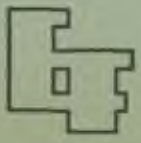
UNIVERSITY OF ZAGREB, CROATIA

FACULTY OF ELECTRICAL ENGINEERING

with a short survey of the history of Croatia



Zagreb, 1992

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Our address is:

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Cover design by D. Ž. The back cover represents among others some of the ligatures from the Croatian Glagolitic Script. The map of Croatia was prepared by Miljenko Mikuc (Department of Telecommunications), Davor Šterc (Department of Applied Mathematics) and Goran Zelić (Department of Electronics). The map of Europe was prepared by Sven Kelemen (student).

The preliminary version for Chapters 3, 4 and 5 has been prepared by Dr. Damir Kalpić, Department of Applied Mathematics

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The aim of this small booklet is twofold. First, to acquaint the reader with the educational and scientific activities of our institution and its organization. Second, we included a short introduction to the history of Croatia, mainly through its interferences with other European cultures.

The author is grateful for valuable suggestions given by his coleagues, but there are too many to name them all. However, special thanks go to Dr. Dubravka Bosnić, Prof. Dr. Vladimir Ćepulić ([illegible]), Dr. Vladimir Dugački, Prof. Dr. Branko Fučić ([illegible]), Alemko Gluhak, Prof. Dr. Ivan Ivanšić, Prof. Dr. Vatroslav Lopašić ([illegible]), Krešimir Mikolčić, Prof. Dr. Vladimir Muljević, Prof. Vlatko Oštrić, Prof. Dr. Uroš Peruško and Željko Tomić. I obtained valuable suggestions from Dr. Trpimir Macan, who reviewed the part of the text devoted to the history of Croatia. The organization and content of the manuscript were discussed on several occasions with our dean Prof. Dr. Danilo Feretić, Dr. Damir Kalpić and Dr. Slavko Krajcar.

Needless to say, and it is not just a pose, that the responsability for all mistakes should be born exclusively by the author.

[illegible] (p. 67)
[illegible], Department of applied mathematics

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1. The University of Zagreb

1.1 A Short History of the University. The first high school institution in Croatia was founded by the Dominicans in Zadar in 1369 as the 'studium provinciale' for theology. This study was transformed into the 'studium generale' in 1495, and from 1553 it had the privilege of conferring doctorates of theology. It existed until the beginning of the 19th century.

Leopold I., the Emperor of the Holy Roman Empire, issued a Diploma in 1669, by which the status and privileges of a university were accorded to the Jesuit Academy in the Royal Free City of Zagreb. This represents the beginning of the University of Zagreb. The Jesuits also started the first grammar school in Zagreb in 1607. Croatia was at that time one of the states of the Holy Roman Empire and bore the old name: the Kingdom of Croatia, Dalmatia and Slavonia.

Let us mention some of the Universities that were founded before and after the University of Zagreb: Bologna 1219, Padova 1220, Paris 1220, Oxford 1249, Lisabon 1290, Rome 1303, Cambridge 1318, Florence 1321, Praha 1348, Krakow 1364, Vienna 1365, Erfurt 1379, Heidelberg 1385, Rostock 1419, Glasgow 1453, Tübingen 1477, Uppsala 1477, Copenhagen 1479, Mainz 1494, Edinburgh 1582, Dublin 1591, Lwow 1661, **Zagreb 1669**, Göttingen 1736, Erlangen 1743, Moscow 1775, Berlin 1809, Saint Petersburg 1819, London 1825, Helsinki 1826, Kiev 1834, Athens 1834, Tokyo 1881, Constantinople 1900, etc.

The Jesuit Academy was oriented mainly to theology, philosophy, law and classical philology. From 1747 there was also a chair for controversistic, aiming to study all the open questions existing between the Eastern and Western Church, conditioned obviously by the presence of Pravoslavs (Orthodox Christians) in Croatia.

The Paulines from Lepoglava near Varaždin organized a three year study of philosophy in 1656 (with lectures on logic, mathematics, physics, metaphysics and etics) and a four year study of theology in 1683. By the rescripts of Pope Clement X in 1671 and Emperor Leopold I in 1674 it became 'studium generale' with a right of conferring doctorates.

During the French rule in Dalmatia (1805–1813) the Gymansium of Zadar was transformed to Lyceum in 1806. After the Illyrian province had been founded it became a Central school with lectures on seven academic disciplines from engineering to medicine and law, having the right of conferring academic titles. So, this institution acted as a university with seven faculties, but unfortunately it was canceled in 1811.

The University in modern sense, including science and engineering, was founded in Zagreb in 1874, thanks to the efforts of the great Croatian Maecenas bishop *Josip Juraj Strossmayer* (born in *Osijek*, 1815–1905). It had three faculties:

Law, Theology and Philosophy, from which soon many new faculties developed. *Ivan Mažuranić*, a great Croatian poet and statesman (1814–1890), was the Ban (governor) and the president of the Croatian governement when the University was opened.

J.J. Strossmayer became internationally known for his speech against the dogma of papal infallibility at the Vatican synod held in 1869-70. He was also one of the originators of the unhappy idea of Yugoslavia, a common state for southern Slavs to live in. He founded the Yugoslav Academy of Sciences and Arts in Zagreb in 1866, long before Yugoslavia was created as a state (first as the Kingodom of Serbs, Croats, Slovenes in 1918, and then renamed to Yugoslavia in 1929). These are the oldest scientific and educational institutions in the south–east Europe.

The Yugoslav Academy of Sciences and Arts was renamed to the Croatian Acadamy of Sciences and Arts first in 1941 and then again in 1991. It is interesting to note that in former Yugoslavia all the six republics and two Serbian autonomous provinces had their own national Academies, except Croatia, where the term 'Yugoslav' was traditionally kept.

Let us mention that the first president of the Serbian Academy of Sciences and Arts, founded in 1887, was a Croat – prof. *Josip Pančić* (1814–1888, born in the Croatian city of Bribir).

We cannot avoid the names of three Czech professors – Karel Zachradnik (1848–1922, mathematics), Gustav Janeček (1848–1929, chemistry) and Vinko Dvorák (1848–1922, physics) who were invited to initiate the educational and scientific work. The University of Zagreb owes them a great deal for its development.

1.2 The University of Zagreb today. Today our University is a huge educational and scientific organization comprising 25 faculties and colleges, some 3 000 professors and teaching assistants and some 35 000 students (we had 5400 students and postgraduates in 1938). It has a rich cooperation with foreign institutions, but needs a further support in this direction. Great importance has the movement called 'Alma Mater Croatica', whose wish and aim is to unite our former

students, now scientists scattered about many universities and research centers on the West. 'Alma Mater Croatica' is the symbolic name for the Zagreb University.

Except in Zagreb, there are very young university centers in Osijek, Split and Rijeka. Parts of the University of Zagreb are in Varaždin and Slavnoski Brod.

There is an army of as many as 45000 specialists educated in Croatia, working today mostly in western countries. On one hand, it points out clearly the quality of our Universities, and on the other, the political and economic conditions in Croatia within former Yugoslavia.

The University library, founded in 1606, has about 2500000 books.

A great care is devoted to the living standard of students. About 6000 students live in student dormitories and subsidized student restaurants serve about 20000 meals daily.

The Zagreb University, and our faculty in particular, had many foreign students, primarily from the developing countries.

Very rich international cooperation, initiated by prof. Ivan Supek in 1971, has been established through scientific seminars and meetings held at the Inter-university Center for Postgraduate Studies in Dubrovnik. In the agression of Serbia and Montenegro on Croatia the Center was totally destroyed (1991).

Among Croatian **Nobel prize** winners we should mention

- *Ivo Andrić*, (studied in Zagreb) for literature, 1961. He was a Croat born in Bosnia and educated by the Bosnian Jesuits. His books reflect the interference of different cultures existing in Bosnia.
- *Lavoslav Ružička* (born in *Vukovar*, of a Czech father and a Croat mother, attended the gymnasium of *Osijek*), for discoveries in organic chemistry, professor at the Technische Hochschule in Zürich, Switzerland 1939,
- *Vladimir Prelog*, (a Croat born in Sarajevo, studied in Zagreb), for discoveries in organic chemistry, worked at the Technische Hochschule in Zürich, 1975,

It is interesting that *Nikola Tesla* (see p.61) refused to receive the Nobel prize for physics, which he was supposed to share with T. A. Edison.

The name of *Mother Theresy* (Albanian, born in Skopje in Macedonia), Nobel prize winner for peace, cannot be avoided. The Croatian Jesuits had a great role in her spiritual developement. The city of Zagreb, where much later she opened a house, was one of the steps on her road to India.

The University Senat conferred Honorary Doctorates to some of the most oustanding persons in certain disciplines. Among others we should mention:

- Tomaš Masaryk, professor at the Charles University in Prague, President of the Republic of Czechoslovakia (Slovak by birth), 1921
- Nikola Tesla, holder of more than 700 patents, 1926,
- Lavoslav Ružička, Nobel prize winner, 1940,
- Vladimir Prelog, Nobel prize winner, 1952
- Niels Bohr, Danish atomic physicist and Nobel prize winner, 1958,
- Robert Robinson, Nobel prize winner for chemistry and professor at Oxford, 1960,

- Sarvepalla Radakrishnan, philosopher and President of India, 1965,
- Henri Lefebre, professor at the University of Nanterre, France, 1965,
- Geörg Lukács, Hungarian Academy of Sciences, 1969,
- Werner Heisenberg, German theoretical physicist and Nobel prize winner, 1969
- Lev Andrejevič Arcimovič, Professor of physics at the Moscow State University, 1969,
- Dorothy Hodgkin, professor of chemistry at Oxford and Nobel prize winner, 1969
- Ernst Bloch, professor of philosophy at Tübingen University, 1969
- Giacomo Devoto, Professor of lingusitics at Florence University, 1969,
- Alois Tavčar, professor of genetics from Zagreb, 1970
- Karol Borsuk, professor of mathematics at the Univeristy of Warszaw, 1976
- Charles Herbert Best, Professor of Physiology at Toronto University (with F. G. Banting discovered insulin in 1921), 1976
- Jean Marie Pérès, Professor of biological oceanography at Aix Marseille University, 1978,
- Cornelis Carl Albert Voskuil, director of the Interuniversity Institute "T.M.C. Asser" for international law in Haag, 1988,
- Rudolf Karl Zahn, director of the Institute for biochemistry "Johannes Gutenberg" in Mainz, 1988,
- Linus Pauling, Nobel prize winner, Professor emeritus, Stanford University California, 1988,
- Herman Herman Northrop Frye, professor emeritus, University of Toronto, Canada, 1990

2. Faculty of Electrical Engineering – [illegible]

2.1 History and organization. The present Faculty of Electrical Engineering (in the sequel [illegible], ETF, the logo for Elektrotehnički fakultet) is a continuation of the old Technical High School founded in 1919 and Technical faculty from 1926. The [illegible] was formed as a separate unit in 1956.

During its history it played a crucial role in the electrification of former Yugoslavia.

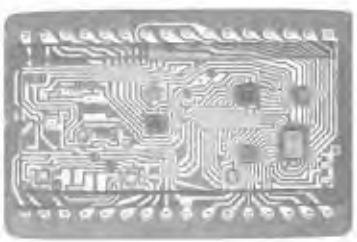
The city of Zagreb had its first telegraph connection with Vienna in 1850. The first telephones were introduced in 1887. The first radio station both in Croatia and in the Balkans was constructed in Zagreb in 1926, only 6 years after its presentation in the USA. We had the first television broadcast in 1939, while in Europe there were only two TV stations at that time – on in London and the other in Berlin (the first television station in the world was installed in London in 1936).

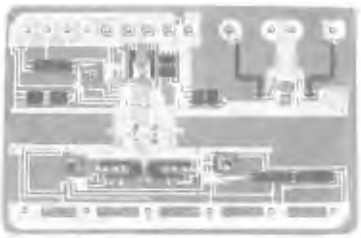
The first power generator was constructed by our technical personnel, the demanding part in constructing power plants throughout former Yugoslavia was carried out by this institution.

Since its beginning [illegible] has educated 7200 electrical engineers, 1100 masters of science and 305 doctors.

The first computer of [illegible] was installed in 1968. Since 1991 the faculty has been well supplied with computers for the needs of students and scientists. The study of computer science and engineering started in 1970. Since then 760 students have specialized in this area, 170 masters of computer science and 34 doctorsin the field of computer science have been awarded high degrees.

This faculty now has 365 employees, among them 66 masters of science and 77 doctors. Many of our professors are equally active in industry and science. About 30% of [illegible]'s finantial expenditures are covered through our collaboration with industry.





Since recently ☞ has considerably improved its equipment, although many things are still either missing or antiquated. The overall area of buildings that ☞ has at its disposal is 38 000 m^2.

Due to its tradition and qualified personnel, ☞ is the major scientific and educational institution in Croatia in the field of electrical engineering and computing. Our future students are selected by a three hour qualification exam, designed of 26 problems in mathematics and 14 in physics. Those candidates who participated in the national competition in either mathematics or physics during their secondary school education, are accepted directly.

During the last four years we had 630 newly registered students annually. About 70% of them got their degree within the avarage time of study equal to 5.2 years. At this moment we have 3 000 students and about 1 000 graduate students.

The duration of lectures and exercises per week should not exceed 30 hours (or 900 hours per year). In principle each exam has two parts: written (practical part) and oral (theoretical part), the marks ranging from 5 (excellent) to 2 (sufficient).

Normal duration of studies is 4.5 years (eight terms plus one term for the graduation work). Lectures and exercises are well covered with textbooks and manuals (about 400 written by our professors). ☞ has a very modern library with 20 000 books and a nice reading hall. It also has 2000 volumes of various international journals, covering all the areas relevant for electrical engineering and computer science. Each department has its own specialized library. A number of professional periodicals are published through the faculty. ☞ also has a photocopying service.

The academic year starts on the 1st October and finishes on the 30th September. It is devided into a winter term (from the 1st October to the 15th January) and a summer term (from the 16th February to the 31st May).

The first two years of study are common for all students. This is the so called 'preparatory study', aiming to give a basic knowledge necessary for future specialization, which starts in the third year of study. There are eight basic branches, planned according to the present and future needs of our industry:

- electrical power engineering
- electrical machines and automation
- industrial electronics
- telecommunications and informatics
- automatic control
- computing
- radiocommunications and professional electronics
- power technologies

The 'preparatory study' represents an effective filter and only hard working students can pass through.

Students are obliged to learn at least one foreign language, according to their own choice (English, German, French, Russian) with emphasise on the ability to read professional electrotechnical literature.

Students are organized in various sectional activities ranging from scientific to cultural and recreational. The Students' Club of [illegible] is among the most popular in Zagreb, comprises a good rock band, dancing and theater evenings, radio club, mountaineering, sports, a student journal etc. [illegible] has a nice restaurant.

A very serious problem that since recently our faculty has to cope with is a considerable influx of students coming to Zagreb from *Sarajevo*, and other university centers, trying to continue their studies. Many of them are without any documentation, as it has been destroyed during the Serbian aggression. Equally difficult is the situation in Croatian primary and secondary schools. They have many exiled children, and the number of pupils per class is now from 35 to 45, and sometimes even more.

Our faculty possesses a very modern and well equiped building for sport and recreational activities. Unfortunately, due to the Serbian and Montenegrin aggression it is now overcrowded with exiles from Bosnia and Herzegovina.

Many of our students continue their education at **postgraduate studies** (2.5 years). In the field of electrotechnics there are seven branches:

- general electronics
- telecommunications and informatics
- radiocommunications and professional electronics
- automation
- electrical power engineering
- electrical machines
- electric measurements

Moreover, in the field of computer sciences there are two additional branches:

- the kernel of computer science
- applications of computer science

At this moment [illegible] has about 1000 postgraduate students.

Unfortunately (though we are proud of this) many of our best students continue their work in scientific and industrial institutions in the West. [illegible] is

regarded to be one of the best organized faculties in the state, and is highly appreciated abroad.

The faculty also conferres the Ph.D.

We close this section with a list of former deans of (a corresponding school year is in parentheses). Our faculty owes them a great deal for its develpment.

Prof.Dr. Anton Dolenc	(1956–57),
Prof.Dr. Danilo Blanuša	(1957–58),
Prof.Dr. Božidar Stefanini	(1958–59),
Prof.Dr. Vatroslav Lopašić	(1959–60),
Prof.Dr. Hrvoje Požar	(1960–61, 1961–62),
Prof.Dr. Vladimir Matković	(1962–63, 1963–64),
Prof.Dr. Radenko Wolf	(1964–65, 1965–66),
Prof.Dr. Vladimir Muljević	(1966–67, 1967–68),
Prof.Dr. Hrvoje Požar	(1968–69, 1969–70),
Prof.Dr. Vojislav Bego	(1970–71, 1971–72),
Prof.Dr. Zlatko Smrkić	(1972–73, 1973–74),
Prof.Dr. Zvonimir Sirotić	(1974–75, 1975–76),
Prof.Dr. Uroš Peruško	(1976–77, 1977–78),
Prof.Dr. Ante Šantić	(1978–79, 1979–80),
Prof.Dr. Berislav Jurković	(1980–81, 1981–82),
Prof.Dr. Milan Šodan	(1982–83, 1983–84),
Prof.Dr. Nedžat Pašalić	(1984–85, 1985–86),
Prof.Dr. Leo Budin	(1986–87, 1987–88),
Prof.Dr. Vladimir Naglić	(1988–89, 1989–90),
Prof.Dr. Ivan Ilić	(1990–91, 1991–92).

2.2 International cooperation. There is a rich international cooperation with various institutions, through the interuniversity or direct agreements:

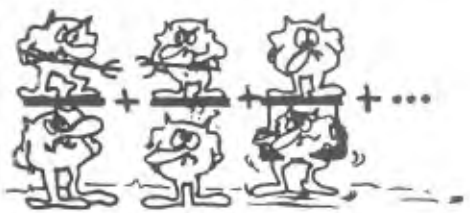
- International Atomic Energy Agency (IAEA), Vienna, Austria,
- Technische Universität Graz, Austria,
- Comissão Nacional de Energia Nuclear, Rio de Janeiro, Brazil,
- Guangxi University, Nanning, China,
- Hangzhou University, Hangzhou, China,
- Vysoka škola strojnia a elektrotechnická v Plzni, Plzeń, ČSR,
- Research Institute of Acoustics, Prague, ČSR,
- České vysoké učeni technické v Praze, Prague, ČSR,
- University of Southampton, Southampton, England,
- Institut of Environmental Engeneering, London, England,
- Centre National d' Étude des Télécommunication, Paris, France,
- Technische Universität Rostock, Sektion Informationstechnik, Dresden, Germany
- Universität Rostock, Sektion Technische Elektronik, Rostock, Germany,
- Ruhr Univesität Bochum, Institut für Experimantalphysik, Bochum, Germany,

- University of Aachen, Aachen, Germany,
- Ludwig–Maximilians Universität, München, BDR,
- Physikalisch–Technische Budesanstalt (PTB), Braunschweig, Berlin, Germany,
- Technische Hochschule Darmstadt, Darmstadt, Germany,
- Universität Stuttgart, Stuttgart, Germany,
- Gesellschaft für Reaktorsicherheit, Garching, Germany,
- Universität Erlangen – Nürnberg, Institut für Nachrichtentechnik, Erlangen, Germany
- Technische Universität Berlin, Germany,
- Universität Mainz, Mainz, Germany
- International Centre for Theoretical Physics (ICTP), Trieste, Italy,
- Uniwersitet Warszawski, Warszawa, Polska,
- Центральный научно исследовательный институт морского флота (CNIIMF), Sankt Petersburg, Russia
- Московский энергетический институт (MEI), Moscow, Russia,
- Technische Hogeschool Delft, Delft, Netherlands,
- Royal Institute for Technology, Stockholm, Sweden,
- Microwave Institute Foundation, Stockholm, Sweden,
- Scweizerisches Institut für Nuklearforschung (SIN), Viligen, Switzerland,
- Eidgenössische Technische Hochschule, Zürich, Switzerland,
- Paul Scherer Institut (PSI), Villigen, Switzerland,
- Kyjiv University, Kyjiv, Ukraine,
- Florida State University, USA,
- Case Western Reserve University, Ohio, Cleveland, USA
- National Bureau of Standards, Washington, DC., USA,
- University of California, Los Angeles, USA,
- University of California, Santa Barbara, USA
- University of Georgia, Athens, USA,
- University of North Carolina, Greensboro, USA
- University of Southwestern Louisiana, Lafayette, USA,
- University of Tennessee, Knoxville, USA,
- University of Utah, Salt Lake City, USA,
- University of Virginia, Charlottesville, Virginia, USA.

Let us mention that ☞ is connected with many scientific and educational institutions in the world through the system of electronic mail (internet).

It is a pleasant feeling to know somebody who can speak Croatian for instance in Beijing or La Paz. Up to now we had students from Algeria, Angola, Austria, Bolivia, Bhurma, China, Cyprus, Ethiopia, Ghana, Greece, Syria, Iraq, Israel, Yordan, Columbia, Lebanon, Hungary, Morocco, Nigeria, Shri Lanka, Somalia, Sudan, Tanzania, Togo, Venezuela, Zair, Zimbabwe.

These witty drawings created by Mrs. Ingrid Afrić (Zagreb) are reproduced from a mathematical booklet intended for gifted children. It was prepared on the Department of mathematics and printed in the Croatian city of Beli Manastir (occupied and devastated during the Serbian agression in 1991). The edition has been completely destroyed.



3. Scientific projects

Scientific projects are supported by the Ministry of Science of the Republic of Croatia. There are currently going on the following projects:

- The Relativistic Classical and Quantum Theory of Nonlinear Fields
- Materials and Systems for Solar Energy Conversion
- Advanced Nuclear Reactors, Fuel Cycles, and Waste Disposal
- Investigation of Finite Mathematics With Help of Computers
- Computer Supported Organisation and Decision Making
- National Electromagnetic Calibration Laboratory
- Research of Physical Phenomena in Electrical Machines
- Research of Synchronous Machines and Methods for its Design
- Electric Drive for Industrial Plants and Traction
- Control of AC electrical drives
- Power System Measurements
- Metrology, Testing and Standardisation Service in Croatia
- Development, Control and Exploitation of Electric Power Systems
- Analysis of Nuclear Power Plants Safety
- Electromagnetic Field Calculations in Development of Machines and Apparatus
- The Intelligent Telecommunications Network
- Telecommunications and Informatics
- Measurements of Biological Quantities with new Impedance Methods
- Contactless Measurement of Mechanical Quantities in the Ship Propulsion
- Process Control for the Ship of the Future
- Intelligent Process Control System in Cement Industry
- Adaptive and Optimum Motor Drive Control
- Measurements, Surveillance, Guidance and Simulation of Processes Using Digital Computers
- Application of Digital Signal Processing in Communications
- Speech Recognition over the Telephone Line
- Prosodics of Synthetic Speech
- Evaluation of the Channel Tunnel on the Structure of Traffic Flows
- Processing of Audio Signals in Radiocommunications
- Distributed Real-Time Computer Systems
- Electronics and Microelectronics
- Knowledge Representation Scheme for Computer Vision Systems
- Computerized Control of the Manufacturing Systems
- Mobile Radiocommunications - Efficiency and Antenna Systems
- Biomedical Effects of Electromagnetic Radiation
- Electromagnetic Compatibility of Radio Systems and Electric Trains

- Research of Advanced Technologies for Croatian Broadcasting System
- New types of Programmable Electrical Nesting Elements

4. Brief description of departments

Our address is:

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FACULTY OF ELECTRICAL ENGINEERING
Avenija Vukovar 39, 41000 Zagreb, CROATIA

Tel: +38 41 62 99 99, Fax: +38 41 61 13 96

Dean: **Prof. dr. Danilo Feretić**
Dean and heads of departments are reappointed biennially.

4.1 Department: Physics

Founded in 1945
Head of the department: Prof. dr. Petar Kulišić
Tel: +38 41 62 96 70, Fax: +38 41 62 96 05
Staff: 4 professors, 2 assistant professors, 6 assistants, 1 research assistant
Educational activities:
a) Lectures in general and applied physics:
Lectures on general physics, Electric and magnetic properties of matter, Laser physics, Elements and applications of superconductivity, Introductory nuclear physics.
b) Lectures on physical basis for new energy technologies:
Selected topics in energy physics, Interactions and detection of nuclear radiation, Nuclear fuel cycles and materials, Nuclear safety and regulation, New energy sources, Energy conversion and storage.
Research and development:
a) Pure and applied physics:
Pion absorption in small nuclear system at intermediate energies, Elementary particles structure and symmetries, weak interaction, field theory, Applications of lasers to plasma diagnostics and Raman spectroscopy.
b) Energy physics:
Advanced fuel cycles and long term nuclear energy strategies, Fuel cycles and reactor selection for medium and small nuclear energy systems. Interdependence of fission and fusion reactor development, Advanced reactor fuel management schemes, Nuclear radiation shielding calculations, Solar energy materials and solar energy conversion, Safety analyses of reactivity transients, Solar cells and photovoltaic systems applications, Kinetic energy storage.

PERMANENT STAFF

Professors:

Vladimir Knapp – nuclear physics and nuclear energy

Petar Kulišić – physics of energy sources

Associate professors:

Višnja Henč-Bartolić – atomic physics, lasers

Tomislav Petković – experimental nuclear and particle physics

Assistant professors:

Mile Baće – nuclear waste management and energy storage

Dubravko Horvat – elementary particles structure and symmetries

Assistants:

Lahorija Bistričić

Tomislav Gjurić

Zoran Narančić

Dubravko Pevec

Branka Prib

Miro Prpić

4.2 Department: Applied Mathematics

Founded in 1919
Head of the department: Prof. dr. Neven Elezović
Tel: +38 41 62 99 00, Fax: +38 41 62 99 46

Chair: MATHEMATICS
Contact person: Prof. dr. Ivan Ivanšić
Tel: +38 41 62 99 69, Fax: +38 41 62 99 46
Staff: 5 professors, 4 assistant professors, 2 assistants, 9 researchers
Educational activities: Calculus, Algebra, Statistics, Numerical methods at the undergraduate and graduate level, mathematics competitions.
Research & development: Investigation of mathematical structures in mathematical models and numerical algorithms, in geometric topology the problems of positioning in different categories, especially PL and form, theory of summability, stochastic processes, probability theory and measures in functional spaces, computing and mathematical methods for statistical number theory and numerical methods for differential equations, nonlinear elliptic equations, construction of combinatorial structures, symmetric block designs, group theory, dynamical systems.

Chair: COMPUTER SCIENCE
Contact person: Dr. Damir Kalpić
Tel: +38 41 62 99 19, Fax: +38 41 62 99 15
Staff: 1 professor, 2 assistant professors, 2 assistants, 6 researchers
Educational activities: Programming, Programming techniques, Data base organisation, Operational research at the graduate and undergraduate level.
Research & development: Algorithms and software for mathematical programming, time scheduling, mine ventilation, text recognition. Information systems design and software in administration, business, production planning and management. Own CASE tools for data base design, normalisation and application generators in different target 4GLs. Consulting and problem solving for administration, business and industry.

Chair: FOREIGN LANGUAGES
Contact person: Prof. Danira Koračin
Tel: +38 41 62 96 09, Fax: +38 41 62 99 46
Staff: 1 lecturer, 5 part-time lecturers
Educational activities: Foreign language courses in English, German, French and Russian with vocabulary required for Electrical engineering and Computing.
Research & development: Professional dictionaries.

PERMANENT STAFF

Professors:

Davor Butković – functional analysis, probability theory
Ivan Ivanšić – topology
Dimitrije Ugrin-Sparac – number theory
Alfred Žepić – numerical methods in computer science

Associate professors:

Vladimir Čepulić – finite mathematics
Neven Elezović – functional analysis, probability theory

Assistant professors:

Marijan Đurek – programming techniques, information system design
Petar Javor – functional equations, semigroups
Damir Kalpić – operations research, information systems, databases
Luka Korkut – numerical methods for PDE-s
Ljubo Marangunić – finite mathematics
Vedran Mornar – operations research, databases
Darko Zubrinić – nonlinear elliptic PDE-s

Lecturers:

Danira Koračin
Daslav Petrizio

Assistants:

Mirta Baranović
Ilko Brnetić
Pavao Mardešić
Vesna Županović

4.3 Department: Fundamentals of Electrical Engineering and Electrical Measurements

Founded in 1923

Head of the department: Dr. Mladen Boršić
Tel: +38 41 62 96 00, Fax: +38 41 62 96 16

Chair: ELECTRICAL MEASUREMENT

Contact person: Doc. dr. Mladen Borišić
Tel: +38 41 62 97 09, Fax: +38 41 62 96 16

Staff: 1 professor, 2 associate professors, 2 assistant professors, 3 assistants, 4 researchers

Educational activities: Introduction to measurement science. European certification and calibration service. The system of units and its realisation. Measurement error theory; uncertainty of measurement and the expression of results. Voltage standards and precise power supplies. Precise resistances, capacitances and coils. Analog electrical instruments: structure and application. Registrating instruments. Bridges and compensators. Semiautomatic and automatic impedance measurement. Current and voltage instrument transformers and testing methods. Instrumentation and operational amplifiers. Analog to digital and digital to analog conversion. Digital voltmeters and multimeters. Calibrators. Oscilloscope. Shielding, grounding, noise suppression. Measurement of electrical signals and quantities: voltage, current, power, impedance and frequency. High voltage testing. Electric power meters and its testing. Transducer practice: temperature, displacement, pressure, mass. Magnetic quantities measurement. Data acquisition and telemetry systems.

Research & development: Absolute volt measurement, Data loggers, Telemetric data acquisition systems, Precise measurements of voltage, resistance and capacitance, Measurement of extremely low frequency electrical and magnetic fields.

Chair: ELECTROMAGNETIC THEORY

Contact person: Prof. dr. Zijad Haznadar
Tel: +38 41 62 96 16, Fax: +38 41 62 96 16

Staff: 1 professor, 1 assistant professor, 1 assistant, 2 researchers

Educational activities: Fundamental laws of electromagnetic theory. Macroscopic approach. Maxwell's equations. Interaction between field and media. Electromagnetic potentials, Lorentz and Coulomb gauge. Field theory. Integral and differential approach to field calculation, boundary conditions. Static and time-varying fields. Electromagnetic wave propagation, plane TEM, TE and TM waves, electromagnetic wave on dielectric-conductor boundary. Waves on transmission lines. Solution of eddy current problem in c nductors. Magnetic circuits. Mathematical models with systems of differential and integral equations in electromagnetic theory, linear and nonlinear, continuous and discrete, static and time

varying systems. Numerical methods. Finite element method (FEM). Boundary element method (BEM). Numerical field analysis in electric machinery. Linear field and linear machines. Stator and rotor fields. Computation of torques and forces. Calculation of parameters of electrical machinery with help of numerical field computations. General concept of design, design process, elements of design theory. Computer aided design (CAD), computer aided manufacturing (CAM). Elements of CAD systems, two)dimensional drafting, three-dimensional modelling in design. Numerical field computation packages as kernels of CAD systems. Examples of computer aided design in electrical engineering (insulation systems, switching apparatus, earthing systems). Fundamentals of manufacturing systems theory. Methods for analysis and design of manufacturing information systems. Computer integrated manufacturing (CIM). Operations management.

`Research & development:` Investigations in the area of numerical calculation of electromagnetic fields, Development of software packages for numerical field calculation suited to application in usual design practice in electrical engineering, especially for the design of rotational machinery, transformers, earthing systems, switching apparatus.

Chair: FUNDAMENTALS OF ELECTRICAL ENGINEERING

`Contact person:` Prof. dr. Enver Šehović

Tel: +38 41 62 96 16, Fax: +38 41 62 96 16

`Staff:` 1 professor, 2 assistant professor, 8 assistants

`Educational activities:` Basic electromagnetics, Basic circuit theory.

`Research & development:` A group of scholars from the chair Fundamentals of Electrical Engineering is included in the research programs carried on by the Telecommunications Department.

PERMANENT STAFF

`Professors:`

Vojislav Bego – absolute measurements, precise measurements of electrical quantities

Zijad Haznadar – electromagnetic fields, electromagnetic fields and CAD

Enver Šehović – telematic services

`Associate professors:`

Josip Butorac –absolute electromagnetic measurements, standards and calibration, precise measurements of the electromagnetic quantities, thermometry and barometry, mass and displacement measurements

Dušan Vujević – precise measurements of the voltage and magnetic quantities

`Assistant professors:`

Sead Berberović – numerical field calculations of earthing systems, CAD

Mladen Boršić – telemetric data acquisition systems, calibration and testing service

Božidar Ferković – precise measurements of the capacitance

Petar Knežević – telematic services, performance of the computer systems

Zoran Skočir – database design in the area of telecommunications
Željko Štih – numerical field calculations, CIM and management

Assistants:

Bruno Blašković
Šandor Dembitz
Ivan Felja
Gordan Gašljević
Vladimir Kozina
Ivica Kunšt
Armin Pavić
Kruno Poljančić
Mirko Randić
Dražen Stojanović
Milan Zorić

4.4 Department: Electrical Machines and Control of Electrical Drives

Founded in 1925

Head of the department: Dr. Drago Ban

Telephone: (+38 41) 629 673 or (+38 41) 629 770 Fax: (+38 41) 629 705

In activities concerning education, research and development participate 45 people: members of faculty staff (both regular and part-time) and scientific researchers. Among them there are 14 Doctors of Technical Sciences, 10 Masters of Science and 9 Junior Researchers.

Educational activities: Electrical Machines, Transformers, Electrical Drives, Control of Electrical Machines and Electrical Drives, Power Electronics, Applied Mechanics for Electrical Engineering, Graphical Communication in Engineering.

Research & development: Scientific and research activity, as well as cooperation with industry, is focused on following:

- Research and development of the methods to analyze rotational electrical machines, transformers and electrical devices, and to design, build, test and exploit them in various industrial, electrical, traffic and other technical plants.
- Modelling, simulation and identification of parameters of electrical machines and power electronics converters.
- Analyzing small and special machines (step motors, linear motors, electronically commutated motors) for general and particular use.
- Electrical drives in general and specific working conditions. Designing, testing and putting them into operation.
- Reconstruction, retrofit and modernization of large power electrical machines and electrical drives in electrical, industrial, mining and other plants.
- Research, development, designing, building and usage of different static power converters.
- Research, development and application of the methods of automatic control of AC and DC electrical drives in industry, mining, traffic, shipbuilding and elsewhere.
- Reconstruction and modernization of controlled electrical drives, their automatization and protection, especially in rolling mills, mining and other similar industrial plants.
- Designing and modernization of industrial and electrical transport plants.

PERMANENT STAFF

Professors:

Ivan Ilić – electrical machines and drives

Nedžat Pašalić – control of electrical machines and electrical drives

Associate professors:

Drago Ban – electrical machines and drives

`Assistant professors:`

Zlatko Maljković – synchronous machines

Zoran Šimunić – electrical machines, industrial plants

`Lecturers:`

Jovan Baldani

Nikola Jurković

`Assistants:`

Mirko Cettolo

Gorislav Erceg

Ivan Gašparac

Željko Jakopović

Fetah Kolonić

Zoran Kovačević

Tihomir Kovačić

Damir Krajačić

Đino Kunjašić

Marina Maleček-Stamać

Boris Miletić

Marinko Miletić

Lukša Padovan

Milivoj Puzak

Zdravko Rabuzin

Danko Sirotić

Nikola Švigir

Josip Zdenković

4.5 Department: Electric Power Systems

Founded in 1934

Head of the department: Prof. dr. Vladimir Mikuličić

Tel: +38 41 62 99 07, Fax: +38 41 62 98 90

Chair: POWER ENGINEERING

Contact person: Prof. dr. Milan Šodan

Tel: +38 41 62 99 08, Fax: +38 41 62 98 90

Staff: 4 professors, 3 assistant professors, 9 assistants, 4 researchers 5 part-time lecturers

Educational activities: Power System Planning, Construction and Operation; Power System Control; General Energetics at the graduate and postgraduate level.

Research & development: Dynamics and Transient Phenomena in Power Systems. AGC and VAR Control. State Estimation and Expert Systems of Power Systems. Adaptive Protection and Optimisation in Power Systems. Network Calculation SW Development. CAD of Distributions Network. Electromagnetic Transients in High Voltage Networks.Power Supply of Electrical Traction Systems.

Chair: NUCLEAR POWER ENGINEERING AND ADVANCED ENERGY TECHNOLOGY

Contact person: Prof. dr. Danilo Feretić

Tel: +38 41 62 99 95, Fax: +38 41 62 98 90

Staff: 2 professor, 1 assistant professors, 1 assistants, 7 researchers

Educational activities: New Energy Conversion Technology, Fluid Mechanics, Heat Transfer, Nuclear Physics Reactor Theory, Nuclear and Thermal Power Plants, Fuel Cycles and Reactors Materials, Engineering Reliability and Safety at the graduate and postgraduate level.

Research & development: Conventional and Nuclear Power Plant Components and Subsystems Mathematical Modelling. Nuclear Power Plant Deterministic and Probabilistic Safety Analyses. Safety Class Electrical Components Qualification.

PERMANENT STAFF

Professors:

Danilo Feretić – nuclear power plants, theory of nuclear reactors, thermal processes in nuclear reactors

Vjekoslav Filipović – swithgear facilities, power plants, optimization of electric power system operation

Milan Šodan – regulation in electric power system, electric power system control, distribution networks

Associate professors:

Srđan Babić – electric power transmission and power system analysis

Zdravko Hebel – transmission networks, computer–aided power system analysis

Vladimir Mikuličić – energy conversion processes, electrical power system relia-

bility

Sejid Tešnjak - electric power system, regualtion in electric power system, electric power system dynamics

Assistant professors:

Nikola Čavlina - nuclear power plant control, nuclear power plant safety

Slavko Krajcar - electrical facility design, distribution networks

Ivo Uglešić - high voltage engineering

Lecturers:

Željko Zlatar

Assistants:

Nenad Debrecin

Irislav Drezga

Ante Marušić

Ivica Pavić

Zdenko Šimić

Davor Škrlec

Tomislav Tomiša

Vladimir Tuk

Radoslav Zelić

4.6 Department: Telecommunications

Founded in 1951

Head of the department: Prof. dr. Ignac Lovrek

Tel: +38 41 62 98 02, Fax: +38 41 62 98 32

Contact person: Prof. dr. Ignac Lovrek

Tel: +38 41 62 98 32, Fax: +38 41 62 98 32

Staff: 6 professors, 4 party-time assistant professors, 6 assistants, 7 researchers

Educational activities: Information theory. Automata theory and logical design. Information networks. Languages and algorithms. Teletraffic theory. Information processing. Digital transmission and switching. Data communications. Hardware and software architecture of telecommunication systems and terminals. Processors and programming languages. Network planning and management. Informatics and service integration. System reliability. Integrated services digital network. Broadband aspects. Performance evaluation and network optimization. Intelligent networks.

Research & development: Investigation of telecommunication network development from the point of view of network planning and management, switching, transmission, signalling and synchronization, service integration as well as new hardware/software technologies. Information flows and traffic, teletraffic theory, queuing network models, modelling of packet and circuit switched communication networks. Network planning and optimization, performance evaluation. Call - service processing algorithms, communication and signalling protocols for telecommunication services, formal specification and verification. Diagnostics and testing, problems of reliability and availability. Integrated local communication systems based on PBX-LAN/WAN concept, multimedia problems. Software tools and workstations for telecommunications domain (Project on Telecommunications and Informatics).

Conceptual models of intelligent networks, relations between information, knowledge and communication. Possibilities of the distribution of intelligence through the functional evolution of ISDN/BISDN nodes as intelligent agents, intelligent service provision and network management. High-speed transmission, fast/broadband switching, adaptive routing and service-specific information processing. Analytical methods and simulations for mixed service traffic, non-Poisson models, integrated space-terrestrial networks. Strategy of network evolution towards intelligent broadband telecommunication network (Project on Intelligent Networks).

Long term cooperation with industry and PTTs, especially in R& D programs for switching systems, test equipment for telecommunication systems, private and public network planning and optimization.

International cooperation: projects COST 226 "Integrated space-terrestrial networks" and COST 239 "Ultra-high capacity optical transmission network".

Department has founded the scientific journal "ITA - Information, Telecommunications and Automata" in 1982.

PERMANENT STAFF

Professors:

Vjekoslav Sinković – information theory, information networks

Mladen Tkalić – automata theory and logical design

Associate professors:

Mladen Kos – performance analysis, network optimization

Marijan Kunštić – information logic and languages, swithing systems

Ignac Lovrek – telecommunication system architecture, call/service modelling and processing

Branko Mikac – reliability and diagnostics, digital transmission

Assistants:

Alen Bažant

Denis Gračanin

Dragan Jevtić

Vjekoslav Matić

Miljenko Mikuc

Gordana Opačić

4.7 Department: Electronic Measurements and Systems

Founded in 1943

Head of the department: Prof. dr. Ante Šantić

Tel: +38 41 62 99 11, Fax: +38 41 62 96 52

Chair: ELECTRONIC MEASUREMENTS AND BIOMEDICAL ELECTRONICS

Contact person: Prof. dr. Ante Šantić

Tel: +38 41 62 99 31, Fax: +38 41 62 96 52

Staff: 2 professors, 3 assistants, 6 researchers

Educational activities: Electronic measurement and instrumentation. Transducers and sensors. Development of electronic instrumentation. Biomedical electronics. Biomedical instrumentation. Biomedical signals and systems. Computers in medicine. Some of this subjects are on the graduate level.

Research & development: Research and development of electronic instrumentation for industrial measurement, particularly in shipbuilding. Multichannel system for measurement mechanical quantities. Electronic devices for torque and trust measurements. Research and development of RF and infrared telemetry systems. Multichannel data aquisition systems in medicine and dentistry. Biomedical telemetry. Bioelectric potentials signal processing. Bioelectric impedance and pulse plethysmography measurements. Noninvasive mesurement of blood ciruclatory system. Electrical heart and spinal cord stimulation. Painrelief stimulation. Bioelectric and biomechanical research of athletes training.

Chair: ELECTRICAL NETWORKS AND SYSTEM THEORY.

Contact person: Prof. dr. Hrvoje Babić

Tel: +38 41 62 99 48, Fax: +38 41 62 96 52

Staff: 2 professor, 3 associate professors, 1 assistant, 13 researchers

Educational activities: Signal and systems theory. Network theory. Systems for signal processing. Linear and nonlinear electric networks. Telemetry systems. Electrical filters. Numerical methods in electric networks and systems design. Some of this subjects are on graduate level.

Research & development: The group covers research in the field of: System and signal theory; Analog and digital signal processing including filtering, correlation and spectrum analysis of signals. Graduate students are involved in research and development of hardware and software for signal processors and advanced multichannel systems for computerized measurements of mechanical vibrations in machine and ship structures and digital instrumentation for special applications and particular for underwater signals. Distributed and modular microprocessor systems for monitoring and control. Numerical methods in electrical network and filter design.

PERMANENT STAFF

Professors:

Hrvoje Babić – system theory and signal processing

Vladimir Naglić – electrical network theory and communication system engineering

Ante Šantić – electronic instrumentation and measurements, biomedical electronics and transducers

Stanko Tonković – electronic instrumentation and measurements, biomedical electronics

Associate professors:

Vladimir Ćosić – network theory and computer aided analisys and design

Branko Jeren – network and system theory, signal processing

Neven Mijat – electrical network and system theory

Assistants:

Mario Cifrek

Sven Lončarić

Ratko Magjarević

Zoran Stare

Ante Šarc

4.8 Department: Regulation and Signal Technics

Founded in 1954

Head of the department: Doc. dr. Zoran Vukić

Tel: +38 41 62 98 15, Fax: +38 41 61 13 96

Chair: AUTOMATIZATION

Contact person: Doc. dr. Zoran Vukić

Tel: +38 41 62 98 15, Fax: +38 41 61 13 96

Staff: 2 professors, 2 assistant professors, 1 lecturer, 4 assistants, 3 researchers

Educational activities: Undergraduate and graduate courses from the areas such as: Applied theory of automatic control, Algebraic control theory, Nonlinear control systems, Optimal control, Adaptive control, System identification, Computer controlled systems, Mathematical modelling and simulation, Servo systems, Robotics, Ship automation, Process automation, Security and alarm systems, and Intelligent measurement systems.

Research & development: Investigation of the algorithms for the control of various processes (ships, DC motors, step motors, robots, processes in the cement industry, energy distribution systems etc.). Design and development of electronic or microprocessor based regulators, (conventional, adaptive , optimal) for servo systems, step motors, and monitoring and alarm systems for water supply systems, air conditioning, ships etc. Research of the new algorithms for control, state estimation and parameter identification.

Chair: COMPUTER SYSTEMS AND PROCESSES

Contact person: Prof. dr. Gabro Smiljanić

Tel: +38 41 62 96 19 , Fax: +38 41 62 96 31

Staff: 1 professor, 1 associate professor, 4 assistants, 1 researcher

Educational activities: Undergraduate and graduate courses: Digital computers, Microcomputers, Computers and processes, Modelling and simulation, Software engineering.

Research & development: Algorithms, hardware and software modules of digital computers, computer and computer systems architectures. Design and development of microcomputer elements, interface modules and systems dedicated for real time applications. Design automation tools based on the UNIX operating system. Software engineering methods and tools. Modelling and simulation methods and languages. Distributed computer systems in computer integrated manufacturing.

PERMANENT STAFF

Professors:

Petar Crnošija – development and microcomputer implementations of adaptive and optimal control algorithms in servo systems (DC, brushless and hybrid step motors)

Ljubomir Kuljača – ship automation, nonlinear control, stochastic control
Gabro Smiljanić – "on-line" real time computing, microprocessors, simulation

`Associate professors:`

Mario Žagar – real-time computing, microcomputers, design automation

`Assistant professors:`

Ivan Husar – security and alarm systems
Zoran Vukić – ship automation, adaptive control, algebraic control theory

`Lecturers:`

Marica Jurišić-Zec

`Assistants:`

Davor Antonić
Željko Ban
Mario Kovač
Zdenko Kovačić
Alan Kurešević
Andrija Maričić
Kalma Zimmermann-Pavčević

4.9 Department: Electroacoustics

Founded in 1954

Head of the department: Prof. dr. Ivan Jelenčić

Tel: +38 41 62 96 40, Fax: +38 41 62 98 62

Staff: 3 professors, 3 assistants, 3 researchers

Educational activities: *Acoustics* – Physical acoustics, Hearing acoustics, Speech and musical acoustics, Architectural and building acoustics, Control of noise and vibrations, Infrasound and ultrasound, Acoustical holography. *Electroacoustics* – Electro-mechano-acoustical analogies, Microphones, Loudspeakers and enclosures, Headphones, Recording and reproduction of sound, Sound reinforcement in closed and open spaces, Electroacoustical measurements. *Audiotechnics and Digital audio* – Preamplifiers and power amplifiers, Digital audiotechnics. *Radio receiver technics* – Reception of analog and digital modulated signals, Digital audio broadcasting, Radio receiver characteristics and measurements, Antennas and antenna coupling, HF amplifiers and gain control, Mixers, Frequency control and local oscillators, Demodulation and demodulators, Communication receivers.

Research & development: Investigation of acoustics, electroacoustics and audiotechnics problems. Physical and physiological acoustics, surface acoustic waves, acoustical optics, hearing, speech intelligibility, audiology and audiometry, radiation of sound, architectural acoustics, problems of noise and noise control, hydroacoustics, ton studios and public address systems. Technics of high fidelity, digital processing of sound, audio amplifiers. Problems of communication and consumer receivers and receiver system planning.

PERMANENT STAFF

Professors:

Ivan Jelenčić – acoustics, electroacoustics, radio receivers,

Branko Somek – acoustics, electroacoustics, audiotechnics

Associate professors:

Momir Vujnović – acoustics, electroacoustics, audiotechnics

Assistants:

Hrvoje Domitrović

Bojan Ivančević

Mladen Maletić

4.10 Department: Electronics

Founded in 1943

Head of the department: Prof. dr. Leo Budin
Tel: +38 41 62 99 36, Fax: +38 41 62 96 53

Chair: Electronic Circuits
Contact person: Prof. dr. Petar Biljanović
Tel: +38 41 62 99 53, Fax: +38 41 62 96 53
Staff: 1 professor, 1 lecturer, 8 teaching assistants, 1 researcher
Educational activities at the undergraduate and graduate level: Electron devices, Analog electronics, Microelectronic devices and circuits technology, Microelectronic standard circuit and ASIC design, Microelectronic circuits reliability.
Research & development: Research of microelectronic materials; special effects in semiconductor materials; research of semiconductor device properties; semiconductor devices simulation tools development; methodology development for design of advanced VLSI technologies; methodology development for IC layout design; new types of semiconductor–ceramic heating elements and temperature sensors.

Chair: Computer Engineering
Contact person: Prof. dr. Uroš Peruško
Tel: +38 41 62 99 47, Fax: +38 41 62 96 53
Staff: 4 professors, 2 assistant professors, 9 assistants, 6 researchers
Educational activities at the undergraduate and graduate level: Computer based circuit analysis, Digital electronics, Digital system design, Datastore design, Arithmetic circuit design; Computer architecture and organization, Multiprocessor and parallel systems; Digital control, Software systems for real-time applications; Operating systems, Computer networks; Compiler design, Fault-tolerant computer systems, Computer system evaluation; Computer graphics, Office automation; Functional programming, Object oriented system design, Automata theory; Pattern recognition, Computer vision, Expert systems, Knowledge representation.
Research & development: Distributed real-time systems and computer control of production systems encompassing the following topics: formal description of process interactions, analysis and validation of special purpose LANs, design and verification of coherence protocols in distributed systems, paradigms for friendly user interfaces, implementation methodologies for hardware layers, as well as the components of CIM like procedures for machine tool working characteristics adjustment, visual object and tool recognition; knowledge representation for computer vision systems including formal modelling, designing inference, inheritance and recognition procedures, modelling of learning and forgetfulness, architecture of knowledge base systems; hardware and software design of intelligent information systems using intelligent programming tools, ASIC approach and open development systems supporting design entry, simulation and verification.

PERMANENT STAFF

Professors:

Petar Biljanović – electron devices, solid state circuits, microelectronics

Leo Budin – operating systems, real-time systems, CAD

Uroš Peruško – digital circuits, reliability and Foult tolerant circuits, memory systems

Slobodan Ribarić – digital system design, computer architecture, robot vision, pattern recognition, knowledge based systems

Assistant professors:

Vlado Glavinić – computer networks, formal definition techniques, user interfaces, office automation

Siniša Srbljić – compiler desing, automata theory, distributed real-time systems, knowledge representation, computer control of production systems

Lecturers:

Aleksandar Szabo

Assistants:

Adrijan Barić
Hrvoje Bunjevac
Željko Butković
Julijana Divković-Pukšec
Boris Kette
Igor Krois
Darko Lukša
Krunoslav Martinčić
Ninoslav Matić
Željka Matutinović-Krstelj
Željka Mihajlović
Miranda Mrković
Joško Radej
Ivo Sekso
Vlado Sruk
Julijan Šribar
Goran Zelić

4.11 Department: High Frequency Technique and Radio Systems

Founded in 1954

Head of the department: Prof. dr. Zlatko Koren

Tel: +38 41 62 98 57

Contact person: Prof. dr. Zlatko Koren

Tel: +38 41 62 96 06,

Staff: 5 professors, 1 associate professor, 1 assistant professor, 4 assistants, 2 researchers

Educational activities: Microwave electronic, passive and active circuits. High frequency electronics, power amplifiers, frequency multipliers, modulators. Radio wave propagation, antennas, radio channel and radio signal analysis, digital and analog modulation methods. Radio links, Satellite communications, Spectrum efficiency. Radionavigation, radiotelemetry, radars, television, video signal generation and processing. Noise in radiocommunications. Electromagnetic compatibility of radio systems. Laser technique and optical communication systems, holography. Mobile radio communication systems. Technology of transmitters and receivers. Baseband and radiofrequency measurement, computer controlled measurement systems. Biomedical effects of electromagnetic fields.

Research & development: Investigation of microstrip antennas and active microwave circuits for applications in active antenna arrays. Transmission and processing of digital signals in satellite radiocommunications. Terrestrial satellite stations in Croatia and their integration in the international and regional satellite network. Land and satellite mobile radiocommunication, spectral efficiency. Electromagnetic compatibility of radiocommunication systems intra- and inter-system problems. Research of advanced technologies for Croatian broadcasting systems, picture, sound and data postproduction, broadcasting signal processing, aliasing measurement on the CCD cameras, fibre optical transmission for CATV, propagation model design and measurement and broadcasting network planing. Biomedical effects of electromagnetic fields.

PERMANENT STAFF

Professors:

Boris Kviz – optical communication systems, radiotelemetry, radiodirection finding

Borivoj Modlic – radio-transmitters, digital radiocommunication systems

Zlatko Smrkić – radiocommunication systems, high-frequency techniques (member coll. of the Croatian Academy of Sciences and Arts)

Ervin Zentner – antennas and propagation, mobile radiocommunications, microwave circuits, electromagentic compatibility, radars

Branka Zovko-Cihlar – television-video signal generation, processing and transmission, noise in radiocommunications

Associate professors:

Zlatko-Tomislav Koren – microwave electronics, microwave measurements, satellite communications, biomedical effects of electromagentic fields, ECM/ECCM

Assistant professors:

Juraj Bartolić – microwave electronics, active antennas

Assistants:

Sonja Bauer
Silvio Hrabar
Robert Nađ
Arno Smolić
Goran Stojkovski
Siniša Habulin

5. Educational programme

A - Lectures
B - Classroom exercises
C - Laboratory exercises
D - Guided research and construction

All the figures for A, B, C, D are expressed in hours per week in a semester (1 hour = 45'). Each semester has 15 weeks. A major revision of our educational programme is under way. Preparatory study below refers to the first and second year of study. Students are specialized after finishing the second year of study.

PREPARATORY STUDY	A	B	C	D
The first year of study:				
MATHEMATICS I	4	4	0	0
PHYSICS I	3	2	1	0
PHYSICAL FUNDAMENTALS OF ELECTRICITY	3	2	2	0
TECHNICAL DOCUMENTATION	0	0	2	0
COMPUTING I	1	1	1	0
PHYSICAL EDUCATION	0	2	0	0
MATHEMATICS II	4	4	0	0
PHYSICS II	3	2	1	0
FUNDAMENTALS OF ELECTROTECHNICS	3	2	2	0
TECHNICAL DOCUMENTATION	0	0	2	0
ELECTROTECHNICAL TECHNOLOGY	2	0	1	0
PHYSICAL EDUCATION	0	2	0	0
The second year of study:				
MATHEMATICS III	4	4	0	0
INTRODUCTORY SOLID STATE PHYSICS	3	2	0	0
MECHANICS	2	2	0	0
ELECTRICAL MEASUREMENTS	2	0	3	0
FUNDAMENTALS OF ELECTROENERGETICS	3	1	0	0
PHYSICAL EDUCATION	0	2	0	0
SCIENCE AND TECHNOLOGY	2	2	0	0
ELECTRICAL MEASUREMENTS	2	0	3	0
ELECTRONIC DEVICES	3	2	1	0
THEORY OF NETWORKS AND LINES	4	2	0	0
FUNDAMENTALS OF ELECTRICAL MACHINES	3	2	0	0
PHYSICAL EDUCATION	0	2	0	0
INDUSTRIAL SOCIOLOGY	2	2	0	0
FOREIGN LANGUAGES	0	2	0	0
PROFESSIONAL STUDY				
The third year of study:				
FIELD: ELECTRICAL POWER ENGINEERING				
TRANSFORMERS	2	2	0	0
THEORY OF ELECTROMAGNETICS	3	3	0	0
ELECTRONIC CIRCUITS	3	1	1	0
FUNDAMENTALS OF MECHANICAL CONSTRUCTIONS	2	1	0	0
ENERGY PROCESSES	4	3	0	0

ECONOMICS FOR ENGINEERS	2	0	0	0
POWER SWITCHING DEVICES	4	1	3	0
SYNCHRONOUS MACHINES	3	1	0	0
POWER SWITCHING DEVICES	0	0	0	1
ELECTRICAL POWER NETWORKS I	4	1	1	0
POWER ELECTRONICS	2	0	1	0
FEEDBACK CONTROL	4	2	1	0
FOREIGN LANGUAGE	0	2	0	0
FIELD: ELECTRICAL MACHINES AND AUTOMATION				
THEORY OF ELECTROMAGNETICS	3	3	0	0
MECHANICAL CONSTRUCTIONS	4	1	0	0
BASIC ELECTRONIC CIRCUITS	2	2	1	0
TRANSFORMERS	2	2	0	0
ELECTRICAL MACHINES I	2	2	0	0
FOREIGN LANGUAGE	0	2	0	0
SELECTED TOPICS IN MATHEMATICS	3	2	0	0
POWER ELECTRONICS	2	2	0	0
ELECTRICAL MACHINES II	0	0	0	1
MECHANICAL CONSTRUCTIONS	0	0	0	2
FOREIGN LANGUAGE	0	2	0	0
ELECTRICAL MACHINES II	3	3	0	0
PULSE AND DIGITAL CIRCUITS	3	2	2	0
FEEDBACK CONTROL	4	2	1	0
FIELD: INDUSTRIAL ELECTRONICS				
ELECTRICAL MEASUREMENTS AND COMPONENTS	3	1	3	0
ELECTRONIC CIRCUITS	4	1	2	0
SELECTED TOPICS IN MATHEMATICS	3	2	0	0
SYSTEMS AND SIGNAL THEORY	3	2	2	0
FOREIGN LANGUAGE	0	2	0	0
PULSE AND DIGITAL ELECTRONICS	4	2	2	0
FOREIGN LANGUAGE	0	2	0	0
ELECTRONIC INSTRUMENTATION	4	1	3	0
AUTOMATIC CONTROL	4	2	2	0
HYBRID AND INTEGRATED CIRCUITS TECHNOLOGY	2	1	1	0
ECONOMICS FOR ENGINEERS	2	0	0	0
FIELD: TELECOMMUNICATIONS AND INFORMATICS				
INFORMATION THEORY	3	1	2	0
LOGICAL ALGEBRA	3	1	2	0
MICROWAVE ELECTRONICS	3	1	2	0
ELECTRONIC CIRCUITS	4	1	2	0
STOCHASTICAL MATHEMATICS	3	2	0	0
FOREIGN LANGUAGE	0	2	0	0
PULSE AND DIGITAL ELECTRONICS	4	2	2	0
INFORMATION NETWORKS	3	1	0	0
DIGITAL AUTOMATA	3	1	0	0
FOREIGN LANGUAGE	0	2	0	0
ECONOMICS FOR ENGINEERS	2	0	0	0
TELECOMMUNICATIONS AND INFORMATICS LABORATORY	0	2	6	0
FIELD: AUTOMATIC CONTROL				
CONTROL SYSTEMS ELEMENTS	2	0	2	0
ELECTRONIC CIRCUITS	4	1	2	0
AUTOMATIC CONTROL THEORY I	4	2	1	0
SELECTED TOPICS IN MATHEMATICS	3	2	0	0
SYSTEMS AND SIGNAL THEORY	3	2	0	0
FOREIGN LANGUAGE	0	2	0	0

PULSE AND DIGITAL ELECTRONICS	4	2	2	0
ANALOG AND HYBRID TECHNIQUE	3	1	2	0
AUTOMATIC CONTROL THEORY II	4	2	2	0
FOREIGN LANGUAGE	0	2	0	0
ELECTRONIC INSTRUMENTATION AND CONSTRUCTIONS	3	1	2	0
FIELD: COMPUTING				
COMPUTER AIDED ANALYSIS	4	3	4	0
ELECTRONIC CIRCUITS	4	1	2	0
STOCHASTICAL MATHEMATICS	3	2	0	0
SYSTEMS AND SIGNAL THEORY	3	2	0	0
FOREIGN LANGUAGE	0	2	0	0
COMPUTER ARCHITECTURE AND ORGANISATION	4	0	6	0
PULSE AND DIGITAL ELECTRONICS	4	2	2	0
PROGRAMMING TECHNIQUES	2	1	2	0
NUMERICAL ANALYSIS	3	2	0	0
FOREIGN LANGUAGE	0	2	0	0
FIELD: RADIOCOMMUNICATIONS AND PROFESSIONAL ELECTRONICS				
INFORMATION THEORY	3	1	2	0
MICROWAVE ELECTRONICS	3	1	2	0
ELECTRONIC CIRCUITS	4	1	2	0
ELECTROACOUSTICS	2	0	2	0
STOCHASTICAL MATHEMATICS	3	2	0	0
FOREIGN LANGUAGE	0	2	0	0
PULSE AND DIGITAL ELECTRONICS	4	2	2	0
MICROWAVE GENERATORS	2	0	2	0
HIGH FREQUENCY ELECTRONICS	4	2	2	0
RADIO RELAY SYSTEMS AND SATELLITE COMMUN	2	0	1	0
FOREIGN LANGUAGE	0	2	0	0
FIELD: POWER TECHNOLOGIES				
SELECTED TOPICS IN ENERGY PHYSICS	3	2	0	0
TRANSFORMERS	2	2	0	0
ELECTRONIC CIRCUITS	3	1	1	0
FOREIGN LANGUAGE	0	2	0	0
FUNDAMENTALS OF MECHANICAL CONSTRUCTIONS	2	1	0	0
ENERGY PROCESSES	4	3	0	0
HEAT TRANSFER IN ENERGY SUBSTATIONS	3	1	0	1
FEEDBACK CONTROL	4	2	1	0
FOREIGN LANGUAGE	0	2	0	0
POWER SWITCHING DEVICES	4	1	3	1
SYNCHRONE MACHINES	3	1	0	0
POWER ELECTRONICS	2	1	0	0
MOTORS AND MOTOR DRIVES	3	0	1	0

The fourth year of study:

FIELD: ELECTRICAL POWER ENGINEERING				
SPECIALISATION: ELECTRICAL POWER SYSTEMS CONSTRUCTION AND EXPLOITATION				
ELECTRICAL POWER NETWORKS I	0	0	0	1
ELECTRICAL POWER NETWORKS II	3	1	1	0
ELECTRICAL MOTORS	2	0	1	0
HIGH VOLTAGE TECHNOLOGY	3	0	2	0
SYNCHRONE MACHINES	0	0	0	1
ELECTRICAL POWER SYSTEM	3	0	1	0
ELECTRICAL POWER PLANTS	0	0	0	1
ELECTRICAL POWER NETWORKS II	0	0	0	1

ELECTRICAL POWER PLANTS	2	0	2	0
ELECTRICAL POWER SYSTEM	0	0	0	1
SELECTED TOPICS IN MATHEMATICS	3	2	0	0
POWER SYSTEM PROTECTION	3	1	2	0
ELECTRICAL POWER NETWORKS III	4	0	1	0
PROJECT LABORATORY	0	0	5	0
ELECTIVES			$\sum$	= 13

FIELD: ELECTRICAL POWER ENGINEERING
SPECIALISATION: MANAGEMENT OF ELECTRICAL POWER SYSTEMS

ELECTRICAL MOTORS	2	0	1	0
HIGH VOLTAGE TECHNOLOGY	3	0	2	0
ELECTRICAL POWER PLANTS	0	0	0	1
ELECTRICAL POWER PLANTS	2	0	2	0
ELECTRICAL POWER NETWORKS I	0	0	0	1
SYNCHRONE MACHINES	0	0	0	1
SELECTED TOPICS IN MATHEMATICS	3	2	0	0
REGULATION IN ELECTRICAL POWER SYSTEMS	2	0	1	0
DIGITAL CONTROL	3	2	2	0
RELAY PROTECTION	3	1	2	0
CONTROL IN ELECTRICAL POWER SYSTEMS	3	0	2	0
CONTROL IN ELECTRICAL POWER SYSTEMS	0	0	0	1
PROJECT LABORATORY	0	0	5	0
ELECTIVES			$\sum$	= 13

FIELD: ELECTRICAL POWER ENGINEERING
SPECIALISATION: GENERAL POWER ENGINEERING

SELECTED TOPICS IN MATHEMATICS	3	2	0	0
ELECTRICAL POWER PLANTS	2	0	2	0
ELECTRICAL POWER PLANTS	0	0	0	1
HIGH VOLTAGE TECHNOLOGY	3	0	2	0
SYNCHRONE MACHINES	0	0	0	1
ELECTRICAL MOTORS	2	0	1	0
ELECTRICAL POWER SYSTEM	3	0	1	0
ELECTRICAL POWER SYSTEM	0	0	0	1
INTRODUCTORY NUCLEAR PHYSICS	2	2	0	0
ELECTRICAL POWER NETWORKS I	0	0	0	1
ENERGY SOURCES	3	2	0	0
ENERGY SOURCES	0	0	0	1
ELECTRICAL POWER SYSTEMS AND POWER BALANCE	3	2	0	0
ELECTRICAL POWER SYSTEMS AND POWER BALANCE	0	0	0	1
OPERATIONS RESEARCH	2	2	0	0
ECONOMICS IN ENERGETICS	2	2	0	0
POWER ENGINEERING AND ENVIRONMENT	2	1	0	0
PROJECT LABORATORY	0	0	7	0
ELECTIVES			$\sum$	= 13

FIELD: ELECTRICAL MACHINES AND AUTOMATION

ELECTRICAL MACHINES III	2	0	1	0
ELECTRICAL MACHINES III	0	0	0	2
ELECTRICAL MOTOR DRIVES	3	2	0	0
CONTROL OF ELECTRICAL DRIVES	3	1	2	0
DIGITAL CONTROL	3	1	1	0
ELECTRICAL POWER DISTRIBUTION	3	1	0	0
ELECTRICAL POWER DISTRIBUTION	0	0	0	1
DISCRETE AND NONLINEAR REGULATION SYSTEM	3	1	1	0
ECONOMICS FOR ENGINEERS	2	0	0	0
ELECTRICAL MACHINES IV	3	1	3	0

PROJECT LABORATORY	0	0	5	0
ELECTIVES			$\sum$	= 15
FIELD: INDUSTRIAL ELECTRONICS				
COMPUTERS	3	2	1	0
SIGNAL PROCESSING SYSTEMS	4	1	2	0
BIOMEDICAL ELECTRONICS	2	1	1	0
INTEGRATED CIRCUITS - TECHNOLOGY AND APPL	2	0	1	0
TRANSMISSION AND TELEMETRY SYSTEMS	3	2	1	0
DIGITAL SYSTEM DESIGN	3	0	2	0
POWER ELECTRONICS	2	0	1	0
NONLINEAR SYSTEMS	2	1	1	0
DEVELOPMENT AND PRODUCTION OF ELECTRICAL DEVICES	3	2	1	0
PROJECT LABORATORY	0	0	5	0
ELECTIVES			$\sum$	= 11
FIELD: TELECOMMUNICATIONS AND INFORMATICS				
COMPUTERS	3	2	1	0
SWITCHING SYSTEMS	3	0	0	0
DATA TRANSMISSION AND PROCESSING	3	0	0	0
INFORMATION SYSTEM EFFICIENCY	3	0	0	0
TRANSMISSION SYSTEMS AND TERMINALS	3	0	0	0
TELECOMMUNICATION NETWORKS	3	0	0	0
COMPUTER APPLICATIONS IN TELECOMMUNICATIONS	3	0	0	0
TELECOMMUNICATIONS AND INFORMATICS LABORATORY	0	2	6	0
INTEGRATED DIGITAL NETWORKS - SEMINAR	0	2	6	0
PROJECT LABORATORY	0	2	6	0
ELECTIVES			$\sum$	= 12
FIELD: AUTOMATIC CONTROL				
COMPUTERS	3	2	1	0
SIGNAL PROCESSING SYSTEMS AND CIRCUITS	3	0	2	0
AUTOMATIC CONTROL THEORY III	4	2	2	0
PROCESS CONTROL	3	1	2	0
SERVO SYSTEMS	3	2	2	0
COMPUTERS AND PROCESSES	3	1	2	0
ECONOMICS FOR ENGINEERS	2	0	0	0
PROJECT LABORATORY	0	0	6	0
ELECTIVES			$\sum$	= 16
FIELD: COMPUTING				
COMPUTERS	3	2	1	0
DIGITAL SYSTEMS DESIGN	3	0	4	0
STORAGE SYSTEMS	3	0	2	0
OPERATING SYSTEMS	3	0	3	0
LANGUAGE PROCESSORS	3	0	3	0
OPERATIONS RESEARCH	2	2	0	0
MODELLING AND SIMULATION	3	0	2	0
ECONOMICS FOR ENGINEERS	2	0	0	0
PROJECT LABORATORY	0	2	9	0
ELECTIVES			$\sum$	= 8
FIELD: RADIOCOMMUNICATIONS AND PROFESSIONAL ELECTRONICS				
COMPUTERS	3	2	1	0
RECEIVERS	3	0	2	0
RADIOLOCATION AND RADIOTELEMETRY	4	1	2	0
AUDIOFREQUECY TECHNOLOGY	3	0	2	0
RADARS AND RADIOCOMMUNICATIONS	4	1	2	0
MAGNETIC RECORDING	2	0	1	0

TELEVISION	3	0	3	0
ECONOMICS FOR ENGINEERS	2	0	0	0
PROJECT LABORATORY	0	0	5	0
SEMINAR	0	2	0	0
ELECTIVES			$\sum$	= 12
FIELD: POWER TECHNOLOGIES				
FUNDAMENTALS OF NUCLEAR REACTOR THEORY	3	1	0	1
SELECTED TOPICS IN MATHEMATICS	3	2	0	0
ELECTRICAL POWER PLANTS	2	0	2	1
CYCLES AND REACTOR FUEL MATERIALS	3	1	0	0
ECONOMICS FOR ENGINEERS	2	0	0	0
REGULATION OF POWER PLANTS	3	0	2	0
LABORATORY FOR RADIATION DETECTION AND PROTECTION	0	0	4	0
ELECTRICAL POWER SYSTEM AND NETWORKS	4	1	1	0
ENERGY SOURCES	3	1	0	0
POWER ENGINEERING AND ENVIRONMENT	2	1	0	0
NUCLEAR POWER PLANTS	4	1	0	1
NUCLEAR POWER PLANTS SECURITY	3	1	0	0
PROJECT LABORATORY	0	0	0	5
ELECTIVES			$\sum$	= 4
ELECTIVES:				
LASER PHYSICS	2	2	0	0
ELECTRICAL APPARATUS	4	2	0	0
INDUSTRY PLANTS DESIGN	2	2	0	0
COMPUTER APPLICATIONS IN ELECTROENEGETIC	2	2	0	0
ELECTROENERGY SYSTEMS RELIABILITY	2	2	0	0
AUTOMATISATION OF ELECTRICAL PLANTS	3	2	0	0
DYNAMICS IN ELECTROENERGY SYSTEMS	2	2	0	0
ELECTRICAL MACHINES LABORATORY	2	4	0	0
LABORATORY FOR CONTROL OF ELECTRICAL MACHINES	2	4	0	0
DIGITAL CONTROL LABORATORY	2	4	0	0
POWER ELECTRONICS - SELECTED TOPICS	2	2	0	0
ELECTRIC TRAINS	3	1	0	0
TRANSDUCERS AND PROCESS MEASUREMENTS	2	2	0	0
INDUSTRIAL MEASUREMENT SYSTEMS	2	2	0	0
PROCESS MEASUREMENTS SYSTEMS AND IND. SURVEILLANCE	2	2	0	0
PROCESS IDENTIFICATION	2	2	0	0
FILTER DESIGN	2	2	0	0
DIGITAL SIGNAL PROCESSING	2	2	0	0
NUMERICAL METHODS IN NETWORK AND SYSTEMS	2	2	0	0
SELECTED TOPICS IN BIOMEDICAL ENGINEERING	2	2	0	0
BIOELECTRIC SYSTEMS	2	2	0	0
AUTOMATED INSTRUMENTATION	2	2	0	0
REAL TIME PROGRAMMING SYSTEMS	2	2	0	0
COMPUTER AIDED DIGITAL SYSTEMS ANALYSIS	2	2	0	0
DATA PROCESSING ORGANIZATION	2	2	0	0
ALGORITHMS AND METHODS FOR SYSTEMS OPTIMIZATION	2	2	0	0
ELECTRONIC SWITCHING SYSTEMS	2	2	0	0
DIAGNOSTICS AND RELIABILITY OF DIGITAL AUTOMATA	2	2	0	0
ORGANIZATION AND EXPLOITATION OF TELECOMMUNICATION NET.	2	2	0	0
INFORMATION NETWORKS TRAFFIC	2	2	0	0
DIGITAL TRANSMISSION SYSTEMS	2	2	0	0
DATA TRANSMISSION	2	2	0	0
MICROCOMPUTERS	2	2	0	0
INDUSTRIAL MEASUREMENTS	2	2	0	0
COMPUTER AIDED SYSTEM DESIGN AND CONTROL	2	2	0	0
AUTOMATION OF FLOATING VESSELS	2	2	0	0

REMOTE SURVEILLANCE AND CONTROL SYSTEMS	2	2	0	0
ALARM SYSTEMS	2	2	0	0
CONTROL IN ROBOTICS	2	2	0	0
COMPUTER GRAPHICS	2	2	0	0
COMPUTER AIDED DESIGN	2	2	0	0
COMPUTER NETWORKS	2	2	0	0
NOISE IN COMMUNICATION SYSTEMS	2	1	0	0
ELECTRONIC EQUIPMENT COMPONENTS AND MEASUREMENTS	2	1	0	0
OPTICAL COMMUNICATION SYSTEMS	2	1	0	0
MOBILE RADIOCOMMUNICATIONS	2	1	0	0
TRANSMITTER-RECEIVER THEORY	2	1	0	0
DIGITAL AND ANALOG MODULATION METHODS	2	1	0	0
SPATIAL ACOUSTICS	2	1	0	0
ULTRASOUND AND HYDROACOUSTICS	2	1	0	0
SPEAKING AND MUSIC ACOUSTICS	2	1	0	0
QUALITY OF ELECTROACOUSTIC DEVICES	2	1	0	0
PUBLIC-ADDRESS AND LOUDSPEAKER SYSTEMS	2	1	0	0
PROFESSIONAL TONAL FREQUENCY DEVICES	2	1	0	0
DIGITAL MICROWAVE COMMUNICATIONS	2	1	0	0
MICROWAVE RECEIVER CIRCUITS	2	1	0	0
DATA BASES	2	2	0	0
FUNCTIONAL PROGRAMMING	2	2	0	0
PATTERN RECOGNITION	2	2	0	0
EXPERT SYSTEMS	2	2	0	0
RADIOFREQUECY AMPLIFIER DESIGN	2	1	0	0
DIGITAL AUDIO TECHNOLOGY	2	1	0	0
ADAPTIVE CONTROL SYSTEMS	2	2	0	0

Dear reader,

When you meet a new friend or colleague, you are necessarily confronted with his cultural and historical background, peculiarities of his own, that are sometimes difficult to conceive.

Having this in mind, we believe you will understand our wish to present in this small booklet not just dry facts about our Faculty of Electrical Engineering within the Croatian *University of Zagreb*. We would also like to give you a better insight into what could be called a Croatian cultural heritage, at least in a rapid and sketchy way. The connections with other European cultures are, as you will see, deep and longstanding. We shall also try to intersperse this text with some interesting facts by which Croatia is recognizable.

In short, we start by describing an extremely complex entity, unique in Europe, revived again after almost nine centuries as the Republic of Croatia (Republika Hrvatska).

6. Generalities and basic facts about Croatia

Croatia has 56 538 m^2, 4.76 million inhabitants (just a quarter of New York), and almost as many abroad, counting through last three generations. It had the greatest emigration rate in the world, after Ireland.

The national structure of Croatia is as follows: Croats 79% (mostly Catholics) and national minorities – Serbs 12.2% (i.e. about 560 000, mostly Orthodox Christians), Hungarians, and many other smaller ethnic groups – Muslims (yes, the nation of the Muslim Slavs, as explained on p. 43), Czechs, Slovaks, Italians, Jews, Germans... altogether 26 national minorities. The figures refer to the situation immediately before the aggression of Serbia and Montenegro on Croatia in 1991.

Parts of the Croatian nation are historically and culturally deeply rooted to the territories of the neighbouring *Slovenia, Hungary, Bosnia and Herzegovina, Serbia, Montenegro*, and also to Austria, Czechoslowakia, Italy, Roumania.

The Croats are represented by: *Bunjevci* and *Šokci* (many of them live also in Hungary and Vojvodina in Serbia), *Slavonci, Zagorci, Međimurci*, then the Croats in Bosnia and Herzegovina, *Gorani, Istrani* (a part of them is in Slovenia), *Gradišćanci* (in Austria and Hungary), *Dalmatinci, Dubrovčani, Bokelji* (in Montenegro), *Janjevci* on Kosovo in Serbia etc. All these Croatian groups and regions provide a great richness of dialects, national costumes, habits, folk songs.

The present capital of Croatia is the city of *Zagreb* (population 1 000 000), very old and pleasant city, mentioned for the first time in 1094. In former Yugoslavia Zagreb was a leading industrial, cultural and scientific center.

The Croatian National Emblems are: the tricolour flag (red, white, blue, arranged in this order perpendicularly to the staff), and the coat of arms (13 red squares and 12 silver squares arranged intermittently in a 5 times 5 pattern). This coat of arms was affirmed by 15th century documents. It is a very old symbol of Croatia ressembling a red–white chess table.

Croatia has

- about a thousand islands,
- as such – probably the most interesting coast in Europe,
- a mountain of unique and incomparable natural beauty – *Velebit* – one of the trademarks of Croatia, with unforgettable views to the islands and the mainland. It was recognized as a part of the international network of Biosphere Reserves, and was the victim of the Serbian aggression in 1991/92,
- the most beautiful national park in Europe – the *Plitvice Lakes* (devastated during the Serbian aggression on Croatia in 1991/92),
- the richest bird reservation in Europe (until the Serbian aggression in 1991) – *Kopački Rit*, near the city of Osijek,
- among the world's most beautiful and best preserved medieval cities (until the Serbian and Montenegrin aggression in 1991) – *Dubrovnik*,

- the smallest and lovliest town in the world – having two streets, two churches and 23 inhabitants – *Hum*, in the Istrian peninsula,
- probably the most ferociously devastated city in the history of mankind, eternal monument of human destructivness and human indifference – *Vukovar*. Five hundred thousand shells were fired by Serbian aggressors onto the area of only several square kilometers, inhabited by 15 000 people (normally 80 000), in the course of three months, by the end of the twentieth century (the year 1991).

Maybe you will find some of these lines exaggerating, but we invite you to check them for yourself.

6.1 Historical and cultural overview. Though Croatia developed under the impact of many different cultures – Greek, Roman, Celtic, Illyrian, Austrian, Hungarian, Byzantine, Islamic – it gave its own and unique imprint to the history of Europena civilization.

Let us first give a very rough sketch of the main historical periods of the Croatia's past:

- the arrival of the Croats to the Balkan peninsula at the beginning of the 7th century,
- the period of Croatian dukes and kings of native birth (until 1102),
- Croatia sharing with Hungary a new state under common Hungarian and Croatian kings (1102–1526),
- Croatia ruled by the the Habsburgs (1527–1918, Austro Hungarian Empire from 1867 to 1918), parts of Croatia under Venice, Turkie and France,
- Croatia in the first Yugoslavia (1918–1941),
- Croatia as a republic in Tito's (or second) Yugoslavia (1945–1991),
- internationally recognized Republic of Croatia (1992).

Croatia is a point of contact of very different cultures and civilizations. Across its territory or along its boundary the border between *Western and Eastern Roman Empire* had been laid (4th century), the border between *Francs and Byzant* (9th century), between *Western and Eastern Christianity* (11th century) and between *Islam and Christianity* (15–19th century).

1. The origins of the Croatian name are Iranian. The earliest mention of the Croatian name as *Horovathos* can be traced on the stone inscriptions in Greek language, dating from the second century, found by the Black Sea (more precisely – the Azov sea). It can be also traced on the sites around Krakow in Poland, Bohemia, Austria, thus showing migrations of the Croatian tribes to their future homeland.

Constantine Porphyrogenitus (905–959), a Byzantine emperor and writer mentiones the state bearing the name *Great or White Croatia*. His description shows that it occupied a wide region around present Krakow. *St. Adalbert* (Vojtěch, 10th century) was a descendant of the White Croats. It is interesting to add that according to some American documents from the beginning of this century there were immigrants

to the USA born around Krakow who declared themselves to be *White Croats* by nationality.

The Byzantine emperor Heraclius (610–641) asked the Croats from White Croatia for help in protecting his Empire from the penetration of the Avars. A part of the White Croats moved to the territories of present Croatia in the 7th century. There they came in touch with the Romans and romanized descendants of Illyrians, Celts and others.

Soon after their arrival in the 7th century they were evangelicized and so accepted Christianity. The Croats were the first among the Slavs who converted to Christianity.

The Roman Empire was divided in 395. Later the Croats entered the Western Roman Empire. The historical border between the Eastern and Western Roman Empire was the river Drina. It flows between present Serbia and Bosnia, and in the past it devided in political and cultural sense two very different civilisations, which had been separated until the penetration of the Turks in the 16th century. Later in 1054 this division also defined the border of the two Churches, one under Byzantium (Constantinople) and the other under Rome. Let us mention that Montenegro and Albania belonged to the Western Church. In 1184 the Serbian Orthodox Church penetrated by military expansion to Montenegro. Until that time the territory of Montenegro was a part of *Red Croatia*. Serbia, and later Montenegro, developed on the heritage of the Eastern Roman Empire (or Byzantine Empire).

2. *Duke Trpimir* ruled from 845 to 864. In 852 he issued the oldest known governmental document in the Latin script, where the Croatian name was mentioned. The fact that his name is recorded in the Čedad evangel (from today's Italian city Cividale) shows the cultural level of his state. The most famous Benedictin monk Gottschalk found refuge at the Croatian court from 846 to 848. Trpimir invited the *Benedictins*, known as great promoters of education and economy. The first Benedictin convent was built in 852 near Split. In the 11th century Croatian Benedictins had more than 40 convents, mostly along the Adriatic coast. They contributed a great deal to the cultural and material development of the Croats.

The Croatian *duke Branimir* made further steps in strenghtening the relations with Rome. During the solemn divine service in St. Peter's church in Rome in 879, Pope John VIII gave his blessing to the duke and the whole Croatian people, about which he informed Branimir in his letters. In his letter dated from 881 the Pope adressed Branimir as the 'glorious duke'. This was for the first time that the Croatian state was officially recognized (at that time the international legitimity was given by the Pope). In Branimir's time Venetians had to pay taxes to the Croatian state for their ships traveling along the Croatian coast.

The earliest dukes and kings we know of lived in the 9th and the 10th century. The strongest among them was *king Tomislav*, who ruled from from 910 to 928. The previously mentioned Constantine Porphyrogenitus, a Byzantine emperor, refered to him as the *Croatian king*. In his time Croatia was one of the most powerful states in Europe. It had an enormous army of 100000 pedestrians and 60000 horsemen, 80 larger and 100 smaller ships. When Bulgaria occupied Serbia in 924, king Tomislav

accepted and protected many Serbs who had escaped and sought refuge in the Croatian state. The Bulgarian tsar Simeon soon tried to spread his reign to Croatia, but Tomislav defeated him in 927. The Serbs organized their earliest internationally recognized kingdom in 1217.

The Arabs began to atack the Croatian coast in the 9th century. So a Croat from Dalmatia, known under the Islamic name *Djawhar ben Abd Allăh* (911–992), was taken as a slave to the court of calif Al–Khaim in Tunisia. Later he made a great career becoming the supreme general. He conquered the land of pharaos, thus extending the Empire of Fatimids from the shores of the Atlantic to the river Nile. He founded the new Egiptian capital Al–Qahira (Cairo), the future second largest Islamic city after Baghdad. In 970 he built up the mosque named Al–Azhar (the Brightest).

The Croats were deeply devoted to the Western Church. When Pope Alexander III visited *Zadar* in 1177, one of the most beautiful European cities, he was solemnly greeted by people singing very old songs in their Slavic language ("...immensis laudibus et canticis altissime resonantibus in eorum Sclavica lingua"). During the shameful aggression of Venetians and Crusaders in 1202, the Christian city of Zadar was robbed and terribly destroyed. The city was again destroyed in the Second World War and bombed in the Serbian aggression 1991/92.

At the beginning of the 13th century the penetration of the Mongolian Tatars was a great danger for Europe. Having occupied Russia, Poland, Hungary they penetrated to Croatia where they were defeated in several battles.

3. From 1102 the Croats had shared together with Hungarians a newly built state under common Hungarian and Croatian kings. The kings were crowned twice: with the Hungarian and the Croatian crown. From that time on, the Croats were dreaming about having their own independent state, and it was revived after almost nine centuries in 1991.

During this very long period parts of Croatian soil were dominated by Venetians, Italy (in the first half of the 20th century), the Ottoman Empire and the Habsburgs. Among all the nations reigned by the Habsburgs (Czechs, Poles, Slovenians and others) the Croats are together with Austrians and Hungarians the only ones who have preserved an uninterrupted continuity of their state since the Early Middle Ages.

From 1918 to 1929 Croatia was one of the states in the Kingdom of Serbs, Croats and Slovenians. In 1929 it was renamed to Yugoslavia and existed as such until 1941 and as a communist state from 1945 to 1991. The Croats are despite all the difficulties the only ones among all the nations of former Yugoslavia whose state has had uninterrupted continuity since the ninth century.

The territory which was called Yugoslavia from 1929 was a point of contact of three very different worlds: the Catholic West, the Orthodox East and Islam, the religion of Muslims. Only Slovenia, situated to the west of Croatia, was relatively safe from the threat of Orthodox Christians and Islam. This is why the Republic of Slovenia was nationally the most compact and economically the most developed region in former Yugoslavia. Please, note the difference between Slovenia, Slovakia and *Slavonia*, which is a part of Croatia (though the origin of all these names is the

same).

4. Especially interesting are the traces left by the Turkish Ottoman Empire. This civilization, that was present on Croatian soil from the 15th to the 19th century (in eastern parts of former Yugoslavia until the beginning of the 20th century), left a deep imprint. Many Croats converted to Islam. The Muslim Slavs are in great majority of Croatian descent, and constitute now a *nation*, recognized according to their own wish in 1968 (*Muslimani* has been the usual name since the beginning of the 20th century). Except in Croatia they live today mostly in Bosnia and Herzegovina and Sandžak (a province in the south of Serbia, between Montenegro, Kosovo and Bosnia).

Very cruel persecutions of the Muslims by the Serbs and Montenegrins resulted in their massive emmigration of Muslims to Turkey soon after the foundation of Kingdom of Serbs, Croats and Slovenes in 1918, where Serbia was the leading and privileged nation. The same happend to several hundred thousand Muslims soon after the Second World War. We have witnessed the same persecutions in 1992. Only in the first half of this year about 250 000 Croats and Muslims were exiled from Bosnia to Croatia, as an adding to its own 350 000 citizens exiled from the occupied areas.

Islam left valuable written and architectural monuments, like in Spain for instance. Let us mention that Croatia's capital Zagreb has one of the biggest and most beautiful newly built mosques in Europe, although in Turkish time it had none (Zagreb was never occuppied by the Turks). For instance in Belgrade, the capital of Serbia, there had been about seventy mosques from the Turkish time, out of which only one survived.

In the province of *Molise* in central Italy there is a small Croatian enclave, living today in several villages, inhabited in the 16th century by the Croats fleeing before the Turks. Among them the most famous was *Pope Sixto V* (he was the Pope from 1585 to 1590), who spoke Croatian at home. Since the 16th century a similar enclave has existed near Bratislava in Slovakia. The largest Croatian community of exiles dating from that period is in the area of Gradišće (Burgenland) in Austria and Hungary. It is estimated that until the 18th century there were about *two million Croats* who had been either exiled or taken as slaves to Turkey. Among the Bosnian Catholics there was a large number of Cryptocatholics, i.e. those who were secretly Catholics at home, and "Muslims" out of it. Children were circumcised, but secretly baptized as well.

After the catastrophic defeat of the Serbs in the Kosovo field in 1389, on whose side both Croatian forces from Bosnia and Albanian troops had also participated, Serbia became a vassal state to the Turkish Empire.

In the 16th century the Turks started settling down Serbian population in the emptied regions previously inhabited by the Croatian Catholics. The representatives of the Serbian Orthodox Church had the privilege to collect taxes from the Croatian Catholics. In this way the Serbs wanted to include the Catholics into the Orthodox Church, which was under the control of the Turks (the residence of the Serbian Patriarch was in Constantinople in present-day Turkey).

Let us mention by the way that the animosity of the Orthodox Christians against Catholics was strenghtened first in Greece and then in Serbia after the Crusaders had occupied Constantinople and formed the Latin Empire (1204–1261).

Before the Turkish penetration in the 15th century there were 151 Catholic churches in Bosnia, about 20 convents, and not a single Serbian Orthodox church. The territories on the right bank of the river Una bore the name of the *Turkish Croatia* in the European literature of 18th and 19th century. Several Catholic orders were present in Bosnia: Benedictins, Paulines and above all Franciscans. Immediately after the arrival of the Turks a large number of Serbian Orthodox churches was built up, many of them on the ruins of Catholic churches. Under the pressure of the Serbian Clergy many Croatian Catholics had to convert to the Serbian Orthodox Christian faith. And the religion was one of the decisive factors in the national affiliation of the people in Bosnia.

Both Croats and Serbs are Slavs. The Serbs living in Bosnia came with the Turks mostly as assisting Turkish troops. It should be emphasised that these Bosnian Serbs were originaly *Valachies* from Montenegro and northern Albania. In fact they were non–slavic nomads – Protoromans and romanized Balkan Celts and Illyrians, who accepted the Serbian Orthodox faith (there were also Catholic Valachies in Croatia, croatized after 16th century). Later, under the influence of the Serbian Orthodox Church in Bosnia, they became Serbs. They had been fighting on the Turkish side until the decline of the Turkish Empire started. Their enclaves in present day Croatia follow roughly the border of the Turkish Empire in the medieval Croatia.

These migrations led to further complications. Counting on these Serbian settlers as a military aid, the Austrian kings supplied them with privileges. This meant that parts of the Croatian territory were not completely under the Croatian jurisdiction and the Croats felt them as intruders within their state. This was the beginning of the so called *Krajina* ('Military Frontier', a unique creation in the military history of Europe), whose complete and systematic ethnical cleansing from Croats and from everything reminding on their existence was finished during the Serbian agression in 1991/92.

Here we see the beginning of the present day drama of Croatia and Bosnia and Herzegovina. It is important to note that the contemporary plan of creating the 'Greater Serbia' defines its borders roughly as those gained by the Turkish Empire in the past, tracing the farthest Serbian enclaves in Croatia. This irrational plan was laid down in a secret written programm, created in 1844 by the Serbian minister of inner affairs. Today the main promotor of this idea today is the Serbian Academy of Sciences and Arts, through systematic indoctrination of the entire Serbian population. This highest cultural institution of Serbia bears the greatest responsability for the terrible tragedy of the Croats, Muslims and even their own people in the aggression that started in 1991. From the total number of*

* More informations about the panserbism you can find in an excellent book of Cristophe Dolbeau

population in the states of Croatia and Bosnia and Herzegovia there are altogether 20% of Serbs.

The scheme for creating the 'Greater Serbia', hidden behind the idea of New Yugoslavia, was planned in Belgrade. Up to now we have seen the following main stages:

1. *canceling the autonomy of Kosovo and Vojvodina through indescribable brutalities in 1987; Montenegro with its puppet regime becoming a Serbian province in political, economical and ecclesiastical sense,*
2. *the withdrawal of the Yugoslav Army from Slovenia and the aggression against Croatia in 1991,*
3. *the aggression on Bosnia and Herzegovina in 1992, which is the key point of the whole plan. The aim is to obtain ethnicaly pure Serbian territory by exterminating the Muslim Slavs and Croats.*

*The second stage of this plan started in the region of Knin, a small Croatian town, which used to be the residence of Croatian kings, now inhabited mostly by the Serbs of the Valachian origin. It was carefully planned immediately after Tito's death in 1980 and coordinated from Belgrade, disguised as pretended care for the 'endangered' Serbs in Croatia. In the beginning it was a very consistent, simultaneous activity of the Serbian Orthodox Church, Yugoslav diplomacy, Belgrade propaganda machinery and armed extremists** supported by the Yugoslav army. The Yugoslav army, which had been ranked as the third in Europe according to its military potential, soon became the greatest and most aggressive formation. It should be said that the most tragic outcome of this terrible war is in great extent due to the behavior of some leading European politicians, who were not willing to admit in time that Croatia was attacked and their hasitating to name the aggressor.*

Let us continue our story on the history of medieval Bosnia. The *"tax in blood"* (devshirma) was the most tragic for Bosnian Catholics. It meant that every three or four years 300 to 1000 healthy boys and young men had to be taken by force to Turkey, converted to Islam and educated for military profession or religious disciplins. Some desperate mothers even mutilated their children trying to save them.

After the arrival of the Turks the states of Bosnia and Albania, which had been previously Catholic, became more and more islamized. Moreover, in the same time in Bosnia the Serbian Orthodoxy, supported by the Turks, was spreading. The Jews exiled from Spain (Sefards) who arrived to Bosnia in the 16th century were accepted by the Turkish state and exempt from the tax in blood, but not from paying taxes to

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** Maybe it will be difficult for the reader to hear about a morbid song of Serbian extremists, revealing in full extent the character of the aggression against Croatia and Bosnia and Herzegovina. It starts like this: "Milošević, bring us salad, we shall have meat, we'll buthcer the Croats". Equally morbid is their flag: it is black, with a skull and cross-bones. All this was shown by CNN on TV (unfortunately without the English translation) in November 1991, when Serbian troops entered *Vukovar*, completely destroyed after three months of uninterrupted shelling and bombing.

the Serbian Church.

It is also interesting to note that the language which the Turkish court officially used to communicate with the Balkan Slavs was Croatian. Many islamized Croats were present at the Turkish court as writers, officers, even great vezirs.

In 1526 the disastrous defeat of Hungarian and Croatian army took place in the Mohač field in southern Hungary. Let us mention by the way that since 1991 this area has offered refuge to 45 000 exiles, mostly Croats from Serbia and occupied parts of Croatia.

Nikola Zrinski Junior (1620–1664), a Croatian statesman and writer, described in his epic "The siege of Siget" the heroic death of his grandfather *Nikola Šubić Zrinski* in 1566, which entered all the historical annals of the 16th century. With his 2500 brave soldiers, mostly Croats, he was defending the fortress of *Sziget* in southern Hungary against 90 000 Turks. The Turkish troops were under the sultan Sulejman the Great and supplied by 300 cannons. It took them a month to defeat the Croatian soldiers, who all died a terrible death in the final battle. Despite his promise, the king Maximillian Habsburg did not help Nikola Šubić Zrinski. Historians say that the Turks had almost 30 000 dead. Cardinal Richelieu, the famous French minister at the court of king Lui XIII, wrote the following: "A miracle was necessary for the Habsburg Empire to survive. And the miracle happened in Sziget". The above mentioned epic was written in the Hungarian language. Though written by the Croat, it is regarded to be one of the greatest acheivements of the early Hungarian literature.

Ban (governor) *Petar Zrinski* (1621–1671) and *Fran Krsto Frankapan* (1643–1671), both outstanding as statesmen and writers, are among the most beloved figures in the history of Croatia. They had a great successes in liberating the areas occupied by the Turks. However, the Viennese Military council, instead of supporting them to free the rest of the Hungarian and Croatian lands, signed a shameful peace treaty with Turkey, by which the liberated territories had to be handed back to the Turks. The result of the rebellion against Vienna was a cruel public decapitation of Zrinski and Frankapan in Wiener Neustadt near Vienna in 1671. The remainings of these two Croatian martyrs were burried in the Cathedral of Zagreb in 1919.

It is interesting that, while in prison, Fran Krsto Frankapan translated Molièr's "George Dandin" into Croatian, written only two years earlier in Paris (it was its first European translation). The letter sent by Petar Zrinski to his wife Katarina and their children just a day before his death is is one of the most deeply moving texts ever written in the Croatian language. It was very soon translated and published in Italian, Latin, Dutch, English, French, Spanish, Hungarian. His wife Katarina, also an outstanding poetesse, was imprisoned by general Spankau in a convent in Graz, where she went insane and died in extreme poverty.

Then these six centuries old noble Croatian families died out and their property was robbed. A period of the influence of the apsolutistic Viennese politics had started.

By the end of the 17th century some of the occupied parts of Croatia and Hungary were liberated from the Turks. The Serbs joined Austrian forces (composed mostly of Croats), hoping to get a full freedom. However, the Austrian forces were

defeated near Skopje in Macedonia. The Turks managed to regain most of the lost teritories, and then a very difficult period for Serbian people started. Fearing the revenge of the Turks, in 1690 Kosovian Serbs (37 000 families) left for present day Vojvodina, a very fertile region, the part of which between the rivers Sava and Danube was a Croatian territory and Hungarian to the north of the Danube. Actually, the exodus of Serbs included even Budapest. Most of the Catholic convents in Vojvodina became the 'property' of the Orthodox Church, whose aggressivity made interconfessional relations very tense. The emptied territories of Kosovo were then populated by the islamized Albanians. Today the official Serbia quite unjustly claims an equal right to both Kosovo and Vojvodina.

The penetration of the Ottoman Empire to Europe was stopped on Croatian soil, which could be in this sense regarded as a historical gate of European civilization. Since 1519 Croatia has been known as *"Antemurale Christianitatis"* in Western Europe. The name was given by Pope Leo X.

The Croats endured the greatest burden of this four century long war against the Turks. The most tragic fact in this war was that many islamized Croats had to fight against the Catholic Croats. It is interesting to note that the city of Zagreb and nearby Sisak despite many attemts were never occupied by the Turks, though they came as far as Vienna in 1683. Budapest for instance was in the hands of the Turks for 160 years.

Present day Croatia is profoundly related to Bosnia and Herzegovina, which is ethnically certainly the most complex state in Europe. It has three major ethnic groups: the Muslims, Serbs and Croats, very intermixed. Let us mention by the way the world–famed *Međugorje*, which is in the area inhabited by Croats. During the last ten years it was visited by millions of pilgrims. It was bombed by Serbian and Montenegrin aggressors in 1992.

Deep traces were left by the *Bosnian Franciscans*, present on Bosnian soil since 1291 (only 80 years after the foundation of the Franciscan order). They were beloved by people, for being educated and humble, for keeping the national and religious identity of the Croats. In 1376 they had 35 convents and about 400 missionaries. In Turkish time, by a special Charter (Ahdnama, 1463) from the Sultan, the Bosnian Franciscans and their Croatian Catholics had a guaranty to live in peace and freedom in his Empire. However, in reality it was rather different. Today the richest library in Bosnia and Herzegovina is in the Franciscan convent of Mostar (bombed in 1992). The most famous Croatian Franciscan is *Nikola Tavelić* (born in Šibenik about 1340–1391), a missionary in Bosnia and Yerusalem, a martyr whom Pope Paul VI proclaimed a Saint in 1970. We should also mention another Franciscian–capuchin, *Saint Leopold Mandić* (1866–1942), who was a forerunner of today's Ecumenism.

God knows how many Croatian martyrs and saints there really are.

Difficult historical conditions, relations with very different civilizations, left deep traces. One of the consequences is the unusual geographical shape of present day Croatia. Note that its mainland is not connected.

5. The territory of the famous *Republic of Dubrovnik* (Ragusa), though some-

how disconnected from the main part of Croatia, was able to keep balance with great forces, which always had respect for its economic wellbeing and culture, and it remained free due to its numerous diplomatic and economic relations. Dubrovnik was especially flourishing from the 15th to the 18th century, and was the chief rival to Venice. In the 16th century Dubrovnik had a fleet of 200 larger ships, which grew to 300 in the 18th century. Around 1780 the ships from Dubrovnik were sailed to New York, Baltimore etc.

Literature written in Croatian flourished there. In the first place we should mention *Marin Držić* (1508–1567), who is one of the most outstanding names of the European Renaissance literature, a predecessor to Molière's comedy and Shakespeare's drama. One of the greatest Croatian poets was *Ivan Gundulić* (1589–1638), who wrote the well known and endeared patriotic verses: "Oh beautiful, oh dear, oh sweet liberty..." The word 'Libertas' is written on the flag of the famous city of Dubrovnik and its freedom loving people.

In 1272 Dubrovnik had its first statute and urban planning, in 1296 a sewerage, in 1377 the *first quarantene in Europe*. The *first European pharmacy* that has been working continuously till these days was opened there in 1317. Among the oldest ones (from 1355) is also the pharmacy of Zagreb, in which a grandson of Dante was a pharmacist. According to some documents the pharmacy in the city of Trogir goes back as early as 1271. The first hospital (Domus Christi) in Dubrovnik was opened in 1347. Slave trade in the Republic of Dubrovnik was forbidden in 1418 (in the British Empire in 1833). The *first orphanage* was founded in 1527. Dubrovnik had the *oldest arboretum in Europe* (Trsteno), founded in 1498, with many rare plants. It was completely destroyed during the Serbian and Montenegrin aggression in 1991/92.

Many of the early European expeditions to the western shore of the Antlantic finished with shipwrecks. So was the case with some ships from Dubrovnik in the 16th century. It is interesting to mention that the *Croatan Indians* in the USA could possibly be the descendants of the saved Croatian crew, as authenticated by their name, blond hair, blue eyes and some of the words in their language.

Didak Izaija Cohen, known under the pseudonym Dydacus Pyrrhus and Jakob Flavije, was a renowned Portugese physician and poet of the Jewish origin. He lived in Dubrovnik from 1558 until his death in 1599.

The greatest and most famous Croatian philosopher and scientist *Ruđer Bošković* (1711–1787), was born in Dubrovnik, where he was educated in the Jesuit Collegium. He was a member of the Royal Society of London, a professor at many European universities. Very delicate work on repairing the cupola of St. Peter's church in Vatican was entrusted to R. Bošković, a proof that he was a leading European authority for static computations and civil engineering of that time. He was also the founder of the astronomical observatory in Brera near Milan. In 1773 a charter granted by Luis XV made him a French subject. Soon he was appointed to a very prestigeous position and became the Director of Naval Optics of the French Navy in Paris. When D'Alembert took him for Italian, he hastened to correct him.

J.J. Thompson, the English physicist, once expressed his opinion that his atomic theory is a pure "Boškovićianism".

With his theory of forces R. Bošković was a forerunner of modern physics for almost two centuries. It was described in his most important book "Theoria Philosophiæ naturalis" (Vienna 1758, Venice 1763, London 1922, American edition in 1966).

He was also very active in astronomy and diplomacy. A great many letters sent to his sister and two brothers written in Croatian witness that he did not neglect his mother tongue. He also wrote poetry. Numerous books, articles and letters of R. Bošković, together with other documents, are kept in the *Friary of Minorites* (Samostan Male Braće) in Dubrovnik, which was severely damaged in the recent aggression in 1991.

During the French occupation in 1808 the Republic of Dubrovnik was abolished, although the Senat refused such a decision with indignation.

The city of Dubrovnik endured a great many attacs in its history. Only during the Serbian Nemanjić dynasty (1168–1371) the Serbs performed 15 unsuccessful attempts to occupy Dubrovnik. The greatest tragedies in the history of Dubrovnik were the earthquake and the fire in 1667, and the well known Serbian and Montenegrin aggression in 1991/92. The population of the Dubrovnik region was 82.4% Croatian before the aggression, with only 6.7% Serbs.

The philosphical and medical works of Ibn–Sina (Avicenna, 980–1037) are a part of the rich collection of our oldest libraries. The *Dominican Library*, founded in 13th century in Dubrovnik, possesses one of the oldest Latin translations of Avicenna's works on methaphysics and logic. It was one of the biggest European libraries in the period between the 15th and the 17th century (bombed in 1991/92).

The city of Dubrovnik, the Plitvice Lakes, and the old part of Split have been under the protection of UNESCO since 1979.

6. The first public schools were founded in Zadar (1282), Dubrovnik (1333) and Zagreb (1362). The first Gymnasium was founded in Lepoglava near Zagreb in 1503.

Croatian students studied at many European Universities, starting from the Early Middle Ages. For example, *Herman Dalmatin* (1110–1154) was our first student who attended lectures of the famous Thierry de Chartres in Paris in the thirties of the 12th century. Born according to his own words in the heart of Istria, he wrote about 20 original books and translations, thus contributing a great deal to natural philosophy and exact sciences in Europe. He traveled a lot, and besides Latin and Greek mastered perfectly Arabic. He translated into Latin many important books, like Euclid's 'Elements', Abu–Ma'ashar's 'Introduction to Astronomy', acquanting thus the West with Aristotel's thoughts, Al–Khwarizmi's 'Tables', and in particular the oldest Latin redaction of Ptolomey's 'Planisphere' (in Islamic literature known as 'Almagest'). With his English friend Robert from Ketton he worked on the translation of Kur'an. Herman's translations from Arabic represent an inavoidable ingredient of the so called 'Toledo corpus' of texts on Islam. Its main objective was to resist Islam not by force as the Crusaders did, but by understanding and love. As we know, the Arabic culture was a bridge across which the spiritual heritage of the Ancient Greeks came to the West.

The Croats were also present at the Court of the Andalusian califs in Cordoba (Spain). The body guard for califs was composed of islamized Croats. Among them the most famous were *Wadha el-Ameri* and *Zahair Alameri* (11th century). The Croatian kingdom maintained relations with the Califat, so that in 953 the Croatian legation visited Cordoba.

Pavao Dalmatin (1190–1255), a professor at the University of Bologna, a founder of the first Dominican communities in Croatia and Hungary, wrote the first systematic tractate on confession in the history of Catholic theology ("Summa de confessione"). Its last edition was printed in 1919 in Dutch.

In the fifteenth century several Croats were professors at the University of Paris: Pavao Nikolin, Ivan Stojković, Petar Gučetić and others. Professor *Martin Berek* was elected Rector of the Paris University in 1430.

George (Juraj) de Slavonie (or de Sorbonne, born in Brežice in present Slovenia, 1355/60–1416), a professor at the University of Paris and a theological writer, wrote the first Croatian abecedarium of Christian science in the *Glagolitic alphabet* (see p. 67) about 1400. He wanted to show his renowned colleagues of Sorbonne that exept Hebrew, Greek and Latin also existed a genuine Croatian alphabet or *alphabetum charwaticum*, having a great graphic and lexical value. With his book "Le chateau de virginité" he entered the history of French and European literature. He was also very fond of Istria, to which he referred as a part of his Croatian homeland: *Istria eadem patria Charwati*.

"Tractatus de Ecclesia", written by *Ivan Stojković de Corvatia* (1390/95–1443), a professor at the University of Paris, was the first systematic tractate about the Church in the history of Catholic theology. Ivan Stojković also headed the delegation of the Council of Basel to Constantinopole, aiming to negociate the Ecumenic questions of the Eastern and Western Church. He wrote that he was from Dubrovnik, which was a Croatian city (de Ragusio quae civitas est in Charvatia).

In the 15th century *Luka Požežanin* and *Juraj from Čazma* were lecturing on mathematics at the University of Vienna. At the same institution *Valent from Koprivnica* was lecturing on natural philosophy, *Ladislav from Požega* was lecturing on astronomy, etc.

7. Among *Croatian Latinists* and writers in Croatian a central place is occupied by *Marko Marulić*, who is the *"father of Croatian literature"* (born in Split, 1450–1524). He was the most famous spiritual writer of his time in Europe, and also the first who defined and used the notion of *'psychology'*, which is today in current use. His book "De institutione bene vivendi", published in Venice in 1506, had fifteen editions until 1686 and was translated from Latin into Italian, German, French, Portuguese and Czech, altogether 40 editions. He left us many beautiful verses and the epic poem Judita written in the Croatian language.

The court of the king Mathias Korvin was a strong European humanistic center, to which the Croats gave a deep imprint. Thus the tutor of Mathias Korvin was *Ivan Vitez* (1405–1472), a Croatian latinist, who also had the merit to open the University of Bratislava (capital of Slovakia) and the Academy and library of Budim

(part of today's Budapest). He was a cardinal and occupied the position of the king's chancellor.

Jannus Pannonius (1431–1472), a Latin poet and humanist, was famous in his time. He was born in a small village near *Aljmaš* on the river Danube (the area that during the Serbian aggression in 1991/92 suffered indescribable atrocities) and died in Medvedgrad near Zagreb.

One of the oldest secular dramas in Europe is 'The Slave', written by *Hanibal Lucić* (1485–1553), a Croatian writer. In 1612 a municipal theater in Hvar (on the island Hvar) was built up. It was the *first communal theatre in Europe* (i.e. the first theater in a closed building).

One of the well known Latinists was *Rajmund Kunić*, who translated the Iliade into Latin in 1776. His translation is even today generally regarded as the best one in the world.

The oldest Croatian book in the Latin script was "The Order and Law", written in 1345 by the Dominicans from Zadar.

8. Croatian soldiers served in many European armies from the seventeenth century. These soldiers gave the world something that is today inavoidable in fashion: the tie, called 'cravate' by the French and by the Germans 'die Krawatte' – the expression was coined from the Croatian name. So when you wear a *tie*, remember its Croatian origin.

9. In the history of Croatian people four scripts were in use: Latin, Croatian Glagolitic alphabet, Croatian Cyrillic alphabet (called also Bosančica) and Croatian Arabica.

The Arabica, also called Adjami (Aljamiado), was in use among the Muslims in Bosnia and Herzegovina. It was in fact the Arabic script used for the Croatian language. Its first sources go back to the 15th century. One of the oldest texts is a love song called "Chirvat–türkisi" (Croatian song) from 1588. Exept for literature it was also used in religious schools and administration. Of course, it was in much lesser use than other scripts. The last book in Arabica was printed in 1941.

The Croatian Glagolitic alphabet, which is in use even today (in liturgy, though rarely), has a long and interesting history of more than a thousand years. The Croats using the Glagolitic alphabet were the only nation in Europe who had a special permission by the Pope (in 1248) to use their own language and this script in liturgy. As you know, Latin and Greek had been the privileged languages in religious ceremonies.

Very important document written in the Croatian Glagolitic alphabet, which mentions the name of the Croatian *king Zvonimir*, is a stone tablet (Baščanska ploča) dating from around 1080 A.D., found in the church of St. Lucy near the town of Baška on the island of Krk.

One of the earliest and most important Croatian juridical documents is *The Vinodol Code*, very different from the Roman law, written in the Glagolitic alphabet in 1288. It also introduced the institution of witnesses. It was unique in Europe by determining moral protection and integrity of women. The Vinodol Code does not

allow tortures in legal proceedings, and is regarded to be one of the most important documents of medieval Europe. Among the Slav Codes only the Russian Pravda is older.

There are many other important juridical documents regarding medieval Croatia, out of which we should mention

- the *Korčula codex* (from the island of Korčula, 1214, written in Latin),
- *Istarski razvod* from the Istrian peninsula, 1275, writen originally in three languages: Croatian in the Glagolitic alphabet, Latin and German. It defined the border between different rulers in Istria. Only the Croatian Glagolitic version is preserved. There are Italian and Latin translations from Croatian dating from the 16th century, which kept the original Croatian names for many places, a proof that the population in Istria was dominantly Croatian. By its juridical and literal value it can be ranked among the most interesting documents of that time in Europe. It is also the oldest international diplomatic document written in Croatian. Earlier written documents bear witness to the presence of the Croats in Istria from the seventh century.
- the *Statute of the Republic of Poljice* (1444, near Split, written in the Croatian Cyrillic Script).

Except very rich sacral literature, the Glagolitic alphabet was also used in private communitcation.

The famous Czech king Charles IV built a Glagolitic convent in Prague in 1347, where Croatian monks were invited as teachers. One of the Glagolitic books from this convent (Emaus) in Prague came to Reims, where for centuries the French kings were sworn in by putting their hands on this holly book. The Polish king Vladislaw II Jagiello also opened a Glagolitic convent in Krakow in 1390.

Probably the most interesting Glagolitic book was a liturgical book called Misal of Hrvoje, written in 1404 by Butko (ⰁⰖⰕⰍⰑ). It has beuatiful illuminations and is now kept in Constantinople. *Hrvoje Vukčić Hrvatinić* was the duke of Bosnia, a Croat who belonged to *Krstjans* (Patarens, members of the Bosnian church), a Christian religious sect about which we still know very little. Hrvoje also left us another very interesting book, Misal for Krstjans, written in the Croatian Cyrillic Script by Hval, which is now kept in Bologna.

It is important to note that the Krstjans had a humble church that strived to be independent from Vatican. The pataren heresy was an excuse for several Crusades, whose primary goal was the occupation of Bosnia. It is therefore not surprising that with the arrival of the Turks most of the Krstjans converted to Islam.

The first Croatian printed book in Glagolitic letters appeared as early as in 1483, only 28 years after Gutenberg's Bible, 6 years after Paris and Venice, and one year before Stockholm. It was a Misal, or ⰏⰉⰔⰀⰎⰟ, printed most probably in the town of Kosinj. Unfortunately, only ten years later a desastrous penetration of the Ottoman Empire took place. Glagolitic books were printed not only in Croatia (Kosinj, Senj, Rijeka, Roč), but also in Rome and in Venice, which had two Glagolitic churches at that time. Here is the exotic Croatian Glagolitic alphabet (we present its version from

the 15th century):

	A	1		I	20		U	400
	B	2		J	30		F	500
	V	3		K	40		H	600
	G	4		L	50		Ot	700
	D	5		M	60		Št, Šć, Ć	800
	E	6		N	70		C	900
	Ž	7		O	80		Č	1000
	Dz	8		P	90		Š	2000
	Z	9		R	100		Ja, Je	
	Iže	10		S	200		Ju	
				T	300			

The fact that the Christianization of the Croats had already been finished when St. Cyrill was born (825), together with the unique multiorthographic tradition of written documents, which was dominantly Glagolitic in the early Middle Ages, seem to give a strong proof that the origins of the Croatian Glagolitic alphabet are *authentically* Croatian. Of course, one can see the influence of other existing alphabets as well. The Glagolitic Script began to acquire a new form (like on the table) since the 12th century, after which it was definitively recognized as a *Croatian Script*.

Thousands of books were printed in the Croatian Glagolitic and Croatian Cyrillic Script during the past centuries, many of them by the generous help of Croatian Protestants who were active in Wittenberg and Urach in Germany. Only in Urach thirty books were printed in 25 000 copies between 1561 and 1565, out of which 300 have been preserved. The last Glagolitic book was printed in Rome in 1905.

The Glagolitic alphabet represents maybe the most interesting cultural monument of Croatia. Except in Croatia, our Glagolitic books and manuscripts are kept in Rome, Saint Petersburg, Berlin, Vienna, Innsbruck, Moscow, Copenhagen, London, Oxford, Constantinople, Paris, Tours, New York, Krakow, Porto, Budapest, Trento, Padova, Sienna and some other places.

10. In contrast to the above, the Croatian Parliament (Sabor) in Zagreb was the last in Europe to use Latin as the official language (until 1847). The reason was to prevent the Hungarian part of the common state and the Hungarian language in their expansion to Croatian territories.

Let us mention by the way that the palace of Banski Dvori near the Parliament in Zagreb was bombed by the Yugoslav Army bomber in 1991, in the attempt to assasinate the Croatian president dr. Franjo Tuđman.

11. One of the greatest writers of his time and besides Luther the most influential promoter of Protestantism in Europe was *Flacius Illiricus* (Matija Vlačić, born in

Labin in Istria, 1520–1575). As a young Croatian philosopher, at the age of 24 he was appointed to be a professor of Hebrew and Greek at the University of Wittenberg, the center of Protestantism. The bibliography of his work is enormous – three hundred books and brochures. His "Catalogus testium veritatis" represents a tremendous historical documentation, probably the best polemical book of his time. He wrote also about Croatian churches that eversince had liturgy in the Croatian version of the Old Church Slavonic language, using holly books written in the Croatian Glagolitic Alphabet. He was the organizer, editor in chief and the chief writer of the famous "Ecclesiastica historia" (The History of the Church), that appeared in 13 volumes in Basel. His greatest linguistic work is "Clavis Scripturæ Sacræ" (The key to the Sacred Script, it contains about 7.5 million letters), analyzing lexicographically the content of the Old and New Testament. When writing about Istria (peninsula in the Adriatic), he calls it 'the sweetest homeland'.

A Croatian jesuit *Mark Antun de Dominis* (Gospodnetić, born on the island of Rab, 1560–1624) ranked among the greatest European philosophers and scientist of his time. His career of a university professor started in Padova. He was especially esteemed in England, where he was invited by king James I. There he lived at the Court of the Archbishop of Cantebury and was appointed to be the Windsor Dean and the king's chancellor. His work in physics was cited in I. Newton's book "The optics" in 1704. Among other things he was the first to explain the phenomenon of the double rainbow. His theory of tides was based on the idea of attractive force between the Moon and the Earth, which was later made more precise in Newton's theory of gravitation. However, his main preoccupation was the problem of European peace and the reform of the Church. His work "De Republica Ecclesiastica", which was published in ten books in London, brought him the anathema of Rome. He was imprisoned by Inquisition and when he died, the burial of his body was not allowed. It was burnt, together with his manuscripts, on the square of Campo dei Fiori in Rome, where Giordano Bruno had been burnt twenty four years earlier.

A Croatian theologist and scientist *Juraj Križanić* (1618–1683) initiated the dialog on the unification of the Russian Church with Rome. He dreamed about an open and peaceful dialog with Orthodox Christians. His major work was "Politics" (in Russian), written during his 15 year exile to Siberia. He was killed near Vienna while participating in its defense against the Turks in the troops of the Polish king Jan Sobiesky.

The first systematic book on the cultural, political and social history of the Croats is "Historia Salonitana", written in Latin by *Thomas Archiacenus* (1200–1268). The oldest historiographic book "The Chronicle" in Croatian (kajkavian dialect) was written in 1578 by *Antun Vramec* (1538–1584). The first original book in the Croatian language (kajkavian dialect) on arithmetic was the voluminous Arithmetica Horwatszka (Zagreb, 1758) written by *Mihalj Šilobod Bolšić* (1724–1787).

12. Now we have come to a very rich history of the *Croatian Encyclopedia*. Its origins go back to the 16th century. *Pavao Skalić*, a humanist–polyhistor (born in Zagreb, 1534–1575), was the first to have used the word *'Encyclopedia'* in its modern meaning, in his book "Encyclopediæ seu orbis disciplinarum ... " (Basel, 1559).

Faust Vrančić (1551–1617) from Šibenik was the author of a five language dictionary "Dictionarium quinque nobilissimarum Europeæ linguarum: Latinæ, Italicæ, Germanicæ Dalmaticæ et Hungaricæ" (Venice, 1595), with more than 5000 words, where Dalmaticæ means Croatian language. He also wrote about logic, ethics and mechanics (see p. 77). *Bartol Kašić* (1575–1650), a Croatian jesuit, was the author of the first Croatian Grammar printed in Rome 1604. *Ivan Lucić* (born on the island of Hvar, 1485–1553) was the founder of modern Croatian historiography, with his major work "De Regno Dalmatiæ et Croatiæ libri sex" (Amsterdam, 1666).

A three language encyclopedic lexicon (Latin, Croatian, Italian) of *Joakim Stulli* (1729–1817), Franciscan from Dubrovnik, written in three parts on 4721 pages, was an important source of traditional Croatian words, especially in medicine. It was finished in 1810, after more than a half of century of systematic work. Its second, Croatian part, contains about 80 000 lexical units.

The first Croatian general Encyclopedia was prepared in *Osijek* in 1887–1890 (in two volumes, 600 pages each, from A to G).

One of the greatest projects in this field was the creation of the Croatian Encyclopedia (initiated in 1938 in Zagreb), but unfortunately the war did not permit our scientists to complete this enormous job. Only five volumes of the highest typographical quality were issued (1941–1945), from A to Elektrika. The whole edition has been systematically destroyed by the Yugoslav communist regime, when the Second World War finished. After 1945 Zagreb was again the center of encyclopedic activity, as a continuation of a very long tradition, with many publications and books being issued during the past 40 years. Here we should mention *Miroslav Krleža* (1893–1981), one of the most outstanding Croatian writers of this century, whose masterpieces were translated throughout Europe. His enormous opus also encompasses a subtle description of tense social and political relations on the territory of former Yugoslavia. During many years he was the president of the Yugoslav Lexicographical Institute in Zagreb (today Lexicographical Institute Miroslav Krleža) and editor in chief of the Encyclopedia of Yugoslavia. At this moment a project is initiated that should result in a new Croatian Encyclopedia.

13. It is interesting that the greatest promotors of creating a state of the Southern Slavs (the idea of Yugoslavia) were the Croats, but they did not conceive of it as the centralized, Serb-dominated state. Their aim was to preserve the Croatian national identity and the sovreignity of Croatia and to organize the new state of South Slavs on a *confederative* basis.

That is why the Kingdom of the Serbs, Croats and Slovenes, established in 1918, did not obtain the confirmation and permission of the Croatian Parliament. This state, created in 1918 from the *Austro-Hungarian part* (Slovenia, Croatia, Vojvodina*, Bosnia and Herzegovina) and *Serbia and Montenegro*, which were opposing sides

* At that time the notion of Vojvodina did not include Srijem (the territory between rivers Sava and Danube), that before 1918 belonged to Croatia. Vojvodina belonged to Hungary before 1918.

during the First World War (1914–1918), contained a germ of numerous future conflicts. It was composed of different traditions, religions, nations, languages and scripts.

The idea of Yugoslavia was in fact the best opportunity for Serbian nationalists to create the Greater Serbia, which was completed in 1918 according to the 1844 secret programme. Montenegro lost its independence in 1918 after being brutaly annected to Serbia. The independance of Montenegro was regained in 1945 within the Tito's Yugoslavia.

The whole property of the Austro–Hungarian state and booty was confiscated by the Serbian authorities. Immediately after 1918 all the leading positions in the army were seized by Serbian officers, who treated Croatia as a hostile territory in the common state (it was publicly declared in 1919!). On the other hand, it was presented to Europe as if the Croats had entered *willingly* the union with Serbia.

The Serbian legislature, juridical and military 19th century law was simply implemented into the new state without changes and without consultations with the Croats. It resulted in unbearable terror and persecutions of Croatian peasants and intellectuals.

Equally difficult was the economic terror of the Belgrade government. The old currencies – Serbian dinars and Croatian (Austrian) crowns, which in 1918 had the *same* value, were in 1919 changed for the new dinar in the following ratio: 1 dinar = 4 crowns!

One of the most outstanding and most popular personalities in the Croatian political history was *Stjepan Radić* (1871–1928), the leader of the Croatian Peasant Party, assassinated in the Yugoslav parliament in Belgrade (capital of present Serbia) in 1928 together with his colleagues. The assassination was organized at the Royal court in Belgrade. Radić strived to renew the Croatian sovreignty and the economic and cultural emancipation of Croatia. He wanted the state of the Southern Slavs to be reorganized on confederative basis, without Serbian hegemony.

The culmination of the Serbian police terror took place during the personal dictatorship of king Aleksandar Karađorđević since 1929. One of the historical documents from that period, showing 'methods' of the Serbian police and administration, is a bill on 13 dinars and 15 paras charged to a Croatian family for four bullets fired at the father, who was sentenced to death. The families were persuaded even to pay the 'expenses' of the execution. After the dramatic events that followed, *Albert Einstein* and *Heinrich Mann* sent an appeal to the International League of Human Rights to protect Croats from the terror and persecutions of the Serbian police.

The tendency of administrative parcelization of Croatia that started in 1922 was revised by the establishment of the autonomous Croatia – *Banovina Hrvatska* – in 1939. It also included parts of Bosnia and Herzegovina.

After the military defeat of the Kingdom of Yugoslavia in 1941, parts of Croatia were annected to Italy and Hungary, and the rest of Croatia was occupied by the Nazi Germany and Fascist Italy. In this part of Croatia and in Bosnia and Herzegovina the occupational forces enabled the formation of the *Independant State of Croatia* (ISC), with its own fascist order introduced from Italy and Germany. It brought misfortune

to many Croats, Serbs, Jews and others.

This state, though awaited by many who wanted to get rid of the Yugoslav terror, led to the new tragedy of the Croats. They were divided in two oposing parts – those who supported the Independant State of Croatia, and those who joined the Antifascist movement, which fought for the new Yugoslavia on federative basis, where the Croatian state would enjoy the same rights as others.

Croatia gave a great contribution to the victory of the Antifascist coalition in the Second World War. Out of all the brigades and divisions of Tito's Liberation Movement created on the territory of former Yugoslavia, the great majority was from Croatia.

Not only the Croats participated in the Antifascist war in Croatia, but also a greater part of the Serbian minority in Croatia and many other ethnical groups. A smaller part of Serbs in Croatia joined the Great–Serbian extremist organization (četniks) which collaborated with the occupational forces.

By the end of the Second World War the remaining parts of the ISC Army began to withdraw to Austria, and in the battles until 15 May 1945 they surrendered to the Yugoslav Army, which surrounded them. Many people who flew to Austria in mid-May 1945, were sent back by the British military authorities (who had jurisdiction over a part of Austria) to the Yugoslav partisans. Tens of thousands of soldiers and civil captives were killed after the capitulation. The symbol of the Croatian tragedy is the slaughter of Croats near the city of *Bleiburg* in Austria. Those who were not killed immediately, were forced to walk up to 700–800 km. (the infamous *"death marches"*) with mass executions on the way, organized mostly by Serbian partisan officers.

Andrija Hebrang (1899–1948), one of the leaders of Tito's partisan movement in Croatia, was killed brutally in Belgrade (date unknown) after being unjustly imprisoned in 1948. Like S. Radić, he wanted Yugoslavia to be organized on the conferderative basis.

A symbol of the spiritual resistence against the Yugoslav communist regime was the Croatian cardinal Dr. *Alojzije Stepinac* (1898–1960). In 1946 he was sentenced to 16 year's imprisonment. He stayed in custody until his death, despite constant protests coming from the free world.

The Yugoslav diplomatic personnel, which was mostly Serbian, together with the well organized Belgrade propaganda, made an attempt to stygmatize the Croats as apt to genocide, by assigning *all* the victims of the war to the Croats, including those killed by partisans, during and immediately after the Second World War. As a result of this, even today we hear from some very uncritical Western intellectuals to operate with quite irrational cyphers.

It is not possible to describe, even in outlines, the extent of the martyrdom of the Croatian emmigrats, and the persecutions of the Yugoslav secret police that followed after 1945, so that here we shall mention it only in passing.

One of the founders of the nonalignment movement, together with presidents Nehru and Naser, was *Josip Broz Tito* (1892–1980), a Croat born near Zagreb, the president of former Yugoslavia. His great merit was the brave 1948 decision, not to

allow the Soviet dictatorship of Stalin. However, he retained a rigid communist system and tolerated the cult of his personality. His attempt to solve the national problem in the former Yugoslavia was not successful in the long run. Although he was a Croat, a great majority of military personnel in the former Yugoslav army was Serbian. This equally applies to the Yugoslav diplomatic personnel and the state administration. The extent of the economic exploitation in favor of Serbia and Yugoslav Army brought Croatia in unequal position within the Yugoslav federation. Especially difficult was the period after Tito's death (1980–1990), when the Yugoslav crisis began to sharpen.

6.2 Music and arts. 1. The first Croatian neum manuscripts for church music date from the 11th century. Some of the Christmas folk songs from the 12th century are still very popular. The earliest known Croatian composers are *Andrija Motovunjanin* (born in the Istrian town of Motovun around 1470) and *Franjo Bosanac* (born in Bosnia around 1490).

Luka Sorkočević (1734–1789), whose beautiful symphonies are performed throughout the world, lived in Dubrovnik. His two sisters were the first women–composers in Croatia.

The first national operas among the Slavs were composed by Russians (M. I. Glinka, 1836, 1842), then the Croats follow immediately. *Vatroslav Lisinski* composed the first Croatian national opera 'Love and malice' in 1846. Then follow the Czechs (B. Smetana in 1862), and these three nations are the only ones among the Slavs who have national operas. Let us mention that Franz Liszt gave piano concerts in Zagreb and in Samobor, a lovely nearby town, in 1846. Operas composed by *Ivan Zajc* (1832–1914) and *Jakov Gotovac* (1895–1982) are performed in concert halls throughout the world.

The verses for the Croatian national hymn "Our beautiful homeland" were written by a Croatian poet *Antun Mihanović* (1796–1861), and the music was composed according to Donizetti's "O sole piu ratto" from the opera "Lucia di Lammermoor" by *Josif Runjanin* (1821–1878), the Serb born in Croatia. It is interesting that many Croats who sang it during the former Yugoslav regime, risked to be imprisoned. There was a jail not far from Zagreb, nicknamed as "Jail for Singers".

Let us add that the melody for the German national hymn is based on a very old Croatian folk song. The poet J. W. Gœthe translated some of our most beautiful folk ballades into German (from their Italian translation, done by Alberto Fortis).

Ivan Padovec (1800–1873) was a guitar virtuoso, who gave concerts in Zagreb, Vienna, Prague, Budapest, Hamburg, London, in Poland, Russia etc. He constructed a ten string guitar. *Franjo Krežma* (born in *Osijek* in 1862) had a reputation of an authentic violin virtuoso, and was a concert master in Berlin. He completed his studies at the Conservatory of Vienna at the age of 13, after which started his spectacular European carreer. Unfortunately, he died very young at the age of 19.

Any admirer of classical music certainly knows the *Zagreb Soloists*. Let us also add the *Zagreb Philharmonic Orchestra*, the violonist *Zlatko Baloković* (1895–1965),

the conductor *Lovro von Matačić* (1899–1985), opera singers *Milka Trnina* (1863–1941), *Zinka Kunc-Milanov* (1906–1989), *Ruža Pospiš-Baldani* (1942), *Dunja Vejzović* (1943), *Vladimir Ruždak* (1922–1987), and the *"Ivan Goran Kovačić student choir"*. Artists of international reputation are the violoncellist *Valter Dešpalj* (1947), the pianist *Ivo Pogorelić* (1958), *Radovan Vlatković* (1962), who plays the first horn in the Phylharmonic Orchestra of Berlin, in jazz – a vibraphonist *Boško Petrović* (1935) – our former student, etc.

In music probably the most original contribution is the *tamburitza*, the Croatian national string instrument and one of the trademarks of Croatia. Our folk music is of great beauty and variety. Some of its themes were used by famous European composers, like Bedřich Smetana and Joseph Haydn, who spoke Croatian. Joseph Haydn was born in a Croatian ethnic enclave in Burgenland (Gradišće) in Austria.

Hand in hand with folk music go the national costumes and dances in which one can see such a rich source of creativeness and imagination that are simply impossible to describe in a short essay like this.

Dr. *Josip Andrić* (1894–1967) is a figure with the wide range of interests. In music he created about 700 songs, an opera for tamburitza (devoted to Bunjevci, Croatian ethnic branch in Vojvodina), collected almost 2000 folk songs, he was conducting at the age of 15. In literature, among the plenty of his books and brochures let us mention his History of Slovak music, the first ever written. We owe him our first information about the glory of the Irish early Christian civilization, the fact that not only the British, but also the Francs received the Christian religion from them. He belonged to the Croatian minority in present day Serbia (Vojvodina), called *Bunjevci and Šokci*. During many years, and especially since 1991, they have been going through the process of almost complete ethnic and cultural extinction, with a rate and violence unknown in Europe after 1945. Only in the period between 1971 and 1991 (before the Serbian agression!) the number of the Croats in Vojvodina dropped from 140 000 to 74 000. There is hardly any other region in the world with such a richnes of national costumes, habits and folk songs.

2. Medieval religious plays were performed in Croatian cities and towns on the squares in front of churches, like in Western Europe. The first secular dramas were presented in Zagreb and *Vukovar* as early as in 14th century. Some of the earliest preserved stage instructions come from the island of Pašman near Zadar, written in the Glagolitic Script.

Croatian literature is quite rich. Among many excellent writers let us mention only *Tin Ujević* (1891–1955), the wizzard of the Croatian language, an erudit, essayist, one of the most outstanding Croatian poets (and Bohemians) of this century. His Croatian translations of Marcel Proust's novels are regarded to be of almost the same literal value as the French originals.

Great importance in the recent history of Croatia had the "Declaration about the Name and Position of the Croatian Literary Language" (Zagreb, 1967). The declaration asked for the right of the Croats to call their language by their own national name (the Croatian language), to enable its unimpeded development, and

expressed a protest against the Serbian predominance in official texts in Croatia. It was signed by numerous leading Croatian writers and linguists, many of whom were then persecuted and maltreated by the Yugoslav police.

3. On the territory of Croatia there exist many remainings of the Ancient Greek and Roman civilization. Let us mention only the beautiful palace of the Roman Emperor Diocletian in Split and the ancient city of Salona near Split.

The beginnings of the Croatian art are represented by a rich *ornamentation in wattle pattern*.

Monolithic stone grave monuments, called *stećak*, are very interesting, some of them weighing 30 tons, the earliest of them dating from the 13th century. Their overall number is more than 66 000, mostly on the territory of Bosnia and Herzegovina. There is no doubt that such monuments put up built by Catholics, Krstjans (Bosnian Patarens) and members of other confessions during the Middle Ages. Some of the stećaks have interesting decorations, some even eastern swastika, with epitafs like: "Please, do not disturb me, I was like you, and you will be like me", written in the Croatian Cyrillic alphabet.

The first documents witnessing of the Croatian Cyrillic alphabet are inscriptions carved in stone in present Bosnia and Herzegovina dating from the 10th or 11th century (Humačka ploča) and on the Croatian island of Brač from the 12th century. They also contain some glagolitic letters. Many written documents concerning medieval Croatia contain simultaneously three Scripts, thus proving their *unexclusiveness and coexistence*, which is unique in the history of European culture. For example some of the religious texts end with 'Amen' written three times: in the Glagolitic, Cyrillic and Latin script (ⰀⰏⰅⰐ–Амен–Amen). Apart from the parallel use of the three Scripts, unique is also the simultaneous use of three languages – Croatian, Latin and Church Slavonic.

Among the best artists of his time was the Croatian sculptor *Radovan* (born in Trogir, 13th century), who left us the beautiful Romanic portal on the Cathedral of Trogir. The wooden portal on the Cathedral in Split carved by *Andrija Buvina* is world's famous. It is ranked among the most beautiful pieces of art in the medieval Europe.

We should also mention *Juraj Dalmatinac* (Georgius Mattei Dalmaticus, 15th century, born in Zadar) who built up Loggia dei Mercanti and the portal of St. Francis Church in Ancona. His epoch represents the golden age of the Croatian medieval art. The most beautiful achievement is the Cathedral of Šibenik, the top monument of Croatian culture, reflecting in a sense the character of urban life of that time, certainly a sculptural chef d'œuvre (bombed during the Serbian agression in 1991).

In the Istrian peninsula you can see little lovely churches beautifully decorated by the famous painter *Vincent from Kastav* (15th century). Especially interesting are his frescos in the solitary church of St. Maria near Beram. By the beauty of small medieval towns and its landscape Istria is unique in Europe. Let us mention here, as a part of musical folklore, the famous Istrian scale. Istria is, together with our greatest island Krk, also the cradle of the Croatian Glagolitic Script.

Julije Klović (Don Giulio Clovio de Croatia, 1498–1578) is regarded to be the last great representative of classical European miniature, whose works decorate many famous galleries, from Uffizi in Florence to the British Museum in London. His pupil was El Greco, who portrayed him. Among his friends let us mention Michelangelo.

The city of *Karlovac* was built in 1579 as the first ideal Renaissance fortification in Europe (then followed Nové Zamky, Palmanova, Neu Breisach). It was bombed during the Serbian agression in 1991/92.

In fine arts of our time probably the most famous is the sculptor *Ivan Meštrović* (1883–1962), who created masterpieces, many of which are dedicated to the history of his motherland. You can see them in the Meštrović gallery in Split and in Zagreb. He also created the grand Monument of the Unknown Soldier and the Monument of Gratitude to France in Belgrade, the beautiful Mausoleum of Petar Petrović Njegoš, Montenegrin poet and statesman (Lovćen in Montenegro), "The Well of Life" and "The History of Croatia" in Zagreb. His sculptures can be seen in London, Florence (in "Uffizi"), Torino, Rome, Praha (in Hradčany), Chicago ('Indians' in Grand Central Park), South Bend (Indiana, USA), Rochester (Minnesota, USA), Baton Rouge (Louisiana, USA) etc.

The white marble from the island of Brač is highly appreciated among sculptors. It was also used in building up the White House in Washington.

One of the symbols of the United Nations that everybody knows is the *Horsewoman (the Monument of Peace)*, a sculpture created by *Antun Augustinčić* (1900–1979). It was given as a gift to the UN and it is situated in front of the main building in New York. Another beautiful equestrian statue he created represents a Polish marshal, Jozef Pilsudski.

Naive art is quite widespread and highly esteemd. First steps were undertaken by the painter *Krsto Hegedušić* (1901–1971) in the Croatian village of Hlebine. It was the famous *Hlebine school*, which got its own written programme in 1930. From a large number of naive painters, whose creations decorate private and state collections from Paris to Tokyo, let us mention only few: *Ivan Generalić* (1914), *Ivan Rabuzin* (1919), *Ivan Lacković - Croata* (1932).

What Louvre is for Paris, the *Mimara Gallery* is for Zagreb – it has a very rich collection, from classical Chinese art to Impressionists. It is a donation of Ante Topić–Mimara. We should also mention *Strossmayer's gallery* in Zagreb. The *Benedictine Gallery of Gold and Silver in Zadar*, the *Meštrović gallery* in Split are also famous. The *Gallery of Vukovar*, a donation of *Antun Bauer*, was very rich. It was robbed in 1991 and the stolen exihbits and works of art are still held in Belgrade, capital of Serbia.

4. The first film was shot in Zagreb in 1912. Many interesting cartoons were created by the *Zagreb School of Animated Film*. Since 1972 Zagreb has been bienually a host to the World Festival of Animated Film.

6.3 Sport. The most outstanding Croatian sportsmen were *Dragutin Surbek* (table tennis), who had won hundreds of tournaments, from Tokyo and Beijing to Zagreb, and a semiheavy weight boxer *Mate Parlov*. *Đurđica Bjedov* won the olympic gold medal in swimming (Mexico, 1968). *Ivo Prebeg*, a professional heavy weight boxer, was the European champion in 1969. *Matija Ljubek* has won a fair number olympic medals in kayak.

Regarding collective sports basketball is very popular. The best players were *Krešimir Ćosić* (the Supreme Mormon Priest for Eastern Europe), *Dražen Petrović*, *Toni Kukoč* and *Dino Rađa*. Two best teams are: *Cibona* and the former *Jugoplastika*, which were several times European champions. Our basketball, waterpolo and handball teams are among the four best teams in the world. They won many gold medals on the Olympic and World champions. Among outstanding sportsman we should mention our colleague Prof. Dr. *Zdravko Hebel*, a waterpolo representative of the former Yugoslavia, who won the olympic gold medal and four gold medals for distinction in European championships. Football is of course the most widespread sport. The champion of the Tournament of Cities (the future UEFA cup) was *Dinamo* (Zagreb) in 1967. Our best tennis player is *Goran Ivanišević*, who is now among the top ten in the world.

The Croatian alpinist *Stipe Božić* climbed twice Mount Everest, the first time in 1979. The Croatian Alpine Association has a long tradition. It was founded in 1874, the same year as in France. Let us mention by the way that the oldest book in the world about mountains is "Planine" (Mountains), written in Croatian by *Petar Zoranić* in 1536 and printed in Venice in 1569. It is also *the oldest Croatian novel*. Petar Zoranić was born in Zadar in 1508.

7. Science

1. In this section we should again mention the names of Mark Antun Dominis and Ruđer Bošković, whose work was veritably encyclopedistic.

The first known manual about book-keeping was "Della mercatura e del mercante perfetto", written by *Benko Kotruljić* (born in Dubrovnik, 15th century).

Frederik Grisogono (born in Zadar, 1472–1538), a mathematician, physicist, astronomer and physician, was educated in Padova, where later he became a university professor. His commentaries on Euclide's 'Elements' were published in Venice in 1507. His most important contribution was the theory of tides, based on the attraction of the Moon, which influenced Mark Antun Dominis. He discovered the antipodal tidal wave.

The first technical discoveries are related to the name of *Faust Vrančić* (1551–1617). Among his numerous inventions the most famous is the parachute, which he tested in Venice. It is true that Leonardo da Vinci had a similar idea earlier, but he made only a rough sketch of it. Vrančić also constructed the mill driven by tides, gave a new construction of metal bridges described in his famous book on mechanics "Machinæ novæ", that was soon translated from Latin into Italian, Spanish, French and German.

Franjo Petris (Patricius, born on the island of Cres, 1529–1597), a philosopher, mathematician and astronomer, was a professor at the University of Ferrara and Rome. With his philosophical views of neoplatonism and sharp antiaristotelism he influenced Giordano Bruno.

Marin Getaldić (1568–1626) born in Dubrovnik, was the most outstanding Croatian scientist of his time. His best results are mainly in physics, especially optics, and mathematics. Among his numerous books let us mention "Promotus Archimedus" (Rome, 1603) and "De resolutione et compositione mathematica" (Rome, 1630). He is the constructor of the parabolic mirror (diameter 2/3 m), kept today in the National Maritime Museum in London. During his sojourn in Padova he met Galileo Galilei. He was a good friend to the French mathematician F. Viète.

One fo the most outstanding Dubrovnik mathematicians, physicists and astronomers of the 17th century was *Stjepan Gradić* (1613–1683), who was a Director of the Vatican Library.

Quite a number of Croats took part in the first Christian Missions, especially in South and North America and Asia. *Ferdinand Konšćak* (born in Varaždin, 1703–1757), was a Jesuit and a Croatian missionary in North America. In 1752 he discovered that Baja California was not an island, as it had been believed until then, but a peninsula. There is a mountain range in northern part of Baja California named in his honour as the *'Consag Rocks'*. Denis Diderot used some of his maps for the French Encyclopedia.

Franjo Domin (born in Zagreb, 1754–1819), studied physics and theology in Vienna and later became a dean at the Faculty of Philosphy and rector of the

University of Budapest. He was among the first who cured various diseases by electrotherapy using static electricity.

Josip Vučetić (1858–1925), a criminologist and antropologist born on the island of Hvar, lived in Argentina. He was one of the pioneers of the scientific dactyloscopy (identification by fingerprints) and occupied the position of the director of the Center for Dactiloscopy in Buenos Aires. His method of identification was throughout South America.

The first torpedo was constructed by *Lupis Vukić* in the 19th century.

David Schwarz, a Zagreb Jew (1852–1897), invented the airship that is today unjustly bearing the name of the German count Zeppelin. Indeed, Zeppelin bought the complete project from Scwartz's wife, shortly after his premature death. It is true that the 'Zeppelin' constructed by Schwartz fell down due to a small technical error in the propeller. He was not able to finance a new experiment. While preparing the project of his flying ship, which for the first time was predicted to be metal made, he had to resolve many technical and technological problems. This led to the discovery of the special aluminium alloy now known under the name dural, also called the Schwartz aluminium.

The Croatian Jews left truly remarkable traces in arts, music, science and architecture.

Modern Slavic studies were founded by *Vatroslav Jagić* (born in Varaždin, 1838–1923), professor of philology at the Universities of Zagreb, Berlin, Vienna, Sankt Petersburg, Odessa. He was a full member of the Petersburg's and Austrian Academies of Sciences. A great importance for the developement of slavistic philology had the journal "Archiv für slavishe Philologie" that he founded in Berlin, and whose editor in chief he was during 45 years. He also initiated and organized the Seminar for Slavic studies in Vienna in 1887, which later grew out to the Institute of Slavic Studies. His scientific opus is enormous: if collected, it would occupy about 100 books with 200 pages each.

Some important discoveries in the field of Croatian archeology were accomplished by *don Frane Bulić* (1846–1936).

One of the pioneers of telegraphy is *Ferdinand Kovačević* (1838–1913). He invented the possibility of telegraphic connection along a single wire (the duplex connection), whereas before four wires had been used.

A zoologyst of international reputation *Spiridion Brusina* (born in Dubrovnik, 1845–1908), analyzed and classified 600 fossile species. He has a great merit for popularizing science in Croatia.

Vinko Dvořak (1848–1922), Czech who came from Praha to Zagreb in 1875 and was lecturing physics at the University of Zagreb, was the student of Ernst Mach. He is well known by his discoveries in acoustics, especially about acoustic forces. He was the first constructor of an acoustic radiometer, which has been unjustly attributed to Rayleigh.

Dragutin Gorjanović Kramberger (1856–1936) was a professor of geology and paleontology at the University of Zagreb. He discoverd the remains of Diluvial

Neanderthal people on a site not far from Zagreb.

The scientific activity *Vladimir Varićak* (1865–1942), professor of mathematics at the Univeristy of Zagreb, was mainly in noneucledian geometry and its applications to Einstein's theory of relativity. His work has been cited in Wolfgang Pauli's "Relativitätstheorie".

Eduard (Slavoljub) Penkala (1871–1922) invented a sort of a chemical *pen* which is bearing his name and now it is in everyday use. He was also one of the first constructors of planes (Zagreb, 1910).

Stanko Hondl (1873–1971), professor of physics at the University of Zagreb, has a great merit for popularizing Einstein's theory of relativity in Croatia.

Franjo Hanaman (1878–1941), chemist and metalurgist, invented together with *Aleksandar Just* the first economical electric bulb with wolfram filament.

Nikola Tesla, born in Croatia (1856–1943), is wll known and need not be particularly introduced. We feel it is necessary to cite his words that he was equally proud of his Croatian motherland and Serbian descent. It is interesting that he belonged to the Serbs of the Valachian descent (p. 58). He is the father of alternating electrical current technology and the three phase system. He is equally known by his contribution to the high frequency technology and wireless communications. The impact of Tesla's numerous inventions on the developement of modern civilization is immeasurable. The unit for magnetic induction Tesla, was named after him.

Among scientists studying seismology the famous *Moho-layer (or Moho-discontinuity)* of the Earth is well known. It was named after the great Croatian geophysicist *Andrija Mohorovičić* (1857–1936), professor at the University of Zagreb. His discovery was essential for understanding the inner structure of the Earth and the behavior of seismic waves. Together with the theory of forces due to J.R. Bošković, this is probably the greatest achievement in the history of Croatian science.

Two Croatian names appear on the *map of the Moon*. The name of J.R. Bošković was given to a mountian on the visible side, and the name of A. Mohorovičić to a mountain on the dark side of the Moon.

Stjepan Mohorovičić (1880–1980), professor of physics at the University of Zagreb, made a very important theoretical discovery of the *positronium* (rotational pair of electron and positron) as early as in 1936, published in 'Astronomishe Nachrichten'. Its existence was confirmed experimentally in 1956.

As an explorer, *Dragutin Lerman* (1863–1918) was a member of Stanley's expedition to Congo (Zaire), and a comissary (Commissaire Général) of the Belgian government in Congo.

Brothers *Mirko* (Karlovac 1871–Peru, 1913) and *Stevo Seljan* (Karlovac 1876–Ouro Preto, Brazil 1936) spent several years in Ethiopia carrying out geomorphological, climatological and ethnographic investigations. They occupied an important postition at the court of emperor Menelik II. Later they went to South America, where they founded the socitey "La Mission Cientifica Croata Mirko y Stevo Seljan" and organized some expeditions, especially in Peru, Chile and Brazil (in the region of the Amazon).

One of the most outstanding representatives of photochemistry was *Ivan Plotnikov* (1878–1955), a Russian emmigrant to Croatia (1918) and a professor of physical chemistry in Zagreb.

Štefan Gelineo, Croat by birth, born in Starigrad on the island of Hvar (1898–1971), studied in Leipzig and Vienna. He was the professor of physiology at the University of Belgrade (capital of Serbia and former Yugoslavia). He is internationally known by his contributions to the the study of *hypothermia*, i.e. the study of vital functions under low temperatures.

Vilim Feller (1906–1970) is a well known name among mathematicians dealing with probability theory. He was a Jew born and educated in Zagreb, a professor at the University of Kiel, Copenhagen, Stockholm, Providence (USA) etc., a member of many scientific organizations. He worked with von Neumann, one of the creators of modern computers.

One of our best theoretical physicists was Prof. *Gaja Alaga* (1924–1988). He worked not only in Zagreb, but also at the Niels Bohr Institute in Copenhagen, Berkeley, Ludwig–Maximilians University in Munich etc.

2. Let us now mention several names of significance in the history of Croatian medicine. *Valent Cibel* (born in Varaždin about 1490), a canon in Pečuh, wrote one of the first antialcoholic publications in history.

Đuro Baglivi (born in Dubrovnik, 1668–1707) was a professor of anatomy and theoretical medicine in Rome and the Pope's physician. He developed a theory that living fibre was the anatomical and physiological element of all pathological processes (fibral pathology). He also had some essential discoveries in the fine structure of muscles.

Mihajlo Šoretić (1741–1786), a Croat who was born and lived in Hungary, was a professor at the Universities of Trnava and Budapest. He conjectured the law of the specific energies of senses. *Niko Ostoić* (born on the island of Hvar, 1810–1848) wrote a book about the influences of light on human body, one of the pioneering works on modern heliotherapy.

Karl Heitzmann (a German, born in *Vinkovci*, 1836–1896) was a histologist and pathologist and worked in Vienna and New York. He was the first who described hematoblasts. *Emanuel Klein* (1844–1925), a Croatian Jew born in *Osijek*, worked as a bacteriologist and histologist in London. He described many fine, until that time unknown structures of human body, and discovered Bacillus enteritidis sporogenes. He proved the streptococal etiology of scarlatina.

Ante Grošić (1849–1926), the head of the surgical ward in the Hospital of Rijeka, was the first to introduce *iodic tincture* in preoperative desinfection of patient's skin. *Stjepan Poljak* (1889–1955), a neuranatomist, was a professor in Berkeley and Chicago. He was successful in some fundamental discoveries concerning the delicate structure of retina. *Milislav Demerec* (1895–1966) worked in the field of genetics in the USA. He had various discoveries in the genetics of bacteria and grew a sort of mould that improved the production of penicillin.

When the University of Zagreb was founded in 1874, the Viennese government

of the Austro–Hungarian Empire did not permit to open a medical school. Professor *Drago Perović* (1888–1968), a Serb who completed his studies in Vienna sub auspiciis regis, was one of the founders of the medical study at the University of Zagreb in 1918. He was one of our experts in the field of anatomy.

Professor *Andrija Štampar* (1888–1958) was our leading expert in the field of epidemiology and a pioneer in preventive medicine. As an expert of the League of Nations he spent three years (1933–1936) in China, developing the health service there. He was also one of the founders of the World Health Organization (WHO) and very active in promoting the health service in Afghanistan, Egypt, Sudan and Ethiopia. He wrote the introductory declaration of the Statute of the WHO and was the first president of this organization. In 1955 he was awarded the medal of Léon Bernard, which is the most prestigeous international acknowledgement in the field of social medicine.

The most outstanding representative of the Croatian medicine, our specialist of international reputation in the field of otorhinolaryngology, was *Ante Šercer* (1896–1968). Due to his efforts a faculty of medical science was founded in *Sarajevo* in 1943 (terribly bombed by Serbian agressors in 1992). He was the editor in chief of our Medical Encyclopedia (the first edition appeared in ten volumes, over 700 pages each, in 1957–1965), which was one of the first in the world. It is interesting to mention that the famous jazz trumpeter and singer Luis Armstrong–Satchmo was professor Šercer's patient in Zagreb, and was treated carcinoma of his lower lip in the sixties. He also cured Mario del Monaco and Giuseppe di Stefano.

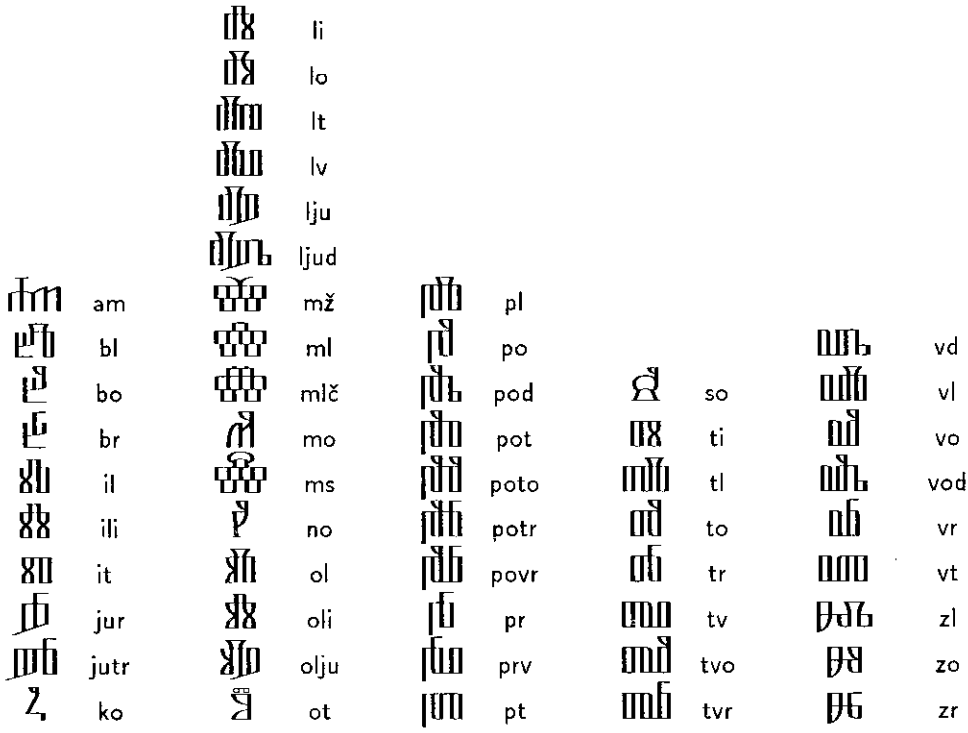
Vladimir Sertić (1901–1983) was a microbiologist. He discovered and classified several bacteryophags, among others the famous *Fi X 174*. He was working for 11 years (1929–1940) in Paris in the Laboratory of Felix d'Herelle, the discoverer of bacteryophags. His colaborator in Paris was Nikolai Bulgakov, who emigrated from the Soviet Union and completed his mediacl studies in Zagreb. The famous Russian writer Michail Bulgakov (the author of 'Master and Marguerite') was Nikolai's brother.

Humanitarian activity of the International Fund *"Hungry Child"* is world-wide known. Its founder (1969 in Zagreb) and the Secretary General was *Vladimir Paleček* (1940–1990). Only in the period from 1969 to 1979 humanitarian aid (medicaments, food, clothing, ambulances, money) has been sent to Afganistan, Algeria, Angola, Bangladesh, Bhurma, Chad, Columbia, Cyprus, Egypt, Ethiopia, Gibuty, Guatemala, Honduras, India, Indonesia, Iraq, Italy, Ivory Coast, Kenia, Lebanon, Madagascar, Mali, Mauretania, Mozabique, Nigeria, Pakistan, Peru, Roumania, Ruanda, Senegal, Somalia, Sri Lanka, Sudan, Syria, Tanzania, Upper Volta, Tunis, Turkey, Uganda, Vietnam, D.R. Yemen, former Yugoslavia, Zambia. Many individuals (painters, musicians etc.) and companies (especially food producing and transport companies) in Croatia contributed to the activity of the International Fund "Hungry Child". V. Paleček also founded and was the Secretary General of the *International Committee for the Protection of Unborn Children* (1986 in Vienna) and the *International Mission for Science and Peace* (1988 in Geneva).

Zagreb has one of the most prestigeous ultrasound diagnostic centers in the field of cardiology and gynecology.

A considerable number of contemporary Croatian scientists are having a world wide reputation. It would be impossible to mention them all in a small booklet like this.

Ligatures in the Croatian Glagolitic Script:



Many people throughout the world contributed to the international recognition of Croatia. We would like to end this booklet with a list of 112 Nobel prize winners who signed an appeal to stop the aggression of the Yugoslav Army to Croatia in 1991/92.

Philip W. Anderson,	physics, 1977
Christian B. Anfinsen,	chemistry, 1977
Werner Arber,	medicine, 1978
Colin M.L. Archer,	peace, 1910
David Baltimore,	medicine, 1975
Derek H.R. Barton,	chemistry, 1969
J. Georg Bednorz,	physics, 1987
Baruj Benacerraf,	medicine, 1980
Paul Berg,	chemistry, 1980
Gerd Binning,	physics, 1986
J. Michael Bishop,	medicine, 1989
James Black,	medicine, 1988
Nicolaas Bloembergen,	physics, 1981
Willy Brandt,	peace, 1971
Joseph Brodsky,	literature, 1987
Thomas R. Cech,	chemistry, 1989
Camilo José Cela,	literature, 1989
S. Chandrasekhar,	physics, 1983
Allan M. Cormack,	medicine, 1979
J.W. Cornforth,	chemistry, 1975
James W. Cronin,	physics, 1980
Gerard Debreu,	economics, 1983
Jean Duasset,	medicine, 1980
Christian de Duve,	medicine, 1974
P.G. de Gennes,	physics, 1991
Hans G. Dehmelt,	physics, 1989
Johann Deisenhofer,	chemistry, 1988
John Carrew Eccles,	medicine, 1963
Manfred Eigen,	chemistry, 1967
Gertrude B. Elion,	medicine, 1988
Richard R. Ernst,	chemistry, 1991
Val L. Fitch,	physics, 1980
William A. Fowler,	physics, 1983
Jerome I. Friedman,	physics, 1983
Milton Friedman,	economics, 1981
Kenichi Fukui,	chemistry, 1981
D. Carleton Gajdusek,	medicine, 1976
Donald A. Glaser,	physics, 1960
Sheldon L. Glashow,	physics, 1979
William Golding,	literature, 1983

Nadine Gorimer,	literature, 1991
Roger Guillemin,	medicine & psychology, 1977
Herbert A. Hauptman,	chemistry, 1985
Dudley Herschbach,	chemistry, 1986
Gerhard Herzberg,	chemistry, 1971
Antony Hewish,	physics, 1974
Dorothy C. Hodgkin,	chemistry, 1964
David H. Hubel,	medicine, 1981
Robert Huber,	chemistry, 1988
Francois Jacob,	medicine, 1965
Niels Jerne,	medicine, 1984
Brien D. Josephson,	physics, 1973
Jerome Karle,	chemistry, 1985
Henry W. Kendall,	physics, 1990
Georges Köhler,	medicine, 1984
Arthur Kornberg,	medinicne, 1959
Dalai Lama,	peace, 1989
Willis E. Lamb Jr.,	physics, 1955
Yuan T. Lee,	chemistry, 1986
Jean–Marie Lehn,	chemistry, 1987
William N. Lipscomb,	chemistry, 1976
M. Corrigan Maguire,	peace, 1977
Bruce Merrifield,	chemistry, 1990
Hartmut Michel,	chemistry, 1988
Czeslaw Milosz,	literature, 1980
Cesar Milstein,	medicine, 1984
Rita Levi–Montaicini,	medicine, 1986
André Lwoff,	medicine, 1965
Nevill Mott,	physics, 1977
K. Alex Müller,	physics, 1987
Joseph E. Muray,	medicine, 1990
Daniel Nathans,	medicine, 1978
Erwin Neher,	medicine, 1991
Severo Ochoa,	medicine, 1959
Wolfgang Paul,	physics, 1989
Linus Pauling,	chemistry 1954, peace 1962
Max P. Perutz,	chemistry, 1962
John C. Polanyi,	chemistry, 1986
George Porter,	chemistry, 1967
Vladimir Prelog,	chemistry, 1975
A.M. Prokhorov,	physics, 1964
Edward M. Purcell,	physics, 1952
Tadeus Reichstein,	medicine, 1950
Burton Richter,	physics, 1976
Heinrich Rohrere,	physics, 1986

Carlo Rubbia,	physics, 1984
Abdus Salam,	physics, 1979
Fred Sangerm	chemistry, 1958 & 1980
Wole Sayinka,	literature, 1986
Robert Schrieffer,	physics, 1972
Glenn T. Seaborg,	chemistry, 1951
William F. Sharpe,	economics, 1990
Kai Siegbahn,	physics, 1981
Claude Simon,	literature, 1985
Herbert A. Simon,	economics, 1978
Hamilton O. Smith,	medicine, 1978
Robert M. Solow,	economics, 1987
Roger Sperry,	medicine, 1981
Jack Steinberger,	physics, 1988
George D. Suell,	medicine, 1980
Henry Taube,	chemistry, 1983
E. Donnall Thomas,	medicine, 1990
Jan Tinbergen,	economics, 1969
Samuel C.C. Ting,	physics, 1976
James Tobin,	economics, 1981
Susumu Tonegawa,	medicine, 1987
Charles H. Townes,	physics, 1964
Desmond Tutu,	peace, 1984
Simon van der Meer,	physics, 1984
Harold E. Varmus,	medicine, 1989
Klaus von Klitzing,	physics, 1985
Ernest T.S. Walton,	physics, 1951.

Basic references:

Unfortunately, most of the references are meant for those who know Croatian.
The following are probably the best books on the history of Christianity in Croatia. We recommend them highly:

- Franjo Šanjek: *Kršćanstvo na hrvatskom prostoru*, Kršćanska sadšnjost, Zagreb 1991,
- Franjo Šanjek: *Crkva i kršćanstvo u Hrvata 1.*, Kršćanska sadšnjost, Zagreb 1988,
- Juraj Kolarić: *Pravoslavni*, VERITAS, Zagreb 1985.
- Josip Turčinović: *Die katolische Kirche in den südslawischen Ländern*, Kršćanska sadšnjost, Zagreb, 1984

A very detailed account on the history of the University of Zagreb is given in:

- Group of authors: *The University of Zagreb*, Liber Zagreb, 1986

An exhaustive survey on the history of the exact sciences in Croatia is given in the following monography:

- Žarko Dadić: *Povijest egzaktnih znanosti u Hrvatskoj I, II*, Globus, Zagreb, 1982

As general references on the history of Croatia we can recommend:

- Dubravko Horvatić: *Croatia*, Turistkomerc Zagreb, 1991 (both French and German translations available)

Trpimir Macan, Josip Šentija: *A short History of Croatia*, The Bridge, Zagreb 1992

- Trpimir Macan: *Povijest hrvatskog naroda*, NZMH, ŠK, Zagreb, 1992
- Josip Horvat: *Kultura Hrvata I, II* Globus, Zagreb 1980
- Zvane Črnja: *Kulturna historija Hrvatske, I, II, III*, 1987 (there are shortened translations into English and French)
- Dominik Mandić: *Hrvati i Srbi, dva stara različita naroda*, Matica Hrvatska, Zagreb, 1990
- Group of authors: *Znameniti Hrvati*, 1991 (reprinted from the 1925. edition)

The relationship between Croatia and medieval Bosnia and Herzegovina is described in:

- Krunoslav Draganović, o. Dominik Mandić: *Herceg–Bosna i Hrvatska*, LAUS, Split, 1991

The history of Istria (until 1925) is well described in

- don Luka Kirac: *Crtice iz istarske povijesti*, Zagreb 1946

For the history of Croatian literature you can consult:

- Radoslav Katičić, Slobodan P. Novak: *Two thousand years of written monuments in Croatia*, SNL, Zagreb, 1987 (there exist also German and Italian translations)
- Eduard Hercigonja: *Tropismena i trojezična kultura hrvatskog srednjovjekovlja*, in 'Pisana riječ u Hrvatskoj', p.39–79, (with summary in English)
- Vinko Grubišić: *Grafija hrvatske lapidarne ćirilice*, KHR Barcelona 1987

The following are the books written with a rare currage:

- Nikolai Tolstoy: *Ministar i pokolji (Minister and killings), Bleiburg i Kočevski rog 1945*, Matica Hrvatska, Zagreb, 1991
- Cristophe Dolbeau: *Le panserbisme, cancer Yougoslave*, The Bridge, Zagreb, 1992

The author would be glad to contact anybody wishing to know more. Critical remarks are most welcome.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Glina
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Nova Gradiška
Vinkovci
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