right to stand for election. If even after the final vote no one obtains the required majority, the procedure of election shall be repeated in the third election. In such case, before the final vote, the candidates have the right on ten-minute speech in front of the Faculty Council members. If even after the final vote from the section 7 of this Article no one obtains the required majority, the Dean orally announces the convocation of a new session of the Faculty Council for the repeating of the voting. The election procedure shall be concluded at the latest four months before the beginning of the mandate of the newly elected Dean. If the new Dean is not elected until the expiration of the previous mandate, the Faculty Council shall, within the term of thirty days, propose to the Senate a person who fulfils the requirements as an acting Dean until the election of the new Dean. The Senate shall appoint the acting Dean within the term of thirty days after receiving the approval of the Rector. In case that the Faculty Council does not submit a proposal within the prescribed term, the Senate shall, at the proposal of the Rector, appoint the acting Dean. The election procedure is detailed in article 18 of the Statute of the Faculty of Metallurgy.

The Vice-Dean for education and Vice-Dean for science and finance assist the Dean in his or her work.

Vice-Dean for education arranges, proposes the agenda and presides over sessions of the Commission for teaching, takes care and is responsible for the execution of teaching, solves students' requests in the first degree, coordinates teaching activities, performs other duties related to teaching and replaces the Dean in all cases of his or her absence.

Vice-Dean for science and finances arranges, proposes the agenda and presides over sessions of the Commission for science and finances, coordinates the scientific work of the Faculty, performs other duties related to science, performs the duty of assets manager, receives and certifies the quantity and quality of assets, takes care of maintenance of assets, as well as their status and movements, and proposes the purchase or expenditure of assets.

The Vice-Deans are responsible to the Dean.

The Vice-Dean may be elected from among the educators of the Faculty with the scientific-educational title. The Vice-Dean is elected and relieved by the Faculty Council via a secret ballot of a majority of all its members. The Vice-Dean is elected for a two-year term and may be re-elected once.

The **Secretary** of the Faculty is an employee with special authorities and responsibilities who organizes and coordinates the work of the Secretariat with the purpose of due and expert execution of all tasks of the Secretariat, as well as specialist bodies of the Faculty, and who participates in drafting general acts and regulations of the Faculty, as well as contracts signed by the Faculty. The person appointed to the position of the Secretary of the Faculty is an individual with a higher education degree in law. The Secretary of the Faculty is authorized to independently organize the executions of tasks of the Secretariat, issue orders to other employees, and sign documents issued by the Faculty. His or her rights and obligations they must fulfil are prescribed by the Book of regulations on the internal organization and employee structure at the Faculty.

The **Faculty Council** is an expert council of the Faculty. The Faculty Council consists of all employees with the scientific-educational status, one representative of the employees with the educational status, and one student representative for each year of undergraduate and graduate study respectively.

The Faculty Council shall:

- enact the Statute of the Faculty by a majority vote of all the members,
- elect the Dean and Vice-Deans,
- elect the members of the field councils,
- approve the annual report of the Dean,
- adopt the budget and the annual financial report of the Faculty,
- take care and make decisions in order to assure quality of studies and of scientific work,
- initiate procedure and take care of implementation of teaching programs, studies, scientific projects and programs as a whole or in parts from its field of operation,
- establish new and develop the existing research capacities on the level of respective scientific disciplines,
- initiate and carry through the procedures of selection into scientific-educational title and other titles, in accordance with the Act, Statute of the University, this Statute and the Book of Rules on Election to Titles,
- ensure conditions for the realization of freedom of individuals or groups of researchers, educators and students in scientific, educational and professional activities,
- give opinion on acquisition, installation and usage of major equipment from the area of its activities,
- give approval to the Dean for undertaking of legal transactions of the value over one million Kuna up to three million Kuna,
- issue study program for undergraduate, graduate and postgraduate study for each academic year as a integral part of University study program,
- appoint leaders to the students for undergraduate and graduate study and mentors in postgraduate study,

- conduct the procedure of gaining the doctoral degree after completion of three-year postgraduate study and producing and defending the doctoral dissertation,
- conduct the procedure of recognition of diploma equality,
- prepare, propose and monitor completion of science and teaching plans and programs,
- analyse and evaluate the results of teaching work,
- appoint the Commission for the teaching, Commission for the science and finance, Board for the mimeographed notes and textbooks, Commission for the students' works and rewards,
- take care of scientific and teaching personnel progress,
- invite and appoint visiting university teacher,
- propose to the Dean conduction of scientific-educational work in other scientific-educational or scientific or other domestic and foreign institutions,
- appoint commissions according to the Statute of the University and this Statute,
- perform other duties as provided by the Statute of the University and this Statute.

The Faculty Council appoints the following work bodies: Commission for teaching, Commission for science and finances, Board for the mimeographed notes and textbooks, Commission for students' works and awards, and the Commission for quality assurance and improvement.

Commission for teaching consists of the vice-dean for education, chiefs of departments and students' representative. Primary task of the Commission for teaching is organization and performance of teaching process on all studies which performs the Faculty. Commission for teaching reviews and prepares suggestions for monitoring of the teaching process in the terms of development of study programs and plans of each study, takes care of realization of current study programs and plans and reviews and suggests to Faculty Council measures for successful implementation of this process (colloquium, tests, mentorship, teaching staff etc.).

Scientific research activities are organized through projects, for which the projects' leaders are responsible, and co-ordination is in charge of the dean and vice-dean for science and finance. **Commission for science and finances** consists of vice-dean for science and finances, projects' leaders and chiefs of departments. Commission for science and finance takes care of tendering for young researchers and their inclusion in the projects; it takes care also for preparation of suggestions for scientific equipment purchasing. Commission for science and finances assists to vice-dean of the science and finance in conducting the business related to assets, verifying the quality and quantity of the assets, taking care of maintenance of the assets, of status and movement of the assets and proposing the purchase or expenditure of the assets.

Board for the mimeographed notes and textbooks initiates the procedure of publishing teaching literature (books, textbooks, mimeographed notes, monographs, etc.) and consists of three members of the Faculty Council with the scientific-educational status.

Commission for students' works and awards reviews and selects students' works for entry and participation at the published call for papers of the kind (e.g. Rector's award). The Commission consists of three members of the Faculty Council, two with the scientific-educational status and one students' representative.

The Commission for quality assurance and improvement of the Faculty of Metallurgy conducts all affairs related to quality assurance and improvement at the Faculty of Metallurgy (as described in detail in 1j).

1d)

Insofar as the higher education institution is a constituent part of the University, list the elements of integration.

The Faculty of Metallurgy is a constituent part of the University of Zagreb. The elements of integration are discernible through the academic, organizational, educational, scientific and research, personnel and financial aspects.

The elements of integration of the Faculty of Metallurgy in the activities of the University are reflected in appointment of scientific-educational titles, implementing new curricula, Statutes and Books of Regulations of the Faculty, balancing and harmonizing the quality of teaching and research. Full financing of respective constituent, including the Faculty of Metallurgy is conducted via the University, which in that manner provides financial and infrastructural support for the constituents. Human resources development is an integral part of the University policy.

The Faculty of Metallurgy participated continually in the work of a number of university bodies, such as the Senate, the Council of technical sciences, the Ethical Council and *ad hoc* committees upon the Rector's decision.

1e)

Name the basic values and ways of supervising ethical behaviour in your activities related to research, teaching and relationship with students.

The Faculty of Metallurgy with all its activities and operations adheres to moral principles and principles of professionalism which should be respected by all teachers, scientists and other Faculty employees in their professional and public lives, as defined by the Ethical Code of the University of Zagreb. The principles of the Ethical Code are in an appropriate manner applicable to students, as well as other individuals who are not employees of the Faculty, but participate in its activities and operations, i.e. insofar as their behaviour and actions can be linked directly to the Faculty.

Regarding the Faculty's scientific field, it was not required to issue an additional Book of Rules and Regulations, instead of which the provisions of the Ethical Code of the University of Zagreb are applied.

The first Ethical Commission of the Faculty of Metallurgy was appointed on the 27th of September 2007. The Ethical Commission consists of three members and two deputies. Two members and two deputies are appointed from the teaching staff, and one member and one deputy from the non-teaching staff. The Secretary of the Faculty, also a member of the Ethical Council of the University of Zagreb, has the right to participate in the activities of the Ethical Commission only in an advisory role, without the right to influence decisions and participate in voting. Insofar as the Ethical Commission is to discuss issues regarding student behaviour or issues of immediate importance to students, the Ethical Commission is expanded with two representatives of the student body. The members of the Ethical Commission are appointed for a four-year term. The Ethical Commission acts in accordance to Article 29 of the

Ethical Code; it issues opinions on fundamental topics and conformity of specific instances of behaviour to the principles and provisions of the Ethical Code.

Since its foundation, the Faculty of Metallurgy has experienced only one instance of starting proceedings of the Ethical Commission. However, the Faculty Council in that case reached a decision that the proceedings will not be initiated (Article 33, item 1 of the Ethical Code).

Pursuant to Labour Act, the Faculty of Metallurgy has appointed an individual responsible for the protection of employees' dignity, who so far has not received a single complaint.

1f)

Describe the mission and vision in line with the strategy of the higher education institution and review its accomplishment through programs executed at the higher education institution (related to study programs, employment policy, international dimension, scientific activities, care for students, quality assurance, business activities, etc.)

The Faculty of Metallurgy is the only faculty for education of students at the undergraduate, graduate and postgraduate level in the field of metallurgy in the Republic of Croatia. Apart from education, the Faculty also conducts research primarily focused on the field of metal production and processing, designing new metal materials, energy industry and environment protection.

The faculty Council of the Faculty of Metallurgy reached a decision at its regular session of the 18th of July 2011, accepting the Developmental Strategy of the Faculty of Metallurgy for the period 2011.2016, of which Mission and Vision are integral parts.

MISSION

The Faculty of Metallurgy as a constituent unit of the University of Zagreb is the only higher education institution in the Republic of Croatia active in the field of technical sciences with a specialty in metallurgy. The Faculty develops its area of expertise through educational, scientific and expert activities. Teaching activities are conducted through the education of highly competent experts at undergraduate, graduate and postgraduate doctoral studies in metallurgy. Scientific and research activities are conducted through science projects increasing the general level of fundamental, applied and developmental expertise in metallurgy. Expert activities enable a quick and efficient transfer of the latest scientific breakthroughs into the economy and other areas of general and public interest. The Faculty cooperates with institutions at an international level by enhancing its mission through the transfer of know-how, as well as student and faculty mobility. At the same time, the Faculty raises general social awareness on the position and role of its field of expertise, i.e. current issues and achievements from the field of its own scientific, educational and expert activities which have broader social implications.

As mentioned, the mission is achieved at several dimensions. The teaching is conducted according to the principles of the Bologna Process with continual improvements and revisions of curriculum based on the noted quality indicators in line with market demand. The said has the goal of increasing the competence of our graduates and market needs so that BSc, engineers and scientists from the field of metallurgy could satisfy the requirements of present-day and future economy, as well as the public sector in the Faculty's field of expertise, considering it is the only higher education institution in the Republic of Croatia which educates experts in the field of technical sciences with a specialty in metallurgy. Within the framework of expanding the study program, the Faculty was awarded a permit of the Ministry of Science,

Education and Sports to start conducting, a new undergraduate specialized study-as-you-work course of Casting in the academic year 2011/2012.

Efforts to increase the level of student performance of all study programs in respect to study performance and learning results are of major importance to the Faculty. Thus, care for students is executed in various manners, of which the following are most significant:

- encouraging students to be creative and work on the development of their individual abilities,
- ensuring a sufficient number of textbooks, notes, e-learning and other teaching materials as well as practical teaching,
- participation at "Technology Games" (a scientific and sports competition of technology students from the region),
- assistance at ensuring quality student standard,
- presentation at the University Fair in Zagreb,
- assistance to students with special needs.

Furthermore, the Faculty has ensured student mobility and their inclusion to organized activities of the University (educational, cultural, sporting, social, charity, etc.).

Regular student evaluation of courses is being regularly used when assessing the quality of teaching. In order for quality teaching to be ensured, a quality teaching staff is required, as well as teachers' competences, experience and dedication to their work. With the goal of enhancing the quality of teachers, certain measures are applied, such as: encouraging young scientists' primary task realization (participation in the teaching process, research activities, PhD, quick achievement of the higher scientific-education status), following the development of gifted and successful students as prospective candidates for research trainees. The average age of the Faculty's teaching staff is 46.7. The fundamental way of rejuvenating the Faculty is employment of research trainees and their education. The research trainees are generally graduates of the Faculty.

Quality execution of the teaching process would be unfathomable without related scientific and research activities, which are based on fundamental, applied and developmental research. The scientific activity is conducted by participating in home and international science projects, publishing in magazines and proceedings, as well as activities connected to the popularization of science via panels, speeches and the like. Scientific and research activities of the Faculty is also achieved via projects mostly financed by the Ministry of Science, Education and Sports, multilateral projects (EUREKA) and bilateral projects, as well as direct cooperation with businesses. The Faculty is prominent for its tradition of organizing international casting council gathering respected experts in the field.

Upon implementing an external audit of the quality system by the Agency for Science and Higher Education, the Faculty started a restructuring of its quality system in 2011 by establishing a new Commission for quality assurance and improvement. The Faculty is implementing a quality assurance system which enables monitoring and improvements of study program quality, as well as quality of teaching, public access, drafting of quality system regulations (Rulebook on quality assurance and improvement at the Faculty of Metallurgy and Manual for quality assurance and improvement at the Faculty of Metallurgy).

The financial affairs of the Faculty are founded on respect of legal acts and regulations applicable to public institutions and other beneficiaries of the national budget within the system of science and higher education, and have been

additionally prescribed by the Rulebook on the basics of financing of the University of Zagreb.

Financial affairs are mostly based on the budget resources of the Republic of Croatia. One of the main reasons for that is the current state of the economy and lack of interest for commercial cooperation.

The business activities of the Faculty are directed towards creating preconditions for long-term achievement of the Faculty's educational and scientific tasks, as well as ensuring material and other rights of the employees.

The final state revision of Faculty's business activities was conducted in 2009, and has confirmed that the Faculty is conducting business in an orderly manner at all levels.

VISION

The Faculty of Metallurgy is to become more recognizable as the place of permanent enhancement and improvement of study conditions and acquiring knowledge and know-how from the fields of metallurgy, metals and environment protection. This institution will continue to encourage innovation, uniqueness and excellence of each individual according to global evaluation standards and act in its environment in line with all positive regulations and needs of the local and broader community. Teaching will be founded upon the best global experiences of interconnectedness of learning, research and business. In line with that, the faculty will continually revise and innovate the existing study programs in order to achieve quality and efficient education at all levels of university study, including the introduction of specialized study-as-you-work courses in the field of metallurgy (Casting). Faculty graduates will be in high demand as highly educated experts competent to efficiently solve issues in their field. The Faculty is to continue institutional efforts concerning the development of scientific, research and specialized activities at home and international projects for the development of innovative and enhancement of existing technology processes, products and materials. The Faculty is to be recognized as a responsible institution for its contributions to the community by raising the level of public education, expertise of engineers within the technical field, development of economic branches connected to metallurgy, materials and environment protection, as well as activities in line with academic ethical principles and standards of the most successful global universities.

The Vision of the Faculty is a result of assessment of circumstances and resources at its disposal, material support and efforts to become an internationally recognized quality higher education institution. Thus, the Faculty will continue implementing its primary task of educating technology experts in the field of metallurgy who will be able to achieve success at home and abroad. Aware of the need for international recognition, the Faculty will continue to encourage new links and intensify the cooperation with international institutions through common projects, and teacher and student exchange. The Faculty considers of great importance to participate in programs of regional development and international trans-border cooperation which have the potential of bringing additional resources for scientific and research equipment, as well as the Faculty's own projects. The existence of certified and reference laboratories would greatly contribute to the realization of higher Faculty income. Certain areas of metallurgy, such as extractive metallurgy, casting, metal and alloy formation, and recycling could become foundations for the development of excellence centres which would promote the scientific, research and specialized activities of the Faculty. Thus, specialized and expert activities, which are

currently neglected, would achieve greater value, more employees would be involved in technology projects or some other form of cooperation with the economy. One of the key steps in achieving that is the undergraduate university specialized study-as-you-work Casting course, for which there has been high demand from business subject for a number of years. Increased involvement of employees in specialized activities would also have a positive effect on the institution's financial situation.

We will expand cooperation with technical institutions through teaching at undergraduate, graduate and postgraduate studies within the constituencies of the University of Zagreb, which will also contribute to this institution's affirmation, as well as the prominence of its employees.

In sum, the achievement of Mission and Vision of the Faculty of Metallurgy is recognized through raising our own level of competence through scientific activities and research, greater competitiveness of business subjects in the Republic of Croatia, cooperation with economic subjects and increasing student motivation by introducing new study programs.

1g)

Describe the significance and uniqueness of your higher education institution in comparison to similar institutions in the Republic of Croatia in your scientific field of expertise.

According to the classification of scientific fields and areas, the Faculty is active within the field of technical sciences, with a specialty in metallurgy. The Faculty of Metallurgy is the only faculty for education of students at the undergraduate, graduate and postgraduate level in the field of metallurgy in the Republic of Croatia. Furthermore, by organization workshops, panels and lectures, it conducts a life-learning education program and the program of expert training in the field of metallurgy. It is also a hub of scientific activities and research, as well as publishing activities in the field of metallurgy. Moreover, it provides scientific and specialized support to business in the industry of metallurgy, casting, metal processing and shipbuilding in the country. The latter role of the Faculty is of immense significance considering the fact that the industrial institutions in the Republic of Croatia no longer exist.

Regarding the lack of economic vision and strategy of the Republic of Croatia, we believe that without industrial production there will be no perspective, progress or financial recovery of the Republic of Croatia.

1h)

Discuss the possible overlapping of your institution's activities with activities of similar institution at the University.

The Faculty of Metallurgy is the only faculty for education of students at the undergraduate, graduate and postgraduate level in the field of metallurgy in the Republic of Croatia. There are no institutions in the same field at the University of Zagreb.

1i)

Enclose the document on the strategy and procedure for quality assurance of scientific activities and teaching at the higher education institution and evaluate the degree of its implementation. Also, mention annual reports.

Enclosed:

- Development Strategy of the Faculty of Metallurgy 2011-2016 (dating from the 18th of July 2011)
- Rulebook on quality assurance and improvement at the Faculty of Metallurgy (dating from the 7th of March 2011)
- Rulebook on quality assurance and improvement at the Faculty of Metallurgy (dating from the 14th of December 2011)

Quality assurance regarding scientific, educational and specialized activities of the Faculty of Metallurgy is regulated by the Rulebook on quality assurance and improvement at the Faculty of Metallurgy (adopted at the session of the Faculty Council of the Faculty of Metallurgy on the 7th of March 2011; available at the Faculty website at <http://www.simet.unizg.hr/osiguranje-kvalitete/dokumenti/pravilnik-za-kvalitetu/view>). Upon the adoption of the said Rulebook, the previous Rulebook on quality assurance and improvement at the Faculty of Metallurgy adopted on the 20th of October 2008 stopped being valid. This Rulebook was the first document regulating quality assurance at the Faculty.

The Rulebook on quality assurance and improvement at the Faculty of Metallurgy determines the organization, activities and assessment of the higher education quality assurance and improvement system at the Faculty.

The aim of higher education quality assurance and improvement system at the Faculty organization is the creation of institutional mechanisms for systemic assessment and coordination of initiatives and development programs with the ongoing purpose of promoting high standards of professional and specialist development of interested parties in all structures (management, teachers, administrative services, specialist quality bodies, students) in all areas of the Faculty's activities.

Quality assurance and improvement system assessment areas are the following:

- Activities, regulations and procedures concerning ongoing quality assurance and promotion at the Faculty,
- Application of the system at all levels of internal and external audit (self-assessment),
- Status of study programs,
- Student enrolment in study programs,
- Learning process,
- Teaching process,
- Students' work assessment process,
- Availability of information,
- Facilities conducive to the education process, scientific activities and research, the library,
- Monitoring and analysis of quality indicators, quality improvements in regards to students, teaching, teachers, administrative services, scientific activities, research, specialist and development-related activities,
- Work safety of students, teachers and associates,
- Up to date IT equipment and system,

- Administrative procedures,
- Administrative-technical resources,
- Updates in applying academic standards,
- Public and internal availability of information on the quality system,
- Public availability of information on the Faculty's activities.

The Commission for quality assurance and improvement at the Faculty of Metallurgy conducts all the affairs related to quality assurance and improvement at the Faculty of Metallurgy.

The acting Commission for quality assurance and improvement at the Faculty of Metallurgy is highly active and current in its activities, and its operations are presented publicly via the Faculty website (<http://www.simet.unizg.hr/osiguranje-kvalitete>) by publishing minutes of their meetings (<http://www.simet.unizg.hr/osiguranje-kvalitete/sastanci-povjerenstva>).

Activities concerning quality assurance and improvement at the Faculty have been graded with the highest marks, to which activities related to adopting Strategy, Mission and Vision of the Faculty have contributed significantly, as well as implementation of procedures of audits and recertification.

The Commission for quality assurance and improvement at the Faculty of Metallurgy submits an annual report on its activities to the Faculty Council. A certified copy of the annual report, adopted by the Faculty Council is then delivered to the Quality Management Office of the University of Zagreb and published at the Faculty website.

1j)

List the bodies which deal continually with quality assurance. Evaluate their operations in the last five years.

Considering that the first commissions for quality assurance and improvement (Commission for quality assurance and improvement at the Faculty of Metallurgy and the Commission for student-faculty relations, monitoring and improving the quality of studying) were appointed only in 2007, we can discuss continual activities in regards to quality only in the period of the past four years.

Still, the Commission for teaching and the Commission for science and finances, as permanent working bodies of the Faculty Council (Rulebook on activities of the Faculty Council of the Faculty of Metallurgy is available at <http://www.simet.unizg.hr/dokumenti/pravilnici>), have participated in the fields of quality assurance and improvement with their regular activities and in their regular sessions. It should be emphasized that the Faculty Council is obliged to authorize all the decisions of the said commissions.

Apart from the said commissions, the Faculty has appointed heads of study years (head for each year of undergraduate study, one head for both years of graduate study, one head for specialized course and one head for doctoral studies, respectively). Through their work with students, reflected in periodical meetings at which current issues and suggestions concerning the studies and teaching are discussed, the heads are also active in quality assurance and improvement to teaching quality at the Faculty.

The Commission for quality assurance and improvement at the Faculty of Metallurgy conducts all the affairs related to quality assurance and improvement at the Faculty of Metallurgy. The acting The Commission for quality assurance and

improvement at the Faculty of Metallurgy was appointed on the 18th of January 2011 by the decree of the Dean.

The Commission has eight (8) members. Its constitution is the following: the Dean of the Faculty, the Vice-Dean for teaching, the Vice-Dean for Science and Finance, representative of the Faculty Administration, representative of external participants, faculty representative, representative of non-faculty staff and student representative. The current composition of the Commission is available at <http://www.simet.unizg.hr/osiguranje-kvalitete/povjerenstvo-i-radne-skupine>.

The Commission members are appointed for a four-year period from the day of appointment, apart from student representatives, who are appointed for a two-year period from the day of appointment.

The Commission organizes, coordinates and implements assessment procedures and develops internal mechanisms of quality assurance and improvement at the faculty level, especially in regards to the following elements:

- Self-assessment,
- Development of quality indicators,
- Student participation in monitoring the quality of study execution,
- Reviewing study performance and causes of non-quality, inefficient or prolonged studying,
- Reviewing the competence of faculty and staff,
- Improving mechanisms of work safety,
- Improving university teachers,
- Life-long education,
- Improving administrative and technical staff,
- Proof of teaching improvements,
- Quality of general and specific competencies obtained following the study program,
- Defining and introducing standardization in the administrative department.

The Commission is also responsible for planning the strategy of quality improvement at the Faculty, implementing assessment program and quality improvement program at the Faculty and coordinating implementation of programs for professional and specialized development of employees in the field of quality.

The Commission is actively involved in the work of each Faculty Council session. The Commission submits an annual report on its activities to the Faculty Council. Certified copies of annual report and activity plans regarding quality, upon adoption by the Faculty Council, are then delivered to the Quality Management Office of the University of Zagreb and are available at <http://www.simet.unizg.hr/osiguranje-kvalitete/dokumenti>.

The Commission for quality assurance and improvement at the Faculty of Metallurgy cooperates with the Quality Management Commission and the Quality Management Office of the University of Zagreb. The level of this cooperation is still quite low, considering that the institutionalized activities in this area of quality system are in its first stages of development. So far it has primarily been reflected in delivering information on Commission members to University bodies, while the president of the Commission and the Dean have participated at one meeting organized by the University Quality Management Commission.

Apart from that, in the field of quality assurance and improvement, the Faculty cooperates with the Agency for Science and Higher Education, primarily because the Faculty is currently undergoing procedures of external audit and recertification.

The Commission for quality assurance and improvement at the Faculty of Metallurgy is active and up to date in conducting all its activities. Activities concerning quality assurance and improvement at the Faculty have been graded with the highest marks, to which activities related to adopting Strategy, Mission and Vision of the Faculty have contributed significantly, as well as implementation of procedures of audits and recertification.

1k)

Name and elaborate main strategic goals that the management of the higher education institution is trying to achieve during its term and possible difficulties (related to study programs, employment policy, international dimension, scientific activities, care for students, quality assurance, business activities, etc.)

The main strategic goals that the management of the Faculty is trying to achieve in its term have been defined by the Development Strategy of the Faculty of Metallurgy 2011-2016 and the Dean's Agenda for the period of his term, i.e. academic years 2011/2012 and 2012/2013.

The main strategic goals are:

- Increase motivation of prospective students to enroll and graduate from the Faculty of Metallurgy;
- Improve the performance of students at the Faculty of Metallurgy and their competence in global market conditions;
- Raise competence of scientists and teachers at the Faculty of Metallurgy;
- To cooperate more intensely with businesses in the Republic of Croatia.

The above listed strategic goals shall be achieved through the following activities:

Motivating prospective students to study at the Faculty of Metallurgy

The Faculty management must explain the role and significance of technical sciences for the development and future of Croatia, the region and the world. Faculty employees should emphasize the significance of basic industrial potentials for economic development in their public appearances. Faculty management should, in line with European countries in terms of adequate industrial branches and insufficient number of experts, promote the Faculty, study programs and the role of the Faculty in the economic and social communities. In those efforts significant support is expected from the Croatian Chamber of Commerce, Ministry of Economy, Labour and Entrepreneurship and the Ministry of Science, Education and Sports.

Continuation of quality education at all study levels.

The continuation of quality education at all study levels has the goal of increasing the number of graduates while increasing the level of their professional competence. In order to achieve that goal, study programs shall be continually revised based on observed quality indicators with the introduction of new programs in line with market demand. This is aimed at increasing the graduates' competence and market needs so that bachelors, engineers and scientists from the field of metallurgy could satisfy demands of current and future economy, as well as the public sector within the Faculty's sphere of interest.

A series of activities aimed at ensuring professional competence are planned, such as:

- Introducing “zero term” for Mathematics, Physics and Chemistry,
- Introducing the “teacher facilitator/student” system,
- Increasing the quantity of teaching materials,
- Modernization of laboratories,
- Increase in the share of field work,
- Courses in foreign languages,
- Increase in student mobility,
- Upgrading students’ IT support.

In the following period, the Faculty plans to get involved more intensely in interdisciplinary university study programs and bilateral monitoring of the teaching process, as well as for teachers to cooperate at and from other higher education institutions from the Republic of Croatia and abroad. In order to increase study performance, especially in terms of fundamental courses, we expect significant amount of cooperation within the technical sciences, where the university management is expected to play a crucial role.

Revision of study programs at the Faculty of Metallurgy.

The primary task of the Faculty management is to increase the number of graduates. Even though the current economic situation is not favorable, efforts of the management and all employees will nevertheless be directed at greater motivation of existing and prospective students through revisions of study programs. Revision of the undergraduate study programs, with introductions of specializations in Metallurgical Engineering and Industrial Ecology, as well as innovations to the existing graduate study of Metallurgy should contribute to greater interest of students based on better employment prospects. Furthermore, due to business demands a new undergraduate specialized study-as-you-work course of Casting has been introduced.

The Faculty of Metallurgy shall continue scientific activities in the field of technical sciences, as well as institutional efforts concerning the development of the field of metallurgy.

Scientific activities and research at the Faculty provides a platform for education and further enhancement of this field. Research is primarily focused on issues of microstructure and properties of various metal and non-metal materials, and issues related to the energy industry and environment protection, foremost in line with the needs metal and metal processing industries, and oil and oil product industry. Faculty teachers are actively involved in scientific research and solving real technical and technology problems.

At the moment, research is being conducting in cooperation with international institutions (National Metallurgical Academy of Ukraine, Faculty of Metallurgy of the Technical University of Košice-Slovačka, Naravoslovnotehniška fakulteta and Inštitut za kovinske materijale in tehnologije iz Ljubljane, Metalurško-tehnološki fakultet Podgorica, Strojniška fakulteta Maribor, Tehnički fakultet Bor, Fakultet za metalurgiju i materijale u Zenici) and Croatian institutions (Faculty of Science in Zagreb, Ruđer Bošković Institute, Brodarski Institute Zagreb, Faculty of Mechanical Engineering and Naval Architecture Zagreb, Faculty of Chemical Engineering and Technology Zagreb, Faculty of Chemical Engineering and Technology Split, Faculty of Engineering Slavonski Brod). We plan to continue the existing joint project and expand

cooperation to other institutions, especially those interested in issues such as waste management and recycling of industrial waste and environment protection.

Results of our scientific activities and research have been published in prominent international journals listed in tertiary data bases (Current Contents, SCI, SCI-Expanded).

The employees of the Faculty of Metallurgy shall continue to publish their research results in a manner which will enable scientific production of higher quality (regarding the number of publications, and impact factor of the journals).

More intense cooperation with businesses, local and wider community.

The Faculty's activities is closely connected to the local community (the town of Sisak, Sisak and Moslavina County). Cooperation started in 1960, when the Assembly of Sisak Municipality provided the facilities which the Faculty still uses today, and which was then to serve as facilities of Sisak departments of the Faculty of Technology in Zagreb. The cooperation is still ongoing through common projects in terms of the needs of local community, especially regarding environment protection. Due to heavy industrialization, environment protection concerns are significantly present in the town of Sisak and Sisak and Moslavina County. Soon accession of Croatia to the European Union is connected to series of activities, including those based on the requirements of integrated prevention and monitoring pollution (pursuant to codified version of the European Parliament Council Directive 2008/1/EZ dated 15th of January 2008). In the coming period we expect greater and more concentrated cooperation directed to the solutions of environmental issues of the local and broader community.

The Faculty cooperates with business subject in the industry of metals and metal processing operating in Sisak, the region and the Republic of Croatia. The development of the Faculty should continue to be based on economic potential, tradition and prospects of metallurgy and metal processing industries. The Faculty plans to increase its role in recovery and development of the Croatian economy by linking science and business in solving technology and developmental problems of the economy.

Independent and efficient quality system which is to link requirement and objectives.

In order to continually monitor and improve quality assurance system at the Faculty, it is necessary to develop quality insurance mechanisms. Those mechanisms imply procedures for quality system implementation, assessment and monitoring and are foundations for activities of external audits of higher education institutions and study programs.

Self-assessment of the Faculty is to be conducted every five years. Its contents has been predetermined by the provisions of the Rulebook on measurement and criteria for quality assessment and performance of higher education institutions and study programs. The Quality Manual shall define the purpose and objective of establishing assessment criteria and indicators, which are to be monitored. It shall also define the ways of gathering information and processing of results in order to establish internal mechanisms for quality assurance in terms of teaching, scientific activities and research. SWOT analyses is also planned.

With the goal of assuring the efficiency of the implemented quality assurance system, it is necessary to develop, document and execute the procedures of

periodical in-house and external audits, ensure transparency and communication with interested parties in the quality assurance system.

1l)

State your view on the main advantages and disadvantages of your higher education institution's program, staff and material resources.

According to the official classification of scientific fields and specialties, the Faculty is active in the field of technical sciences. Its basic program orientation, education of metallurgy students, requires certain interdisciplinary skills. In order to ensure the planned learning results of the study program, along with contents from the field of technical sciences, the curriculum contains a significant amount of natural sciences (mathematics, physics, chemistry). One advantage of an interdisciplinary program is the fact that the educators participating in its execution are required to have other scientific competences which enable to Faculty to apply and work on more complex projects. However, this potential is not sufficiently used.

Human resources potential of the Faculty has been formed in line with University of Zagreb employment policy in regards to educational needs. As these resources are being rationally used at the Faculty level, all teachers have the required working-hour norm, but at the same time are devoted to scientific research. This results in a high scientific productivity of the Faculty in comparison to other technical faculties. It is necessary to emphasize that quality criteria prescribed by legal acts and university documents are taken into consideration at employment procedures. The greatest disadvantage is the limited possibility of employment of research trainees (currently, the Faculty has only one research trainee). Available information indicates that the Faculty is given less room for employment of research trainees than some other faculties from the same field.

The current human resources situation at the Faculty of Metallurgy is the following: there are about a dozen professors with a permanent title, meaning that they are soon to be retired, and about a dozen associate professors who can rightfully be called the teaching potential of the Faculty of Metallurgy. Considering the lack of PhDs in metallurgy at the labour market, a certain vacuum which will be hard to fulfil in a short time period is very likely due to lack of research trainees. About a dozen associate professors represent the wealth and future of the Faculty of Metallurgy, however, as a group their international experiences are lacking and they are not adequately connected to businesses. Faculty management encourages international cooperation via cooperation protocols with a significant number of businesses, trying to motivate associate professors to post-doctoral studies and engagement.

Involvement in projects in science and technology in the country and internationally is of immense importance to the employees of the Faculty of Metallurgy. On the other hand, acquiring such projects is conditioned by the profiles of respective scientists, i.e. his or her scientific and international reputation and competence. The Faculty expects more involvement in this sphere from all its employees, especially associate professors.

1m)

Insofar as you have experienced a certain form of external audit, comment on the recommendations and improvements implemented so far.

The Faculty of Metallurgy is currently in the last stage of external independent periodical assessment of the quality assurance system (follow-up stage) executed by the Agency for Science and Higher Education.

Upon delivering the required documentation and visit of the members of the Commission for the execution of external independent periodical assessment of the quality assurance system at the Faculty of Metallurgy with the University of Zagreb, the Commission issued its report. The report said that the quality assurance system, according to development stage, is currently between the preparatory and beginner stages, and according to the general development of the system, it is closer to beginner stage, while only certain system elements belong to the developed stages.

Respective segments of the quality assurance system have been assessed as follows:

- Policy and procedures of the quality assurance system
 - Development stage: preparatory with elements of beginner stage
- Authorization, monitoring and periodic review of study programs and education levels/scientific activities and research
 - Development stage: preparatory - beginner stage
- Student assessment
 - Development stage: beginner - developed stage
- Assurance of quality teaching and research
 - Development stage: beginner with elements of developed stage
- Study resources and student support
 - Development stage: preparatory
- Importance and access to information on the quality assurance system
 - Development stage: beginner
- Availability of public information
 - Development stage: beginner - developed stage

Four work groups appointed by the Dean were involved in the processes of implementing revisions based on issues mentioned in the report: Work group for drafting the Strategy, Mission and Vision of the Faculty of Metallurgy, Work group for revisions to the curricula of undergraduate and graduate studies at the Faculty of Metallurgy, Work group for the drafting of quality rulebook and manual at the Faculty of Metallurgy and the Work group for revision of the Faculty of Metallurgy website. The composition of all work groups is available at the Faculty website: <http://www.simet.unizg.hr/osiguranje-kvalitete/povjerenstvo-i-radne-skupine>.

The operations of all work groups were supervised by the Commission for quality assurance and improvement.

Upon analyzing the report, reaching plans of activities for respective work groups and realization of the plans, the Commission composed a final statement and delivered it to the Agency for Science and Higher Education. The statement is enclosed in full. The course of the Commission's activities with regards to the audit may be reviewed in minutes published at the Faculty website: <http://www.simet.unizg.hr/osiguranje-kvalitete/sastanci-povjerenstva>.

The procedure of external independent periodical assessment of the quality assurance system has prompted the Faculty to consider a new perception of working at the quality system. Previous efforts were disclosed as insufficient, especially considering the fact that there had been no assessment and therefore no monitoring after certain implementations. Currently, the Faculty is satisfied with what has been achieved since January and expects a positive opinion of the Agency for Science and Higher Education on quality assurance system at the Faculty of Metallurgy.

Table 1.1. Internal quality assurance

Type of activities	Responsible for activities (names of bodies or persons)	Frequency of activities (number of meetings or operations per annum)	Number of reports on respective activities in the last 5 years	Practical results of activities (as described in the self-assessment)
Topical sessions on the quality of teaching	Faculty Council	12	5	Faculty Council decisions
				Revision of the undergraduate and graduate Metallurgy study curricula
				Introduction of the university specialist study-as-you-work course in Casting
				Curriculum proposal for the study of <i>Engineering metal materials</i>
	Commission for quality assurance and improvement	5	2	Revision of the undergraduate and graduate Metallurgy study curricula
	Work group for revision of the undergraduate and graduate Metallurgy study curricula	10	7	Work group Minutes
Proposal of the revised undergraduate and graduate Metallurgy study curricula				
Proposal of the revised undergraduate and graduate Metallurgy study curricula				
Commission for teaching	11	60	Proposals to the Faculty Council	
Activities of the Commission for quality assurance and improvement	Commission for quality assurance and improvement	12	2	
Student poll (execution, processing, student information, teachers' statements)	Commission for quality assurance and improvement	2	2	Student poll results
SWOT analysis at the Faculty level	Commission for quality assurance and improvement	1	1	SWOT analysis
Monitoring quality indicators at the Faculty*	Faculty Council	5	5	Report on activities
Other forms of evaluation				

1n)

If there is such a higher education institution, name an international higher education institution comparable to your own, and explain the considered criteria.

The Faculty of Metallurgy educates students and executes study program in the field of technical sciences, specialty in metallurgy, and as such it is unique in the Republic of Croatia. In the European framework, metallurgy is taught at independent faculties of metallurgy, but also within the framework of other faculties with specialized departments (mostly for metallurgy and metals). A typical example are faculties in Slovakia and Slovenia. Thus, Technická Univerzita v Košiciach has a faculty of metallurgy (Hutnícka fakulta) and Naravoslovnotehniška fakulteta in Ljubljana has a Oddelek za materiale in metalurgijo.

The compatibility of study programs, as well as similar challenges common to countries in transition are foundations for comparison of above mentioned faculties with the Faculty of Metallurgy. On the level of study programs the Faculty of Metallurgy is best compared to the Slovenian Oddelek za materiale in metalurgijo, with which it has been cooperating for a number of years, thus having an ongoing teacher exchange programs, common research projects and similar issues concerning the number of students and their performance. Slovenia currently has better system of state financing, business investments and investments into infrastructure and equipment, not to mention Montanuniversität Leoben of Austria and the German RWT Aachen, positive examples to aspire to.

1o)

Describe when and how you have reacted to and/or participated in reaching decisions of public interest.

The Faculty, i.e. the employees of the Faculty of Metallurgy are actively involved in forming public opinion and reaching decisions of public interest through individual public appearances, expert associations (e.g. Croatian Foundry Association), panels, interviews to the media, etc.

Through active participation in economic councils and within the Croatian Chamber of Commerce, employees of the Faculty of Metallurgy consider prospects and development of the industry of metal processing (e.g. Croatian Chamber of Commerce – Željezara Sisak, July 2011, more details at <http://hgk.biznet.hr/hgk/fileovi/22400.doc>). The University of Zagreb, i.e. a number of its faculties, has considered the issue of renewable energy, situation in shipbuilding, etc., in which the Faculty of Metallurgy was included. At panels of the Croatian Casting Association, which the Faculty of Metallurgy is proud to organize for a significant number of years including businesses from the region, issues of direct importance to the economy are discussed, reviews of which can be found in scientific journals (e.g. IRT3000 issue 15/2011, more at: <http://hr.irt3000.si/tekoci-letnik2/?id=12>).

Employees of the Faculty of Metallurgy are also, through the Academy of Technical Sciences of Croatia, included in discussion on the strategic development of the Republic of Croatia.

1p)

Define as to how satisfied you are with the current state of affairs and suggest possible improvements.

In the segment of report relating to the vision and mission of the Faculty, there are reviews as to how satisfied the Faculty management is with the current state of affairs. The satisfaction level is clear in the priority given to strategic goals and policies for their realization.

We are to a significant extent satisfied with the quality of teaching and set criteria of passing exams and graduating. The basic problem is the low enrolment, quality, previous knowledge and motivation of students to graduate. We appeal to the general increase in high-school knowledge from science subjects, as the foundation of technical sciences. Aware of the significance of metallurgy in the world, therefore in Croatia as well, we are trying to change the perception of metallurgy as the industrial sector of the 19th century, indicating various forms of production and application of metal material within the general economy of Croatia and Europe. The reputation of the field, work conditions and incomes in this industrial sector are currently unfavorable for increased enrolment to the Faculty of Metallurgy. The public perception, followed by prospective students' perception is that this is a "difficult" faculty with bad material and work conditions and non-existing reputation and prominence of teachers. The global financial crisis, inability to gain loans and the existing loan obligations have culminated in a recognition of the need for industrial production, new jobs, increased investments and financial discipline. Thus, as a result, a part of the public is now more aware of the importance of metallurgy, which is followed by more interest in technical occupations, including metallurgy. Student enrolment at the University of Zagreb in the academic year 2011/2012 seems to confirm the above elaborated thesis.

With regards to teaching, it is necessary to continue with activities connected to improving the quality of teaching, study programs, e-learning, etc.

The Development Strategy of the Faculty of Metallurgy has set quality improvement of scientific activities and more involvement of teachers as a primary objective, especially through cooperation with businesses.

We are dissatisfied with the delay of capital investment in the infrastructure and equipment of the Faculty. The region in which we operate has had the least investment in higher education facilities of all Croatian regions. The Faculty conducts operations in two buildings built 50 years ago. An additional problem is the lack of student dormitory in Sisak, as well as the low student living standard.

2 Study programs

2a)

Display the vertical configuration diagram of all study programs (undergraduate, graduate, integrated, and postgraduate) with their possible branches into specializations. If you have specialist studies, display their configuration. Elaborate of the functional reasons for such a configuration, especially in regards to achieving optimum educational effects (employment possibilities, continuation of studies, mobility) in comparison to enrolment quotas. List the dislocated study programs and comment of the justification for dislocation.

The Faculty of Metallurgy already has a permit to conduct undergraduate, graduate and postgraduate doctoral university study as the only higher education institution in the Republic of Croatia in the field of metallurgy. Study structure consists of three levels:

- Undergraduate studies in the duration of six semesters (three years), upon the completion of which students are awarded the academic title of Bachelor of Science in Metallurgy (univ.bacc.ing.met.).
- Graduate studies in the duration of four semesters (two years) upon the completion of which students are awarded the academic title of Master in Metallurgy (mag.ing.met.).
- Postgraduate doctoral studies in the duration of six semesters (three years), upon the completion of which students are awarded the academic title of PhD in the field of technical sciences, specialty in metallurgy.

Undergraduate study – Metallurgy since acad. year 2005/2006

Graduate study – Metallurgy since acad. year 2008/2009

Postgraduate doctoral study – Metallurgy since acad. year 2005/2006

The undergraduate studies have no specialties. The graduate studies currently have three modules (four semesters):

- Processing Metallurgy
- Foundry Engineering
- Metal Processing

The presented study programs are executed due to market needs, support of the local community and businesses. Enrolment quotas (55 full-time students, three exchange students for undergraduate studies and 30 students for graduate studies) have been determined on the basis of market needs and available resources of the Faculty of Metallurgy.

Undergraduate study of metallurgy develops analytical abilities and problem-solving skills in regards to engineering challenges of medium complexity in the field of metallurgy and other related fields.

Within the framework of metallurgy studies, upon the completion of study results at the undergraduate level, there is a possibility of vertical and horizontal mobility of students towards graduate studies of metallurgy at the Faculty of Metallurgy and/or other study programs at technical faculties of the University of Zagreb.

The existing ECTS system for each course of metallurgy studies at the Faculty of Metallurgy enables greater mobility of students within the country, as well as in EU countries. Rulebook on studying at undergraduate and graduate level of Metallurgy study, the students are allowed to choose one optional course per semester at a related faculty of the University of Zagreb or some other Croatian or foreign

university. Likewise, students of other universities and faculties may choose a certain number of courses at the Faculty of Metallurgy. This enables greater transferability of students in regards to studies. The said is achieved on the foundation of cooperation agreements with respective technical colleges (e.g. Faculty of Mechanical Engineering and Naval Architecture of the University of Zagreb, Faculty of Chemical Engineering and Technology of the University of Zagreb, Faculty of Science and Technology of the University of Ljubljana, the Faculty of Metallurgy of the University of Technology in Košica, Slovakia, etc.).

Regarding the horizontal mobility of students within the University of Zagreb, person responsible for study programs usually authorizes choice and enrolment of courses (normally, Vice-Dean for teaching), alongside with the ECTS coordinator at the Faculty of Metallurgy, with approval of ECTS coordinator of the constituent unit of the University in which the chosen course is executed. A special document of approval is issued, carrying the name of the course and the determined value of the subject (number of ECTS points). Student mobility among Croatian universities is determined in the same manner as international mobility pursuant to general acts (Statute) of the University of Zagreb.

The employees at the Faculty of Metallurgy successfully cooperate with all metallurgy and metal processing subject in the Republic of Croatia. Based on 51 years of experience and tradition of the Faculty of Metallurgy, support of the local community and businesses, it is concluded that there is a need for experts in metallurgy. The Republic of Croatia has a long tradition in the field of metals, metal processing and production of metal products (cast iron products, steel pipes, aluminium and aluminium alloy products, ship building parts, ship engines, etc.). Apart from being employed in the industry (casting and processing of metal materials, metal processing, naval architecture, etc.), experts in metallurgy are also employed by institutes and research laboratories, as designers of industrial facilities, in environment protection offices, standardization offices, state administration departments dealing with technical issues, etc. Without their contribution it would be impossible to expect the maintenance of the current industrial production.

Upon the completion of graduate studies, Masters in Metallurgy may be employed by the metallurgy and metal complex of the Republic of Croatia including CMC Sisak d.o.o. (in 2010, approximately \$ 60 million was invested in industrial production), Adrial Plus Šibenik, HS-Produkt Karlovac, shipbuilding, one of 60 casting facilities (26 industrial and 34 entrepreneurial), numerous engineering and metal processing industries, such as Adria-Diesel Karlovac, Alstom Karlovac, etc. Masters in Metallurgy may also be employed in the broader technical field of expertise, such as Petrokemija Kutina, Applied Ceramics Sisak, Selk Kutina, etc., as well as technical-commercial companies (e.g. Elkem Zagreb, Kovintrade Hrvatska Zagreb), but also in local government units (e.g. Business zone Sisak, County Office for environment protection Sisak, Sisak Projekti, etc.). Upon completion of studies, Masters in Metallurgy may also be employed at scientific and research projects at higher education and research institutions.

2b)

If there is such a higher education institution, name an international higher education institution comparable to your own. Explain the steps that have been made in order to avoid such overlapping in the future.

The study programs of the Faculty of Metallurgy are unique and not comparable to any other related program at the University of Zagreb and in the wider area. Undergraduate and graduate metallurgy studies at the Faculty of Metallurgy of the University in Zagreb may be compared to the following study programs: RWTH Aachen (www.rwth-aachen.de), Metallurgie Montanuniversität Leoben of Austria (www.muleoben.at), and Oddelek za materiale in metalurgijo Naravoslovnotehniška fakulteta in Ljubljana (www.ntf.uni-lj.si).

2c)

For each of the following levels; undergraduate, graduate, integrated and postgraduate (especially postgraduate specialist) studies, as well as specialist studies (if you have any), answer the following questions respectively:

- Name the criteria taken into consideration when proposing enrolment quotas for undergraduate (or integrated undergraduate and graduate), i.e. specialist studies (if you have any). Evaluate the functionality of enrolment quotas in regards to social priorities an unemployment, ability of the higher education institution to ensure quality teaching based on group work and the number of capable and motivated students for efficient studying concerning the set program.

When proposing enrolment quotas at study programs of the Faculty of Metallurgy, the primary consideration was that the Faculty of Metallurgy is the only higher education institution in the Republic of Croatia which educates students in the technical and scientific field of metallurgy. Furthermore, the environment of metallurgy and metal processing sector, as well as the number of unemployed metallurgy engineers in the Republic of Croatia were also taken into consideration. The Faculty of Metallurgy ensured resources connected to staff and infrastructural capacity which enable quality teaching based on group work even before the introduction of the Bologna Process. The number of motivated students is negligible, however increased interest has been noted in the current academic year 2011/2012, which resulted in 51 students enrolling at the first year of metallurgy study.

- Analyze the pass and fail percentage at the first year of studies (undergraduate, integrated and specialist) and compare it to criteria for enrolment, mentioning the high schools of your candidates' background and their average grades during high-school education.

Data for three consecutive years is presented in Tables 2.3a, b, c and 2.4a,b. Data indicate a low interest in the Faculty's study programs and in average quality candidates enrolled. Considering a low number of 'serious' candidates at the undergraduate level, enrolment to graduate studies is also low. The pass and fail ratio according to study programs varies at undergraduate and graduate levels. The pass and fail ratio at the graduate level is excellent, which is a direct consequence of the high threshold in regards to quality candidates set at the undergraduate level (especially in sciences, i.e. mathematics, physics and chemistry), and also due to providing a teacher-student mentorship in almost every course so that the students of this study program have the privilege of availability of teachers for all kinds of assistance.

The pass and fail ratio at the undergraduate level is characterized by serious challenges for enrolled students regarding knowledge and skills acquisition determined in the curriculum. The analysis did not include the significant number of students at the Faculty of Metallurgy who do not get involved in classes during the

first semester and lose their student rights already at the first step, i.e. after the first semester. The Faculty management appointed in 2009 has set this problem as priority and has conducted several comprehensive steps in order to solve it, namely revision of existing and introduction of new study programs, implementing all elements of quality assurance system defined by positive regulations, creating the Faculty Strategy, as well as modernizing teaching and instruction methods. The description of these activities is given below. The undergraduate study of metallurgy, just as most technical studies, implies a series of challenging courses in the first year, such as mathematics, physics, basic and inorganic chemistry, mechanics. The pass and fail ratio according to achieved ECTS points is demonstrated in Tables 2.4a and 2.4b. Considering that most students who enroll in this study program possesses an average or below-average high-school knowledge background (c.f. Table 2.3a), they are practically illiterate when it comes to studying literature, unused to fulfil their obligations in set periods, and this is why the beginning of studying is usually quite challenging and painful to them. The teachers of most challenging courses have provided a series of additional activities with the goal of successful completion of their courses. There have been additional classes, passing exams in parts via continual monitoring and assessment has also been adopted, as well as including attendance and due execution of tasks into the final grade. Regardless of the presented efforts, we believe that only new and more attractive study programs (including revised existing programs) will improve the current state of affairs. It is generally well-known that most other technical faculties also face the problem of reduced interest of quality candidates. We believe that this problem can be solved only by state-adopted viewpoint that technical and science studies are extremely important for the economic recovery and prosperity of the country as a whole. To be more precise, these study programs provide immediate support to the development of industrial sectors in the Republic of Croatia. Thus, within the revision framework of undergraduate studies of metallurgy, a new program was proposed, consisting of two specialties (Metallurgy Engineering and Industrial Ecology) in the hope of finding its position in general efforts aimed at the economic recovery of the Republic of Croatia based on high-technology industrial production including all the elements of sustainable development and protection of natural resources.

- Explain the methodology used in determining learning results in planning study programs. Provide one example how a study program incorporates courses and acquired competencies.

When determining learning results at the program level of undergraduate and graduate metallurgy studies, the primary principles were development of analytical skills and problem-solving abilities for complex engineering metallurgy tasks in the field of metal material production, processing and application. In line with market demands, continuation of studies and general social needs, learning results at the undergraduate study level contain 26 learning results, and 28 learning results at the graduate study program.

When planning the revised study programs, special attention was directed at the correct ratio and representation of general and generic skills towards specific and specialized knowledge and skills. A table of representation in respective courses of the program has been drafted for all the learning results, which should ensure that the results are covered in the contents of the course. Considering that the entire educational system is founded on learning results from relatively early stages, the study elements which previously demonstrated positive results have been used to a greater extent, but they are now clearly defined by the study programs. Aware of the

fact that the available methodologies are limited, prone to errors, we have approached their elaboration in a way to keep all the positive experiences accumulated in all the years of program execution.

A special challenge arose due to the lowering of interest in undergraduate studies for a significant number of years, which implied that the direct measurements of achievements were in a way 'hidden' due to reduced numbers of students and their general quality. The aim we have tried to achieve is approaching high transparency standards in terms of expected achievement of students during the course of studies at the level of respective courses, as well as the program as a whole.

The example of incorporating obligatory courses and study results acquired at the proposed revised metallurgy study: courses Theory of metallurgy processes I (fourth semester), Iron metallurgy (fifth semester) and Steel metallurgy (sixth semester) are interconnected. They contribute with 25 % (seven learning results at the level of subjects) to total learning results at the level of the study program.

- List the most important objectives when determining study results. Evaluate as to what extent the objectives taken into consideration when creating new undergraduate, integrated, i.e. specialized (if you have any) study programs have been achieved.

The most important objectives when determining learning results were real demands of businesses, alumni feedback, and global trends in the field of education in technical areas, especially metallurgy. The set objectives have been partly achieved, which is why revision of study programs has been initiated.

- Describe the ways and comment on procedures for harmonizing awarded ECTS points with a realistic estimation of student workload.

The ECTS point system at revised study programs was founded at precise definitions of all forms of teaching at the level of the entire programs, from which appropriate have been chosen for respective courses at undergraduate, graduate and postgraduate metallurgy studies considering the aimed achievements. When awarding ECTS points, we have used positive experiences on realistic student workload for particular subjects. The estimation has included projected extracurricular activities necessary for successful knowledge and skills acquisition of the students and their gradual introduction to the study.

- Assess your graduates' competencies in comparison to related studies at esteemed universities in Europe and the world, and add to what extent your study programs adhere to the recommendations of European and international expert associations.

Acquired skills and competencies of Faculty of Metallurgy graduates are satisfactory. Study programs at the Faculty of Metallurgy are harmonized with similar studies in respective EU countries. Proof of that are numerous graduates employed in Italy, Germany, Norway, Sweden, the US, Australia, etc.

- Describe the process of study program monitoring and improvement, as well as adaptations to new research. Define possible alterations introduced to originally adopted Bologna study programs. Describe the purpose of those changes and the procedure of decision-making.

Metallurgy study programs at the Faculty of Metallurgy, apart from being adapted to the research and developments interests in metal productions and metal products, are also expanded by introduction of subjects program of which is studying physical and chemical processes taking place during metal material production and processing. Detailed knowledge on metallurgy processes from the viewpoint of physical and chemical understanding is of crucial importance to metal and metal products processing in realistic application conditions. The teaching process

(especially in regards to final papers and doctoral dissertations) is partly reliant upon research within the framework of programs and projects conducted by the Faculty of Metallurgy.

Upon the analysis of the current study program and alumni feedback, there appeared a need to revise the university undergraduate and graduate metallurgy studies after the five-year cycle of its application. It should be noted that during 2010 the Faculty of Metallurgy has proposed the undergraduate and graduate study Engineering Metal Materials. The program has received a positive review and has been adopted at the Technical Council of the University of Zagreb. However, due to limited human resources, the program was abandoned, and in the subsequent revision, certain segments of this study program have been transformed into one of the modules (Engineering Metal Materials) at the graduate study.

The analysis of metallurgy undergraduate and graduate studies has demonstrated that the current structure of the studies is not satisfactory, especially in regards to the ratio of specialized subjects at respective study levels.

General

The framework of the revision of metallurgy study program has enabled greater horizontal and vertical mobility of students upon the completion of undergraduate study results. What has been provided for is the vertical mobility of students of Industrial Ecology towards graduate studies of metallurgy at the Faculty of Metallurgy after passing required exams (approximately ten) and/or some other graduate study program (in environment protection) at some of the technical constituent units of the University of Zagreb. In the course of studies, numerous elective courses are offered which enable the desired profiling of experts. The undergraduate study of metallurgy (with two specialties: Metallurgy and Industrial Ecology) is completed upon writing a final dissertation, achieving the academic title of Bachelor of Science in Metallurgy (univ.bacc.ing.met.) with indication of specialty (Metallurgy or Industrial Ecology).

The new proposal for the study of Industrial Ecology at the study of metallurgy is closely connected to the restricting and privatization of the industrial and energy sectors, including the adjustment of other economic segments. In the effort to fulfil the prerequisites in terms of environment, it is necessary to have qualified experts, i.e. bachelors of science in metallurgy with the specialty in industrial ecology.

It is necessary to emphasize the fact that the environment protection issues are highly prominent in the town of Sisak and the Sisak-Moslavina County as a consequence of industrial saturation. The Sisak-Moslavina County used to represent 20% of total Croatian industrial activities. Considering previous experiences in the field of environment protection, the Faculty of Metallurgy presents an obvious solution as the institution responsible for the execution of the industrial ecology study program within the undergraduate study of metallurgy. Recently, numerous activities of the town of Sisak have been directed at resolving environmental challenges through projects such as 'Waste water management of the town of Sisak', via which the European Bank for Reconstruction and Development is financing the construction of a plant for waste water management in Sisak. The objective is for Sisak to obtain a waste water management system by 2013, which should raise the quality of life in the area.

Thanks to numerous subsidies, the so-called southern industrial zone in Sisak has been included in Top 10 entrepreneurial locations, out of 317 considered industrial zones in the Republic of Croatia. Thus, it has become 'the entrepreneurial heaven'. As a result of those efforts, a branch of Applied Ceramics from Freemont,

California started operating in Sisak, which is of great importance to the town because it places it on the nanotechnology map of the world. Also, the US company CMC acquired the former Željezara Sisak and invested approximately \$65 million into modernization, i.e. construction of the new steel mill, which should produce around half a million of steel annually. The same zone now hosts a Cial smelting plant for aluminium waste recycling, operation within CIOS Group. Soon, the Austrian company Obernsdorfer will begin producing concrete elements. Hence, due to industrial growth and the microclimate which is getting more saturated, there arises a need for the study of industrial ecology in the town of Sisak.

Positive developments in terms of the energy industry in the region are reflected through various activities, namely application of renewable energy and increasing energy efficiency. For example, on the 5th of September 2008, Sisak hosted the first solar technology fair 'Solar Sisak 2008'.

Meeting legal acts and provisions of the Republic of Croatia and the European Union in contemporary industrial facilities implies conducting complex activities in terms of construction, maintenance and improvement of the system which encompasses all the aspects of environment protection. All-encompassing environment protection is the obligation of all businesses, especially producers and processing businesses, and it implies monitoring of production processes and their impact on the environment, as well as implementing measures regarding the reduction of the impact. Successful fulfilment of obligations of international character (such as monitoring, audits, data processing, reporting to authorities, participation in educational activities, rationalization and innovation) can be achieved only if the said activities are conducted by competent specialists who possess requires skills and knowledge alongside with know-how in environment protection.

The employees at the Faculty of Metallurgy successfully cooperate with all metallurgy and metal processing subject in the Republic of Croatia. Following such experience, a unique study of industrial ecology is proposed, with emphasis on real industrial challenges.

The proposed industrial ecology study is conceived in a way that the bachelor would, upon completion of studies, have a wide knowledge base related to pollution of respective ecosystems segments by various pollutants and in different manners, while the other group of courses would provide them with knowledge required for pollution prevention, i.e. application of techniques for minimizing undesired pollution effects, as well as the know-how necessary for permanent monitoring of technological development in this field. Through numerous elective courses (three out of ten offered are chosen), students are given the opportunity to master contemporary technologies and achieve possibilities for introduction to the labour market upon the completion of studies without any additional training.

Review on environment protection education at the Faculty of Metallurgy

At the moment when the economic crises is once again gaining momentum, the education in environment protection specializing in industrial production is becoming more and more significant. With the aim of more efficient environment protection and natural resources protection, it is vital to raise public awareness to a higher level through intense activities of scientific and educational institutions. It is also necessary to increase control systems and application of existing regulations, as well as encourage drafting additional provisions. These tasks should be conducted by environmentally aware, motivated and qualified engineers who will ensure a fully

integrated approach to process management in the industrial sector in order to limit resource depletion and air, soil and water pollution.

The Faculty of Metallurgy has a long educational tradition in environment protection, which started in the academic year 1960/1961, when the Faculty of Technology in Zagreb started a higher education in Sisak at the Technology-industrial department for Oil and the Department of Metallurgy. The teachers of those departments cooperated extensively with numerous industrial subjects in Sisak, Rijeka, Kutina, Šibenik and Mostar, monitoring issues related to production and management of waste by-products in facilities for production of iron, steel, coke, aluminium, oil products and other products of chemical industry. Within joint projects with the industry, the knowledge base of the Faculty of Metallurgy in Sisak grew, indicating the need to transfer the knowledge to new generations of students. Hence, new studies for industrial engineers were started (then first degree engineers), who were educated in water processing and analysis of water solutions in several faculty orientations: Process analysis (1974/1975), Chemical technology (1974/1975), Oil refinery engineering (1975/1976), etc.

Following the restructuring of the Faculty of Technology in 1978, most teachers of Metallurgy engineering in Sisak continued to operate at a separate four-year undergraduate study in metallurgy (simultaneously participating in teaching the students of chemistry and technology at the Faculty of Technology in Zagreb until the academic year 1985/1986), incorporating their knowledge and experiences on environment protection in newly introduced courses such as: Ecology (1980/1981) and Environment protection (from 1981/1982 to 1990/1991).

The Faculty of Metallurgy in Sisak had the first associate professor in environment protection at the University of Zagreb, and the first masters' dissertation on the topic of environmentally aware waste management of solids was also written at the Faculty of Metallurgy. Apart from teaching, the educators at the Faculty of Metallurgy started an intense scientific activities connected to environment protection issues in Sisak, which resulted in 1982-1984 project entitled 'Program of long-term monitoring and environment protection in Sisak', the first official document of the kind in Croatia. It is necessary to emphasize that long before adopting the Charter of the University of Zagreb on sustainable development, the Faculty of Metallurgy promoted the principles of sustainable development and environment protection through several courses (Preparation of mineral raw materials, Usage of secondary raw materials, Metal recycling, Industrial furnace waste gas recycling).

The above mentioned activities of the Faculty of Metallurgy scientists' long-term involvement have raised public awareness in Sisak. In order to avoid a wrong and sensational approach to environment protection issues, the tradition of monitoring the state of the environment should be continued in new generations of qualified engineers. The younger generations of Sisak's citizens are involved in education in sustainable development since kindergarten and in primary schools (official statuses of 'Eco-kindergartens' and 'Eco-schools'). The Technical high school in Sisak educates ecology technicians ever since school year 2003/2004. So far 71 students have graduated from high school with that occupation (the first generation of seniors in 2007), and 42 of them are now at college, mostly technical faculties of the University of Zagreb (Faculty of Chemical Engineering and Technology, Faculty of Food Technology and Biotechnology, Faculty of Forestry, Faculty of Agriculture, Faculty of Science, Faculty of Mechanical Engineering and Naval Architecture, Faculty of Metallurgy, Higher school of medicine – sanitary engineering). The town of

Karlovac also has the same high school, hence also prospective students of Industrial Ecology.

Everything above said indicates that there exists an interest and need for the study of environment protection in Sisak and wider area, so that future generations of ecology technicians might continue their education at academic levels. Hence, the study of Industrial Ecology at the Faculty of Metallurgy, as the only higher education institution in the Sisak-Moslavina County, is an essential prerequisite for achieving the said objective.

The teaching staff of the Faculty of Metallurgy has published numerous scientific papers, and conducted many studies in the period of relatively low presence of such activities in Croatia, especially in the period from 1981 to 1992. The Faculty of Metallurgy or its work groups participated in organizing a number of academic conferences and panels. Since the 1990s, the Faculty of Metallurgy is involved in the following fields of scientific activities and research:

- Reuse of metallurgy waste in production
- Application of metallurgy waste in other industrial segment
- Waste management.

The Faculty of Metallurgy was involved (via membership in the committee) in drafting Environment Protection Program, i.e. local AGENDA 21 and Waste Management Program. The Committee participated in drafting the Programs by representing community interest in different stages of environment protection policy preparation process and its application according to the principles of sustainable development. The primary task is to ensure environment protection alongside with sustainable economic development.

Teaching and scientific activities of the group of scientists from the Faculty of Metallurgy involved in environment protection affected raising of public awareness in Sisak vital for sustainable development, but also the decision-making authorities, and this cooperation with bodies of public administration of the town and county resulted in the previously mentioned environment protection program (1982-1984), first of the kind in the former state in terms of scope and interconnection of science, industry and town administration. Monitoring of air, soil and water quality as well as waste management procedure has been conducted to this very day. The said group, apart from other things, also participated in drafting first environment protection regulations, and certain individuals acted as committee members on the level of the community. They have been awarded numerous times. The members of that group from the Faculty of Metallurgy have also been appointed to important position related to environment protection in the town and state public administration.

Expert activities related to environment protection resulted in numerous studies, such as: The state of monitoring and needs of human environment in Sisak (1981), Study of Željazara Sisak's Seamless pipe mill impact on the environment – Previous study (1982), Program of long-term monitoring and environment protection in the county of Sisak (1982-1984), Study on the saturation of the Sisak town area by industrial pollutants (1985), Study on environmental impact of INA-Oil refinery Sisak and its Alkylation plant (1991). Numerous experts from a number of businesses in Sisak also participated in these projects coordinated by the Faculty of Metallurgy.

Furthermore, the project entitled Black metallurgy waste management and possibilities of recycling (2002-2006) was of immense importance to the town and its surroundings. The project studied waste reuse in production processes, applications of the waste in other industrial branches and waste management. The project was conducted in cooperation with Felis d.o.o. in Sisak, which produces steel casts.

Research of the program proposed by the Faculty of Metallurgy entitled 'Metal materials – properties, processing and energy use' is a part of scientific research within the framework of short-term (energy and materials) and long-term studies in the Republic of Croatia in the energy sector (e.g. energy conservation), environment protection (e.g. reductions of CO₂ and NO_x emissions) and development of new metal materials (e.g. CuAlNi alloys, Ti-alloys, etc.).

Within the framework of joint Croatian and Slovenian bilateral program, cooperation was achieved on the project Characterization of Slovenian and Croatian steel and casting mills' waste (2004-2005). Research was conducted on samples of electric furnace dust from Željezara Sisak, Želježara Split and steel mill Acroni from Jesenice as well as the casting mill Felis d.o.o. from Sisak. The project included economic experts as well.

The Faculty of Metallurgy with the Croatian Casting Association held annual conferences entitled The influence of environment protection regulations on the casting industry (11th of November 2009, with 50 participants from the business world attending) at the facilities of the Croatian Chamber of Commerce Sisak branch. In 2010, the Faculty organized a conference entitled 'Casting – state and prospects.

The scholars of the Faculty of Metallurgy have published approximately one hundred papers in journals and conference proceedings on the topic of air, water and soil environment protection.

Following discussions of the Work group for curricula revision of metallurgy studies in multiple sessions from the 1st of February to the 20th of May 2011, taking into consideration feedback of the Faculty of Metallurgy teachers, the Work group presented the Faculty Council of the Faculty of Metallurgy revised study programs at the level of above 40 % to be discussed and adopted.

The revised undergraduate and graduate programs of metallurgy were adopted at the Faculty Council session on the 23rd of May 2011, with 20 votes for the adoption and one restrained. Following this, the study programs were sent to further procedure at the University of Zagreb.

A summary of the proposal for the revised and current metallurgy study program:

- It is proposed that the undergraduate metallurgy studies have two modules (Metallurgy Engineering and Industrial Ecology), whereas the graduate studies are to have three revised modules (Process Metallurgy and Casting, Mechanical metallurgy and Engineering Metal Materials).
- The duration of all courses is one semester (at both undergraduate and graduate studies), as required by the Bologna Process.
- The number of courses at respective studies is the same (35 courses at both modules of undergraduate studies – the currently valid program has 34 courses at the undergraduate study in metallurgy; whereas 23 courses are proposed for graduate studies, while the currently valid program has 24 courses, see courses for the academic year 2010/2011).
- Smaller weekly student workload at the undergraduate study of metallurgy (65+18+58=141 hours) in comparison to the previous program (72+15+68=155 hours, see courses for the academic year 2010/2011).
- More specialist courses at the undergraduate study of metallurgy.
- Less direct students' weekly educational responsibilities in the sixth semester (8+3+4=15, whereas in the current program it is 10+5+9=24 hours, see courses for the academic year 2010/2011) due to time-related provisions for writing the final dissertation of higher quality.

- Assessment of students' work by ECTS points.
- Introduction of a new module (Industrial Ecology) at the undergraduate study of metallurgy with 22 joint courses (97 ECTS points), just as in case of Metallurgy Engineering module.
- Vertical mobility of Industrial Ecology students towards the undergraduate study of metallurgy with passing required exams (approximately 60 ECTS points) and/or some other graduate study program (in environment protection) at some of the technical constituent units of the University of Zagreb.
- Ten elective courses (three are to be chosen) at the undergraduate study of metallurgy, module Industrial Ecology, of which two are courses at the graduate study of metallurgy (Engineering Mathematics, Energy Management).
- Almost the same weekly student workload at the graduate study of metallurgy (23 courses, 49+10+25=84 hours) in comparison to the previous program (24 courses, 49+7+24 hours, see courses for the academic year 2010/2011).
- Introduction of courses Thermodynamics of Materials and Engineering Mathematics at the first year of the graduate study of metallurgy; course in Hydrometallurgy proposed as obligatory.
- Introduction of obligatory research project in the third semester of the graduate study of metallurgy.
- Module restructure at the graduate study of metallurgy: old modules Process Metallurgy, and Casting are joint into one entitled Process Metallurgy and Casting, whereas Metal Processing module is renamed into Mechanical Metallurgy, with introduction of a new module Engineering Metal Materials.

The originally approved programs have been slightly revised with the objective of adaptations to technological developments. Changes were adopted by Faculty Council decisions and University of Zagreb Senate decision.

- Only for specialist graduate studies: explain their justification, i.e. reason why they are conducted at the higher education institution.

Based on the long experience of the Faculty of Metallurgy as well as industrial demands, in 2007 the Faculty estimated that there is a need for experts in the field of casting. Croatia has approximately 60 casting facilities (26 industrial and 34 entrepreneurial), which, according to available data, employ 4419 people and produce different construction moulds, moulds for the car industry, mechanical engineering and shipbuilding, radiators, furnaces, etc. Sisak-Moslavina County alone has five casting facilities. The Faculty of Metallurgy achieves successful cooperation with most of them. Croatian casting facilities' output is bigger every year. During 2008, Croatia produced 72 448 t of moulds¹, 72.8 % of which for export (value €155 million). Analysis of Croatian casting industry indicates that it is an export industry, competitive and adaptable to market. One of the biggest concerns of Croatian casting facilities is the lack of competent experts and insufficient implementation of contemporary technologies. The study in Casting is designed so as to train students to conduct operations in the field of casting in a short time period when compared to undergraduate and graduate studies of metallurgy.

The university specialized study-as-you-work course of Casting is designed pursuant to the Bologna Declaration and it enables quality and efficient training. Additional continued training is ensured through conferences on the topic of casting in order to maintain long-term international cooperation with scientists from this field

¹ Report of the Croatian Foundry Association for 2009 (28.01.2010.).

and industry experts. Teaching is organized in a manner which can be seen as the Faculty's contribution to life-long learning based on contemporary breakthroughs.

2c)

Elaborate on the ways monitoring of attendance is regulated and state your opinion on existing procedures.

Attendance is regulated via teachers' signature sheets. This year, we have introduced the obligation of monitoring attendance within additional e-courses (LMS Moodle Attendance).

We believe that the existing attendance monitoring system is adequate, considering the number of students and courses.

2d)

Describe and assess teaching methods, practical and field work. Elaborate on problems and possible improvements.

Courses are conducted as lectures, practical work (auditory or laboratory work), seminars and field work (visiting businesses in the metallurgy or metal processing sectors). Practical work may be auditory or experimental. One of the problems is old equipment in laboratories, which should be improved by updating laboratories.

2c) defines all the changes and improvements incorporated in revised undergraduate and graduate study programs. Proposals for revised programs also include detailed descriptions of forms of teaching for respective courses.

2e)

Describe and assess teaching in case it is conducted as practical work outside faculty facilities (workshops, farms, etc.). Describe the system of monitoring practical work outside the institution. Elaborate on problems and possible improvements.

In the third year of undergraduate studies, students are required to have obligatory practical work in metallurgy and metal processing companies not incorporated in the Faculty of Metallurgy. Each student is appointed a teacher who supervises his or her practical work. Students are required to produce a paper, following the completion of practical work. All the details are approved at the sessions of responsible Faculty bodies. The Rulebook on studying at undergraduate and graduate metallurgy studies (Guidelines on practical work), defines forms and procedures elaborating all steps of students' practical work.

2f)

Assess availability and quality of study programs' online contents.

Study programs are available at the Faculty of Metallurgy website. Apart from general information regularly posted at the Faculty portal (notifications, revised materials for respective courses, event announcements, information on the Faculty and employees, rulebooks and other documents), the Faculty has, by decree of the Faculty Council, become the institutional user of LMS system 'Merlin' of the University Computing Centre. Since the current academic year 2011/2012, each course is followed by an e-course in this system. Moreover, on the 18th of July 2011, the Faculty Council, upon proposal by the Commission for teaching, decided on minimum contents e-courses are obliged to have, describing obligatory elements each e-course should contain in mixed-form teaching. All elements have been incorporated in the general plan of improving the teaching process of the quality assurance system. Minimum amount of elements and offered infrastructure enables constant availability of information on respective courses, uninterrupted communication channels and other advanced elements (forum, wiki, polls,

workshops, assessment). The current state of affairs at undergraduate and graduate metallurgy studies is shown in tables 2.8a and 2.8b. With the goal of promoting and developing the teaching process, the Faculty organized a series of workshops for teachers in which the possibilities and operations of the LMS system were presented.

2g)

Comment on the program concepts at the higher education institution and provide possible proposals and plans to revise study programs in the immediate future, explaining the reasons for such activities.

Already covered in 2c).

2h)

Name life-long education programs at the higher education institution, with a table of the programs not awarding ECTS points and programs awarding ECTS points and their durations.

The Faculty of Metallurgy does not have life-long education programs awarding ECTS points, but does have specialized and technical workshops for the needs of the industry, especially casting, steel and steel pipe production and microstructural analysis of metal materials, etc.

2i)

Elaborate on the system of recognizing acquired competencies (informal education). Elaborate on the system of recognizing foreign academic competencies.

Recognizing academic competencies and studies with the purpose of employment in the Republic of Croatia is the authority of the Agency for Science and Higher Education, i.e. its National ENIC/NARIC Office.

Recognizing academic competencies and studies with the purpose of further education in the Republic of Croatia (academic competencies and duration of studies) is the authority of universities and higher education institutions.

Request for recognizing foreign academic competencies, as well as study periods at a foreign higher education institution with the purpose of further education at constituent units of the University of Zagreb is submitted to the Office for recognizing foreign academic competencies.

The procedure and system for recognizing foreign academic competencies is defined here: <http://www.unizg.hr/nastava-i-studenti/akademsko-priznavanje-visokoskolskih-inozemnih-kvalifikacija/hrvatski/>.

2j)

Name and describe formal mechanism for approval, revisions and monitoring of your programs and qualifications.

The formal mechanisms are defined within quality assurance system, whereas specific tasks are set in the Faculty of Metallurgy Strategy, chapter on the Teaching process. The Strategy clearly, in the form of specific tasks, defines formally all the procedures of revising and monitoring study programs, dynamics of certain monitoring elements and persons responsible.

2k)

In case your higher education institution has the possibility of self-certification of study programs, explain the procedure and criteria applied at proposals.

The Faculty of Metallurgy does not conduct self-certification procedures.

2l)

Define as to how satisfied you are with the current state of affairs and suggest possible improvements.

From the standpoint of study programs, the current state of affairs is not satisfactory, which is why a revision of undergraduate and graduate metallurgy studies was initiated. We believe that the introduction of Industrial Ecology module will significantly improve the existing situation, which might result in better pass-and-fail ratios. The proposed revision of current study modules and introduction of the new module Engineering Metal Materials at the graduate level will contribute to better profiling of the study program. Furthermore, the revision of the study programs balances the ratio of general, social and specialist courses. For more details, go to 2c).

Tables

According to AZVO instructions, 21st of July 2011.

Table 2.1. has been separated into two parts. The first is a joint table containing the list of teachers, type of employment and titles, whereas other information are presented according to study programs.

Table 2.1.a List of teachers and their qualifications.

Teacher	Type of contract (with MF) ²	Titles	Field	Year of last election to title
A. Begić Hadžipašić	EC	assist.prof.	Metallurgy	2011
A. Štrkalj	EC	assist.prof.	Metallurgy	2010
I. Brnardić	EC	assist.prof.	Chemical engineering	2010
Lj. Slokar	EC	assist.prof.	Metallurgy	2011
R. Pezer	EC	assist.prof.	Physics	2007
S. Kožuh	EC	assist.prof.	Metallurgy	2009
T. Holjevac Grgurić	EC	assist.prof.	Chemical engineering	2009
Z. Glavaš	EC	assist.prof.	Metallurgy	2008
Z. Zovko Brodarac	EC	assist.prof.	Metallurgy	2010
D. Hršak	EC	assoc.prof.	Metallurgy	2008
S. Rešković	EC	assoc.prof.	Metallurgy	2011
V. Grozdanić	EC	assoc.prof.	Metallurgy	2007
J. Lopatić	EC	lecturer	Mathematics	2010
A. Markotić	EC	full prof.	Metallurgy	1997
A. Rađenović	EC	full prof.	Metallurgy	2010
F. Unkić	EC	full prof.	Metallurgy	2007
J. Črnko	EC	full prof.	Metallurgy	1996
J. Malina	EC	full prof.	Metallurgy	2007
L. Lazić	EC	full prof.	Metallurgy	2007
M. Gojić	EC	full prof.	Metallurgy	2008
P. Matković	EC	full prof.	Metallurgy	2005
T. Matković	EC	full prof.	Metallurgy	2011
N. Dolić	EC	s. assistant	Metallurgy	2011
N. Tadić	SC	lecturer	Humanities – field of philosophy and sociology	2008
A. Preloščan	SC	full prof.	Metallurgy	2008
I. Lovreković	SC	s. lecturer	Education	2000
V. Arbanas-Smolković	SC	s. lecturer	Research on Language and Literature – English	1994

² EC – employment contract, SC – service contract

Undergraduate study

Table 2.1.1 List of study programs and courses in 1st academic year.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Mathematics I	M	7	190	lectures	1	45	90	J. Lopatič
				seminars				
				exercise	2	45	90	J. Lopatič
Mathematics II	M	7	190	lectures	1	45	90	J. Lopatič
				seminars				
				exercise	2	45	90	J. Lopatič
Physics I	M	7	190	lectures	1	45	90	R. Pezer
				seminars				
				exercise	2	45	90	R. Pezer
Physics II	M	7	190	lectures	1	45	90	R. Pezer
				seminars				
				exercise	2	30	60	R. Pezer
General Chemistry	M	7	180	lectures	1	45	90	D. Hršak
				seminars				
				exercise	2	45	90	D. Hršak
Inorganic Chemistry	M	8	210	lectures	1	45	90	A. Rađenović
				seminars	1	15	22,5	A. Rađenović
				exercise	2	30	60	A. Rađenović
Ethics of Science and Society	M	2	50	lectures	1	15		N. Tadić
				seminars	1	15		N. Tadić
				exercise				
Introduction to Metallurgy	M	2	60	lectures	1	30		A. Markotić
				seminars				
				exercise				
Mechanics I	M	4	110	lectures	1	30		L. Lazić
				seminars				
				exercise	1	30		L. Lazić
Mechanics II	M	3	90	lectures	1	15		L. Lazić
				seminars				
				exercise	1	30		L. Lazić
English Language	M	2	60	lectures	1	15		V. Smolković-Arbanas
				seminars				
				exercise	1	15		V. Smolković-Arbanas
Physical Training I	M	1	60	lectures				
				seminars				
				exercise	1	60		I. Lovreković

Table 2.1.2 List of study programs and courses in 2nd academic year.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Mineral Raw Materials	M	5	130	lectures	1	30		A. Markotić
				seminars				
				exercise	1	15		A. Markotić
Physical Chemistry I	M	6	170	lectures	1	30		J. Malina
				seminars	1	15		J. Malina
				exercise	1	30		J. Malina
Physical Metallurgy I	M	11	330	lectures	1	75		T. Matković
				seminars	1	30		T. Matković
				exercise	1	60		T. Matković
Technical Drawing and Documentation	M	5	130	lectures	1	30		L. Lazić
				seminars				
				exercise	1	30		L. Lazić
Bases of Electrical Engineering and Automation	M	5	140	lectures	1	30		J. Črnko
				seminars				
				exercise	1	30		J. Črnko
Physical Chemistry II	M	5	130	lectures	1	30		J. Malina
				seminars	1	15		J. Malina
				exercise	1	30		J. Malina
Machine Elements	M	5	130	lectures	1	30		L. Lazić
				seminars				
				exercise	1	30		L. Lazić
Metallurgy of Iron and Steel I	M	5	130	lectures	1	30		A. Markotić, M. Gojić
				seminars				
				exercise	1	30		A. Markotić, M. Gojić
Computer Application	M	5	135	lectures	1	30		J. Lopatič
				seminars				
				exercise	1	30		J. Lopatič
Introduction to Ecology	M	4	110	lectures	1	30		I. Brnardić
				seminars	1	30		I. Brnardić
				exercise				
Introduction to Entrepreneurship	M	2	50	lectures	1	15		A. Preloščan
				seminars	1	15		A. Preloščan
				exercise				
Physical Training II	M	1	60	lectures				
				seminars				
				exercise	1	60		I. Lovreković

Table 2.1.3 List of study programs and courses in 3rd academic year.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Theory of the Metallurgical Processes I	M	7	180	lectures	1	30		A. Markotić
				seminars	1	15		A. Markotić
				exercise	1	30		A. Markotić
Refractory Materials	M	5	130	lectures	1	30		A. Rađenović
				seminars	1			
				exercise	1	30		A. Rađenović
Technical Thermodynamics	M	5	125	lectures	1	30		L. Lazić
				seminars	1			
				exercise	1	30		L. Lazić
Chemical Analysis Techniques	M	4	120	lectures	1	30		A. Štrkalj
				seminars				
				exercise	1	30		A. Štrkalj
Material Testing	M	5	150	lectures	1	30		S. Rešković
				seminars				
				exercise	1	30		S. Rešković
Metallurgy of Iron and Steel II	M	5	140	lectures	1	30		M. Gojić, A. Markotić
				seminars	1			
				exercise	1	15		M. Gojić, A. Markotić
Fundamentals of Metal Castings	M	5	140	lectures	1	30		F. Unkić
				seminars				
				exercise	1	30		F. Unkić
Technology of Shaping by Means of Deformation	M	5	130	lectures	1	30		S. Rešković
				seminars				
				exercise	1	30		S. Rešković
Metallurgy of Non-Ferrous Metals I	M	5	130	lectures	1	30		F. Unkić
				seminars				
				exercise	1	30		F. Unkić
Fuels and Combustion	M	5	140	lectures	1	30		A. Rađenović
				seminars				
				exercise	1	30		A. Rađenović
Bachelor Thesis	M	5	140	lectures	1			
				seminars	1	75	112,5	
Ore Enrichment	E	4	100	lectures		30		A. Markotić
				seminars				
				exercise	1	30		A. Markotić
Electrometallurgy	E	4	100	lectures	1	30		J. Malina
				seminars	1	15		J. Malina
				exercise		15		J. Malina
Surface Treating	E	4	100	lectures	1	30		M. Gojić
				exercise	1	30		M. Gojić

Graduate study

Table 2.1.4 List of study programs and courses in 1st academic year.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Thermotechnology I	M	5	140	lectures	1	30		J. Črnko
				seminars				
				exercise	1	30		J. Črnko
Theory of the Metallurgical Processes II	M	5	150	lectures	1	30		A. Markotić, V. Grozdanić
				seminars				
				exercise	1	15		A. Markotić, V. Grozdanić
Metallurgy of Non-Ferrous Metals II	M	5	140	lectures	1	30		F. Unkić
				seminars				
				exercise	1	15		F. Unkić
Physical Metallurgy II	M	10	280	lectures	1	75		P. Matković
				seminars				
				exercise	1	45		P. Matković, Lj. Slokar
Metallurgy of Iron and Steel II	M	5	130	lectures	1	30		M. Gojić, A. Markotić
				seminars				
				exercise	1	15		M. Gojić, A. Markotić
Thermodynamics of Alloys	M	5	150	lectures	1	30		T. Holjevac Grgurić
				seminars				
				exercise	1	30		T. Holjevac Grgurić
Statistics	M	4	120	lectures	1	30		J. Lopatić
				seminars	1			
				exercise				
Thermotechnology II	M	5	130	lectures	1	30		J. Črnko
				seminars				
				exercise		15		J. Črnko
Theory of Shaping by Means of Deformation	M	5	180	lectures	1	45		S. Rešković
				seminars				
				exercise	1	30		S. Rešković
Metallurgical Measurements	M	4	120	lectures	1	15		T. Holjevac Grgurić, A. Štrkalj
				seminars				
				exercise	1	15		T. Holjevac Grgurić, A. Štrkalj
Industrial Furnace I	M	5	140	lectures	1	30		J. Črnko
				seminars				
				exercise	1	30		J. Črnko
Information Science	M	2	50	lectures	1	15		A. Rađenović
				seminars				
				exercise				

Table 2.1.5 List of study programs and courses in 2nd academic year.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Industrial Furnace II	M	5	140	lectures	1	30		J. Črnko
				seminars				
				exercise	1	30		J. Črnko
Materials in Metallurgy	M	5	140	lectures	1	30		P. Matković
				seminars				
				exercise	1	15		S. Kožuh
Techniques of Joining and Cutting	M	4	100	lectures	1	30		M. Gojić
				seminars				
				exercise	1	15		M. Gojić
Special Steels	M	4	110	lectures	1	30		S. Kožuh
				seminars				
				exercise				
Environment Protection	M	4	100	lectures	1	30		I. Brnardić
				seminars	1	15		I. Brnardić
				exercise				
Numerical Methods in Thermal Analysis	M	4	110	lectures	1	15		L. Lazić
				seminars				
				exercise	1	15		L. Lazić
Corrosion of Metals	M	4	110	lectures	1	30		J. Malina
				seminars				
				exercise	1	15		J. Malina
Master Thesis	M	7	250	lectures				
				seminars	1	75		
				exercise				

Table 2.1.5a List of study programs and courses in 2nd academic year module Processing Metallurgy.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Metallurgy of Aluminium	M	5	140	lectures	1	30	60	F. Unkić
				seminars				
				exercise	1	15	15	F. Unkić
Reduction Smelting Processes	M	5	140	lectures	1	30	60	A. Markotić
				seminars				
				exercise	1	15	15	A. Markotić
Methods of Secondary Metallurgy	M	4	110	lectures	1	30	60	A. Markotić
				seminars				
				exercise	1	15	15	A. Markotić
Powder Metallurgy	M	5	145	lectures	1	30	60	Lj. Slokar
				seminars				
				exercise	1	15	15	Lj. Slokar
Sintering and Sintered Materials	E	4	115	lectures	1	30	60	T. Holjevac Grgurić
				seminars				
				exercise	1	15	15	T. Holjevac Grgurić
Hydrometallurgy	E	4	100	lectures	1	30	60	D. Hršak
				seminars				
				exercise	1	15	15	D. Hršak
Metallurgy of Ferroalloys	E	4	100	lectures	1	30	60	A. Markotić
				seminars				
				exercise	1	15	15	A. Markotić
Production of Carbon Materials	E	4	100	lectures	1	30	60	A. Rađenović
				seminars				
				exercise	1	15	15	A. Rađenović

Table 2.1.5b List of study programs and courses in 2nd academic year module Foundry Engineering.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Metal Solidification Theory	M	5	145	lectures	1	30	60	F. Unkić
				seminars				
				exercise	1	15	15	F. Unkić
Solidification Simulation	M	5	140	lectures	1	30	60	V. Grozdanić
				seminars				
				exercise	1	15	15	V. Grozdanić
Casting of Non-Ferrous Metals	M	4	110	lectures	1	30	60	Z. Zovko Brodarac
				seminars				
				exercise	1	15	15	Z. Zovko Brodarac
Ferrous Metal Casting	M	5	140	lectures	1	30	60	Z. Glavaš
				seminars				
				exercise	1	15	15	Z. Glavaš
Casting Defects Analysis	E	4	110	lectures	1	30	60	Z. Glavaš
				seminars				
				exercise	1	15	15	Z. Glavaš
Heat Treatment	E	4	120	lectures	1	30	60	M. Gojić, S. Kožuh
				seminars				
				exercise	1	15	15	M. Gojić, S. Kožuh
Structure and Properties of Non-Ferrous Alloys	E	4	110	lectures	1	30	60	T. Matković
				seminars				
				exercise	1	15	15	T. Matković
Optimization of Casting Forming	E	4	105	lectures	1	30	60	Z. Zovko Brodarac
				seminars				
				exercise	1	15	15	Z. Zovko Brodarac

Table 2.1.5c List of study programs and courses in 2nd academic year module Metal Processing.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Shaping Metals by Rolling	M	5	160	lectures	1	30	60	S. Rešković
				seminars				
				exercise	1	15	15	S. Rešković
Heat Treatment	M	4	120	lectures	1	30	60	M. Gojić, S. Kožuh
				seminars				
				exercise	1	15	15	M. Gojić, S. Kožuh
Surface Treating	M	5	100	lectures	1	30	60	M. Gojić
				seminars				
				exercise	1	15	15	M. Gojić
Processing of Aluminium and Al-Alloys	M	5	130	lectures	1	30	60	S. Rešković
				seminars				
				exercise	1	15	15	S. Rešković
Automation in Metal Working	E	4	110	lectures	1	30	60	S. Rešković
				seminars				
				exercise	1	15	15	S. Rešković
Structure and Properties of Non-Ferrous Alloys	E	4	120	lectures	1	30	60	T. Matković
				seminars				
				exercise	1	15	15	T. Matković
Machines in Plastic Processing	E	4	110	lectures	1	30	60	L. Lazić
				seminars				
				exercise	1	15	15	L. Lazić

Postgraduate doctoral study

Table 2.1.6a List of study programs and courses in 1st academic year.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Physics of Metals	M	16	300	lectures	1	60		R. Pezer
				seminars				
				exercise	1	0		R. Pezer
Advanced Methods Investigation of Metals	E	7	200	lectures	1	30		P. Matković, M.Gojić
				seminars				
				exercise	1	0		P. Matković, M.Gojić
Numerical Thermal Analysis	E	7	200	lectures	1	30		L. Lazić, B. Kosec
				seminars				
				exercise	1	0		
Solid State Reactions	E	7	200	lectures	1	30		A.Rađenović
				seminars				
				exercise	1	0		
Thermodynamics and Kinetics of Metallurgical Processes	E	7	200	lectures	1	30		A. Markotić, J. Lamut
				seminars				
				exercise	1	0		
Modelling of Process Operations	E	7	200	lectures	1	30		J.Črnko
				seminars				
				exercise	1	0		
x-Ray Structure Analyses of Metals	E	7	200	lectures	1	30		T. Matković, P. Matković
				seminars				
				exercise	1	0		

Table 2.1.6b List of study programs and courses in 2nd academic year.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Metallurgy of Metals and Alloys	E	10	270	lectures	1	45		A. Markotić
				seminars	1			
				exercise	1	0		
Solidification and as-cast structures	E	10	270	lectures	1	30		F. Unkić
				seminars	1			
				exercise	1	15		F. Unkić
Deformation Properties of Metals and Alloys	E	10	270	lectures	1	30		S. Rešković
				seminars	1	15		S. Rešković
				exercise	1	0		
Light Metals and their Alloys	E	10	270	lectures	1	45		F. Unkić
				seminars	1			
				exercise	1	0		
Management and Recovery of Metallurgical Waste	E	10	270	lectures	1	30		I. Brnardić
				seminars	1	15		
				exercise	1	0		
Plastic Processing of Metals and Alloys	E	10	270	lectures	1	30		S. Rešković
				seminars	1			
				exercise	1	15		S. Rešković
Techniques for Metal Surface Engineering	E	10	270	lectures	1	30		M. Gojić
				seminars	1	15		M. Gojić
				exercise	1			
Corrosion of Structural Metals	E	10	270	lectures	1	30		J. Malina
				seminars	1	15		J. Malina
				exercise	1			
Innovative Metal Casting Processes	E	10	270	lectures	1	30		F. Unkić, P. Mrvar
				seminars	1	15		F. Unkić, P. Mrvar
				exercise	1			

Table 2.1.6c List of study programs and courses in 3rd academic year.

Title of the course	Mandatory / elective	ECTS	Student workload	Type of teaching	Number of groups	Number of hours	Number of standard hours	Teacher
Methods for Optimizing Thermal Processes	E	10	270	lectures	1	30		J. Črnko
				seminars	1	15		J. Črnko
				exercise	1	0		
Modelling in Foundry	E	10	270	lectures	1	30		V. Grozdanić
				seminars	1			
				exercise	1	15		V. Grozdanić
Modelling of Process Operations	E	10	270	lectures	1	30		S. Rešković
				seminars	1	0		
				exercise	1	15		S. Rešković
Methods of Calibration in Metallurgy	E	10	270	lectures	1	30		S. Rešković
				seminars	1	15		S. Rešković
				exercise	1	0		
Special Methods of Plastic Processing of Metals	E	10	270	lectures	1	30		S. Rešković
				seminars	1	15		S. Rešković
				exercise	1	0		
PhD Thesis	E	60	1500	lectures	1	0		
				seminars	1	0		
				exercise	1			

UNDERGRADUATE STUDY IN METALLURGY

Table 2.2a The dynamics of course delivery

ACADEMIC YEAR 2010/2011

Code	Teacher	Course	I.sem	II.sem
1st year				
24123	J.Lopatič	Mathematics I	3+0+3~7	0+0+0~0
24134	J.Lopatič	Mathematics II	0+0+0~0	3+0+3~7
24124	R.Pezer	Physics I	3+0+2~7	0+0+0~0
24135	R.Pezer	Physics II	0+0+0~0	3+0+2~7
14225	D.Hršak	General Chemistry	3+0+3~7	0+0+0~0
24136	A.Rađenović	Inorganic Chemistry	0+0+0~0	3+1+2~8
24126	N.Tadić	Ethics of Science and Society	1+1+0~2	0+0+0~0
67154	A.Markotić	Introduction to Metallurgy	0+0+0~0	2+0+0~2
24127	L.Lazić	Mechanics I	2+0+2~4	0+0+0~0
24138	L.Lazić	Mechanics II	0+0+0~0	1+0+2~3
67139	V.Smolković-Arbanas	English Language	1+0+1~2	1+0+1~2
67156	I.Lovreković	Physical Training I	0+0+2~1	0+0+2~1
2nd year				
	A.Markotić	Mineral Raw Materials	2+0+1~5	0+0+0~0
24332	J.Malina	Physical Chemistry I	2+1+2~6	0+0+0~0
67142	T.Matković	Physical Metallurgy I	3+1+2~6	2+1+2~5
24334	L.Lazić	Technical Drawing and Documentation	2+0+2~5	0+0+0~0
	J.Črnko	Bases of Electrical Engineering and Automation	2+0+2~5	0+0+0~0
67141	J.Malina	Physical Chemistry II	0+0+0~0	2+1+2~5
24368	L.Lazić	Machine Elements	0+0+0~0	2+0+2~5
24364	A.Markotić, M.Gojić	Metallurgy of Iron and Steel I	0+0+0~0	2+0+2~5
24350	J.Lopatič	Computer Application	0+0+0~0	2+0+2~5
67155	I.Brnardić	Introduction to Ecology	0+0+0~0	2+2+0~4
24137	A.Preloščan	Introduction to Entrepreneurship	1+1+0~2	0+0+0~0
67157	I.Lovreković	Physical Training II	0+0+2~1	0+0+2~1
3rd year				
24354	A.Markotić	Theory of the Metallurgical Processes I	2+1+2~7	0+0+0~0
24355	A.Rađenović	Refractory Materials	2+0+2~5	0+0+0~0
24370	L.Lazić	Technical thermodynamics	2+0+2~5	0+0+0~0
24357	A.Štrkalj	Chemical Analysis Techniques	2+0+2~4	0+0+0~0
24358	S. Rešković	Material Testing	2+0+2~5	0+0+0~0
26042	M.Gojić, A.Markotić	Metallurgy of Iron and Steel II	0+0+0~0	2+0+1~5
24362	F.Unkić	Fundamentals of Metal Castings	0+0+0~0	2+0+2~5
67208	S.Rešković	Technology of Shaping by Means of Deformation	0+0+0~0	2+0+2~5
24365	F.Unkić	Metallurgy of Non-Ferrous Metals I	0+0+0~0	2+0+2~5
24366	A.Rađenović	Fuels and Combustion	0+0+0~0	2+0+2~5
67324	Bachelor Thesis		0+0+0~0	0+5+0~5
ELECTIVE – choose one				
24371	A.Markotić	Ore Enrichment	2+0+2~4	0+0+0~0
85571	J.Malina	Electrometallurgy	2+1+1~4	0+0+0~0
24372	M.Gojić	Surface Treating	2+0+2~4	0+0+0~0

ACADEMIC YEAR 2009/2010

Code	Teacher	Course	I.sem	II.sem
1st year				
24124	J.Lopatič	Mathematics I	3+0+3~7	0+0+0~0
24134	J.Lopatič	Mathematics II	0+0+0~0	3+0+3~7
24124	R.Pezer	Physics I	3+0+2~7	0+0+0~0
24135	R.Pezer	Physics II	0+0+0~0	3+0+2~7
24125	D.Hršak	General Chemistry	3+0+3~7	0+0+0~0
24136	A.Rađenović	Inorganic Chemistry	0+0+0~0	3+1+2~8
24126	N.Tadić	Ethics of Science and Society	1+1+0~2	0+0+0~0
24137	A.Preloščan	Introduction to Entrepreneurship	0+0+0~0	1+1+0~2
24127	L.Lazić	Mechanics I	2+0+2~4	0+0+0~0
24138	L.Lazić	Mechanics II	0+0+0~0	1+0+2~3
67139	V.Smolković-Arbanas	English Language	1+0+1~2	1+0+1~2
67156	I.Lovreković	Physical Training I	0+0+2~1	0+0+2~1
2nd year				
24331	A.Markotić	Mineral Raw Materials	2+0+1~4	0+0+0~0
24332	J.Malina	Physical Chemistry I	2+1+2~6	0+0+0~0
67141	J.Malina	Physical Chemistry II	0+0+0~0	2+1+2~5
67142	T.Matković	Physical Metallurgy I	3+1+2~6	2+1+2~5
24334	L.Lazić	Technical Drawing and Documentation	2+0+2~5	0+0+0~0
24368	L.Lazić	Machine Elements	0+0+0~0	2+0+2~5
24335	R.Pezer	Bases of Electrical Engineering and Automation I	2+0+2~5	0+0+0~0
24369	J.Črnko	Base of Electrical Engineering and Automation II	0+0+0~0	2+0+2~5
24350	J.Lopatič	Computer Application	0+0+0~0	2+0+2~5
67154	A.Markotić	Introduction to Metallurgy	2+0+0~3	0+0+0~0
67155	A.Rastovčan Mioč	Introduction to Ecology	0+0+0~0	2+2+0~4
67157	I.Lovreković	Physical Training II	0+0+2~1	0+0+2~1
3rd year				
			V.sem	VI.sem
24354	A.Markotić	Theory of the Metallurgical Processes I	2+1+2~7	0+0+0~0
24355	A.Rađenović	Refractory Materials	2+0+2~5	0+0+0~0
24370	L.Lazić	Technical Thermodynamics	2+0+2~5	0+0+0~0
24357	A.Rastovčan Mioč	Chemical Analysis Techniques	2+0+2~4	0+0+0~0
24358	S.Rešković	Material Testing	2+0+2~5	0+0+0~0
24362	F.Unkić	Fundamentals of Metal Castings	0+0+0~0	2+0+2~5
67208	I.Mamuzić	Technology of Shaping by Means of Deformation	0+0+0~0	2+0+2~5
24364	A.Markotić, M.Gojić	Metallurgy of Iron and Steel I	0+0+0~0	2+0+2~5
24365	Z.Lenhard	Metallurgy of Non-Ferrous Metals I	0+0+0~0	2+0+2~5
24366	A.Rađenović	Fuels and Combustion	0+0+0~0	2+0+2~5
67324	Bachelor Thesis		0+0+0~0	0+5+0~5
ELECTIVE – choose one				
24371	A.Markotić	Ore Enrichment	2+0+2~4	0+0+0~0
24360	J.Malina	Electrometallurgy	2+0+2~4	0+0+0~0
24372	M.Gojić, Š.Nižnik	Surface Treating	2+0+2~4	0+0+0~0

ACADEMIC YEAR 2008/2009

Code	Teacher	Course	I.sem	II.sem
1st year				
24124	Đ.Nikolić	Mathematics I	3+0+3~7	0+0+0~0
24134	Đ.Nikolić	Mathematics II	0+0+0~0	3+0+3~7
24124	R.Pezer	Physics I	3+0+2~7	0+0+0~0
24135	R.Pezer	Physics II	0+0+0~0	3+0+2~7
24125	D.Hršak	General Chemistry	3+0+3~7	0+0+0~0
24136	A.Rađenović	Inorganic Chemistry	0+0+0~0	3+1+2~8
24126	N.Tadić	Ethics of Science and Society	1+1+0~2	0+0+0~
	A.Preloščan	Introduction to Entrepreneurship	0+0+0~0	1+1+0~2
24127	L.Lazić	Mechanics I	2+0+2~4	0+0+0~0
24138	L.Lazić	Mechanics II	0+0+0~0	1+0+2~3
40005	V.Smolković-Arbanas	English Language I	1+0+1~3	1+0+1~3
40003	I.Lovreković	Physical Training I	0+0+2~0	0+0+2~0
2nd year				
			III.sem	IV.sem
24331	A.Markotić	Mineral Raw Materials	2+0+1~4	0+0+0~0
24332	J.Malina	Physical Chemistry I	2+1+2~6	0+0+0~0
24349	J.Malina	Physical Chemistry II	0+0+0~0	2+1+2~5
24341	T.Matković	Physical Metallurgy I	3+1+2~6	2+1+2~5
24334	L.Lazić	Technical Drawing and Documentation	2+0+2~5	0+0+0~0
24368	L.Lazić	Machine Elements	0+0+0~0	2+0+2~5
24335	R.Pezer	Bases of Electrical Engineering and Automation I	2+0+2~5	0+0+0~0
24369	J.Črnko	Bases of Electrical Engineering and Automation II	0+0+0~0	2+0+2~5
24350	Đ.Nikolić	Computer Application	0+0+0~0	2+0+2~5
40006	V.Smolković-Arbanas	English Language II	1+0+1~3	1+0+1~3
40004	I.Lovreković	Physical Training II	0+0+2~0	0+0+2~0
3rd year				
			V.sem	VI.sem
24354	A.Markotić	Theory of the Metallurgical Processes I	2+1+2~7	0+0+0~0
24355	A.Rađenović	Refractory Materials	2+0+2~5	0+0+0~0
24370	L.Lazić	Technical Thermodynamics	2+0+2~5	0+0+0~0
24357	A.Rastovčan Mioč	Chemical Analysis Techniques	2+0+2~4	0+0+0~0
24358	S.Rešković	Material Testing	2+0+2~5	0+0+0~0
24362	F.Unkić	Fundamentals of Metal Castings	0+0+0~0	2+0+2~5
24363	I.Mamuzić	Technology of Plastic Processing	0+0+0~0	2+0+2~5
24364	A.Markotić, M.Gojić	Metallurgy of Iron and Steel I	0+0+0~0	2+0+2~5
24365	Z.Lenhard	Metallurgy of Non-Ferrous Metals I	0+0+0~0	2+0+2~5
24366	A.Rađenović	Fuels and Combustion	0+0+0~0	2+0+2~5
67324	Bachelor Thesis		0+0+0~0	0+5+0~5
ELECTIVE – choose one				
24371	A.Markotić	Ore Enrichment	2+0+2~4	0+0+0~0
24360	J.Malina	Electrometallurgy	2+0+2~4	0+0+0~0
24372	M.Gojić, Š.Nižnik	Surface Treating	2+0+2~4	0+0+0~0
24373	A.Rastovčan Mioč	Introduction to Ecology	2+0+2~4	0+0+0~0

GRADUATE STUDY IN METALLURGY

Table 2.2b The dynamics of course delivery

ACADEMIC YEAR 2010/2011

Code	Teacher	Course	I.sem	II.sem
1st year				
26038	J.Črnko	Thermotechnology I	2+0+2~5	0+0+0~0
26039	A.Markotić, V.Grozdanić	Theory or the Metallurgica Processes II	2+0+1~5	0+0+0~0
26040	F.Unkić	Metallurgy of Non-Ferrous Metals II	2+0+1~5	0+0+0~0
26041	P.Matković	Physical Metallurgy II	2+0+2~5	3+0+1~5
26042	M.Gojić, A.Markotić	Metallurgy of Iron and Steel II	2+0+1~5	0+0+0~0
67209	T.Holjevac Grgurić	Thermodynamics of Alloys	2+0+2~5	0+0+0~0
26047	J.Lopatič	Statistics	0+0+0~0	2+0+0~4
26044	J.Črnko	Thermotechnology II	0+0+0~0	2+0+1~5
67313	S.Rešković	Theory of Shaping by Means of Deformation	0+0+0~0	3+0+2~5
26048	T.Holjevac Grgurić, A.Štrkalj	Metallurgical Measurements	0+0+0~0	1+0+1~4
58292	J.Črnko	Industrial Furnace I	0+0+0~0	2+0+2~5
26050	A.Rađenović	Information Science	0+0+0~0	1+0+0~2
2nd year				
58301	J.Črnko	Industrial Furnace II	2+0+2~5	
26079	P.Matković	Materials in Metallurgy	2+0+1~5	
26080	M.Gojić	Techniques of Joining and Cutting	2+0+1~4	
26081	S.Kožuh	Special Steels	2+0+0~4	
26082	I.Brnardić	Environment Protection	2+1+0~4	
26083	L.Lazić	Numerical Methods in Thermal Analysis	0+1~4	
26084	J.Malina	Corrosion of Metals	2+0+1~4	
68185		Master Thesis	0+0+0~0	0+5+0~7

IV. SEMESTER: ELECTIVE GROUPS

Processing Metallurgy

Mandatory courses

26051	F.Unkić	Metallurgy of Aluminium	2+0+1~5
26052	A.Markotić	Reduction Smelting Processes	2+0+1~5
26053	A.Markotić, Z.Glavaš	Methods of Secondary Metallurgy	2+0+1~4
26054	Lj.Slokar	Powder Metallurgy	2+0+1~5

Elective courses – choose one

67311	T.Holjevac Grgurić	Sintering and Sintered Materials	2+0+1~4
67238	D.Hršak	Hydrometallurgy	2+0+1~4
67302	A.Markotić	Metallurgy of Ferroalloys	2+0+1~4
67249	A.Rađenović	Production of Carbon Materials	2+0+1~4

Foundry Engineering

Mandatory courses

67303	F.Unkić	Metal Solidification Theory	2+0+1~5
67308	V.Grozdanić	Solidification Simulation	2+0+1~5
67309	Z.Zovko Brodarac	Casting of Non-Ferrous Metals	2+0+1~4
67239	Z.Glavaš	Ferrous Metal Casting	2+0+1~5

Elective courses – choose one

67240	Z.Glavaš	Casting Defects Analysis	2+0+1~4
67247	M.Gojić, S.Kožuh	Heat Treatment	2+0+1~4
67229	T.Matković	Structure and Properties of Non-Ferrous Alloys	2+0+1~4
67310	Z.Zovko Brodarac	Optimization of Casting Forming	2+0+1~4

Metal Processing

Mandatory courses

67230	S.Rešković	Shaping Metals by Rolling	3+0+1~5
67247	M.Gojić, S.Kožuh	Heat Treatment	2+0+1~4
67260	M.Gojić	Surface Treating	2+0+1~5
67312	S.Rešković	Processing of Aluminium and Al-Alloys	2+0+1~5

Elective courses – choose one

67231	S.Rešković	Automation in Metal Working	2+0+1~4
67229	T.Matković	Structure and Properties of Non-Ferrous Alloys	2+0+1~4
67232	L.Lazić	Machines in Plastic Processing	2+0+1~4

ACADEMIC YEAR 2009/2010

Code	Teacher	Course	I.sem	II.sem
1st year				
26038	J.Črnko	Thermotechnology I	2+0+2~5	0+0+0~0
26039	A.Markotić, V.Grozdanić	Theory of the Metallurgica Processes	2+0+1~5	0+0+0~0
26040	Z. Lenhard	Metallurgy of Non-Ferrous Metals II	2+0+1~5	0+0+0~0
26041	P.Matković	Physical Metallurgy II	2+0+2~5	3+0+1~5
26042	M.Gojić, A.Markotić	Metallurgy of Iron and Steel II	2+0+1~5	0+0+0~0
67209	T.Holjevac Grgurić	Thermodynamics of Alloys	2+0+2~5	0+0+0~0
26047	J.Lopatič	Statistics	0+0+0~0	2+0+0~4
26044	J.Črnko	Thermotechnology II	0+0+0~0	2+0+1~5
67313	S.Rešković	Theory of Shaping by Means of Deformation	0+0+0~0	3+0+2~5
26048	A.Rastovčan Mioč	Metallurgical Measurements	0+0+0~0	1+0+1~4
58292	J.Črnko	Industrial Furnace I	0+0+0~0	2+0+2~5
26050	A.Rađenović	Information Science	0+0+0~0	1+0+0~2
2nd year				
58301	J.Črnko	Industrial Furnace II	2+0+2~5	
26079	P.Matković	Materials in Metallurgy	2+0+1~5	
26080	M.Gojić	Techniques of Joining and Cutting	2+0+1~4	
26081	S.Kožuh	Special Steels	2+0+0~4	
26082	A.Rastovčan Mioč	Environment Protection	2+1+0~4	
26083	L.Lazić	Numerical Methods in Thermal Analysis	1+0+1~4	
26084	J.Malina	Corrosion of Metals	2+0+1~4	
68185		Master Thesis	0+0+0~0	0+5+0~7

IV. SEMESTER: ELECTIVE GROUPS

Processing Metallurgy

Mandatory courses

26051	Z. Lenhard	Metallurgy of Aluminium	2+0+1~5
26052	A.Markotić	Reduction Smelting Processes	2+0+1~5
26053	A.Markotić, Z.Glavaš	Methods of Secondary Metallurgy	2+0+1~4
26054	Lj.Slokar	Powder Metallurgy	2+0+1~5

Elective courses – choose one

67311	T.Holjevac Grgurić	Sintering and Sintered Materials	2+0+1~4
67238	D.Hršak	Hydrometallurgy	2+0+1~4
67302	A.Markotić	Metallurgy of Ferroalloys	2+0+1~4
67249	A.Rađenović	Production of Carbon Materials	2+0+1~4

Foundry Engineering

Mandatory courses

67303	F.Unkić	Metal Solidification Theory	2+0+1~5
67308	V.Grozdanić	Solidification Simulation	2+0+1~5
67309	Z.Zovko Brodarac	Casting of Non-Ferrous	2+0+1~4
67239	Z.Glavaš	Ferrous Metal Casting	2+0+1~5

Elective courses – choose one

67240	Z.Glavaš	Casting Defects Analysis	2+0+1~4
67247	M.Gojić, S.Kožuh	Heat Treatment	2+0+1~4
67229	T.Matković	Structure and Properties of Non-Ferrous Alloys	2+0+1~4
67310	Z.Zovko Brodarac	Optimization of Casting Forming	2+0+1~4

Metal Processing

Mandatory courses

67230	S.Rešković	Shaping Metals by Rolling	3+0+1~5
67247	M.Gojić, S.Kožuh	Heat Treatment	2+0+1~4
67260	M.Gojić	Surface Treating	2+0+1~5
67312	S.Rešković	Processing of Aluminium and Al-Alloys	2+0+1~5

Elective courses – choose one

67231	I.Mamuzić	Automation in Metal Working	2+0+1~4
67229	T.Matković	Structure and Properties of Non-Ferrous Alloys	2+0+1~4
67232	I.Mamuzić	Machines in Plastic Processing	2+0+1~4

ACADEMIC YEAR 2008/2009

Academic year 2008/2009 is the first year of graduate study performance according the Bologna system.

Code	Teacher	Course	I.sem	II.sem
1st year				
26038	J.Črnko	Thermotechnology I	2+0+2~5	0+0+0~0
26039	A.Markotić, V.Grozdanić	Theory of the Metallurgical Processes II	2+0+1~5	0+0+0~0
26040	Z. Lenhard	Metallurgy of Non-Ferrous Metals II	2+0+1~5	0+0+0~0
26041	P.Matković	Physical Metallurgy II	2+0+2~5	3+0+1~5
26042	M.Gojić, A.Markotić	Metallurgy of Iron and Steel II	2+0+1~5	0+0+0~0
26047	Đ. Nikolić	Statistics	0+0+0~0	2+0+0~4
26044	J.Črnko	Thermotechnology II	0+0+0~0	2+0+1~5
26043	S.Rešković	Theory of Plastic Deformation	2+0+1~5	2+0+2~5
26048	A.Rastovčan Mioč	Metallurgical Measurements	0+0+0~0	1+0+1~4
58292	J.Črnko	Industrial Furnace I	0+0+0~0	2+0+2~5
26050	A.Rađenović	Information Science	0+0+0~0	1+0+0~2
2nd year				
			III.sem	IV.sem
58301	J.Črnko	Industrial Furnace II	2+0+2~5	
26079	M.Ćosić	Materials in Metallurgy	2+0+1~5	
26080	M.Gojić	Techniques of Joining and Cutting	2+0+1~4	
26081	A.Preloščan	Special Steels	2+0+0~4	
26082	A.Rastovčan Mioč	Environment Protection	2+1+0~4	
26083	L.Lazić	Numerical Methods in Thermal Analysis	1+0+1~4	
26084	J.Malina	Corrosion of Metals	2+0+1~4	
68185		Master Thesis	0+0+0~0	0+5+0~7

IV. SEMESTAR: ELECTIVE GROUPS

Processing Metallurgy

Mandatory courses

26051	Z.Lenhard	Metallurgy of Aluminium	2+0+1~5
26052	A.Markotić	Reduction Smelting Processes	2+0+1~5
26053	A.Markotić	Methods of Secondary Metallurgy	2+0+1~4
26054	M.Ćosić	Powder Metallurgy	2+0+1~5

Elective courses – choose one

67311	M. Ćosić	Sintering and Sintered Materials	2+0+1~4
67238	D.Hršak, Z.Lenhard	Hydrometallurgy	2+0+1~4
67302	A.Markotić	Metallurgy of Ferroalloys	2+0+1~4
67249	M.Legin Kolar	Production of Carbon Materials	2+0+1~4

Foundry Engineering

Mandatory courses

67303	F.Unkić	Metal Solidification Theory	2+0+1~5
67308	V.Grozdanić	Solidification Simulation	2+0+1~5
67309	F.Unkić	Casting of Non-Ferrous Metals	2+0+1~4
67239	F.Unkić	Ferrous Metal Casting	2+0+1~5

Elective courses – choose one

67240	F.Unkić	Casting Defects Analysis	2+0+1~4
67247	M.Gojić, S.Kožuh	Heat Treatment	2+0+1~4
67229	T.Matković	Structure and Properties of Non-Ferrous Alloys	2+0+1~4
67310	F.Unkić	Optimization of Casting Forming	2+0+1~4

Metal Processing

Mandatory courses

67230	I.Mamuzić, M.Golja	Shaping Metals by Rolling	3+0+1~5
67247	M.Gojić, S.Kožuh	Heat Treatment	2+0+1~4
67260	M.Gojić	Surface Treating	2+0+1~5
67312	I.Mamuzić	Processing of Aluminium and Al-Alloys	2+0+1~5

Elective courses – choose one

67231	I.Mamuzić	Automation in Metal Working	2+0+1~4
67229	T.Matković	Structure and Properties of Non-Ferrous Alloys	2+0+1~4
67232	I.Mamuzić	Machines in Plastic Processing	2+0+1~4

POSTGRADUATE DOCTORAL STUDY OF METALLURGY

ACADEMIC YEAR 2010/2011

Teacher	Course	I.sem	II.sem
1st year			
R.Pezer	Physics of Metals	2+0+0~8	2+0+0~8
	Elective courses (enroll one)		
P.Matković, M.Gojić	Advanced Methods Investigation of Metals	2+0+0~7	
L.Lazić, B.Kosec	Numerical Thermal Analysis	2+0+0~7	
A.Rađenović	Solid State Reactions	2+0+0~7	
A.Markotić, J.Lamut	Thermodynamics and Kinetics of Metallurgical Processes		2+0+0~7
J.Črnko	Modelling of Process Operations		2+0+0~7
T.Matković, P.Matković	x-Ray Structure Analyses of Metals		2+0+0~7
2nd year	Elective courses (enroll one)	III.sem	IV.sem
A.Markotić	Metallurgy of Metals and Alloys	3+0+0~10	
F.Unkić	Solidification and as-cast Structure	2+0+1~10	
S.Rešković	Deformation Properties of Metals and Alloys	2+1+0~10	
F.Unkić	Light Metals and their Alloys	3+0+0~10	
I.Brnardić	Management and Recovery of Metallurgical Waste	2+1+0~10	
S.Rešković	Plastic Processing of Metals and Alloys		2+0+1~10
M.Gojić	Techniques for Metal Surface Engineering		2+1+0~10
J.Malina	Corrosion of Structural Metals		2+1+0~10
F.Unkić, P.Mrvar	Innovative Metal Casting Processes		2+1+0~10
3rd year	Elective courses (enroll one)	V.sem	VI.sem
J.Črnko	Methods for Optimizing Thermal Processes	2+0+1~10	
V.Grozdanić	Modelling in Foundry	2+0+1~10	
S.Rešković	Modelling of Process Operations	2+0+1~10	
S.Rešković	Methods of Calibration in Metallurgy	2+1+0~10	
S.Rešković	Special Methods of Plastic Processing of Metals	2+1+0~10	
	Mandatory		
	PhD Thesis		0+0+0~60

ACADEMIC YEAR 2009/2010

Teacher	Course	I.sem	II.sem
1st year			
R.Pezer	Physics of Metals	2+0+0~8	2+0+0~8
	Elective courses (enroll one)		
P.Matković, M.Gojić	Advanced Methods Investigation of Metals	2+0+0~7	
L.Lazić, B.Kosec	Numerical Thermal Analysis	2+0+0~7	
A.Rađenović	Solid State Reactions	2+0+0~7	
A.Markotić, J.Lamut	Thermodynamics and Kinetics of Metallurgical Processes		2+0+0~7
J.Črnko	Modelling of Process Operations		2+0+0~7
T.Matković, P.Matković	x-Ray Structure Analyses of Metals		2+0+0~7
2nd year	Elective courses (enroll one)	III.sem	IV.sem
A.Markotić	Metallurgy of Metals and Alloys	3+0+0~10	
F.Unkić	Solidification and as-cast Structure	2+0+1~10	
S.Rešković	Deformation Properties of Metals and Alloys	2+1+0~10	
Z.Lenhard	Light Metals and their Alloys	3+0+0~10	
A.Rastovčan-Mioč	Management and Recovery of Metallurgical Waste	2+1+0~10	
I.Mamuzić, S.Rešković	Plastic Processing of Metals and Alloys		2+0+1~10
M.Gojić	Techniques for Metal Surface Engineering		2+1+0~10
J.Malina	Corrosion of Structural Metals		2+1+0~10
F.Unkić, P.Mrvar	Innovative Metal Casting Processes		2+1+0~10
3rd year	Elective courses (enroll one)	V.sem	VI.sem
J.Črnko	Methods for Optimizing Thermal Processes	2+0+1~10	
V.Grozdanić	Modelling in Foundry	2+0+1~10	
I.Mamuzić, M.Math	Modelling of Process Operations	2+0+1~10	
I.Mamuzić	Methods of Calibration in Metallurgy	2+1+0~10	
I.Mamuzić	Special Methods of Plastic Processing of Metals	2+1+0~10	
	Mandatory		
	PhD Thesis		0+0+0~60

ACADEMIC YEAR 2008/2009

Teacher	Course	I.sem	II.sem
1st year			
R.Pezer	Physics of Metals	2+0+0~8	2+0+0~8
	Elective courses (enroll one)		
P.Matković, M.Gojić	Advanced Methods Investigation of Metals	2+0+0~7	
L.Lazić, B.Kosec	Numerical Thermal Analysis	2+0+0~7	
A.Rađenović	Solid State Reactions	2+0+0~7	
A.Markotić, J.Lamut	Thermodynamics and Kinetics of Metallurgical Processes		2+0+0~7
J.Črnko, T.Kolenko	Modelling of Process Operations		2+0+0~7
T.Matković, P.Matković	x-Ray Structure Analyses of Metals		2+0+0~7
2nd year	Elective courses (enroll one)	III.sem	IV.sem
A.Markotić	Metallurgy of Metals and Alloys	3+0+0~10	
F.Unkić	Solidification and as-cast Structure	2+0+1~10	
S.Rešković	Deformation Properties of Metals and Alloys	2+1+0~10	
Z.Lenhard	Light Metals and their Alloys	3+0+0~10	
A.Rastovčan-Mioč	Management and Recovery of Metallurgical Waste	2+1+0~10	
S.Rešković	Plastic Processing of Metals and Alloys		2+0+1~10
A.Preloščan, M.Gojić	Techniques for Metal Surface Engineering		2+1+0~10
J.Malina	Corrosion of Structural Metals		2+1+0~10
F.Unkić, P.Mrvar	Innovative Metal Casting Processes		2+1+0~10
3rd year	Elective courses (enroll one)	V.sem	VI.sem
M.Kundak, J.Črnko	Methods for Optimizing Thermal Processes	2+0+1~10	
V.Grozdanić	Modelling in Foundry	2+0+1~10	
I.Mamuzić, M.Math	Modelling of Process Operations	2+0+1~10	
I.Mamuzić	Methods of Calibration in Metallurgy	2+1+0~10	
I.Mamuzić	Special Methods of Plastic Processing of Metals	2+1+0~10	
	Mandatory		
	PhD Thesis		0+0+0~60

Table 2.3a Structure of enrolled students and interest for the study program in the last three years UNDERGRADUATE STUDY IN METALLURGY (N=2011).

Full-time students								
Year	Registered	1 st choice	2 nd choice	Enrolled in the 1 st year of the study	Gymnasium		Vocational school	
					No.	Average score	No.	Average score
N-1	76	21	3	22	3	3.7	19	3.6
N-2	35			33	3	3.7	10	3.6
N-3	40			29	4	3.9	6	3.6

Comment: The table does not contain the students which enrolled the study but did not come to lectures.

Table 2.3b Structure of enrolled students and interest for the study program in the last three years GRADUATE STUDY IN METALLURGY (N=2011).

Full-time students								
Year	Registered	1 st choice	2 nd choice	Enrolled in the 1 st year of the study	Gymnasium		Vocational school	
					No.	Average score	No.	Average score
N-1	6			6				
N-2	2			2				
N-3	4			4				

Table 2.3c Structure of enrolled students and interest for the study program in the last three years POSTGRADUATE DOCTORAL STUDY IN METALLURGY (N=2011).

Full-time students								
Year	Registered	1 st choice	2 nd choice	Enrolled in the 1 st year of the study	Gymnasium		Vocational school	
					No.	Average score	No.	Average score
N-1	2			2				
N-2	3			3				
N-3	0			0				

Table 2.4a Transience at the study program UNDERGRADUATED STUDY IN METALLURGY.

Year of enrolment	Number of enrolled students	Number of students which gained to 1/3 possible ECTS	Number of students which gained from 1/3 to 2/3 possible ECTS	Number of students which gained more than possible 2/3 ECTS	Number of graduated students	Number of students which lost the right to study	Average score on the study
2005/2006	45	38	5	2	2	37	3.6
2006/2007	52	48	2	2	1	49	2.9
2007/2008	35	23	4	8	6	23	3.7

Table 2.4b Transience at the study program GRADUATED STUDY IN METALLURGY.

Year of enrolment	Number of enrolled students	Number of students which gained to 1/3 possible ECTS	Number of students which gained from 1/3 to 2/3 possible ECTS	Number of students which gained more than possible 2/3 ECTS	Number of graduated students	Number of students which lost the right to study	Average score on the study
2008/2009	4	0	0	4	4	0	3.9
2009/2010	2	0	0	2	2	0	
2010/2011	6	1	0	5	0	0	

Table 2.5a Testing of study results at the UNDERGRADUATE STUDY OF METALLURGY.

Final exam only	Final written exam	2
	Final oral exam	5
	Final oral and written exam	25
	Practical work and final exam	0
	Homework/Preliminary exam	0
	Homework/Preliminary exam and final exam	21
	Paper	10
	Paper and final exam	3
	Practical work	9
	Other forms	4

Table 2.5b Testing of study results at the GRADUATE STUDY OF METALLURGY.

Final exam only	Final written exam	9
	Final oral exam	4
	Final oral and written exam	26
	Practical work and final exam	0
	Homework/Preliminary exam	4
	Homework/Preliminary exam and final exam	22
	Paper	6
	Paper and final exam	5
	Practical work	2
	Other forms	6

Table 2.6 Number of published papers in scientific journals by PhD candidates during writing doctoral dissertations

Name of doctoral studies	Scientific doctoral study- metallurgy
Number of successful viva in the last five years	7
Number of publications required to approach viva	1
Number of publications by PhD candidates in foreign scientific journals relevant for academic titles	19
Number of publications by PhD candidates in Croatian scientific journals relevant for academic titles	24

Table 2.8a UNDERGRADUATE STUDY OF METALLURGY website

Number of courses with websites	33
Aims and contents of the course and reading list	33
Dates of written and oral exams, plus office hours	33
Results of preliminary and final exams	33
Exercises from previous exams	2
Additional teaching material (lecture notes, power-point presentations, drawings, images, videos, etc.)	6
Possibility of interactive teacher-student communication	33

Table 2.8b GRADUATE STUDY OF METALLURGY website

Number of courses with websites	39
Aims and contents of the course and reading list	39
Dates of written and oral exams, plus office hours	39
Results of preliminary and final exams	39
Exercises from previous exams	2
Additional teaching material (lecture notes, power-point presentations, drawings, images, videos, etc.)	6
Possibility of interactive teacher-student communication	39

Table 2.8c POSTGRADUATE DOCTORAL STUDY OF METALLURGY website

Number of courses with websites	1
Aims and contents of the course and reading list	1
Dates of written and oral exams, plus office hours	1
Results of preliminary and final exams	0
Exercises from previous exams	0
Additional teaching material (lecture notes, power-point presentations, drawings, images, videos, etc.)	1
Possibility of interactive teacher-student communication	1

3 Students

3a)

State your opinion on the quality and structure of applicants and students (numerical data in table 2.3.) to undergraduate, graduate and integrated undergraduate and graduate, as well as specialized study programs (if you have them). Based on previous experiences, provide estimation on the homogeneity and sufficiency of their background knowledge.

A significantly larger number of students from vocational schools (86.4% in the academic year 2010/2011) enroll the undergraduate study of metallurgy in comparison to general high-school students (13.6% in the academic year 2010/2011), however their average grades are almost the same (3.6, i.e. 3.7). Still, there are notable discrepancies in the quality of knowledge of first year students considering high school background. There is general consensus that their knowledge level is insufficient, especially in mathematics, physics and chemistry. Most likely, this is a result of the fact that the said subjects are not equally represented in all high schools. Teachers are trying to bridge this knowledge gap through individual consultations during office hours.

Homogeneity of knowledge with graduate students is significantly better, considering they have also successfully completed undergraduate studies at the Faculty of Metallurgy. Almost all students who start graduate studies complete them successfully. We estimate that there is a general decrease in interest regarding technical studies present throughout the European Union, which is reflected in particular at metallurgy. The developments in the Republic of Croatia ever since it proclaimed independence have had an even more negative impact on the whole field of technical sciences. Considering the dislocation of the Faculty, as well as negative trends in regional industry, there is a significant downward trend in terms of interest of quality candidates in metallurgy studies. Hence, the Faculty management has conducted a comprehensive revision of study programs (revised program is presented in detail in 2c).

3b)

Comment on the pass-and-fail ratios (figures in table 2.4) at the study program, mentioning enrolment quotas, student motivation and teaching organization.

The pass-and-fail ratio of students at the undergraduate study of metallurgy is not satisfactory. For instance, of 35 students enrolled at the undergraduate study of metallurgy in the academic year 2007/2008, only 22.6% achieved more than 2/3 of possible ECTS points, while 65.7% lost their student rights (table 2.4a). On the other hand, almost all students enrolled at the graduate study of metallurgy achieve more than 2/3 of possible ECTS points and graduate successfully (table 2.4b). The most challenging issue, which the Faculty has been trying to address in the last two years, is lack of student motivation, especially a part of students enrolled in the first year of undergraduate study. Larger part of them did not get involved in teaching at all, which soon resulted in their administrative removal from the Faculty of Metallurgy after the first semester.

The other part of students who do participate in the teaching process for a while, after a certain period stop attending classes mostly due to difficulty of studies of insufficient motivation, resulting in dropping out. Some of them reenrol. All this is reflected in extremely low pass-and-fail ratio for the first year of studies. Analysis of entry competencies indicates that students' background knowledge is insufficient for our program. Teaching is organized in adequate conditions considering the number

of students, meaning that teaching organization should not be considered as element influencing the pass-and-fail ratio. Students have at their disposal a number of mechanisms for overcoming difficulties in the course of studies. The most challenging courses offer additional classes and special training for passing the exam.

3c)

Describe the way in which you notify prospective students on the higher education institution and offered study programs (qualifications, competencies, possibility of continued education and employment) – information packages, websites, leaflets, etc.

Advertising campaign of the Faculty of Metallurgy study programs usually begins with the University Fair in Zagreb. For this purpose, every year the Faculty creates a strategy, promotional video, flyers, etc. This is followed by visits to high schools from which prospective students are most likely (technical high school in Sisak-Moslavina County, general high schools in Sisak and Petrinja, technical schools in Karlovac, etc.). In the previous several years the Faculty of Metallurgy organized Open Day with the objective of introducing high school graduates in the Sisak-Moslavina County with the possibilities of study and teaching organization at the Faculty, as well as employment prospects. All information on study programs is available at the Faculty of Metallurgy website. Within the revised quality assurance system at the Faculty, a special work group has designed a new IT architecture of the Faculty aimed at improving the availability of information on all Faculty activities.

3d)

Elaborate on the guiding reasons when testing students' learning results (table 2.5). List the measures ensuring impartiality and objective grading of the exams.

The Faculty of Metallurgy normally grades students on the basis of continuous monitoring. At the undergraduate level only two courses have a final exam as an exclusive knowledge test, whereas 21 courses approach grading via preliminary exams and homework, and 25 courses have a final written and oral exams. Only 9 courses at the graduate level have a final exam. Monitoring model is defined on the course level and is publicly available. Cumulative grading of preliminary exams and other forms of testing is recommended and mostly applied. There are rare examples of elimination-based grading of preliminary exams. A significant number of courses require writing a paper, as one of preconditions of completing the said course. In case the student does not meet the criteria of continuous monitoring, they may approach taking the exam via a final exam.

Impartiality and objective grading, as well as continuous monitoring is based on the fact that exams are public documents and are published according to existing procedures. A part of activities is conducted and published at e-learning system 'Merlin'.

Alongside with written exams, most courses contain certain forms of oral exam, preliminary exams, papers, presentations, etc. We believe this to be a good practice because human, personal and social components often get lost in the desire for achieving automation and objectivity of testing.

3e)

List students' opinions on teacher-student cooperation expressed in polls and obtained in other ways and comment on possible problems and procedures of their solving as well as way of informing students on conducted measures.

At the end of each semester, students express their opinions on teachers via online polls. The way of processing information and results are available to the Dean and teachers via teachers' portal of the ISVU system. This way, teachers are provided with insight on areas of improvement. Previous polls suggest that undergraduate and graduate students at the Faculty of Metallurgy are satisfied with teacher-student cooperation. However, the main issue of not just the Faculty of Metallurgy, but University of Zagreb as a whole, is a small percentage of students who participate in the opinion poll, which is why statistically relevant information are still lacking. This issue is handled by attempting to reinstate written opinion polls. In case of major issues (so far this has not been the case) between students and teachers (disputes on exams and the like), there is a system of procedures. The Vice-Dean for teaching would be involved, who would try to come to a satisfactory solution through interviews with the student and teacher involved. Students may approach the Vice-Dean for teaching and head of their study year in regards to any questions and assistance. All information is available to students via notice board, web portal of the Faculty and student representatives in various Faculty bodies (Faculty Council, Commission for teaching, etc.).

3f)

State your opinion on issues of accommodation and catering facilities for your students. If there is one, comment on the organization of extracurricular activities for students (courses, sports, etc.). Comment on the level of student standard at your higher education institution (according to data in table 3.1.) and assess the degree of use. In case you are dissatisfied with the current state of affairs, identify reasons and propose possible solutions.

Accommodation for students at the Faculty of Metallurgy still presents an issue unresolved in a satisfactory manner. Sisak does not have a student dormitory. Catering facilities and student standard are currently satisfactory, but occasionally problems arise the solutions to which should be prompted by students, where the Faculty would provide support and advise. Catering facility is dislocated from the Faculty buildings.

As for other student activities, the Faculty of Metallurgy has a branch office of the Student Assembly, which organizes competition in sports and science for students of technology faculties from Croatia and the region entitled 'Technology Games'.

Furthermore, students are actively involved in associations, as well as public, social, cultural and sporting activities in Sisak in various ways.

Students may copy documents in the Faculty Library. The Faculty of Metallurgy has no sporting facilities, so that PE education takes place in the gym of primary school Viktorovac, whereas other sporting activities are available in other objects in Sisak.

A construction of a student dormitory with related facilities is vital for an improved student standard, which would attract a greater number of students from other counties.

3g)

List possible special measures which your higher education institution has initiated in order to motivate students (awards, prizes, etc.), and comment on the effects of those measures.

With the objective of increasing student motivation, every year on the Day of the Faculty of Metallurgy, the Faculty of Metallurgy awards special certificates and financial prizes to most successful students at respective study years (2-3 students per year). This is aimed at developing students' competitive traits directed towards skills and knowledge as important characteristics in the development of potentials of respective students. Moreover, the Rulebook on Dean's award introduced the Dean's award to students with the purpose of permanent encouragement of students' success in metallurgy studies, which recognizes their diligence, responsibility and excellence in terms of knowledge acquisition at respective study years and participation in teaching, scientific or specialized activities of the Faculty. Commission for student work and awards is also active at the Faculty of Metallurgy, reviewing and proposing student work for entry and participation at the published call for papers of the kind (e.g. Rector's award). The Commission consists of three members of the Faculty Council, two with the scientific-educational status and one students' representative. Student mobility and their involvement in organized activities of the University are also made possible (educational, cultural, sporting, social, charity, etc.)

3h)

List forms of support for students at the higher education institution (mentorship, career consultancy, learning assistance, assistance to students with special needs and international students, legal and financial support, etc.).

Student support mechanisms are defined in the Manual for quality assurance and improvement of the Faculty of Metallurgy:

1) Teacher – head of study year.

This relationship enables:

- Improved communication with students
- Due and efficient provision of relevant information

Teacher – head of study year is obliged to:

- Be available for students' questions
 - Ensure adequate assistance concerning study program acquisition
- 2) In line with the budget, the Faculty provides means for students willing to participate in competitions, conferences, congresses, study visits and so on, also providing expert assistance for the said events. These activities are approved by order of the Dean, following students' proposal.
- 3) Public information:
- Publishing Enrolment Guidebook
 - Regular participation at the University Fair
 - Leaflet for the University Fair
 - Regular updates of the Faculty website
 - Continual encouragement to teachers regarding updates of their courses' websites interactively provided by the teachers' portal Merlin.
- 4) Record of students' mobility is regularly updates. Two-way mobility is encouraged.

From 2007 to January 2011, the Faculty of Metallurgy had a Commission for teacher-student cooperation and monitoring and improvement of studying. It discussed all issues of significance to students and took necessary steps in

cooperation with other Faculty bodies, i.e. proposed way to overcome existing challenges. Active today is the Commission for quality assurance and improvement at the Faculty of Metallurgy, appointed on the 18th of January 2011 by decree of the Dean. Apart from the said commissions, the Faculty has appointed heads of study years (head for each year of undergraduate study, one head for both years of graduate study, one head for specialized course and one head for doctoral studies, respectively). Through their work with students, reflected in periodical meetings at which current issues and suggestions concerning the studies and teaching are discussed, the heads are also active in quality assurance and improvement to teaching quality at the Faculty. Support for students is also provided for via Commission for teaching, Students' desk, Faculty website, ECTS coordinator, and Ethical commission of the Faculty of Metallurgy. The Faculty has a special IT room of the CARnet system with three computers used by students exclusively for extracurricular purposes (writing papers, browsing the Internet for available reading, etc.). Students often use the mentioned computers for executing study course requirements, writing papers and dissertations. Furthermore, during the course of studies, students have at their disposal the Students' Assembly room (with one computer) and two online student desks ('studomat'). They have internet access via a local network facility (LAN) and wireless.

At the Faculty of Metallurgy, there is Coordination for students with disability taking special care of students with disabilities. Within the framework of interinstitutional and international cooperation, the coordinator for international cooperation provides assistance to students applying for various forms of such cooperation (scholarships, studying abroad, student mobility within Erasmus program, etc.)

The Faculty of Metallurgy has of late introduced a practice of financial awards to students successful in fulfilling their course requirements in due time, relieving them of paying tuition.

The Faculty of Metallurgy assists students by covering a part of expenses of participation at sporting and scientific competition of technology students ('Technology Games'). Every year, the Faculty of Metallurgy organizes International Foundrymen Conference, with participation of senior year students. Occasionally, the Faculty organizes specialist field trips, visiting metallurgy industry subjects in Croatia and neighbouring countries (Slovenia, Bosnia and Herzegovina).

3i)

Enclose regulations on student right protections (procedures for appeal, student attorney, etc.)

Student right protection is regulated under the Statue of the Faculty of Metallurgy, Rulebook on studying at undergraduate and graduate metallurgy studies, Rulebook on postgraduate doctoral metallurgy studies, Rulebook on quality assurance and improvement at the Faculty of Metallurgy and Regulations on quality assurance and improvement at the Faculty of Metallurgy, which outline all the procedures for handling student appeals,

According to the Regulations on quality assurance and improvement at the Faculty of Metallurgy, procedure upon student's appeal is conducted in the following manner:

- Student dissatisfied with the final grade may demand to take the exam in front of a commission within 48 hours following taking the exam
- Request for retaking the exam must be explained in the appeal

- A three-member commission is appointed by the Dean within 48 hours upon receiving the appeal
- Teacher in question may not be appointed as commission member, but can be present at the exam, without the right to ask questions and grade the student
- The Dean determines the time and place of the exam
- The new exam is to take place within five days upon the appeal
- Written exams are to be re-graded by the commission
- The exam is taken according to study program
- At the oral exam one appointed teacher asks the question, but other members may ask questions as well
- The commission reaches a decision by majority vote

It should be noted that student representatives at the Faculty of Metallurgy participate in activities of most Faculty bodies (Faculty Council, Commission for teaching, etc.) and have the right to veto decisions on issues of special interest to students at the Faculty Council. Issues of special interest relate to changes in study system, quality assurance, curricula, teaching plans, student standard. There is no students' attorney at the Faculty of Metallurgy, but one exists on the level of the University of Zagreb within the Students' Assembly in the Office of Students' Attorney, at the disposal of the students of the Faculty of Metallurgy as well. Furthermore, the Faculty of Metallurgy has appointed an Ethical Commission expanded with two students in case issues regarding student behaviour or issues of special interest to students are discussed.

3j)

Elaborate on alumni monitoring and information on their employment, as well as other information relevant to study program improvement.

Alumni association of the Faculty of Metallurgy in Sisak (<http://www.simet.unizg.hr/alumni>) is active from June 2011. Pursuant to State Administration of Sisak-Moslavina County, Service for general administration decree, it was listed in the Association Registry of the Republic of Croatia. Some of the Association's objectives are as follows: protection of tradition of the Faculty of Metallurgy and the University of Zagreb, promotion of reputation of the Faculty of Metallurgy, strengthening of links and cooperation among the Faculty of Metallurgy alumni as well as similar institutions at home and abroad, etc. Primary activities of the Association are concerned with being up to date with the activities of the Faculty of Metallurgy and the University of Zagreb, connecting members with the purpose of cooperation on teaching and scientific projects, assistance with employment of young engineers, etc.

Data on alumni employment are occasionally, upon written request, received from the Croatian Bureau of Employment, branch office Sisak (table 3.2). In general, unemployment is low (data in table 3.2 relate to the territory of Croatia).

Other data relevant to study program improvements are gathered via polls according to the Regulations on quality assurance and improvement at the Faculty of Metallurgy, determining the organization, activities and assessment of quality assessment and improvement of higher education at the Faculty of Metallurgy. A portion of the graduates are members of the above mentioned Association, a part of them is active in working bodies of the Faculty of Metallurgy, as well as at International Foundrymen Conference, and are present at workshops and seminars organized by the Faculty (life-long education).

3k)

Define as to how satisfied you are with the current state of affairs and suggest possible improvements.

The Faculty of Metallurgy is not fully satisfied with the current state of affairs. Despite numerous efforts (described in 3a, 3c, etc.), interest in metallurgy studies is still low. Unfortunately, this development is in line with trends in EU countries (with the exception of Slovakia, where the state is actively involved in providing support for metallurgy), as well as in SEE countries (Bosnia and Herzegovina, Montenegro).

The problem arises from the state of the economy and inadequate status of metallurgy as a profession. Lack of economic strategy, processes of deindustrialization in Croatia and market openness towards imports is unfavorable regarding the activities of the Faculty of Metallurgy. The situation in the Croatian industrial sector is sadly adverse, providing an insignificant number of scholarships for technical sciences.

Efforts concerning the revision of the undergraduate metallurgy study program with the introduction of a new module Industrial Ecology are expected to increase the number of quality students, which would result in better pass-and-fail ratio. The Faculty of Metallurgy will continue to monitor and adapt study programs in line with economy and professional development trends and taking into consideration graduate's feedback.

Table 3.1 Student standard

	Area (m2)	Number of sets or active places
Study area	Library MF 70	8
Student cafeteria (X-card)	Trattoria Restaurant	30
Other catering facilities	-	-
Mimeograph room ³	-	-----
Copy room	-	-----
Student accommodation	-	-
Sporting facilities ⁴	-	-
Rooms for student associations and other cultural activities	22+20	10+5
**Sporting facilities	-	-

Table 3.2. Graduates' employment

Study program	Number of graduates in the past 3 years	Unemployment according to Employment Bureau statistics
Undergraduate study in metallurgy	8	25*
Undergraduate study in metallurgy	24	
Graduate study in metallurgy	4	

³ The Faculty of Metallurgy does not have a mimeograph or copy room, however those services may be used within the Library.

⁴ The Faculty of Metallurgy does not have its own sporting facilities, thus PE education takes place in the neighbouring primary school gym, while other sports are available in different facilities in Sisak area.

*According to Croatian Bureau of Employment, branch office Sisak statistics, as of the 7th of October 2011, there are 25 unemployed metallurgy experts. It should be noted that the methodology used by the Croatian Bureau of Employment is inadequate for determining the exact number of unemployed metallurgy engineers, for it includes other degrees of education.

4 Teachers

4a)

Comment on the teachers' and associates' structure as in table 4.1. Assess positive and negative aspects of the ratio of employees at the higher education institution and external associates. Analyze problems in human resources policy.

According to the data on teachers' and associates' structure, it is clear that the ratio of employees and external associates is 5:1. In the last five years, the ratio of employees and external associates has not changed significantly (2006/2007 – 7:1; 2007/2008 – 7:1; 2008/2009 – 7:1, 2009/2010 - 5:1).

External associates do not cover specialist areas. Thus, involvement of external associates employed in the industry would prove to be an immense benefit in improving the quality of teaching.

In the last several years, almost all research trainees have been awarded a higher scientific-educational degree of assistant professor. Previous job openings were not satisfactory as only one research trainee has been employed in the last five years, which is insufficient.

4b)

Comment on the teacher-student ratio and its trends in the last five years.

The Faculty of Metallurgy has 20 teachers with scientific-educational titles, two senior assistants and one assistant. The ratio has worsened in the last few years, due to the fact that positions of 8 teachers have been terminated.

The total number of undergraduate and graduate students in the academic year 2011/2012 is 86. Thus, the ratio is 1:3 (one teacher for three students).

In the last five years, enrolment has changed insignificantly, thus the ratio remained at the same level (2006/2007 – 1:5; 2007/2008, 2008/2009, 2009/2010 – 1:4).

4c)

Comment on the scope of teachers' and associates' workload (table 4.2).

The analysis of the past five years of the teaching process indicates an imbalance regarding teaching workload. Causes of that may be tracked into reduced numbers of employees due to retirement or inadequate employment in regards to specific fields. Likewise, there is a lack of research trainees. Furthermore, the Faculty of Metallurgy does not provide funds for overtime work.

In the academic year 2011/2012, teacher workload analysis was conducted, which resulted in adopting a balanced teaching plan, in line with standards of the State contract for science and higher education.

In the academic year 2010/2011 of 6050 standard hours total, external associates have realized 427,5 standard hours.

4d)

List formal procedures for monitoring teachers' non-institutional work activities.

Teachers' non-institutional work activities at other higher education institutions or other organization are achieved by contract. The Dean may ban, limit or condition employees' involvement with legal entities outside the Faculty insofar such a contract would have a negative effect on the Faculty or if the contract is to be signed with an organization competitive to the Faculty. The Dean issues approval for teaching at other institutions.

4e)

Elaborate on group sizes for lectures, seminars and other forms of teaching and your assessment on the efficiency of teaching in the said groups. Comment on students' opinions on the issue as expressed in opinion polls.

Teaching is conducted in study groups most commonly determined according to available teaching facilities (size and number of classrooms, laboratory work areas, seats in IT classrooms). Bologna Process standard conditions are always taken into consideration.

The number of students in study groups varies depending on year of study and number of students in respective courses. The size of study groups in lectures typically does not cross the limit of 55. Seminar and laboratory groups are adjusted to number of students, 15 for seminars and 10 for laboratory work. IT classroom teaching is conducted in groups of 15 students. The only notable challenge is presented by the lack of assistants and research trainees, meaning that teachers with scientific-educational and educational titles must conduct all types of teaching.

According to student opinion polls, group sizes in lectures, seminars and practical work enables great efficiency and interactive teaching.

4f)

Elaborate on the indicators for assessment of teachers' and external associates' competence. Comment on comparability of those indicators in Croatian and international terms. Add student opinions expressed in opinion polls and their effects.

Teacher's and associates' competence is assessed on the basis of awarding adequate scientific-educational and educational titles pursuant to legal acts and Regulations on academic titles of the Faculty of Metallurgy. The criteria for awarding academic titles at the Faculty of Metallurgy may be compared to similar criteria at Naravoslovnotehniška fakulteta Univerza v Ljubljani. Additional teaching quality indicators are the following: textbook and teaching material publication, participation in scientific projects, publication of research papers, all in line with the Regulations on quality assurance and improvement at the Faculty of Metallurgy. The quality of teaching is verified through continuous evaluations of teachers via student opinion polls, and monitoring increased share of e-learning in the teaching process. Student poll results present useful feedback on the current situation.

4g)

Elaborate on forms of expert support to your teachers and external associates in terms of improving teaching competencies. Elaborate on improvements of teachers and external associates at other Croatian or international higher education institutions and evaluate the scope and success of those processes. Provide comparison to other higher education institutions.

Forms of expert support to teachers and external associates in terms of improving teaching competencies are the following: occasional e-learning workshops and workshops on active use of e-learning infrastructure at the Faculty, workshops on mathematical methods and program support in the teaching process, etc.

Teachers are encouraged to participate in topical workshops organized by the University, Ministry of Science, Education and Sports, Agency for Science and Higher Education, as well as other relevant institutions. The Faculty provides support for teachers' activities regarding the publication and reviews of university textbooks, as well as other publications for teaching purposes. Teacher mobility within the Republic of Croatia and abroad is still insignificant. Thus, motivation and active approach are encouraged, especially with younger teachers, in terms of continued training in Croatia and abroad. Within the framework of inter-institutional cooperation,

participation of our teachers at study programs of other higher education institutions is strongly encouraged. The Faculty of Metallurgy, being the only national institution educating experts in the field of metallurgy, enables professional training of its teachers through cooperation with industrial businesses, entrepreneurs, field trips and ongoing upgrades of IT equipment and software.

4h)

Elaborate on special measures your higher education institution has introduced with the objective of motivating teachers (awards, recognitions, etc.) and comment on the effects of those measures.

At this point, the Faculty provides non-financial stimulations through the following awards:

- Recognition for total contribution to the development of metallurgy studies,
- Letter of thanks for long-term continued contribution to teaching and the development of the Faculty.

The Faculty currently does not have any special measures for teacher motivation. System of awarding teacher excellence is necessary. A commission should be appointed, which would then draft regulations on awards and recognitions, with regards to motivating teachers who:

- continually improve curricula and teaching materials for undergraduate, graduate and specialist studies,
- Work overtime, for which they receive no compensation,
- Execute unpredicted and demanding tasks which demand increased investment of effort due to deadlines and intensity,
- Improve business processes or in other ways contribute to business enhancement,
- Apply international projects
- Write, translate and publish prominent university and faculty textbooks,
- Receive best students' comments in polls.

The Faculty proposes teachers for state and/or university awards (annual 'Fran Bošnjaković' award, best e-course award, etc.).

4i)

Summarize and assess the type and quality of teaching materials prepared by your teachers. Provide a list of textbooks published by your teachers in the past five years. Express opinion on specialized literature for your curriculum.

We believe that teaching materials are of high quality and that the courses have a good basis in literature. In the past five years the following textbooks have been published:

No.	Author	Title	Type	Year
1.	Gojić, Mirko	Metallurgy of Steel	Textbook University of Zagreb	2006.
2.	Grozđanić, Vladimir & Markotić, Anto	Metallurgy of Iron and Steel: Theory and Solved Problems	Textbook University of Zagreb	2006.
3.	Lazić, Ladislav	Numerical Methods in Thermal Analysis	Textbook University of Zagreb	2007.
4.	Gojić, Mirko	Techniques of Joining and Cutting	Textbook University of Zagreb	2008.
5.	Hršak, Damir	Hydrometallurgy	Textbook University of Zagreb	2008.
6.	Gojić, Mirko	Surface Treating of Metals	Textbook University of Zagreb	2010.
7.	Rađenović, Ankica	Refractory Materials	Textbook University of Zagreb	2010.

As above mentioned, all the titles are University of Zagreb textbook, and are as such used in Faculty's courses, as well as in other constituent units of the University of Zagreb and other universities. Quality is discernible from the fact that professor Mirko Gojić's textbook have a second unaltered edition.

Furthermore, considering the number of teachers at the Faculty and textbooks in the past five years, there is good reason to be satisfied with publishing activities. However, it is possible to achieve even better results by introducing instruments which would motivate teachers to write or translate different globally acclaimed textbooks and literature.

Undergraduate and graduate study teaching program is 36% covered by teaching materials produced by the Faculty of Metallurgy teachers (the percentage relates to university textbooks, university practice books and revised teaching materials published at the Faculty website). 13 reviewed teaching materials have been posted at the Faculty website.

4j)

Define as to how satisfied you are with the current state of affairs and suggest possible improvements.

Unsatisfactory age structure (average age of professors is 62, for associate professors 52) and non-existence of research trainees will create systemic problems related to empty seats following retirement. One of the consequences of such a scenario will be imbalance in certain fields within metallurgy in terms of appropriately qualified teachers.

Thus, we propose drafting a human resources strategy at the Faculty level with the following objectives:

1. Increase in the number of research trainees,
2. Increasing the Faculty's independent income (financing researchers outside the Ministry of Science, Education and Sports system),
3. Awarding teachers' and researchers' excellence,

4. Drafting regulations on awards and recognitions for teachers and researchers,
5. Encourage educational trainings and improvements of teachers,
6. Support staff and faculty mobility.

Teaching at the Faculty study programs has been modernized in the past few years, not only in terms of contents, but also by applying contemporary forms of teaching process, most significant of which is e-learning and detailed elaboration of revised study programs based on study result concept.

Teachers' workload is mostly connected to various projects of reforms concerning higher education: Bologna Process, internal development projects, new evaluations, analyses and other administrative requirements the Faculty is obliged to honour.

Table 4.1. Structure of staff

Staff	Employed full-time		Employed in cumulated employment		External co-operation of teachers in full-time	External associate	
	No.	Average age	No.	Average age		No.	Average age
Full professor	9	62	-	-	-	1	67
Associate professor	3	52	-	-	-	-	-
Assistant professor	7	38	-	-	-	-	-
Teachers	1	34	-	-	-	3	65,3
Young researcher – assistant	1+2	32	-	-	-	-	-
Young researcher – senior assistant							
Teaching associate	-	-	-	-	-	-	-
Professional associate	1	59	-	-	-	-	-
Technical staff	4	48,5	-	-	-	-	-
Administrative staff	8	41,5	-	-	-	-	-
Support staff	4	46,25	-	-	-	-	-

Table 4.2. Workload of teachers and external associate

Name of study program	Lectures		Seminars and auditory exercise		Mentoring*		Other types of teaching (laboratory exercise)	
	Teachers of this Faculty	External associate	Teachers of this Faculty	External associate	Teachers of this Faculty	External associate	Teachers of this Faculty	External associate
Undergraduate study	2280	120	1035	195	-	-	600	0
Graduate study	1470	-	307.5	-	-	-	120	-
Postgraduate doctoral study	630	-	60	-	-	-	0	-

*It refers only to Arts.

Table 4.3. List of teachers

Teacher	Title	Academic degree	Institution of higher education which issued the diploma	Field	Date of the last title selection	Percentage of employment	Workload at home institution in standard hours	Workload at external institution in standard hours
Begić Hadžipašić Anita	Assistant professor	PhD	Faculty of Metallurgy	Metallurgy	11.07.2011.	100	187.5	-
Brnardić Ivan	Assistant professor	PhD	Faculty of Chemical Engineering and Technology	Chemical engineering	10.5.2010.	100	292.5	-
Črnko Josip	Full professor	PhD	Faculty of Metallurgy	Metallurgy	25.6.1996.	100	525.0	-
Dolić Natalija	Young researcher – senior assistant	PhD	Faculty of Metallurgy	Metallurgy		100	157.5	-
Glavaš Zoran	Assistant professor	PhD	Faculty of Metallurgy	Metallurgy	12.5.2008.	100	240.0	-
Gojić Mirko	Full professor	PhD	Faculty of Metallurgy	Metallurgy	8.7.2008.	100	263.0	-
Grozđanić Vladimir	Associate professor	PhD	Faculty of Metallurgy	Metallurgy	24.9.2007.	100	217.5	-
Holjevac Grgurić Tamara	Assistant professor	PhD	Faculty of Chemical Engineering and Technology	Chemical engineering	8.6.2009.	100	263.0	-
Hršak Damir	Associate professor	PhD	Faculty of science	Metallurgy	8.9.2008.	100	255.0	-
Jandrić Ivan	Young researcher – assistant	BSc	Faculty of Metallurgy	Metallurgy		100	0.0	-
Kožuh Stjepan	Assistant professor	PhD	Faculty of Metallurgy	Metallurgy	11.5.2009.	100	292.0	-
Lazić Ladislav	Full professor	PhD	Faculty of Metallurgy	Metallurgy	10.7.2007.	100	390.0	-
Lopatić Josip	Lecturer	MSc	Faculty of science	Mathematics	13.1.2010.	100	420.0	-
Malina Jadranka	Full professor	PhD	Faculty of Metallurgy	Metallurgy	15.5.2007.	100	160.0	115,5
Markotić Anto	Full professor	PhD	Faculty of Metallurgy	Metallurgy	28.10.1997.	100	300.0	-
Matković Prosper	Full professor	PhD	Faculty of Metallurgy	Metallurgy	11.10.2005.	100	240.0	-
Matković Tanja	Full professor	PhD	Faculty of Metallurgy	Metallurgy	10.5.2011.	100	225.0	-
Pezer Robert	Assistant professor	PhD	Faculty of science	Physics	8.5.2007.	100	240.0	-
Rađenović Ankica	Full professor	PhD	Faculty of Metallurgy	Metallurgy	9.2.2010.	100	345.0	-

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Rešković Stoja	Associate professor	PhD	Faculty of Metallurgy	Metallurgy	14.2.2011.	100	547.5	-
Slokar Ljerka	Assistant professor	PhD	Faculty of Metallurgy	Metallurgy	18.4.2011.	100	150.0	-
Štrkalj Anita	Assistant professor	PhD	Faculty of Metallurgy	Metallurgy	14.6.2010.	100	252.0	-
Unkić Faruk	Full professor	PhD	Faculty of Metallurgy	Metallurgy	15.5.2007.	100	90.0	24
Zovko Brodarac Zdenka	Assistant professor	PhD	Faculty of Metallurgy	Metallurgy	14.6.2010.	100	240.0	-

Table 4.4. Dynamics of teacher employment in the last 5 years.

Year	Number of new-employed teachers	Number of teachers who completed the employment
2011	-	-
2010	2	3
2009	1	2
2008	-	3
2007	1	-
TOTAL	4	8

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Table 4.5. Teaching materials used in previous academic year.

Number of textbooks in Croatian	Number of foreign textbooks translated to Croatian	Number of scientific publications related to teaching	Number of manuals	Number of handy materials related to the Arts	Number of courses with reviewed manuals on the web site of the Faculty	Number of courses with web page with support teaching materials	Number of courses which are performed as e-course
54	2	30	7	-	7	All courses	All courses
16	-	20	-	-	7	All courses	All courses

5 Scientific and expert cooperation

5a)

Describe the strategic program of scientific research for the period of at least five years in the scientific area in which your institution operates from the Registry of scientific organizations.

There are three basic groups of activities of the Faculty of Metallurgy: teaching process, scientific work and research and specialized activities in the field of technical science, metallurgy and other fields relevant to metallurgy. Strategic research program at the Faculty of Metallurgy is connected to two of three basic activities (scientific work and research and specialized activities). Scientific work and research is based on fundamental, applied and developmental research gathering scientific contents, systemizing existing scientific knowledge, forming and presenting scientific achievements. It is conducted by participating in home and international scientific projects, publishing papers in journals and proceedings from conferences, and activities connected to popularization of science via panels, public discussions, etc.

Such activity program is followed by internal Faculty structure with three constituent units: Department of Process Metallurgy, Department of Mechanical Metallurgy and Department of Physical Metallurgy. Research funded by the Ministry of Science, Education and Sports within the framework of the said constituent units are conducted in regards to projects, i.e. field as demonstrated in figures 5a1 and 5a2.

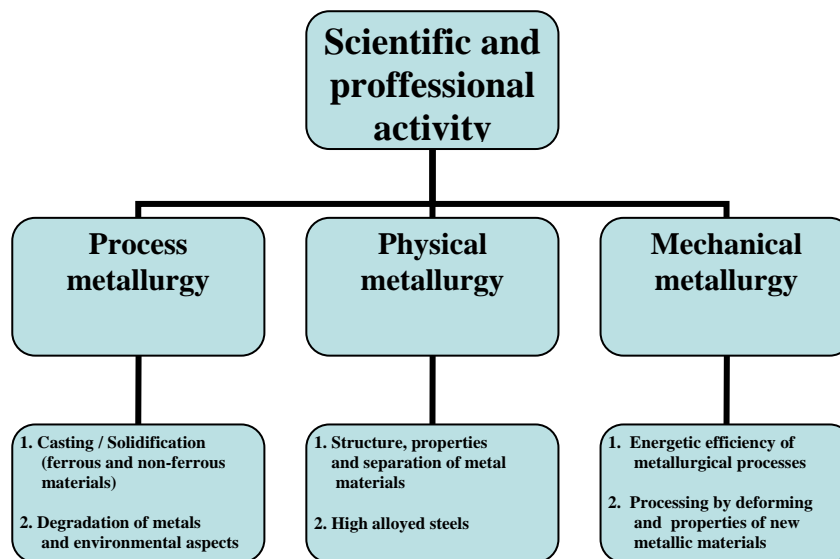


Figure 5a1. Schematics of scientific and specialist activities of the Faculty of Metallurgy within metallurgy fields

Within the framework of the mentioned areas of activities, there has been research at six scientific projects, four of which were connected into one joint program entitled Metal materials – property, processing and energy consumption. The four scientific projects within the same program are a logical continuation of previous research at the Faculty of Metallurgy, based on experimental research and verification in real life. The following schematics demonstrates projects in the program, one independent project and one project in cooperation with another higher education institution (Faculty of Mechanical Engineering and Naval Architecture, Zagreb).

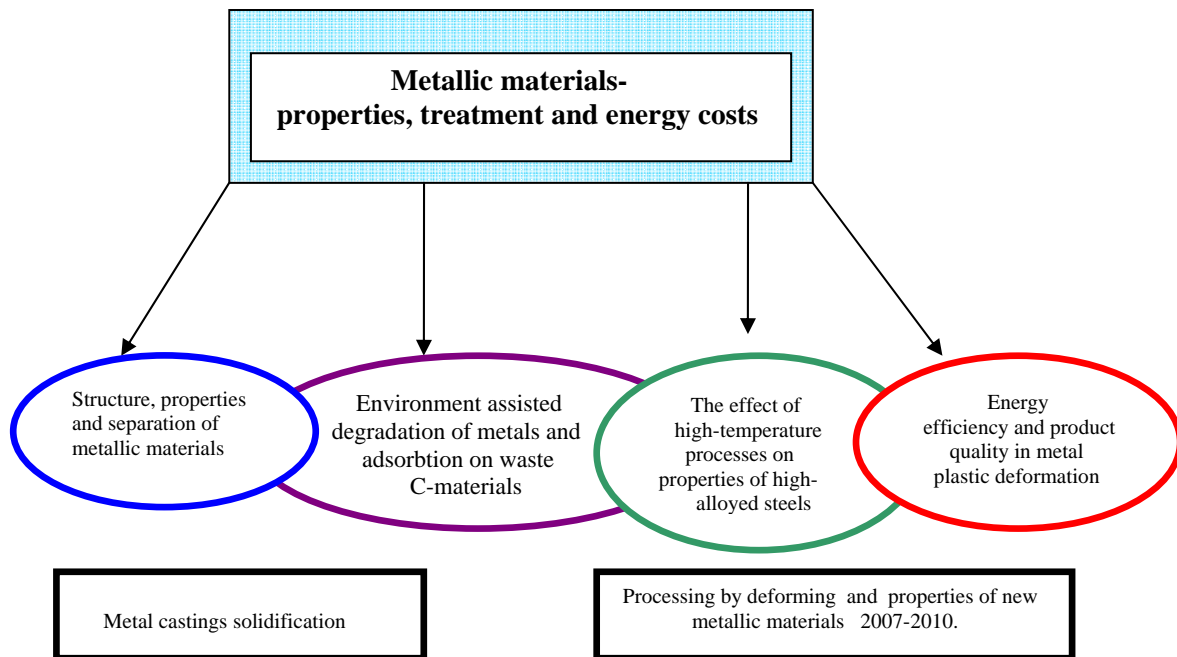


Figure 5a2. Scientific program and projects at the Faculty of Metallurgy

The idea for the proposed program arose from previous experience and knowledge from interdisciplinary activities and the latest global research in this field. The program is directed at studying steel material behaviour (carbon, low-alloy, highly firm and micro-alloy, TMP, multi-stage DP and TRIP, austenite and duplex non-corrosive steel), aluminium, aluminium alloys and potentially biomedical Ti-alloys (Ti-Co-Cr, Ti-Nb, Ti-Mo) highly dependent upon casting and processing methods. Scientific research use numerous complementary methods (OM, SEM, TEM, EDS, XRD, DTA, AAS etc), including the application of mathematical modelling and real life situations. By applying study results, we expect higher energy efficiency of the processing of heating, determining optimum parameters of processing, welding and heating, more appropriate choice of respective materials for real life applications and acquiring new scientific knowledge on the interrelation of microstructure and properties of metal materials.

Scientific researches at the Faculty are the result of long and systemic scientific activities of high quality and long scientific cooperation with universities and institutions at home and abroad.

It should be noted that all project pay special attention to environmental aspects and energy efficiency in respect to metallurgy, metallurgy technology and metal materials.

5b)

Name 10 distinguished international scientific journals which publish the works of your teachers. Comment on relevant impact factors. Name several distinguished cultural institutions, museums and galleries which present the works of your teachers.

The teachers/scientists of the Faculty of Metallurgy publish the results of scientific research in relevant domestic and international journals for technical sciences in the fields of metallurgy, chemical engineering and physics. According to Croatian scientific literature, in the past five years (2006-2011) the Faculty of Metallurgy scientists have published the total of 156 papers in 51 domestic and international journals, of which 26 is referenced in the Current Contents database. Most research has been published in international journals. In the past five years, works have been published in 40 international and 10 domestic journals. Ten of the most significant journals publishing the work of Faculty of Metallurgy scientists are the following:

- Journal of Alloys and Compounds (IF = 2.134)
- Journal of Materials Science (IF = 1.855)
- Applied Thermal Engineering (IF = 1.823)
- Journal of Thermal Analysis and Calorimetry (IF = 1.752)
- Materials & Design (IF = 1.694)
- Journal of Applied Electrochemistry (IF = 1.494)
- Metallurgy and Materials Transactions B-Process Metallurgy and Material Science (IF = 0.963)
- Engineering Failure Analysis (IF = 0.765)
- Kovové Materiály (IF = 0.471)
- Metalurgija (IF = 0.348)

Mentioned journals cover all three basic metallurgy areas: process metallurgy, physical metallurgy and mechanical metallurgy. In the last five years, most papers have been published by the journal 'Metalurgija'.

Some of the journals listed in Current Contents database publishing the work of Faculty of Metallurgy scientists in other fields are the following: Thermochemica Acta (IF = 1.899), Journal of Applied Clay Science (IF = 2.303), Physical Review Letters (IF = 7.621) and Physical Review A (IF = 2.861).

Medium value of impact factor of journals publishing the work of Faculty of Metallurgy scientists (2006-2010) in the field of technical sciences is 1.332, whereas medium value of impact factors of science journals is 3.913.

5c)

Name 10 most significant papers for the institution and explanation (for each area of your institution's activities) in the past five years. Name and comment on the citations of papers according to global databases (WOS, SCOPUS). Compare the scope of your scientific achievements with similar domestic and international higher education institutions.

According to ISI Web of Science information, Faculty of Metallurgy scientists published the total of 88 scientific papers referenced in this base (table 5.5). Analysis of papers according to the year of publication (figure 1) indicated that in the past five years 15-16 papers have been published in journals cited in WOS base, with significantly larger number of publications in 2008, when Faculty of Metallurgy scientists published 25 papers. Scientific papers published 2006-2010 were quoted 233 times, while the citation of total 219 papers published by the Faculty of

Metallurgy is 506. Citation analysis indicates a significant increase in quotations of all published papers in the past five years compared to the previous period (Figure 2). According to data of Croatian scientific literature (<http://bib.irb.hr>), in the past five years the total of 156 scientific papers was published in domestic and international journals, 156 in proceedings from international and domestic conferences, 7 others and 20 specialized papers. Of the total 156 papers published in journals, 46 were published in journals referenced in the CC database, of which 24 in the field of technical science – metallurgy, 13 in the field of technical science – chemical engineering and 9 in the field of science – physics. According to CROSBİ base, 110 scientific papers were published in journals references in other databases approved at awarding academic titles. The number of published scientific papers in journals references in ISI Web of Science base per employee is 3.14. Considering the total number of published scientific papers according to CROSBİ database, ratio per employee is significantly higher: 11.39. The number of published scientific papers in journals referenced in CC base per employee in the last five years is 1.6, whereas the ratio is 3.9 for papers published in journals listed in other databases. According to analysis of papers in the past five years (source: CROSBİ), of total 319 published papers, 158 was in cooperation with international researchers, serving as evidence of developed international cooperation of Faculty of Metallurgy scientists.

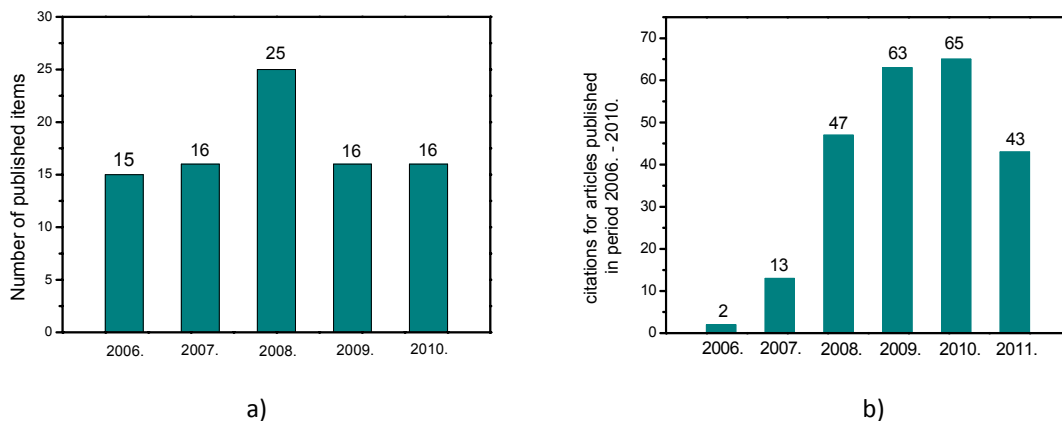
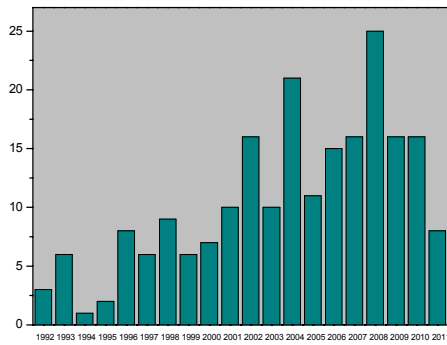


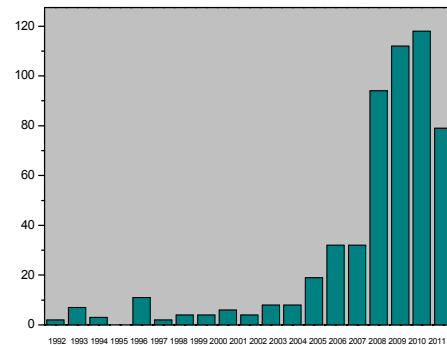
Figure 5c1. Published items in period 2006. - 2010. (a) citations of articles published in period 2006. - 2010. (b) according to Web of Science

Published Items in period 1992. – 2011.



a)

Citations in period 1992. – 2011.



b)

Figure 5c2. Published items (a) and citations (b) in period 1992. – 2011. according to Web of Science

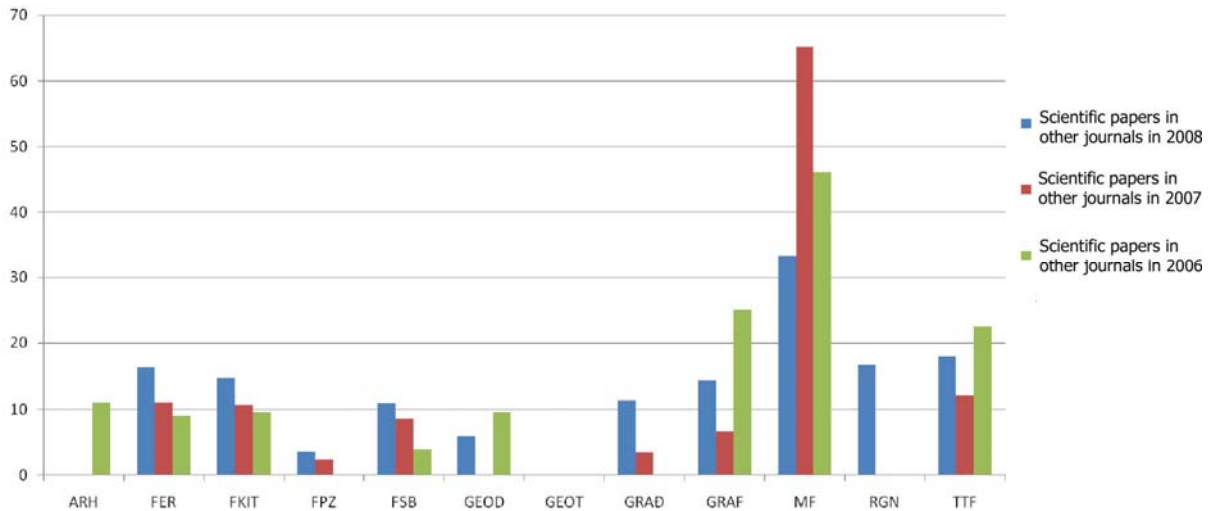


Figure 5c3. Scientific articles published jointly with other scientific institutions in period 2006. – 2008. at University of Zagreb in the field of technical science (origin: Scientific activities at the University of Zagreb – technical field, 14 December 2009., <http://bib.irb.hr>)

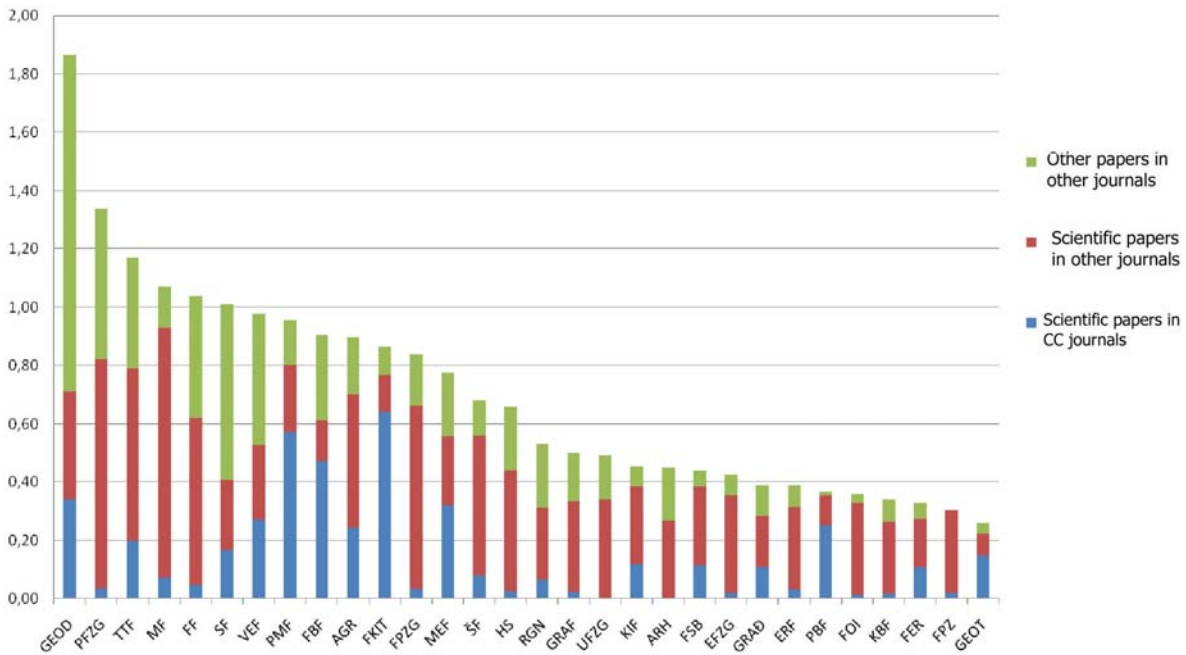


Figure 5c4. Number of published articles per employee for all faculties at the University of Zagreb for 2007. (origin: Scientific activities at the University of Zagreb – 14 December 2009., <http://bib.irb.hr>)

According to the analysis of research activity of the University of Zagreb constituents 2006-2008, the Faculty of Metallurgy is in the first position in the field of technical sciences considering the ratio of scientific papers published in journals referenced in other databases and the number of employees, and also in the first position considering the percentage of scientific papers published in cooperation with foreign authors (figure 3). Furthermore, according to the total number of scientific papers published per employee in 2007, according to the University report, the Faculty of Metallurgy is in the fourth position in comparison to all constituent units of the University of Zagreb, i.e. the third in the field of technical sciences (figure 4). (Source: <http://bib.irb.hr> 2007, June 2009)

By comparing published papers in regards to constituent units of the Faculty of Metallurgy (Department of Process Metallurgy, Department of Physical Metallurgy and Department of Mechanical Metallurgy), it is clear that all three units actively publish in international and domestic journals. In the last five years, Department of Process Metallurgy published the most papers quoted in CC database (26), followed by Department of Physical Metallurgy (16), while Department of Mechanical Metallurgy published the largest number of scientific papers references in other databases (64). (table 5.6, source: WOS and CROSB)

The number of papers published in journals quoted in CC database per employee is: Department of Process Metallurgy – 1.8, Department of Physical Metallurgy – 1.7, and Department of Mechanical Metallurgy – 0.8. The ratio of total number of papers per employee: Department of Process Metallurgy – 11.8, Department of Physical Metallurgy – 5.60, and Department of Mechanical Metallurgy – 28.25. (Note: During 2010, one employee of the Department of Process Metallurgy was retired and one at the Department of Mechanical Metallurgy, in 2009 one employee with the Department of Physical Metallurgy, and in 2008 one employee of the Department of Physical Metallurgy, one employee of the Department of Process

Metallurgy and one employee of the Department of Mechanical Metallurgy.) Average impact factor for journals publishing papers of the Faculty of Metallurgy in the last five years is highest for the Department of Physical Metallurgy.

Considering that the Faculty of Metallurgy is the only higher education institution in the Republic of Croatia in the field of metallurgy, it cannot be compared to any other Croatian institutions in regards to scientific research.

Scientific accomplishments of the Faculty of Metallurgy and its significance in relation to similar regional institutions are obvious upon comparison of the Faculty of Metallurgy with the Technical Faculty in Bor at the University of Belgrade, Faculty of Metallurgy and Materials in Zenica and Naravnoslovnotehniškom fakultetom of the University of Ljubljana. Scientists of the Technical Faculty in Bor published more papers in the last five years (170, source ISI Web of Science), but the ratio of publications per employee is lower in comparison to the Faculty of Metallurgy (Technical Faculty in Bor - 2.20, the Faculty of Metallurgy 3.26). Faculty of Metallurgy and Materials in Zenica has significantly less published papers in comparison with the Faculty of Metallurgy, whereas the Slovenian faculty has more published papers (226 in the past five years, Source: WOS). However, it should be noted that Naravnoslovnotehniškom fakultetom of the University of Ljubljana has a wider scope, as it consists of more former faculties, i.e. Department for materials and metallurgy, Textile department, Geology department, Geotechnology and mining department and Chemical engineering and IT department.

Ten most significant publications published in the last five years by the Faculty of Metallurgy are the following:

Process Metallurgy:

- **Rađenović, Ankica, Malina, Jadranka, Štrkalj, Anita**, Removal of Ni²⁺ from aqueous solution by blast furnace as an adsorbent from aqueous solution by blast sludge as an adsorbent, **Desalination and Water Treatment**, 21, 9, 2010, 286-294.
- **Dolić, Natalija, Markotić, Ante, Unkić, Faruk**, Structural Homogeneity of Direct-Chill Cast Ingots of Aluminium Alloy EN AW-5083, **Metallurgical and Materials Transactions B -Process Metallurgy and Materials Processing Science**, 38, 3, 2007, 491-495.
- **Zovko Brodarac, Zdenka, Mrvar, Primož, Medved, Jožef**, Temperature interval determination for the performing local squeezing casting process on the AlSi10Mg alloy castings, **Kovové Materialy**, 47, 3, 2009, 209-214.
- **Malina, Jadranka, Vručinić, Goran, Malina, Marijan**, Evaluation of Welded TMCP Steel for Resistance to HIC and SSC, **Welding in the World**, 51, 2007, Special Issues, 537-546.

Physical Metallurgy:

- **Matković Tanja, Slokar Ljerka, Matković Prošper**, Structure and properties of biomedical Co-Cr-Ti alloys, **Journal of Alloys and Compounds**, 407, 2006, 294-298.
- **Kožuh Stjepan, Gojić Mirko, Kosec Ladislav**, Mechanical properties and microstructure of austenitic stainless steel after welding and post-weld heat treatment, **Kovové Materialy** 47, 4, 2009, 253-262.
- **Gojić, Mirko, Kožuh Stjepan, Kosec, Borut**, SEM and EDX analysis of continuous casting of steel, **Acta Metallurgica Slovaca**, 16, 1, 2010, 235-237.

Mechanical Metallurgy:

- **Lazić, L., Borovkin V., Varga, A., Kizek, J.**, Hot Rolling Mills Opportunities of Carbon Dioxide Emission Reduction, **Acta Metallurgica Slovaca**, 15, 1, 2009, 159-167.
- **S. Rešković, R. Križanić, F. Vodopivec**, Numerical design of hot-stretch reducing process for welded tubes, **Materiali in tehnologije** 44, 5, 2010, 243-250.
- **Lazić, Ladislav, Jelić, P., Črnko, J., Borovkin, V.**, Fuel Economy through Improving the Furnace Temperature Regime, **Acta Mechanica Slovaca**, 11, 4-D, 2007, 103-107.

5d)

In case other types of publications are relevant to your field, name up to ten most important publications. Comment on criteria for selection.

Considering the field of metallurgy is covered by a relatively small number of journals referenced in CC database, Faculty of Metallurgy scientists publish a significant number of papers in journals referenced in other databases. Among the most significant journals published and issues by relevant higher education institution and metallurgy associations are:

- Acta Metallurgica Slovaca
- Journal of Mining and Metallurgy – Section B
- RMZ – Materials and Geoenvironment
- Metallurgicheskaya teplotehnika
- Journal of Achievements in Materials and Manufacturing Engineering
- Materials and Technology
- Ljevarstvo
- Acta Stomatologica Croatica
- MP Materialprüfung Materials Testing
- Livarski vestnik

A significant number of papers (214) was also published in the *Proceeding from the International Foundrymen Conference*, of great importance to the Faculty of Metallurgy, considering it is one of only three domestic publications in the field of metallurgy, specialization casting and is published by the Faculty of Metallurgy.

5e)

Name the criteria of scientific productivity the mentors of doctoral dissertations in your PhD studies must satisfy and compare them to the same at similar higher education institutions in the country and abroad.

Mentors of doctoral dissertations at the Faculty of Metallurgy must satisfy the conditions prescribed by the Regulations on PhD studies of the University of Zagreb (www.unizg.hr) and conditions of the Regulations on PhD studies in metallurgy (www.simet.hr). Mentors of doctoral dissertations are chosen among teachers with scientific-educational title of at least associate professor and are obliged to advise and monitor students from the very beginning of studies and help them when choosing courses at postgraduate studies. The Commission for teaching proposes mentors of doctoral dissertations to the Faculty Council in line with the scientific preferences of the student. With the purpose of assuring doctoral dissertation quality and interdisciplinary research, the Faculty of Metallurgy encourages co-mentorship for doctoral dissertation, where the co-mentor may be a scientist from the Republic of Croatia or abroad.

In 2010, at the Faculty of Metallurgy there was one PhD viva with co-mentorship of one professor of the Faculty of Metallurgy and professor of Naravnoslovnotehniška fakulteta at the University of Ljubljana. Furthermore, in 2009 there was one PhD viva with co-mentorship of one professor of the Faculty of Metallurgy and Naravnoslovnotehniške fakultete.

From 2006, under the mentorship of five Faculty of Metallurgy professors, there have been six successful PhD vives. The productivity of the five mentors can be seen also in the publication of total 131 scientific papers in the last five years, of which 82 with cooperation from PhD candidates.

Formal conditions for doctoral dissertations mentorship are in most cases not significantly different from conditions for doctoral dissertations mentorship at similar institutions abroad; however there are notable differences compared to certain universities, regarding conditions for awarding academic titles.

The Faculty of Metallurgy conducts constant quality improvements of the PhD studies, as well as the quality of doctoral dissertations, as expressed in Development Strategy of the Faculty of Metallurgy 20011-2016, as well as quality assurance system (Regulations on quality assurance and improvement at the Faculty of Metallurgy, Manual for quality assurance and improvement at the Faculty of Metallurgy). Through the Development Strategy, the Faculty has set guidelines for systematic monitoring of scientific research, thus also competences of mentors and doctoral dissertations themselves by monitoring the number and quality of papers published in international and domestic journals (total number of published papers and papers from scientific research within the framework of doctoral dissertations), monitoring and encouraging publishing in journals with a large impact factor, and monitoring h-factor. Furthermore, mobility and training of teachers is highly encouraged, which will surely contribute to mentorships of higher quality and knowledge transfer to young researchers.

Moreover, with the objective of systematic monitoring of mentorships, and pursuant to University of Zagreb guidelines, the Faculty of Metallurgy executes analyses of the number of enrolled candidates and those who successfully complete PhD studies, as well as analyses of pass-and-fail ratio and duration of studying.

5f)

Comment on your institution's policy on the scientific development of young researchers.

The Faculty of Metallurgy supports and enables the scientific development of young researchers, as expressed in Development Strategy of the Faculty of Metallurgy 20011-2016. The scientific development of young researchers is supported at undergraduate and graduate levels by encouraging student to participate at 'Technology Games', competition of technology students, with their papers, as well as to apply works for Rector's Award of the University of Zagreb awarding the best student paper. Furthermore, at writing final papers and dissertations, students are involved in conducting experiments and research at the Faculty of Metallurgy projects, through topics of final papers and dissertations. At the very beginning of the postgraduate doctoral studies, the mentor is intensely involved in assisting the PhD candidate in the teaching process, course options and scientific activities and research. By transferring know-how on research methods, approaches to scientific research, planning of research activities, mentors assist increasing the level of young researchers' scientific and research competencies.

5g)

Mention the number of scientific papers as results of international cooperation of your teachers and associates, with foreign scientists and artists as co-authors. Compare the results with other institutions' practices.

The Faculty of Metallurgy has agreements on scientific and teaching cooperation with five international institutions: Inštitut za kovinske materijale in tehnologije Ljubljana, Sveučilište u Zenici Fakultet za metalurgiju i materijale, Sveučilište u Mariboru Fakulteta za strojništvo, Metalurški fakultet Tehničko sveučilište Košice and Nacionalna metalurška akademija Dnjepropetrovsk from Ukraine. The Faculty of Metallurgy also has agreements on cooperation with international faculties:

Sveučilište Crne Gore Metalurško-tehnološki fakultet Podgorica, Sveučilište u Ljubljani Naravoslovnotehniška fakulteta and Sveučilište u Beogradu Tehnički fakultet Bor (<http://www.simet.unizg.hr/znanost/meduinstitucijska-i-medunarodna-suradnja>).

Along with protocols and agreements on cooperation, the Faculty of Metallurgy has achieved bilateral and multilateral cooperation with international institutions. As a result of intense scientific and research cooperation in the last five years, 158 scientific papers were published in with international scientists as co-authors, of which 20 joint papers in journals referenced in Current Contents database, 74 papers in journals referenced in other databases, 46 papers published in proceedings from domestic and international conferences and 2 other scientific papers (Source:CROSB). In comparison to total number of published scientific papers 2006-2010, 48.46 % are papers published on the basis of Faculty of Metallurgy employees' international cooperation. According to the ISI Web of Science database, 41 papers were published with international scientist as co-authors in journals referenced in this database. The most significant number of papers were published in cooperation with scientists of Tehničkog sveučilišta u Košicama , result of common scientific research within the framework of protocol consisting of six research topics: *Hydrometallurgical preparation and refinement of inorganic materials, Regeneration of core and moulding sands, The role of microstructure in H-diffusion through HSLA-steels:IF, DP, TRIP, Energetic efficiency of metallurgical processes in connection with ecological aspects of fuel combustion and Development of advanced metallic materials (Ti based and shape memory alloys).*

Result analysis by constituent units of the Faculty in the last five years indicates that all three units publish papers with international associates as co-authors.

In comparison to other similar institution in the region, the Faculty of Metallurgy published more papers with international associates as co-authors in the last five years than Sveučilište u Zenici Fakultet za metalurgiju i materijale (2 papers) (source: WOS). Sveučilište u Beogradu Tehnički fakultet Bor published 55 papers with international associates as co-authors in the last 5 years, which is slightly more than the Faculty of Metallurgy. The ratio of published papers with international associates as co-authors per employee for the Faculty of Metallurgy is 1.51, while for Tehnički fakultet Bor it is 0.71.

5h)

State PhD candidates' opinions on the availability of doctoral dissertation mentors, i.e. time dedicated to them for introduction to research methods.

Postgraduate doctoral study in metallurgy is based on the unity of research and teaching as proscribed by the Bologna Process. The study was approved by University of Zagreb Senate decree as of 2004.

From academic year 2005/2006 to 2010/2011, 15 candidates enrolled in the Postgraduate doctoral study in metallurgy at the Faculty of Metallurgy (three from the Faculty of Metallurgy and 12 from the industry. Only one PhD candidate (employed as research trainee at the Faculty of Metallurgy) had a viva within doctoral studies according to Bologna Process. The rest of the PhD candidates of the Faculty of Metallurgy are still in the stage of passing obligatory and elective courses at the doctoral study. Mentors systematically present methods of scientific research and cooperate successfully on realization of set topics for PhD dissertations. Furthermore, PhD candidate with the title of research trainees actively cooperate with mentors in teaching at undergraduate and graduate studies of metallurgy. Work-

related obligations are still a major issue for candidates employed in the industry, which is why their PhD studies are delayed.

From 2006 to 2011, 6 PhD candidates completed doctoral studies at the Faculty of Metallurgy. They were all research trainees who completed doctoral studies in due time. They were awarded the scientific-educational title of assistant professor and are still employed by the Faculty of Metallurgy. They emphasize positive experiences related to cooperation with mentors while writing doctoral dissertations, which is still ongoing. The mentors introduced them successfully to a significant number of research methods, which they still use in research and teaching. In cooperation with mentors or independently they have published a number of scientific papers in domestic or international journals and at domestic or international conferences.

One PhD candidate, also employed as research trainee at the Faculty of Metallurgy, did not complete doctoral studies in due time. The cause of that was disregard for mentor's remarks.

In the period 2006-2011, six teachers at the Faculty of Metallurgy were PhD mentors. It is necessary to additionally motivate prospective mentors to get involved more actively into mentorships and mentorship workshops organized by the University of Zagreb.

5i)

Describe the contents and character of up to 10 most significant scientific research projects of your higher education institution active in the last five years (figures in table 5.2). State your opinion on the quality and results.

The Ministry of Science, Education and Sports approved six scientific projects at the Faculty of Metallurgy with funding from 2007. Four of them are incorporated into the program 'Metal materials – properties, processing and energy consumption', one is independent and one is within the project "Advanced procedures and simulations in forming via deformations of new materials" with the Faculty of Mechanical Engineering and Naval Architecture of the University of Zagreb. The latter is not active at the Faculty of Metallurgy from 2010 due to changes in project leader because the professor at the Faculty of Metallurgy who headed the project was retired.

Research within scientific projects includes applied research directed at development of new materials, products and technologies in line with basic activities of the Faculty of Metallurgy. Priority topics are correlated with strategic research directions in the Republic of Croatia in terms of developing advanced materials, environment protection and energy efficiency research.

29 scientists of the Faculty of Metallurgy, 35 international associates and 11 associates from other Croatian institutions were involved in research projects at the time when they were registered (2006).

Program „Metal Materials – Properties, Processing and Energy Consumption“

Leader Professor Mirko Gojić

Active projects within the program:

- The Effect of High-Temperature Processes on Properties of High-Alloyed Steels
Leader Professor Mirko Gojić
Project 124-1241565-154

- Energetic Efficiency and Product Quality in Metal Plastic Deformation
Leader Professor Ladislav Lazić
Project 124-1241565-1524
- Environment Assisted Degradation of Metals and Adsorption on Waste C-
Materials
Leader Professor Jadranka Malina
Project 124-1241565-1524
- Structure, Properties and Separation of Metallic Materials
Leader Professor Tanja Matković
Project 124-1241565-1537

Independent scientific project:

- Metal Casting Solidification
Leader Professor Faruk Unkić
Project 124-0000000-1503

Scientific project within the program of the University of Zagreb Faculty of mechanical engineering and naval architecture

active at the Faculty of Metallurgy in the period of 2007 - 2010

- ***Processing by Deforming and Properties of New Metallic Materials***
Leader Professor Ilija Mamuzić (now Professor Aleksandar Povrzanović)
Project 124-1201787-1491

Abstracts of the scientific projects:

The Effect of High-Temperature Processes on Properties of High-Alloyed Steels

Leader Professor Mirko Gojić

Owing to their wide application austenitic and duplex stainless steels play an increasingly important role in numerous fields. Their properties largely depend on high-temperature processes (heat treatment and/or welding). Irregular heat treatment and/or long-time service of austenitic steels at elevated temperatures tend to result in precipitation of carbides, nitrides and intermetallic phases, worsening of mechanical properties (especially in respect to toughness), and weakening of resistance to creep and corrosion. The proposed project is partly a continuation of earlier science research. The idea for the project came from previous experience and from the literature. Despite numerous investigations the creep and precipitation phenomena have not been sufficiently well explained. In some cases explanations are contradictory. The project is focussed on the study of the effect of high-temperature processes (annealing, welding) on creep resistance, and on the mechanical, microstructural and corrosion properties of austenitic stainless steels (AISI 304, 304L, 316, 316L, 321, 347) and duplex steel (SAF 2205 or UNS 31803). The project is based on experimental investigations involving annealing of austenitic and duplex steels (at 500–900 and 600–1000 °C, respectively) after welding as well as testing of properties, and identification of precipitates and intermetallic phases. Precipitation of carbides, nitrides and intermetallic phases will be examined using a number of complementary methods (OM, SEM, TEM, EDS, XRD, etc.). Their effect on creep resistance, mechanical properties (especially hardness and Charpy impact energy), and resistance to corrosion (stress, intergranular and pitting corrosion) will be analysed. Fracture mechanisms and places of initiation of corrosion failures (breaking of passive film) will be determined by electrochemical (DC and AC EIS techniques) and surface analysis methods (AES, XPS). Results will be checked in real conditions, i.e. during industrial application of the treated steels. They are expected to be beneficial, especially to numerous industrial plants where these steels are used, in the Republic of Croatia and elsewhere. It is also

expected that the optimum welding and heat treatment (annealing) parameters will be established and that the quality of finished products will improve. Hopefully, the results of the project will make a contribution to science in the field of heat treatment and welding of metallic materials.

Energetic Efficiency and Product Quality in Metal Plastic Deformation Leader Professor Ladislav Lazić

Current manufacture of seamless and welded tubes, profiles and sheets in the Republic of Croatia, with the present-day technology, cannot guarantee quality and profitability or meet the environmental demands concerning pollutant emissions. In order to improve this situation research will be conducted in three principal areas: reheating furnaces, refractory materials and hot rolling (tubes, profiles, sheets). Investigations concerning the reheating furnace aim at developing mathematical models of the heating process in order to optimize heating parameters, at examining the possibility of reburning and recirculation of flue-gases in order to reduce NO_x emissions, and at examining the efficiency of indirect roof heating by means of a selective-grey mathematical model of heat transfer of own design and a computational fluid dynamic code. The results from the project are expected for the most part to be applied to modernizing the existing furnaces. In the area of refractory materials it is important to improve economic efficiency of rolling mill furnaces by optimizing refractory materials in respect to cost and quality. The goal is to devise a technological procedure for the production of forsterite refractory material from the domestic mineral raw material serpentinite as well as to select rolling mill furnaces for its application. By hydrometallurgical treatment of this mineral raw material valuable pure inorganic materials, magnesium oxide and silica, will be prepared. Investigations in the area of hot rolling have the following objectives: to decrease specific energy consumption and at the same time to achieve equally good or better properties of the hot-rolled product, to enhance material exploitation by increasing the output, to explore steel deformation properties (especially of the new type of alloyed steel for specific use), and those of aluminium alloys, and to produce hot-rolled products with better structural and mechanical properties. From the point of view of their scientific value the results of investigations will be checked through graduation theses and doctoral dissertations, in papers published in prestigious foreign and Croatian journals, and in industry. The importance of the proposed research lies, on the one hand, in the formation of new data bases and contribution to the scientific development of this particular area, and on the other, in improved energy efficiency and product quality accompanied by diminished environmental pollution.

Environment Assisted Degradation of Metals and Adsorption on Waste C-Materials Leader Professor Jadranka Malina

Environmentally assisted degradation of metals is an unavoidable part of every single producing process in which metal materials release Me-ions due to interaction with aggressive working medium, and what's more, the unexpected failures with catastrophic consequences can be the result of high residual- and working/outer stresses. Thus, within the frame of this project, the investigations will be conducted with the emphasize on the technical material/working media interphase, with the aim to recognize the metallurgical factors which could increase the resistance to stress corrosion cracking and to increase the life time of metallic components built in the process equipment. Special concerns will be put on the degradation phenomena known as hydrogen embrittlement (HE) and sulfide stress corrosion cracking (SSCC) which preferably occur in oil-, petrochemical-, and thermoenergetic- industry, as a result of the contact between the construction material and wet hydrogen sulfide environment. With the aid of microstructure modification methods, the new qualities of metallic and carbon materials with optimized mechanical and corrosion properties are expected to be designed. Consistent study of the behaviour of such modified materials in aggressive environments should satisfy the needs of producers as well as the users of metal- based products (Oil Country Tubular Goods-OCTG steels, TMP and MP -multiphase steels for pressure wessels and boilers, nodular iron, vermicular iron, and implant alloys) and carbon-based products (electrodes, powders) following the criteria of economical efficiency with the regard to human health and environment protection issues. Namely, released Me-ions can significantly pollute the environment, particularly if they are toxic or cancerogeneous. In order to decrease the environment pollution with Me-ions, one of the idea in this project is to use waste carbon-based materials from steel production to remove the heavy metals from the environment.

Structure, Properties and Separation of Metallic Materials

Leader Professor Tanja Matković

The proposed project under title "Structure, properties and separation of metallic materials" is continuation of previous investigation in project 0124003, it is interdisciplinary (materials science, hydrometallurgy, environment protection) and belongs to the priority investigations. In the proposed project the multicomponent alloys of selected properties for biomedical application will be investigated. Development of biomedical alloys with combination of high strength, excellent corrosion resistance and fatigue and good biocompatibility is of vital interest, because they have a function to replace or repair a body feature, tissue, organ or function. In addition to the traditional cobalt and chromium based alloys titanium and its alloys are mostly used owing to their relatively high strength to weight ratio, low E- modulus, good corrosion properties and excellent biocompatibility. As the well known titanium alloy Ti-6Al-4V lost on attraction because of vanadium and aluminum toxicity, the new biomedical Ti- alloys have been studied intensively. The aim of this study is to develop a new Ti- alloys with the β - phase microstructure, lower E- modulus and better formability by addition of different alloying elements (for example Nb, Ta, Mo, Zr). On the laboratory prepared samples the microstructure, phase composition and fundamental mechanical and corrosion properties will be examined. This study is expected to contribute to the theoretical knowledge of a complex relationship between the microstructure of material and their properties and to result with a new metallic materials for biomedical application. The proposed research also aims at developing new procedures for the separation of cobalt and nickel (as important components of investigated alloys) with commercial organophosphorous extractants. Beside the investigation of new extractants application the phenomenon of synergism and co-extraction and the procedure of recycling valuable components from low-grade or used materials will be investigated.

Metal Casting Solidification

Leader Professor Faruk Unkić

Recent market developments, as well as the technical and economical goal of "production without the defects" necessitate better understanding of the castings manufacturing process. The solidification process and the microstructure development are key events in casting production. During these processes all of significant parameters which directly precede to this event were manifested, and solidification alone influences in great deal not only on the as-cast structure and through it the mechanical and physical properties but also the soundness of casting and further steps in castings treatment. Pattern and morphology of solidification affect the soundness of the castings in relation to feeding and appearance of micro- and macro shrinkage cavity, porous shrunken structure, hot tears, cold crack, micro- and macro segregations, dimensional inconsistency, etc. On the base of measuring and mathematical and statistical analysis of results it is expected to obtain correlations between significant variables of melting and solidification processes and resulting microstructure, mechanical and service properties of castings. Comparison of results and application of appropriate models will enable optimization of certain stages of melting process and melt treatment, as well as the control of the solidification process. Systematic examination of relations between microstructure and properties of multi-component alloys, based on Fe and Al, should allow improvement of performances of the casting components, as well as the adopting new qualities and products. During investigation modern analytical methods for determining chemical composition, gas content, inclusions, etc. will be used. Microstructural and mechanical examinations will be performed as well as the control of solidification via cooling curves analysis and determinations of the undercooling degree. Some service properties like wear resistance, heat fatigue, impact resistance, corrosion, etc. will be analyzed. Applications of these investigations are directed to design and adoption new products, to selection of materials for the complex strained cast components, to the rapid prototyping, etc. Implementation of the researches will provide for the deepening and widening of scientific knowledge about foundry engineering, as well as the transfer of obtained knowledge in industrial practice.

Processing by Deforming and Properties of New Metallic Materials

Leader Professor Ilija Mamuzić (now Professor Aleksandar Povrzanović)

(active at the Faculty of Metallurgy in the period of 2007 – 2010)

In connection to forming by deformation, all round the world intensive research into new metallic materials are carried out: - with ultra fine grain structure in nano (grain cross-section $d < 100$ nm) and submicroscopic size ($100 < d < 1000$ nm), with special mechanical and physical properties. This can be achieved by severe plastic deformation SPD – optimising thermomechanical processes TRIP (transformation induced plasticity) in steel quality: advance high strength steels – AHSS and ultra high strength steels – UHSS – optimising properties and deformability of high alloyed steels 22Ni Mo Cr 37, X20

Cr Mo V121 etc. – researches into new Al alloys of the kind AL-Li-X and metallic composites, especially microlayered materials. Simulation methods and comprehensive experiments in laboratory and industrial conditions are the basis for these researches. Our researches in collaboration with 17 prestigious scientists from 10 countries start with application of physical and mathematical modelling and computer simulation for these materials. Secondly, application of laboratory bending methods, pressing, torsion on torsion plastometer, determination of mechanical properties on universal testing machines, Gleeble tensile-pressure testing, comprehensive metallographical testing for determination of properties and deformation characteristics of these materials. Checking in practice. The results are expected that will be contributions to the science (models and algorithms of laboratory researches into forming by deformation realized by application of optimal computer and physical simulation etc.) In practice, an application and optimisation of technological parameters formed by deformation of these materials intended to power supply metallurgy, mechanical engineering, electrical engineering, etc. The results of these researches will be published in prestigious foreign and domestic journals where it will be possible to check them (minim. 15 articles per year) and international symposiums (minim. 10 published conference papers). It will be able to check them also in practice, specifically in the plants of Croatian metallurgy, but as well in the countries whose scientists participate in this project. The importance of research is in establishing of new databases and contributing to the science, defining laboratory and technological deformation conditions of new metallic material, and for research follows to acquire higher academic titles doctor's degrees).

Research results of active projects at the Faculty of Metallurgy 2007-2010 were given in 5c. Considering the Ministry of Science, Education and Sports funding for the realization of science project, we believe that the results are very good. During 2011, 49 scientific papers were published, of which 6 in CC journals.

Quality of scientific and research activities at the Faculty of Metallurgy is further confirmed by 19 undergraduate dissertations, 25 final dissertations, five dissertations at the new study program, five masters' theses and six doctoral dissertation 2007-2011 related to research topics at the Faculty of Metallurgy projects.

The last assessment of projects funded by the Ministry of Science, Education and Sports (from 2010), all active projects of the Faculty of Metallurgy received a positive evaluation.

Apart from the Ministry of Science, Education and Sports science projects, in the last five years the Faculty of Metallurgy participated in bilateral Croatian-Slovenian program of cooperation in science and technology via the project 'Development of new metal materials' headed by Mirko Gojić, PhD, and also in the EUREKA program with the project „*Rapidly Solidified Shape Memory Alloys*“, E! 3704 RSMA, also headed by Mirko Gojić, PhD. The EUREKA project was emphasized as one of the most successful of all EUREKA projects in which Croatian higher education institutions participated (www.simet.unizg.hr/znanost; www.eurekanetwork.org).

Furthermore, science research results are regularly presented at domestic and international science conferences, among others International Foundrymen Conference organized by the Faculty of Metallurgy since 1999 (www.simet.hr/~foundry/). The initiator and chair of the Organization committee is Faruk Unkić, PhD.

Even though international cooperation at the Faculty of Metallurgy is highly active, additional activities and more international projects, as well as participation in EU projects would surely have a positive impact and raise the quality level of scientific research and publication of scientific papers.

5j)

Name your own journals and describe their character, composition of the editorial team, selection procedure, possible impact factor, etc.

The Faculty of Metallurgy does not have its own publication. However, many of the teachers of the Faculty of Metallurgy actively participate (as editors or members of editorial teams) in the operations of domestic and international journals (Ljevarstvo, Livarski vestnik, The Holistic Approach to Environment etc.).

5k)

Describe how research contributes to the entire industrial activity, i.e. teaching and intellectual and technological contribution to the society. Describe the contents and character of specialized projects of the higher education institution in the last five years (figures in table 5.2). State your opinion on the quality and results.

Scientific cooperation:

The basic task of the Faculty of Metallurgy is the production of new knowledge, education of academics in the field of technical science – metallurgy, and production and application of innovative technical solutions with the objective of social and economic development of the Republic of Croatia, especially in the metal processing industry. The excellence of scientific research is a key factor in realization of that task and the foundation of a quality teaching process at the Faculty. Research conducted within scientific projects at the Faculty of Metallurgy contribute to the growth of fundamental, applied and developmental know-how in the field of metallurgy and related fields. This also contributes to development of teaching competencies of the Faculty of Metallurgy employees and more quality knowledge and skills transfer at undergraduate, graduate and postgraduate study in metallurgy. Quality scientific research and international reputation of the Faculty of Metallurgy, as well as publications in cooperation with international scientists also raise the level of mentorships and the education of PhD candidates. Experience acquired through scientific and research activities also contributes to high quality of published books, textbooks, workbooks, university and internal teaching materials and finally, the quality of the teaching process. In the last five years, the Faculty of Metallurgy published 6 university textbooks, one workbook and four internal teaching materials. Furthermore, exchange of latest scientific knowledge through the International Foundrymen Conference and other scientific and specialized organizations enabled the Faculty of Metallurgy to achieve the position of a central institution gathering scientists in research, businesses and representatives of domestic and international associations of metallurgy experts.

Thus, the Faculty of Metallurgy had five scientific panels in which scientists presented their research:

1. Nikola Mrvac, PhD

professor at the Faculty of Graphic Arts University of Zagreb

Topic: *New approach to higher education system* (13th of November 2007)

2. Muhamed Sućeska, PhD

science advisor at the Naval Architecture Institute Zagreb

Topic: *Peaceful use of explosives* (13th of December 2007)

3. Milan Kljajin, PhD

professor at the Faculty of Mechanical Engineering J.J.Strossmayer University Osijek
Topic: *Management of electric and electronic waste* (17th of January 2008)

4. Aleksandar Durman, PhD

professor at the Faculty of Philosophy University in Zagreb
Topic: *European early metallurgy – the real beginning* (27th of March 2008)

5. Štefan Nižník, PhD

professor at the Faculty of Metallurgy of the Technical University in Košice, Slovakia
Topic: *Enamel* (25th and 26th of November 2008)

Result of ongoing scientific activities and research at the Faculty of Metallurgy, 12 patents were applied for and a series of innovative solutions for the industry. In the last five years, the Faculty of Metallurgy applied one patent: (*D. Hršak, V. Bermanec, L. Lazić, G. Sučik, Procedure of obtaining magnesium oxide and silicon oxide from ultrabasic mineral raw material, The Republic of Croatia, State bureau for intellectual property, patent number: PK20080589*).

Since all research at the Faculty of Metallurgy is interdisciplinary in character, the projects are the result of cooperation among experts not only from technical sciences, i.e. metallurgy but also science in general. The Faculty of Metallurgy accomplished this due to employment of young experts, PhDs in the last five years in metallurgy, physics, mathematics and chemical engineering. This brought more quality and new research and teaching impulses, enabling the expansion of the institution's science activities, new approaches in teaching and stronger intellectual capacities of the institution.

Expert cooperation:

From the very beginning of teaching at the Faculty of Metallurgy, there were expert activities including elaboration, projects, expert opinions and solving specific problems of metallurgy production. The Faculty of Metallurgy cooperated extensively with numerous businesses: CMC Sisak d.o.o., Tvornica lakih metala Šibenik, Željezara Split, INA-Rafinerija nafte Sisak, ZIK Zagreb, etc. In the past 10 years, cooperation with casting and foundry businesses was intensified: Felis Produkti d.o.o. Sisak, Metalska industrija Varaždin, Dalit CT d.o.o. Daruvar, Ferro-Preis Čakovec, Lipovica Popovača, Plamen International Požega, Ljevaonica Duga Resa, etc. The Faculty of Metallurgy had agreements on business cooperation with: CMC Sisak d.o.o., Dalit CT d.o.o. Daruvar, Felis Produkti d.o.o. Sisak, HEP-Proizvodnja d.o.o. – Pogon Termoelektrana Sisak, HS Produkt d.o.o. Karlovac, Jadranski naftovod d.d. Zagreb, Lipovica d.o.o. Popovača, TIM – Tvornica istegnutih metala d.o.o. Topusko and RS metali d.d. Sveta Nedjelja, as well as protocols on business cooperation with foundries and casting plants: MIV Varaždin, Plamen International, Ljevaonica Bjelovar, Ljevaonica Duga Resa, RS Metali and Dalit CT.

In the last five years, the Faculty of Metallurgy concluded two technology projects under the Ministry of Science, Education and Sports.

- Project TP-02-124-04
Improved procedure for casting blocs from aluminium alloys
Project leader: Ante Markotić, PhD, full professor
Project duration: 2003 - 2007

This project was conducted in cooperation with TLM d.d. Šibenik. Upon monitoring and controlling the technology process of melting, especially semi-continuous casting of aluminium alloy, correlation was confirmed between process parameters with resulting structural, mechanical and processing properties of casted blocks in terms of determining causal connections and controlled process management.

The production of cast blocs is the initial and the most important stage in technology process of production from aluminium alloys, as all errors in primary casting materials are reflected on multiple ways in the quality of end product.

Based on gathered data on the foundation of basic technology parameters, and experimentally determined results of chemical, mechanical, macro and micro analyses of casting blocs via statistical analysis of data, algorithms and models were developed with the objective of optimizing process variables. With the objective of repetition of production, as well as property assessment process control, a concept of artificial neuron networks was used, recently shown to be a very useful contemporary tool in assessment and identification of highly non-linear systems. This project determined the conditions for timely and due decision-making in the industry and production rationalizations in terms of reproducibility of properties and raising quality levels.

- Project TP-07/0124-02
Producing and functionality testing for rotating casing engine
Project leader: Faruk Unkić, PhD, professor
Project duration: 2006 - 2008

Internal combustion engine with rotating casing has been executed on the foundation of patent P950592A issued by the National bureau for intellectual property of the Republic of Croatia. This enables a four-stroke engine process without the valve for change in work medium. The change is conducted through slits in the sleeping part of the engine where the casing with cylinders is located. The shaft rotates simultaneously with the casing, but in the opposite direction. This enables two full processes of four-stroke engine in one round of the casing. The advantage of this engine is the fact that it enables the application of standard engine parts, keeping a significant number of parts available at specialized producers. In comparison to standard models, this one has less cylinders and smaller total mass and dimensions. This model enables a compact engine adequate for automobiles with limited engine space.

Pursuant to ideas and drafts of the Proposing party, documentation has been made and technology elaborated on, models produced and engine segments successfully cast in thermally firm aluminium alloy AlSi12Mg. Thus, in line with drafts, respective engine parts have been made (cylinder casing, shaft, cog wheel, gasket, oil pump parts, etc.). Engine prototype was successfully modelled and tested by the Faculty of Mechanical Engineering and Naval Architecture. The engine operated for 60 hours, 4 without interruptions, at 1400-2200 o/min. The prototype was not tested

for engine performance, as in testing stage there occurred damages to respective engine parts.

Based on the observed, it is concluded that the project objectives have been accomplished: engine prototype was produced, its functionality and faults determined which are to be corrected in the following version.

Some of the expert opinions for industry and businesses made in the last five years are as follows:

- Testing of seamless pipes with internal surface faults $\varnothing 8'' \times 6,35$ mm of steel quality Gr-B, Sisak seamless pipe mill
- Testing of seamless pipe microstructure $\varnothing 323,9 \times 7,1$ mm of steel quality X-52, Sisak seamless pipe mill
- Hydrogen fragility of oil equipment steel, STSI d.o.o., Zagreb
- Testing of shape and size of graphite, ferrite and perlite share in metal base and determining nodule/mm² in samples of nodular cast, Faculty of Mechanical Engineering and Naval Architecture
- Testing of micro and macro structure of aluminium bloc quality EN AB-ALSi12Cu1(Fe)Al-131-D, ZIK d.o.o., Sisak
- Fault analysis on nodular cast, Petrokemija d.d., Kutina
- Metallographic analysis of steel casts, Felis Produkti d.o.o., Sisak
- Quartz sand as absorbant in water processing INA d.d., Rafinerija nafte Sisak
- Cavitation-erosion corrosion of steel pipes in sugar juice steamer, Šećerana Virovitica
- Corrosion of steel pipes in thermal exchanger, CMC Sisak d.o.o.
- Testing of SEM and EDAX samples via continually cast semi-product analysis, CMC Sisak d.o.o.
- Testing of cylinder casing sheets from grey cast, 3.maj-Motori i dizalice d.d., Rijeka
- Testing samples of steel quality 4732, , HS Produkt d.o.o., Karlovac

As of the 7th of March 2003, the Faculty of Metallurgy has the approval of Ministry of Environment Protection of the Republic of Croatia to conduct expert monitoring of air emissions. Thus, the Faculty of Metallurgy has been authorized to measure pollutant emissions from stationary sources pursuant to ordination from the Official Gazette 140/97. The Faculty of Metallurgy also has the approval of Ministry of Environment Protection of the Republic of Croatia to conduct monitoring expert elaborations in the field of environment protection.

5l)

Elaborate on impact of your projects' results on the development of the domestic economy, service sector and state administration.

Expert project realized at the Faculty of Metallurgy in the last five years have been elaborated on in detail in 5k). The Faculty of Metallurgy in Sisak as a higher education institution from its foundation operates in the town of Sisak, Sisak-Moslavina County as a nucleus of higher education in the local and regional communities.

In Development Strategy of Sisak-Moslavina County (2011-2013), the Faculty of Metallurgy in Sisak is listed as a developmental requirement for higher education and the need to make it a central regional institution for research and development.

During Croatian accession to the European Union, in the current circumstances of economic and financial crises, the Croatian production and processing industries require processes of market, technology, financial and organizational adaptations in line with new circumstances at the market.

The production and processing industry in Sisak-Moslavina County underwent a transitional period 2005-2010, marked by company restructuring, struggle for survival at the domestic market, and export efforts, modernization investment, new project and products, as well as human resources issues. In the second half of that period (late 2008), global recession and deepening of economic crisis in Croatia had a significantly negative effect on conditions and results of business activities in the county.

Due to lack of economic strategy and expressed process of deindustrialization in Croatia, as well as openness of the market towards imports, the key processing industries (Petrokemija, INA Rafinerija nafte, CMC Sisak, Gavrilović) have survived the difficult transitional period and kept its position in the economy, while remaining economic initiators and symbols of Sisak-Moslavina County.

Crucial business in Sisak-Moslavina County are in the business of metal production.

The largest business in this field is CMC Sisak d.o.o., producer of steel pipes. Following privatization and unsuccessful attempts to revive production by four respective owners, in 2007 it was acquired by the US company Commercial Metals International AG. Investing in reconstruction and construction of the new steel mill, production capacity of 45 000 t of quality steel per year have been accomplished. A part of the steel is processed in the Seamless pipe mill, whereas the rest is sold.

Foundries and casting facilities in Sisak-Moslavina County are in the business of producing steel (Felis produkti d.o.o. Sisak, Bensam d.o.o. Glina) and aluminium moulds (Lipovica d.o.o. Popovača, Almos d.o.o. Kutina). Prior to recession, these were stable companies which developed new products, contributed to exports and invested in new equipment. Crisis caused fewer orders, but positive trends are expected at the end of the observed period due to revival of export markets. The companies adopted a new buyer structure, invested in new equipment and technical standards.

Companies producing finished metal products in Sisak-Moslavina County have been directed towards production rationalization, technology investments, employee training, increasing product quality and productivity, innovations and competitiveness prior to global recession and deepening of economic crisis in Croatia. Recession and deepening of economic crisis slowed down the growth of this economic sector. The companies adopted a new buyer and market structure, invested in new equipment and production programs with the objective of overcoming negative results caused by fewer orders and production reduction.

During the observed period, several small businesses were strengthened, which are competitive in the domestic and export markets due to innovation and quality products.

Long tradition of the Faculty of Metallurgy in Sisak cooperation with local and regional businesses is directed at encouraging business cooperation, technical transfer, knowledge transfer and research commercialization, as well as providing support in terms of international and regional cooperation with the goal of technological development and the development of innovative entrepreneurship.

Through life-long education program at the Faculty of Metallurgy in Sisak, specific know-how is transferred to industrial experts. The Faculty of Metallurgy in

Sisak also participates in training experts through life-long education program by organizing workshops, lectures, seminars, etc. These are organized at the Faculty of Metallurgy in Sisak for the needs of businesses, primarily casting and foundry, such as Simulation of casting processes, Metallographic analysis of iron moulds (2008). Each seminar had 50 to 60 participants from around 20 companies. In 2009, the Faculty of Metallurgy in Sisak held a special training program for CMC Sisak employees in the field of raw iron production, steel casting, plastic processing and the energy industry.

Furthermore, teachers at the Faculty of Metallurgy in Sisak are active in the Croatian bureau form standardization, Technical committees 25 and 503 (moulds and metal materials).

The Faculty of Metallurgy in Sisak is a partner of the Town of Sisak as project manager for project proposal 'Foundation and development of Technology park Sisak and its application to EU funds'.

The general objective of this project is to enable business infrastructure for sustainable development and job openings by encouraging innovative start-ups, skills and know-how, networking of science and business and transfer of new research innovations into SME. This project would ensure a quality business infrastructure and potentials of Sisak Southern industrial zone to attract investment of a higher technology level and contribute to underdeveloped town and county.

The County implemented EU ICPR project (Investment Certification Programme for Regions) and chose key strategic sectors for economic development: metal processing and electronics. The Faculty of Metallurgy was actively involved in drafting Strategic sector study of the Sisak-Moslavina County.

ICPR project develops Croatian potential for attracting FDIs with the primary objective of attracting foreign investors from the chosen sector, i.e. metal processing for the Sisak-Moslavina County.

Metal processing in the Sisak-Moslavina County is known for its tradition and know-how, qualified workforce and capacities, thus representing an interesting investment destination. Although the region is currently insignificant, by attracting foreign investors it would restore its old glory days.

Finally, synergy of the Faculty of Metallurgy activities in cooperation with industrial subjects and local and regional administration is evident.

5m)

Elaborate on the systematic policy of monitoring scope and quality of scientific activities at the higher education institution and define its elements and efficient applications.

The Faculty of Metallurgy adopted systematic policy of monitoring scope and quality of scientific activities in the Development Strategy of the Faculty of Metallurgy 2011-2016, following Regulations on awarding academic titles. The first element obliges each scientist/researcher/teacher to declare their contribution to the scientific status of the institution in an annual report on published papers (for the need of University of Zagreb statistics), and enter them into CROSBI database. The second element concerns mentor reports on research trainees' activities with the list of publications on the project (an annual decision on adoption of report is reached annually at the Faculty Council session). The third element is awarding academic titles, procedure of which is initiated by the Commission for Science and Finances in 5-year cycles.

Furthermore, the quality of scientific activities is monitored via quality assurance system, guidelines of which are defined by regulations and manuals on quality assurance at the Faculty of Metallurgy (2008 and 2011).

Pursuant to strategic decision of the Faculty (2011), with the objective of increasing the number of publications, a yearly analysis and comparison is to be conducted, in regards to previous numbers of publications in domestic and international journals, analysis of journals' impact factor and citing of the publications. Moreover, a 5-year analysis is to be executed, regarding the number of applied and approved domestic and international science projects. Aimed at strengthening international cooperation, there will be regular analysis of contacts and protocols on international cooperation, as well as number of publication with international scientists as co-authors.

There shall be an annual report on scientific and research activities of the Faculty, comprising all of the above and analysis of resources available for research, as well as analysis of equipment.

5n)

Elaborate on award policy for publications in renowned journals (or prominent publishing houses), i.e. support system for publication in journals of significant impact factor.

Support system for publication in journals of significant impact factor, as previously mentioned is a strategic goal of the Faculty of Metallurgy. At the moment, there is no award policy for publications in renowned journals at the Faculty, but this should be revised.

Alongside with teaching and research, the Faculty of Metallurgy encourages publishing activities. In previous periods (1979-1984; 1991-1992), the Faculty of Metallurgy published the journal 'Metalurgija'. Furthermore, the Faculty of Metallurgy participates in funding (with the Ministry of Science, Education and Sports) publication of books, textbooks, workbooks and teaching materials. The Faculty of Metallurgy also published 10 Proceedings of International Foundrymen Conference.

5o)

Elaborate on concerns regarding ethical research and the implementation of European and global employment standards (e.g. The European Charter for Researchers).

Ethical research at the Faculty of Metallurgy is under the provisions of the Ethical Code of the University of Zagreb as defined in 1e). When proposing and applying research projects of the Faculty of Metallurgy employees, the members of the Ethical Commission of the Faculty of Metallurgy are required to state an opinion on breaches of ethical principles and academic behaviour, pursuant to University of Zagreb Statute, the Faculty of Metallurgy Statute and the Ethical Code of the University of Zagreb.

5p)

Define as to your level of satisfaction with the current state of affairs and propose possible improvements.

There are five research projects at the Faculty of Metallurgy funded by the Ministry of Science, Education and Sports, which is satisfactory considering the number of employees. International cooperation is intense, as evident from the number of publications in cooperation with international scientists; however the number of international projects is relatively low. It is necessary to motivate Faculty of Metallurgy scientists to involvement in international projects, especially EU projects. The Faculty of Metallurgy capacities have been significantly increased in the last five

years due to new equipment purchased, partially funded by the Faculty funds. Despite, it is vital to encourage applying for Ministry of Science, Education and Sports projects and EU funds, which would enable financial means required for improvements to existing facilities. With the objective of promoting quality of research, the Faculty should devise a reward system regarding the number of publications and impact factor of journals. The Faculty achieves significant activities in cooperation with businesses, especially in the field of casting, which is to be continued and intensified. It is necessary to continue organizing seminars with the objective of know-how transfer in regards to latest accomplishments in metallurgy.

Table 5.1. Mentors
(Mentors for scientific field)

Name of doctoral study	Number of mentors with successful PhDs in the last five years	Number of mentors' published papers in domestic reviewed journals in the last five years	Number of mentors' published papers in international reviewed journals in the last five years
Postgraduate doctoral study in metallurgy	5	9	14

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Table 5.2. Research project funding

Start	Project (name)	Project duration (months)	State budget (MZOŠ)	State budget (other sources – specify)	Local administration budget	EU funds	Economy – private sector	Economy – public companies	Other (specify)	TOTAL
2007	Energy efficiency and quality of products in plastic metal deformation	Active (57 months)	410820,00	-	-	-	-	-	-	410820,00
2007	Environmental metal degradation and adsorption at waste C-materials	Active (57 months)	429834,00	-	-	-	-	-	-	429834,00
2007	Impact of high temperatures on properties of high-alloy steel	Active (57 months)	238339,00	-	-	-	-	-	-	238339,00
2007	Structure, properties and separation of metal materials	Active (57 months)	398678,00	-	-	-	-	-	-	398678,00
2007	Hardening of metal moulds	Active (57 months)	507000,00	-	-	-	-	-	-	507000,00
2007	Forming by deformation and properties of new metal materials	Active for 40 months	252000,00	-	-	-	-	-	-	252000,00

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Table 5.3. Specialized project funding

Start	Project (name)	Project duration (months)	State budget (MZOŠ)	State budget (other sources – specify)	Local administration budget	EU funds	Economy – private sector	Economy – public companies	Other (specify)
2003	Improved procedure for casting blocs from aluminium alloys	58	1500000,00	-	-	-	1000000,00	-	2500000,00
2006	Production and testing of rotating casing engine	29	820676,00	-	-	-	-	-	820676,00

Table 5.4. List of science and development projects

List of all science and development projects awarded by the Ministry of Science, Education and Sports with project leaders
<p>Science projects funded by the Ministry of Science, Education and Sports:</p> <ul style="list-style-type: none"> ▪ Impact of high temperatures on properties of high-alloy steel (M. Gojić) ▪ Energy efficiency and quality of products in plastic metal deformation (L. Lazić) ▪ Environmental metal degradation and adsorption at waste C-materials (J. Malina) ▪ Structure, properties and separation of metal materials (T. Matković) ▪ Hardening of metal moulds (F. Unkić) ▪ Forming by deformation and properties of new metal materials (I. Mamuzić until 2010, from 2010 Povržanović Aleksandar (FSB))

List of active science and development projects from other national sources with project leaders

List of all science and development projects from international sources with project leader
<ul style="list-style-type: none"> ▪ EUREKA E! 3704 „Rapidly Solidified Shape Memory Alloys“ Project leader Mirko Gojić Coordinator: Sveučilište u Mariboru Fakulteta za strojništvo Partners: Montanuniversität Leoben, Austria, Sveučilište u Ljubljani Naravoslovnotehniška fakulteta and The Faculty of Metallurgy University of Zagreb Project duration 2006 - 2009 ▪ Bilateral Croatian- Slovenian cooperation „Razvoj novih metalnih materijala s prisjetljivosti oblika“ Project leader. Mirko Gojić Partner: Sveučilište u Mariboru Fakulteta za strojništvo Project duration 2009 - 2010

Table 5.5. Bibliography (in the last 5 years)

Type of publication	Total number of papers	Teachers' papers	Papers written by two or more teachers at the higher education institution	Papers resulting from cooperation with other higher education institutions and science organizations
Science papers represented in CC, WoS (SSCI, SCI- <i>expanded</i> and A&HCI) bases and Scopusu	88 (46 CC)	76,54 (35,515 CC)	20 (11 CC)	75 (38 CC)
Other reviewed work represented in bases acknowledged when awarding academic titles	110	96,65	35	85
Authors of books published internationally	/	/	/	/
Authors of books published in Croatia	8	8	1	/
Papers in domestic journals with international reviews	56	50,02	18	44
Reviewed papers in proceedings of international conferences*	96	79,75	55	62
Papers in domestic journals with domestic reviews	16	15,75	5	7
Specialist papers	20	18,25	14	8
Chapters in reviewed books	6	5,25	1	6
Reviewed papers in proceedings of domestic conferences*	6	5,75	2	5
Editing international books*	/	/	/	/
Editing domestic books*	8	8	1	/
Number of papers in your institution's journals	/	/	/	/

Table 5.6. Science productivity according to constituent units of your higher education institution

Type of publication	Total number of papers	Teachers' papers	Papers written by two or more teachers at the higher education institution	Papers resulting from cooperation with other higher education institutions and science organizations
Science papers represented in CC, WoS (SSCI, SCI-expanded and A&HCI) bases and Scopusu	88 (46 CC)	76,54 (35,515 CC)	20 (11 CC)	75 (38 CC)
Other reviewed work represented in bases acknowledged when awarding academic titles	110	96,65	35	85
Authors of books published internationally	/	/	/	/
Authors of books published in Croatia	8	8	1	/
Papers in domestic journals with international reviews	56	50,02	18	44
Reviewed papers in proceedings of international conferences*	96	79,75	55	62
Papers in domestic journals with domestic reviews	16	15,75	5	7
Specialist papers	20	18,25	14	8
Chapters in reviewed books	6	5,25	1	6
Reviewed papers in proceedings of domestic conferences*	6	5,75	2	5
Editing international books*	/	/	/	/
Editing domestic books*	8	8	1	/
Number of papers in your institution's journals	/	/	/	/

6 Mobility and international cooperation

6a)

Name how you support internal student mobility (student transfers from other study programs).

The Faculty of Metallurgy currently has only one undergraduate study, however, according to a newly proposed program, two more studies will become available (Metallurgy Engineering and Industrial Ecology), enabling internal student mobility, with the difference of 60 ECTS points.

The Faculty of Metallurgy states a possibility and procedure from transfer from other study programs. The ECTS coordinator and the Commission for teaching propose to the Faculty Council all the right and obligations of such students (in regards to practical work, tuition fees, etc.).

With the condition of compatibility, student mobility within the University of Zagreb is supported in a manner that the student leaving or coming to the Faculty are recognized ECTS points, followed by the harmonization of courses, so that students would gain content knowledge, but also not get lost in the dynamics, i.e. continuation of studies. In order for this to be accomplished, it is necessary to harmonize and agree upon activities and courses the student should complete via ECTS coordinators of respective institutions. The procedure of student mobility needs to be carried out via heads of study years and Commission for teaching.

6b)

Describe the objectives of international cooperation. Elaborate on the forms of cooperation (European projects, bilateral cooperation with international higher education institutions, individual research cooperation, longer and shorter periods of study in foreign countries, international scholarships for teachers and students, organization of international conferences in Croatia, participation at international conferences and other forms of cooperation) and assess the scope and success of current international cooperation of your higher education institution.

The objective of Faculty of Metallurgy international cooperation is to affirm metallurgy studies and achieve its recognition beyond the Republic of Croatia. This cooperation is achieved through European projects, bilateral cooperation with international higher education institutions, student and teacher exchange (more at: <http://medjunarodna.unizg.hr/> and <http://www.simet.unizg.hr/znanost/meduinstitucijska-i-medunarodna-suradnja>).

Our most important partners are Naravonoslovnotehniška fakulteta Ljubljana, Slovenia and Hutnicka fakulta Košice, Slovakia.

Faculty of Metallurgy teachers are actively involved in international conferences presenting their research results, but also within activities in program committees and science councils of respective international conferences. Within international cooperation, International Foundrymen Conference (<http://www.simet.hr/~foundry/>) has an important role, gathering scientists from numerous European countries, but also from around the world.

Likewise, Faculty of Metallurgy teachers are active in editorial boards of respective international scientific journals (e.g. Livarski vestnik, IRT3000).

Considering the number of teachers and previous course of international cooperation, we are in principle satisfied with cooperation intensity. However, it should be expanded, especially in regards to junior staff via postdoctoral studies and study visits to international higher education institutions.

6c)

Name international associations of similar institutions you are involved with and describe how you contribute to common goals.

The Faculty of Metallurgy is a corporate member of international associations of similar institutions such as World Foundry Organisation (WFO) and Verein Deutsche Eisenhüttenleute (VDH). Furthermore, Faculty of Metallurgy teachers are members of numerous international associations (Društvo livarjev Slovenije, Slovenska Hutnickska Spoločnost, American Foundry Society (AFS), Verein Österreichischer Giessereifachleute (VÖG), American Society of Metals (ASM), American Institute of Mining, Metallurgical and Petroleum Engineers (AIME), European Federation of Corrosion (EFC), International Society of Electrochemistry (ISE), The International Committee for the Study of Bauxite, Alumina & Aluminium (ICSOBA)), and participate in their operation as heads of certain sections or board members, contributing to organization of conferences. One example is participation in International Commission 3.3 "Computer Simulation of Casting Processes" within WFO (World Foundry Organisation).

6d)

Describe your involvement in EU Life-long learning program.

The Faculty of Metallurgy has invested significant efforts during the last academic year 2010/2011 to realize the possibility of life-long learning in the field of metallurgy. A new curriculum for the university study-as-you-work undergraduate study of Foundry was accepted and approved. The Faculty is unique by teachers' participation in life-long learning of specialist studies at the faculty of Mechanical Engineering and Naval Architecture (e.g. EWE education according to the program of International welding institute), at inter-faculty (Faculty of Chemical Engineering and Technology, Faculty of Science, Faculty of Graphic Arts, Faculty of Mechanical Engineering and Naval Architecture, Faculty of Metallurgy) postgraduate study Corrosion and protection, as well as Environment Protection at the Faculty of Chemical Engineering and Technology.

Moreover, the Faculty of Metallurgy organizes conferences in cooperation with the Croatian Casting Association and the Croatian Chamber of Commerce Sisak. Two such conferences were organized in the last 5 years:

- Impact on environmental legislation on the casting industry, Sisak, 10th of November 2009
- New technologies and materials in foundries, Sisak, 10th of November 2011.

The Faculty of Metallurgy also organizes metallurgy seminars for the purpose of life-long learning:

- Simulation of foundry processes, Sisak, 31st of January 2008
- Metallographic analysis of iron moulds, Sisak 27th of November 2008.

In December 2010, the Faculty of Metallurgy in Sisak held a special training program for CMC Sisak employees in the field of raw iron production, steel casting, plastic processing and the energy industry.

6e)

Analyze the application of your teachers' and associates' experience from extended study visits (one year or longer) at renowned global universities or institutes. Compare with other similar higher education institution and state your opinion.

In the past three years, none of the teachers at the Faculty of Metallurgy in Sisak has visited international universities or institutes for a period longer than one year. However, repeated visits of several months throughout dozen or so years to our partner institutions (e.g. Hutnicka fakulta Košice, Slovakia or National Metallurgical Academy of Dnepropetrovsk, Ukraine) are of immense importance to certain scientists/teachers, as they result in strengthening not only their careers, but also contribute to paving the way towards inter-institutional cooperation opening mobility possibilities for other teachers and especially undergraduate, graduate and postgraduate students of metallurgy.

We believe that there will be no extended study visits to international university centres or transfer of international experiences to the Faculty of Metallurgy until this is conditioned and regulated by documents on awarding academic titles and provision of funds.

6f)

If there is one, describe and assess cooperation in teacher exchange with other international higher education institutions. Provide students' opinions on guest teachers.

In the past five years, the Faculty of Metallurgy has achieved successful teacher exchange with Naravoslovnotehniška fakulteta Ljubljana (prof. Medved, prof. Mrvar), Strojniška fakulteta Maribor (prof. Anžel), Hutnicka fakulta Košice (prof. Tomašek, prof. Nižnik) and Linneuniversitetet Växjö, Sweden (Dugić, PhD).

Guest teachers' lectures proved to be highly interesting, educational and most of all inspiring in terms of initiating new cooperative programs.

Students see these lectures as significant expansion of teaching content and knowledge on metallurgy in modern technologies. Moreover, in the said lectures students initiate conversation on possibilities of study visits to the international institution.

6g)

Elaborate on the ways in which you support teaching in English or some other language in order to attract international students.

When adopting the curriculum of metallurgy studies according to the Bologna Process in 2005/2006, a series of courses in English was offered. However, the Faculty of Metallurgy so far has not supported teaching in English or some other language by special efforts. Teachers are aware of the public bids published by the University of Zagreb. In the academic years 2011/2012, four courses in English were offered.

6h)

Analyze international cooperation of your students, especially in terms of specialty (specialized student conferences, study visits, etc.) and in regards to promoting student rights.

The students at the Faculty of Metallurgy do not have an expressed international cooperation. However, their involvement in the activities of International Foundrymen Conference organized by the Faculty of Metallurgy for the past ten years (thus including respective student generations at least twice) assists them in gaining

important experience of communicating in an international surrounding of experts and gather contacts with fellow students from the international community.

In the last several years, the Faculty of Metallurgy has initiated promoting the possibilities of participating in studies at international colleges and practical work for students in international companies. These activities resulted in two students going to Slovenian Naravoslovnotehniška fakulteta Ljubljana and the possibility of conducting practical work in companies Kovis d.o.o. Štore and Livar d.d. Ivančna Gorica, Slovenia.

For a number of years, the Faculty of Metallurgy organizes study trips to important metallurgy companies in Croatia and the region, for example, study visit to companies Adrial Šibenik, Aluminij Mostar, Željezara Zenica and Cimos Zenica in 2010.

6i)

Comment on your students' possibilities to spend a part of their studies abroad and forms of institutionalized support.

The students at the Faculty of Metallurgy may spend a part of their studies abroad. So far they have used the institutionalized support within the framework of ERASMUS program. Two undergraduate students of metallurgy are currently at a study visit in Ljubljana (Naravoslovnotehniška fakulteta Oddelek za metalurgijo in materiale). In order to simplify the realization of studies/practical work of its students in foreign countries, the Faculty of Metallurgy introduced a coordinator for international cooperation to its organizational structure, who is engaged in preparation of students' applications, ensuring dormitory accommodation, gathering approval of teachers on recognition of ECTS points for successfully completed courses upon return to mother faculty, etc.

6j)

Describe foreign students' visit at your higher education institution (duration and contents, table 6.2).

There have been no foreign students at the Faculty of Metallurgy in the past five years.

6k)

Define as to your level of satisfaction with the current state of affairs and propose possible improvements.

The Faculty of Metallurgy has been trying hard to improve student and teacher mobility in the past three year, evident on the grounds of awarding ERASMUS study visits and practical work of metallurgy students (three study visits, and two practical worked approved within the ERASMUS program).

In general, the Faculty of Metallurgy is only partially satisfied with state of affairs concerning mobility and international cooperation, especially in regards to foreign students at the Faculty of Metallurgy, the interest for which has so far been non-existent. Furthermore, the number of study visits of Faculty of Metallurgy teachers at renowned international institutions should be increased.

Table 6.1. Teacher mobility in the last three years

	Number of teachers' and associates international study visits			Number of foreign teachers' and associates study visits at the higher education institution		
	1-3 months	3-6 months	Over 6 months	1-3 months	3-6 months	Over 6 months
Science	2	1	-	1	-	-
Art	-	-	-	-	-	-
Teaching	-	-	-	-	-	-
Specialized	-	-	-	-	-	-

Table 6.2. Student mobility in the last three years

	Number of students in international exchange		
	1-3 months	3-6 months	Over 6 months
Students of the higher education institution	-	2	-
Foreign students	-	-	-

Table 6.3. Mobility of non-teaching staff in the last three years

Number of non-teaching staff study visits at international institutions		
1-3 months	3-6 months	Over six months
-	-	-

7 Resources: administrative and technical services, facilities, equipment and finances

7a)

Analyze the number of administrative, technical and auxiliary staff in comparison to number of teachers and associates, students, teaching facilities, technical and other equipment for maintenance and financial state of the higher education institution.

Taking into consideration the ever increasing demands of the Ministry of Science, Education and Sports, the University of Zagreb and various agencies for reports and other administrative activities, as well as increased demand for providing quality teaching, the number of administrative staff is insufficient. The Faculty of Metallurgy is one of the few without administrative support in form of a Department. Immediate employees, even management, are thus obliged to conduct administrative affairs.

The Faculty of Metallurgy is in all its activities overly dependent on the support of contemporary technologies, which on one hand require adequate maintenance, administration and technical support. The Faculty of Metallurgy has only one IT expert in permanent staff, who administrated 90 or so computers, which is minimum number of employees for the said amount of computing equipment.

One janitor is responsible for maintenance of the central heating system, takes care of facility safety and conducts other activities by order of the Dean and Secretary.

The current state of affairs, as well as the ratio of administrative (AS), technical (TS) and support (SS) staff in regards to teachers (T), associates (A) and students (S) is illustrated in table 7a1.

Table 7a1. The ratio of administrative, technical and support staff in relation to the number of employed teachers and associates and student numbers

Acad. year	2006./07.	2007./08.	2008./09.	2009./10.	2010./11.
Number of students (S)	106	90	70	87	78
Number of teachers (T)	21	22	21	22	22
T/S	0,20	0,24	0,3	0,25	0,28
Number of associates (A)	9	8	6	4	3
A/S	0,08	0,09	0,09	0,05	0,04
Number of administrative staff (AS)	8	8	8	8	8
AS/S	0,08	0,09	0,11	0,09	0,10
Number of technical staff (TS)	4	4	4	4	4
TS/S	0,04	0,04	0,06	0,05	0,05
Number of support staff (SS)	4	4	4	4	4
SS/S	0,04	0,04	0,06	0,05	0,05

7b)

Comment on the qualifications of non-teaching staff and their professional training prospects.

The number of non-teaching staff fully meets the current needs and all affairs are conducted timely. Still, due to more administrative tasks which are to be further increased in the future, we believe that the non-teaching staff will not be able to execute their obligation in due time and at a quality level, especially considering the duties of the Secretary and manager of Student Desk. All employees have adequate competencies considering their responsibilities and duties, as well as equal life-long learning opportunities, regulated by the Directive on education and professional training of the Faculty of Metallurgy employees. The qualification structure of non-teaching staff is shown in table 7b1.

Table 7b1. Qualification structure of non-teaching staff

NON-TEACHING STAFF	NUMBER
Technical assistant	4
University degree – Master in Metallurgy	1
High school diploma – Chemical Technician	3
Administrative staff	12
University degree – Master of science in Metallurgy	2
University degree – Master in Law	
College degree – Bachelor in Informatics	3
College degree – Electrical engineer	
College degree – IT	
High school diploma – Energetic Technician	4
High school diploma – Office Correspondent	
High school diploma – Economics Technician	
Unqualified – Primary School	3
TOTAL	16

7c)

Describe the state and your satisfaction with existing classrooms and laboratories considering the number of students, enrolment quotas and optimum number of students. Compare facilities with other similar higher education institutions.

The Faculty of Metallurgy is a dislocated constituent unit of the University of Zagreb. Today teaching and research of the Faculty is conducted at the same place (in two buildings at the same location, table 7.1), which contributes to significantly lower utilities expenses, as well as faster and better communication between members of the faculty, but also teachers and students. As the said facilities were not built for the contemporary teaching process and research, adaptations needed to be made. Due to the Faculty's own involvement and funds for investment maintenance of the Ministry of Science, Education and Sports, maintenance of Faculty buildings and the surrounding area has become a priority in the last ten years. Thus, a parking lot was built between two Faculty buildings, boiler room was updated, central heating system improved, a new roof was built in one of the buildings, electrical wires partially replaced in the central building, etc. However, more funds should be invested in maintenance of the Faculty buildings. Development Strategy of the Faculty of Metallurgy (2011-2016) predicts reduction of heating expenses and adjustments regarding the disabled. Unfortunately, financial means for the said are currently unavailable, but assistance of the University of Zagreb is expected.

Table 7.c.1. Buildings of the institution of higher education

Identification of building	Location of building	Year of construction	Year of the addition or reconstruction	Total surface area to perform activities of higher education (m ²)	Total surface area for the implementation of scientific research (m ²)
Main building	Aleja narodnih heroja 3, Sisak	1960	-	2208	560
Courtyard	Aleja narodnih heroja 3, Sisak	1960	Reconstruction of the roof 2005 y.	1020	511

The Faculty of Metallurgy comprises 3228 m², of which 339m² are classrooms (including IT classroom of 72 m²) and 1071 m² are laboratories. Classrooms are in a good state as significant funds have been invested into their reconstruction as of recently (new desks and chairs, smart boards, projector). A part of the laboratories has also been restored, while the other part is currently undergoing restoration, upon which students shall be able to execute most lab work at the Faculty.

Considering the number of students and enrolment quota, facilities are harmonized with the Faculty's needs, so that teaching takes place optimally, in the mornings, apart from some lab work and lectures by external associates.

The Faculty does not have laboratory for teaching purposes exclusively, but the laboratories are used for research and scientific activities of both teachers and students.

There are no teaching sites at the Faculty of Metallurgy.

Table 7.c.2. Classrooms

Identification of building	Number or designation of classroom	Area (m ²)	Number of seats for students	Number of hours for use in the week	Rating of features* (1 to 5)
Main building	I	73	52	Winter semester: 22 hours Summer semester: 25 hours	4
Main building	II	39	55	Winter semester: 20 hours Summer semester: 25 hours	4
Main building	III	70	48	Winter semester: 22 hours Summer semester: 28 hours	4
Main building	IV	54	38	Winter semester: 30 hours Summer semester: 20 hours	4
Main building	V	31	20	Winter semester: 29 hours Summer semester: 16 hours	4
Courtyard	Computer classroom	72	30	Winter semester: 6 hours Summer semester: 4 hours	4

**Features of classroom include quality of furniture, technical and other equipment.*

Table 7.c.3. Laboratories/Practicums used in teaching and

Table 7.c.7. Place used for scientific-research and professional work

Identification of building	Internal marks of room Laboratory /Practicum	Area (m ²)	Number of working places for students	Number of hours for use in the week	Rating of features (1 to 5)
Courtyard	Laboratory for iron, steel and foundry	87	15	20	3
Main building and courtyard	Laboratory for separation and hidrometallurgy	55	5	10	3
Main building	Laboratory for chemistry	448	20	30	3
Courtyard	Laboratory for deformation of metals	107	10	20	3
Courtyard	Laboratory for heat and mechanical engineering	41	10	20	4
Main building and courtyard	Laboratory for physics and investigation of structure	235	12	30	3
Courtyard	Laboratory for the development and application of materials	98	15	20	3

7d)

Elaborate on the state and functionality of IT equipment used in teaching, with emphasis on students' extracurricular use.

The Faculty obtains IT equipment for teaching purposes from its own means. Most of the equipment is up to date and good enough for the needs of teaching.

Table 7.d5. Features of computer classroom

Number of new computers (up to 3 years)	Number of computers over 3 years	Rating of functionality (1 to 5)	Rating of maintenance (1 to 5)	Rating of options to use outside of teaching (1 to 5)
22	3	4	4	3

There is one IT classroom (72m²) at the Faculty containing 25 computers. The faculty also has one computer, i.e. work station ProCast for education of students via simulation of casting processes. Furthermore, The Faculty has a special IT room of the CARnet system with three computers used by students exclusively for extracurricular purposes (writing papers, browsing the Internet for available reading, etc.). Students often use the mentioned computers for executing study course requirements, writing papers and dissertations. Furthermore, during the course of studies, students have at their disposal the Students' Assembly room (with one computer) and two online student desks ('studomat'). They have internet access via a local network facility (LAN) and wireless within AAI@EduHr system (so-called EDUROAM) was introduced at the Faculty of Metallurgy in 2010.

7e)

Elaborate on internal procurement policy and use of computer equipment.

The Faculty executes public procurement system. Internal procurement policy is executed in line with the Faculty needs. In regards to teachers' personal computers, the general principle is for teachers to provide means for computers equipment via project, while computers are purchased with the Faculty's means and partially donations of the Ministry of Science, Education and Sports.

7f)

Comment on teachers' offices and their number and functionality. Assess appropriateness for successful teaching and scientific activities.

The Faculty of Metallurgy has a satisfactory number of teachers' offices even though they are not well equipped. The teachers' offices are appropriate for successful teaching and scientific activities. Most of them are also big enough in size.

Table 7.f6. Teachers' offices

Identification of building	Number of teachers' offices*	Average area (m ²)	Rating of features (1 to 5)	Average area in m ² per full-time teacher/associate
Main building	14	25	3	15
Courtyard	2	23	3	23

* Teachers' offices that are used

7g)

Describe the size and equipment in spaces for scientific and research activities and assess space usage.

Size of spaces for scientific and research activities at the Faculty is satisfactory. All three departments have their own classrooms and laboratories, while others are common. The Faculty does not have laboratory for teaching purposes exclusively, but the laboratories are used for research and scientific activities of both teachers and students (tables 7.3 and 7.7). As of recently, significant funds have been invested into infrastructure of laboratories and procurement of laboratory equipment.

The Faculty has at its disposal a negligent amount of scientific equipment of capital value (table 7.9). One part of the equipment at the Faculty has been dismissed due to age of over 30 years. Procurement of new equipment started being approached systematically in the recent period. Of the new capital equipments, one should emphasize SEM with EDS, DCS and atomic absorption spectro-photo-meter. Lately, procurement is assured through the Faculty's own funds, and project leaders participate in procurement of capital and other equipment (tables 7.9 and 7.9a), such as SED and EDS, micro and macro hardness measuring device, optical microscope with software support, smoke gas analysis device, electrochemical and corrosion testing device, DSC, atomic absorption spectro-photo-meter. However, due to age of certain equipment, further procurement is of vital importance (e.g. furnace for thermal processing with protective atmosphere, XRD, etc.). Generally, we are not satisfied with the state of the equipment, especially of capital value. However, we are doing our best to procure a part of its using the Faculty's own funds.

Table 7.g9. Capital equipment

Name of device	Purchase value	Age
Atomic absorption spectro-photo-meter.	299.992,08	1
Thermal analysis system	754.811,97	2
EDS	460.235,24	3
Electronic microscope	1.010.150,85	4
Optical microscope with a digital camera	378.278,97	7

Table 7.g9a. Small and medium equipment

Name of device	Purchase value, kn	Age
Vacuum pump HTP 40/AG	43.824,90	1
Measuring device RAYTEK RAYK 312ML2	22.928,07	2
Digestors (3 units)	98.700,00	2
Hot sample preparation device	70.234,79	2
Electrochemical measurement device Potentiostat/Galvanostat FRA PARSTAT 2273	235.714,85	3
Spectro-photo-meter CAMSPEC	17.080,00	4
Microscopic digital camera	30.464,61	5
Macro measuring unit of hardness	147.681,00	5
Gravimetric measuring devices	171.606,42	6
Digital image transfer system at SEM	83.983,58	6
Oxygen analyzer	161.528,00	6
Stereo-microscope	45.803,42	7
ATAS	34.695,02	8
Analytical scale AB204-S/A	23.965,07	9
Smoke gas analyzer	137.667,75	9
Welding equipment	16.644,00	9
Cutter	69.271,60	9
Grinder	68.111,38	10
Micro measuring unit of hardness	207.400,00	10
Digital microscopic photography system	49.388,67	10

7h)

Describe the library of your higher education institution and working hours. Comment on the number of books and journals in the library (domestic and international) and funds invested in publications each year.

The Faculty Library, with publications in fields of metallurgy, chemistry, chemical technology, consists of the library and reading room, as well as archive (in the basement). It was renewed in 2007, installing movable shelves. The Library also contains one computer, printer and xerox machine for its users. The Library acquires journals and books. All dissertations are processed and archived by the Library. A new program for library contents processing was recently installed (Aleph).

The Library procures 20-30 books per annum, with a budget between ten and twenty thousand kuna (table 7.10b). Generally, we are not satisfied with the state of acquiring new books, especially metallurgy journals. However, limited funds present a key challenge in that respect, since book and journals are mostly procured from the Faculty budget or active projects of the Ministry of Science, Education and Sports.

Working hours are adapted to users. The library is open for everyone from 8 a.m. to 2 p.m. It is open 30 hours per week. At that time, all its resources are at the users' disposal. Anyone can use the library's services, but may not borrow books and journals.

The rules on Library's activities, terms and conditions of using books and other library contents are regulated by the Regulations on the Library of the Faculty of Metallurgy:

<http://www.simet.unizg.hr/dokumenti/pravilnici/Pravilnik%20o%20radu%20Knjiznice%20MF-a.pdf/view>

Table 7.h10. Library equipment

Area (m2)	Employees	Seats	Number of students using the Library	Is there a computer database of books and journals
165	1	8	70	YES

Books	Textbooks *	How contemporary are books and textbooks (grade 1-5)	International journals	Domestic journals	Grade how functional the catalogues, journals and books are	Grade equipment (1-5)**	Grade availability and quality of electronic content***
10791	109	3	26	23	4	5	3

* All textbooks regardless of number of copies.

** Copying for teachers and students, procurement of copies from other libraries, catalogues, etc.

*** Digital and electronic editions of books, journals, databases and library catalogues.

Table 7.h10b. Money used for purchasing of books and journals

Year	Money used for purchasing of journals (kn)	Money used for purchasing of books (kn)	Total money spent (kn)
2006.	7.512,00	18.122,00	25.634
2007.	17.125,00	18.338,00	35.463
2008.	50.010,00	15.465,00	65.475
2009.	5.202,00	10.695,00	15.897
2010.	9.403,00	7.385,00	16.788

The Library is at the disposal of the users and contributes to meeting their IT needs. One big disadvantage is the size of the Library as the information desk should, according to standard for libraries at higher education institutions, be separated from other parts of the library due to privacy concerns. Standards prescribe separation of the reading room, journal room, IT room and recommend space for group work. However, at the Faculty of Metallurgy all activities take place in the same room, which is not adequate for successful studying.

7i)

Evaluate the degree of digitalization of the Library. List the databases of books and journals available to teachers, associates and students, and comment on the frequency of use in comparison to other higher education institutions.

Digitalization of the Library has so far been satisfactory, and is dependent on the funds provided by the Ministry of Science, Education and Sports. Databases are available to all users within Online Database centre for the needs of the Croatian academic community funded by the Ministry of Science, Education and Sports. Databases are available exclusively via publishers' search engines and access is regulated by validating IP address. Access is direct, without username and password. The provider automatically verifies IP address as registered as institution at the Online Database centre. Due to lack of financial means, access to numerous databases has been terminated, which is a great disadvantage which we are trying to overcome by cooperating with the Naravoslovnotehniškom fakultetom Ljubljana.

Thus, we believe that the availability and access to sources of information are satisfactory. Considering Library space, we believe that student standard might be improved. To be more precise, the Library does not provide adequate space for teamwork, which is becoming common in contemporary teaching methods.

7j)

Comment on offices of administrative services (e.g. secretariat, accounting IT service, etc.)

Considering the average area and number of employees, administrative services offices are satisfactory (table 7j1). Since the faculty does not have IT service, all affairs related to software maintenance are conducted by one system engineer.

Table 7.j10. Offices for professional services

Identification of building	Professional service	Average area (m ²)	Rating of features (1 to 5)	Average area in m ² per full-time worker
Main building	Secretariat	15	5	15
Main building	Accounting Office	15	5	7,5
Main building	System-engineer	8	4	8
Main building	Students` office	13	4	13
Main building	Office of the Dean	7	4	7
Main building	Economics	12	4	12

7k)

Elaborate on the ratio of budget (teaching, science and art) and market income of your higher education institution and comment on the degree of autonomy and flexibility of your higher education institution in financial affairs.

The Faculty income in 2009 was 10.003.345,27 kuna, of which budget share was 9.367.041,27 kuna, and market share 626,235,79 kuna. The ratio of budget versus market share is 6,68%.

The Faculty income in 2010 was 9,825,449,10 kuna, of which budget share was 9,307,085,32 kuna and market share 427,991,10 kuna. The ratio of budget versus market share is 4,59%.

Autonomy of financial affairs of the Faculty of Metallurgy is founded on the Faculty of Metallurgy Statute. The Dean has a right to make business decisions on behalf of the Faculty up to one million kuna. For all legal actions up to three million kuna, the Dean requires approval of the Faculty Council, i.e. Senate for bigger sums. The Faculty Council authorizes the Dean to make legal actions on behalf of the Faculty from one million to three million kuna. Pursuant to Regulations on the basics of finances of the University of Zagreb, the University's and its units' budget contains all the inputs and outputs systematized according to financial regulations, with respect to legal acts and regulations, provisions of the University Statute and the Regulations, and general acts of constituent units.

The consolidated University budget specifies:

- Funds for primary activities, ensured by the National budget and given to the University as lump sum (chapter higher education, University of Zagreb regular activities)
- Funds for primary activities, ensured by the National budget, but not included in lump sum.
- All funds acquired at the market or from other sources by conducting primary and auxiliary activities.

7l)

Comment on the detailed structure of market income sources (tuition, research projects, services, other) of your higher education institution.

Market income of the Faculty of Metallurgy comprises of organizing International Foundrymen Conference, publishing, tuition, enrolment fees, ECTS points, cooperation with businesses and Contract on educational cooperation with the Faculty of organization and IT from Varaždin.

7m)

Elaborate on the manner in which you manage market income funds in order to improve overheads.

Market income funds are primarily used for improvements to the Faculty, i.e. procurement of new scientific equipment. Also, a part of the funds is invested in the maintenance of the Faculty.

7n)

Comment on the percentage of market income expenditure and assess how the lack or reduction of those means would influence the functionality of your higher education institution and realization of its primary activities.

Approximately 10% of research project income, total tuition fee income and other market income are used for the procurement of new scientific equipment and regular functioning of the Faculty. Lack or reduction of these means would jeopardize the activities of the Faculty.

7o)

State your priorities in case of increased budget funding to your higher education institution.

The Faculty's priorities are human resources, i.e. employment of new research trainees and associates. Thus, a significant share of increased budget funding would also be invested in new equipment (laboratories, the Library). For the purpose of better connections with the economy, procurement of laboratory equipment useful for businesses and certification of laboratories is also quite important. Further management and maintenance of Faculty buildings and facilities is also required (alternate central heating system, repairs to roofs and paint, infrastructural support for the disabled, etc.)

Also, it is necessary to improve student standard (e.g. by building a student dormitory and catering facility), for which support of the Ministry, University and local community is expected.

7p)

Describe as to how satisfied you are with the current state of affairs and propose possible improvements.

The current state of affairs is not satisfactory, on the level of the Faculty, the University and the country as a whole (insufficient GDP funds). It is past time to define strategies, priorities, human resources standards, spatial standards, technical standards, service quality standards, etc. at the level of the University, but also within the system of science and higher education, and based on that start applying a sustainable financial system. Analyses of human resources use are essential, as well as system workload. The analyses should be published, and available, at least for components financed from the budget.

University of Zagreb Faculty of Metallurgy

Table 7.11. Financial evaluation

		N-2 Calendar year (2009.)	N-1 Calendar year (2010.)
	INCOME		
1.	INCOME FROM THE STATE BUDGET	9.367.041,27	9.307.085,32
1.1.	Wages for employees	7.795.743,54	7.741.420,88
1.2.	Operating expenses (including fieldwork)	592.701,00	602.494,00
1.3.	External co-operation in education	69.785,00	4.658,00
1.4.	National scientific projects	453.680,80	473.331,00
1.5.	International scientific projects	126.000,00	141.470,00
1.6.	International cooperation	15.405,00	18.860,00
1.7.	Organization of conferences	30.510,00	28.890,00
1.8.	Purchase of the journal		
1.9.	Ongoing maintenance		
1.10.	Construction and repairs		
1.11.	Equipment – a refund of VAT	262.590,93	228.091,44
1.12.	Other types of income (specify) university tuition fees, systematic Mo, 50 Year of Faculty of Metallurgy	5.520,00 15.105,00	57.370,00 6.500,00 4.000,00
2.	INCOME FROM OTHER PUBLIC SOURCE BUDGET	4.625,00	87.155,00
2.1.	Income and grants from local government (city, counties, etc.)	4.625,00	87.155,00
2.2.	Revenue and grants from other entities (such as the National scientific foundation)		
2.3.	Total other species (specify)		
3.	INTEREST INCOME	5.443,21	3.217,68
4.	INCOME FROM OWN ACTIVITY	536.370,07	341.487,75
4.1.	Tuition fees – graduate specialist		
4.2.	Tuition fees – postgraduate doctoral	55.000,00	5.000,00
4.3.	Scientific projects		
4.4.	Projects		
4.5.	Income from rent		
4.6.	Total other types of income (specify)		
	International Foundrymen Conference	218.813,07	135.997,75
	Cooperation with business subjects	29.357,00	21.740,00
	Cooperation Agreement of Education University three years study “Application of information technology in business”, Faculty of Organization and Information Varaždin	233.200,00	178.750,00
5.	INCOME FROM SPECIAL REGULATIONS	89.865,72	86.503,35
5.1.	Tuition - undergraduate, graduate, professional	70.649,34	71.294,34
5.2.	Additional checks of specific knowledge, skills and		

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	abilities (if implemented by the state graduation exams)		
5.3.	Enrolment fees	7.000,00	8.089,01
5.4.	Publishing activity	2.510,00	3.101,00
5.5.	Charges of student applications, certificates, diplomas, indexes etc.	9.706,38	4.019,00
5.6.	Total other types of income (specify)		
6.	OTHERS (NON MENTIONED) INCOME (specify)		
A	TOTAL OPERATION INCOME	10.003.345,27	9.825.449,10

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		N-2 calendar year (2009.)	N-1 calendar year (2010.)
	COSTS		
1.	COSTS FOR EMPLOYEES	7.666.901,59	7.561.049,03
1.1.	Wages for employees	7.390.681,80	7.341.007,46
1.2.	External co – operation education	51.237,94	55.153,83
1.3.	Total other (specify) Medical check – up Others expenditures for employees according to the Labour act and Collective Agreement for Science and higher Education	224.981,85	10.920,00 153.967,74
2.	EXPENDITURES FOR MATERIAL AND ENERGY	398.703,54	407.392,78
2.1.	Office supplies and other material costs	87.365,36	104.489,33
2.2.	Laboratory supplies	37.388,00	63.544,71
2.3.	Energy	220.479,11	225.248,27
2.4.	Supplies and components for current and investment maintenance	49.295,56	13.073,85
2.5.	Small inventory	4.175,51	1.036,62
2.6.	Total others (specify)		
3.	COSTS FOR SERVICES	649.247,41	756.191,60
3.1.	Telephone, mail, transport	262.047,75	307.041,00
3.2.	Services current and investment maintenance	27.478,12	34.453,14
3.3.	Promotion and information	28.617,34	23.307,75
3.4.	Utilities services	142.141,79	150.845,93
3.5.	Lease, rent		
3.6.	Intellectual and personal services (contract services, fees)	188.962,41	240.543,78
3.7.	Computer services		
3.8.	Total others (specify)		
4.	COSTS FOR NON - FINANCIAL ASSETS	1.120.771,15	461.460,17
4.1.	Business facilities		
4.2.	Computer equipment	104.357,25	77.711,96
4.3.	Laboratory equipment	870.174,55	359.294,91
4.4.	Office equipment	24.466,41	
4.5.	Communications equipment		
4.6.	Other equipment	999,99	4.564,61
4.7.	Literature	5.202,65	9.403,41
4.8.	Investments in facilities, machinery and others equipment		
4.9.	Additional investments in buildings		
4.10.	Total others (specify) license books	104.875,10 10.695,20	3.099,60 7.385,68
5.	EMPLOYEES REIMBURSEMENT	450.475,18	465.044,58
5.1.	Business trip	408.901,94	437.640,38
5.2.	Professional training	41.573,24	27.404,20
5.3.	Total others (specify) including transportation costs		

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6.	OTHERS NON MENTIONED BUISNESS EXPENSES	99.996,62	122.188,40
6.1.	Insurance premiums	17.593,50	17.809,35
6.2.	Presentation	32.171,56	56.017,66
6.3.	Membership fees	12.759,15	11.332,14
6.4.	Banking service payments	16.144,43	14.128,93
6.5.	Interest		
6.6.	Others financial expenditure	21.327,98	22.900,32
B	TOTAL OPERATING EXPENSES	10.386.095,49	9.773.326,56
C	Amount brought forward from previous year	1.284.253,00	901.502,78
	TOTAL STATE 31.12. (A-B+C)	901.502,78	953.625,32