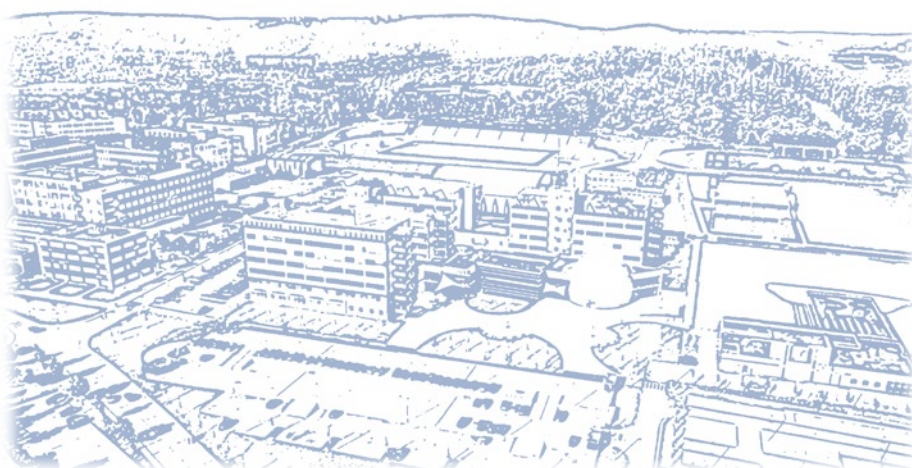
# ANNUAL REPORT 2014

## FACULTY OF ELECTRICAL ENGINEERING AND COMMUNICATION

## BRNO UNIVERSITY OF TECHNOLOGY



# Contents

# Introduction

## History

Brno University of Technology (BUT) is the second largest and the second oldest technical university in the Czech Republic. It was founded in 1849 for technical, agricultural and commercial specializations In consequence of political and national disputes, Czech gradually ceased to be used as a language of instruction until in 1899 the Czech Technical High School was established in Brno. After World War I and the founding of Czechoslovakia this school merged with the German Technical School (originally bilingual) to form the High Technical School in Brno (later bearing the name of Dr. Edvard Beneš, the second President of Czechoslovakia). In the period between World War I and World War II the school was among the best technical high schools in Europe. During World War II the school was, as all other Czech high schools were, closed and the premises were used by German military institutions, and most equipment was destroyed. Immediately after the end of World War II the activities of the school were resumed. In 1951 at the beginning of Cold War, the Technical High School was closed and some departments became parts of the newly established Military Academy. Tuition for civilians continued at the former Faculty of Civil Engineering only.

Electrotechnical disciplines were first taught at the university in 1905. Since the Faculty of Power Engineering was founded in 1959, and subsequently transformed into Electrotechnical Faculty, 25,000 students have graduated from the faculty. In 1993 the structure of the faculty was changed. It received a new name Faculty of Electrical Engineering and Computer Science (FEECS). The faculty was the third largest among the then existing seven faculties of Brno University of Technology after, at the beginning of 2000, the Faculty of Technology and the Faculty of Management joined to establish Tomáš Baťa University in Zlín.

A number of historical decisions were taken in 2001 in connection with the founding of a new faculty in 2002 - Faculty of Information Technology (FIT) and transformation of the Faculty of Electrical Engineering and Computer Science (FEECS) into the Faculty of Electrical Engineering and Communication (FEEC) A significant milestone in the faculty history was the year 2013 when construction of new faculty premises was completed. After more than fifty years of the existence of the faculty all departments and workplaces moved to one location in the BUT campus Pod Palackého vrchem.

## The Faculty in 2014

At the end of January 2014 Professor Karel Rais finished his second term as Rector of Brno University of Technology. His team of vice-rectors included one of the leading personalities of the Faculty of Electrical Engineering and Communication Professor Pavel Jura from the Department of Control, Measurement and Instrumentation, who was Vice-Rector for Information and Communication Technologies.

The new Rector Professor Petr Štěpánek took office on 1 February 2014 and his Vice-Rector for Creative Activities is Professor Lubomír Grmela from the Department of Physics.

The Dean of the faculty in 2014 was Professor Jarmila Dědková and the four vice-deans were Professor Vladimír Aubrecht (research and doctoral study programme, acting dean), Associate Professor Jiří Háze (external relations and international affairs), Associate Professor Petr Fiedler (Bachelor study programme), Professor Stanislav Hanus (Master study programme). Miloslav Morda was faculty bursar.

At the end of 2014 there were 220 academics at the faculty (professors, associate professors, lecturers and other pedagogical and research staff) and 3,776 students in all forms of government supported programmes. Moreover, instruction was provided for 291 students of the

Faculty of Information Technology, 37 students of the Faculty of Mechanical Engineering, 29 students of the Faculty of Management and 2 students of the Institute of Forensic Engineering. On the other hand, the Faculty purchased instruction for 15 students from the Faculty of Management. Then, the number of students educated at the Faculty totalled 4,135. In 2014 education was provided in study programmes Electrical Engineering, Electronics, Communication and Control Technology (EECR, accredited in 2001) and Biomedical Technology and Bioinformatics (BTBIO-A, reaccredited in 2013), Biomedical Engineering and Bioinformatics (BTBIO-F, accredited in 2010), English in Electrical Engineering and Information Technology (AJEI-H, accredited in 2012) and Audio Engineering (AUDIO, accredited in 2012) in the Bologna system. The study programmes at FEEC are now fully compatible with the educational systems applied in the European Union, and student mobility has been facilitated. Among the FEEC graduates in 2014 there were 486 students who completed the Bachelor degree programme, 420 follow-up Master programme graduates and 53 doctoral students completed the Ph.D. programme. There were 1,227 admisions to the Bachelor programmes, 653 admissions to the follow-up Master programmes, and 74 students started their study for the Ph.D. degree. Instruction in English was provided to 2 international students paying their fees. Four academics were appointed associated professors and one as professor.

## Events and Activities

- reconstruction of premises Technická 8,
- unveiling of plaques near Professor Kalendovský assembly hall at Technická 10 and by Professor Brauner assembly hall at Technická 12
- meeting of the deans of the Faculty of Electrical Engineering and Faculty of Information Technology with members of the club Elektron
- meeting to commemorate avalanche victims on Kubínská hola
- accreditation of the Bachelor degree programme Safety in Information Technology
- courses for secondary school students interested in study at FEEC organized by Department of Mathematics to help them prepare for entrance examination at FEEC
- Open Door Days (November, December 2014), visits by students to secondary schools, secondary school advisors visiting FEEC, Night of Scientists (26 September 2014),
- presentation of new study programmes at 21th European trade fair of higher and lifelong education Gaudeamus 2014, 4-7 November 2014, to promote FEEC and arise interest of secondary school students in study at FEEC, participation in trade fairs in Bratislava, Nitra and Prague
- meeting of the leaderships of Czech and Slovak faculties of electrical engineering and associated faculties in Mikulov, 20-22 May 2014
- publication of the faculty yearbook 2013/14
- development of programmes leading to habilitation and appointment procedures
- 20th STUDENT EEICT 2014 Conference and Competition organized in cooperation with the Faculty of Information Technology, sponsored by Honeywell, ABB, ON Semiconductor etc, with 65 Bachelor, 90 Master, 57 Ph.D. papers, and 19 papers by secondary-school students
- Lifelong Learning Programme-Erasmus and other European programmes
- full use of the central BUT information system
- commencement of the project ‘Energy in Conditions of Sustainable Development (EN-PUR)’ of the regional centre CVVOZE (Centre for Renewable Electric Energy Sources) funded from NPU I, investigator Vladimír Aubrecht
- preparation of a project of the regional centre SIX (Centre for Sensor, Information and Communication Systems) funded through the National Proramme of Sustainability I

- opening of the mininursery Edisonka supported by BUT faculties
- activities of Academic Senate member Ivana Jakubová in her capacity as a member of the Higher Education Council
- activities of Academic Senate members, mainly the chairman Miloslav Steinbauer, focused on the development and economic interests of FEEC
- activities of Advisor for Equal Opportunities Naděžda Uhdeová focused on consultancy for female students and study opportunities for handicapped students
- recruitment and care of international students paying their fees. Education of these students is a valuable experience for participation of individuals and departments in mobility projects, and also a source of additional income for qualified teachers with language skills.
- forty-eighth faculty ball at the Voroněž hotel


## Achievements

Economic situation of the faculty in 2014 was satisfactory. Income for educational activities did not attain the level of 2013 and budget investment funds had to be used. The trend in salaries and material supply was favourable due to outstanding pedagogical and research achievements of academic staff and faculty expenditure minimization.

Economic stability of departments was mainly due to involvement in research projects of the Czech Science Foundation, Czech Technology Agency of the Czech Republic, Ministry of Trade and Industry, European Commission (FP7), and efforts of those who under the leadership of chief investigators participated in OP VK and NPU projects.

All staff members and Ph.D. students deserve appreciation and my gratitude.

*Jarmila Dědková*
*Dean*

# Faculty of Electrical Engineering and Communication

## Dean

Prof. Ing. Jarmila Dědková, CSc.

## Vice-Deans

Prof. RNDr. Vladimír Aubrecht, CSc.
Acting Dean, Vice-Dean for Creative Activities and Doctoral Degree Programme

Doc. Ing. Petr Fiedler, PhD.
Vice-Dean for Bachelor Degree Programme

Prof. Ing. Stanislav Hanus, CSc.
Vice-Dean for Master Degree Programme

Doc. Ing. Jiří Háze, Ph.D.
Vice-Dean for External Relations and International Affairs

## Chairman of Academic Senate

Doc. Ing. Miloslav Steinbauer, Ph.D.

## Faculty Secretary

Ing. Miloslav Morda

## Student Advisor to the Dean

Bc. Daniel Janík

## Advisor for Equal Opportunities

RNDr. Naděžda Uhdeová, Ph.D.

## Trade Unions Representative

Prof. Ing. Vítězslav Hájek, CSc.

## Departments

Department of Control and Instrumentation
Department of Biomedical Engineering
Department of Electrical Power Engineering
Department of Electrical and Electronic Technology
Department of Physics
Department of Languages
Department of Mathematics
Department of Microelectronics
Department of Radioelectronics
Department of Telecommunications
Department of Theoretical and Experimental Electrical Engineering
Department of Power Electrical and Electronic Engineering

## Scientific Board

**Internal members**

Prof. RNDr. Vladimír Aubrecht, CSc.
Prof. Ing. Lubomír Brančík, CSc.
Prof. Ing. Jarmila Dědková, CSc.
Doc. Ing. Petr Fiedler, Ph.D.
Prof. Ing. Eva Gescheidtová, CSc.
Prof. Ing. Lubomír Grmela, CSc.
Prof. Ing. Stanislav Hanus, CSc.
Doc. Ing. Jiří Háze, Ph.D.
Prof. RNDr. Jan Chvalina, DrSc.
Prof. Ing. Jiří Kazelle, CSc.
Prof. Ing. Vladislav Musil, CSc.
Doc. Ing. Vít Novotný, Ph.D.
Doc. Dr. Ing. Miroslav Patočka
Prof. Ing. Ivo Provazník, Ph.D.
Prof. Dr. Ing. Zbyněk Raida
Prof. Ing. Zdeněk Smékal, CSc.
Doc. Ing. Petr Toman, Ph.D.
Doc. Ing. Pavel Václavek, Ph.D.
Prof. Ing. Radimír Vrba, CSc.
Doc. Ing. Jaroslav Zendulka, CSc.

**External members**

Doc. Ing. Otto Dostál, CSc.
Doc. Ing. Ladislav Dušek, CSc.
Ing. Leoš Dvořák
Ing. Jiří Holoubek
Doc. Dr. Ing. Pavel Horský
Prof. Ing. Miroslav Husák, CSc.
Prof. Dr. Ing. Josef Lazar
Doc. Ing. Jiří Masopust, CSc.
Ing. Petra Peterková, Ph.D.
Ing. Jiří Potěšil
Prof. Ing. Aleš Richter, CSc.
Ing. Roman Schiffer

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Facebook: http://www.facebook.com/FEKTVUT
Youtube: http://www.youtube.com/user/perFEKTniFakulta

# Accredited study programmes and specializations

## Accredited Study Programmes

**Bachelor Degree Programme Electrical, Electronic, Communication and Control Technology**

Study areas: Automation and Measurement Technology
Electronics and Communications
Microelectronics and Technology
Power Electrical and Electronic Engineering
Teleinformatics

**Bachelor Degree Programme Biomedical Technology and Bioinformatics**

Study area: Biomedical Technology and Bioinformatics

**Bachelor Degree Programme English in Electrical Engineering and Information Technology**

Study area: English in Electrical Engineering and Information Technology

**Bachelor Degree Programme Audio Engineering**

Study area: Audio Engineering

**Follow-up Master Degree Programme Electrical, Electronic, Communication and Control Technology**

Study areas: Biomedical and Ecological Engineering
Electronics and Communications
Electrotechnical Manufacturing and Management
Cybernetics, Control and Measurement
Microelectronics
Power Electrical Engineering and Power Electronics
Telecommunications and Information Technology

**Follow-up Master Degree Programme Biomedical Engineering and Bioinformatics**

Study area: Biomedical Engineering and Bioinformatics

**Doctoral Degree Programme Electrical Engineering and Communication Technology**

Study areas: Biomedical Electronics and Biocybernetics
Electronics and Communications
Physical Electronics and Nanotechnology
Cybernetics, Control and Measurement
Mathematics in Electrical Engineering
Microelectronics and Technology
Power Electrical and Electronic Engineering

Teleinformatics
Theoretical Electrical Engineering

**Doctoral Degree Programme Biomedical Technology and Bioinformatics**
Study area: Biomedical Technology and Bioinformatics

## Accredited Areas for Habilitation Procedures and Procedures for Appointment to Professorship

Biomedical Engineering
Electronics and Communications
Electrical and Electronic Technology
Power Electrical Engineering
Technical Cybernetics
Teleinformatics
Theoretical Electrical Engineering

# Study Programmes

## Bachelor Degree Programme Electrical, Electronic, Communication and Control Technolog

The faculty has been providing education in the Bachelor programme Electrical, Electronic, Communication and Control Technology (EECR) in full-time form of study since academic year 2002/03 and in part-time form of study since academic year 2004/05.

There were 1,480 full-time students enrolled in the Bachelor programme EECR-B in 2014. The programme was completed by 381 students,76 of them in the study area Automation and Measurement Technology (B-AMT), 57 in Electronics and Communications (B-EST), 32 in Microelectronics and Technology (B-MET), 66 in Power Electrical and Electronic Engineering (B-SEE) and 87 in Teleinformatics (B-TLI).

In the part-time Bachelor programme EECR-BK there were 236 students in 2014. The programme was completed by 21 students, 2 of them in study area Automation and Measurement Technology (BK-AMT), 3 in Electronics and Communications (BK-EST), 2 in Microelectronics and Technology (BK-MET), 5 in Power Electrical and Electronic Engineering (BK-SEE) and 9 in Teleinformatics (BK-TLI).

Applications for full-time and part-time Bachelor study were accepted. There was a written entrance test in either mathematics and physics, or mathematics and the basics of informatics. Students who met one of the following requirements were exempt from the examination:

passed their school-leaving examination in mathematics or physics with grade 1 or 2 in at least one of these subjects

completed a preparatory course in mathematics or physics with grade 1 or 2

achieved a secondary-school average better than 2.0 (arithmetical average of grades in final reports for 1st, 2nd and 3rd year and the first half of 4th year)

passed National Comparative Examinations and Test of General Study Prerequisites with a minimum of 60% in all three assessed parts

completed National Comparative Examinations with a minimum of 60% in each part of the mathematics test.

The maximum number of points to be achieved in the entrance examination for each subject was 50 and the pass was 12 for each subject. All applicants who passed the entrance examination or who were exempt from it were admitted.

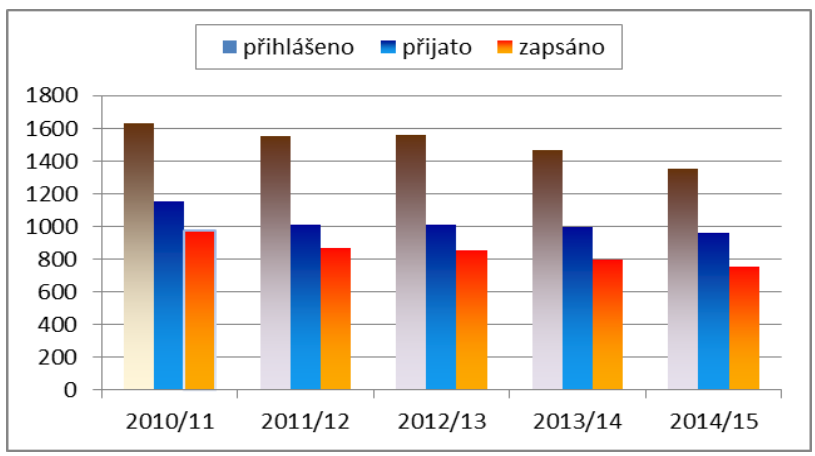
In 2014 there were 1, 245 applicants, 1, 038 for full-time study and 207 for part-time study. Finally, 868 students were admitted, 709 in full-time study and 159 in part-time study. As the number of admitted students did not reach full capacity, a second term was announced. There were 75 applications for full-time study and 35 applications for part-time study. The total number of students enrolled was 753, 590 full-time students and 163 part-time students. It can be said that part-time study remains in the focus of interest.

Numbers of applicants, admitted and enrolled in full-time study since 2010 are in graph 1. There is a decreasing trend in the numbers of enrolled students which is in accordance with the demographic trend and students' interest in newly accredited Bachelor programmes at other universities. Statistics for the period 2010/11 - 2014/15 of students' interest in study areas are given in Table 1.

Preparatory courses were offered by the Department of Mathematics and Department of Physics to assist applicants preparing for entrance examinations and help them adapt to university studies. Information on study programmes and qualifications such as Certificate of Electrotechnical Qualification, Certificate of Pedagogical Practice, Microsoft Certificate, Cisco Certificate are regularly presented in the media, on Open Door Days, visits by teachers and students to secondary schools, and at the GAUDEAMUS fair. All above activities are focused on promotion of FEEC and increasing the interest in studies at the faculty.

Table1: Interest of full-time students in Bachelor programme study areas – Automation and Measurement Technology (B-AMT), Electronics and Communications (B-EST), Microelectronics and Technology (B-MET), Power Electrical and Electronic Engineering (B-SEE), Teleinformatics (B-TLI)

| ***Acad. year*** | | B-AMT | B-EST | B-MET | B-SEE | B-TLI | Total |
|---|---|---|---|---|---|---|---|
| | Number | 144 | 151 | 47 | 146 | 214 | |
| 2010/11 | % | 20.5 | 21.5 | 6,7 | 20.8 | 30.5 | 702 |
| | Number | 138 | 109 | 100 | 160 | 189 | |
| 2011/12 | % | 19,.8 | 15.7 | 14.4 | 23 | 27.2 | 696 |
| | Number | 140 | 97 | 71 | 159 | 182 | |
| 2012/13 | % | 21.6 | 14.9 | 10.9 | 24.5 | 28.0 | 649 |
| | Number | 113 | 105 | 67 | 146 | 189 | |
| 2013/14 | | 21.5 | 14.9 | 10.9 | 24.4 | 28.0 | 620 |
| | Number | 116 | 63 | 83 | 112 | 172 | |
| 2014/15 | % | 21.2 | 11.5 | 15.2 | 20.5 | 31.5 | 546 |




Graph 1: Applicants, admitted and enrolled in full-time and part-time study in EECR-B in academic years 2010/11 - 2014/15

## Bachelor Degree Programme Biomedical Technology and Bioinformatics

In academic year 2007/08 the Bachelor programme Biomedical Technology and Bioinformatics (BTBIO-A) was launched. The full-time form of study covers one study area Biomedical Technology and Bioinformatics (A-BTB). Also taking part in instruction in this interdisciplinary programme is the Faculty of Medicine at Masaryk University in Brno.

The study area Biomedical Technology and Bioinformatics is mainly focused on practical training, but it also prepares graduates for further studies in the follow-up Master programmes at universities providing education in biomedical engineering, medical informatics and mathematical biology (Brno University of Technology, Czech Technical University in Prague, Charles University, Masaryk University). Students gain theoretical knowledge in mathematics, physics and chemistry, basic knowledge in biology, human anatomy and physiology, needed to understand the basic biological processes taking place in human organism, but also for communication with doctors and medical staff. They get acquainted with operation principles and use of medical technology and informatics, and gain ability to work with them. Moreover, they are offered information on medical legislative and learn how to apply it in practice. Emphasis is laid on general and professional language skills.

The Bachelor programme includes a four-week professional training in hospitals, health centres, institutions and companies focused on running clinics, treatment, research and trade in biomedical technology and bioinformatics in the Czech Republic and abroad The training is arranged by the students themselves and takes place outside scheduled instruction (mainly during the summer holidays) by the time of completion of the Bachelor programme.

The top limit approved by Academic Senate for admission to full-time study in the programme BTBIO-A in academic year 2013/14 was 150. The written examination contained tests in mathematics and biology. Applicants with secondary-school grade average of 1.25 were exempt from the examination. The maximum number of points to be achieved in each subject was 50 and the pass was 12 points for each subject. All applicants exempt from entrance examination and those who passed the examination with excellent results were admitted. In 2014 there were 199 paid applications for study in the programme BTBIO-A, 131 admissions and 101 enrolled. And there were 230 full-time students in the BTBIO-A programme.

## Bachelor Degree Programme English in Electrical Engineering and Information Technology

In academic year 2012/13 the Bachelor programme English in Electrical Enginering and Information Technology (AJEI-H) with the study area English in Electrical Engineering and Information Technology (H-AEI) was launched. English in Electrical Engineering and Information Technology as a specific professional variety had not been taught before at universities in the Czech Republic though English is the lingua franca of engineering specializations. The programme also includes cultural studies, and fundamentals of electrical engineering and economics. The graduates will be equipped for work in industrial companies, government administration, research institutions, management, and translating technical texts. They will acquire basic knowledge of electrical engineering and professional language competences on level C1 of the 'Common European Reference Framework'.

The subjects selected for entrance examination were mathematics and English. The entrance examination contained an English language test (multiple choice) at the intermediate level B1 of the 'Common European Reference Framework'. Exempt from the examination in English were students who submitted a certificate or report confirming the required level of knowledge (Upper-Intermediate).

Students who met one of the following requirements were exempt from the examination in mathematics:

passed their school-leaving examination in mathematics with grade 1 or 2

completed a preparatory course in mathematics with grade 1 or 2

achieved a secondary-school average better than 1.70 (arithmetical average of grades in final reports for 1st, 2nd and 3rd year and the first half of 4th year)

passed National Comparative Examinations and reached 60.0% in each part of the test in mathematics

The maximum number of points to be achieved in entrance examination for each subject was 50 and the pass was 12 for each subject. All applicants who passed the entrance examination or who were exempt from it were admitted. There were 142 applicants for academic year 2014/15, 112 applicants were admitted and 109 of them enrolled.

## Bachelor Degree Programme Audio Engineering

Since academic year 2013/14 a new full-time Bachelor programme Audio Engineering (AUDIO-J) with one study area Audio Engineering (J-AUD) has been offered. The programme provides interdisciplinary Bachelor education in audio engineering and is focused on training of audio engineers with technical and artistic approach to the latest audio technology, audio signal processing, musical production and studio practice. The programme was prepared and implemented in cooperation with Janáček Academy of Music and Performing Arts, Faculty of Music.

Applicants for admission to the study programme AUDIO-J are required to take an aptitude test and entrance examination in mathematics and physics or mathematics and basics of informatics. The aptitude test is taken prior to the above entrance examination. Decisive for admission are results of the aptitude test. The requirement for entrance examination is to achieve the given minimum number of points. The aptitude test cannot be exempt. Exempt from entrance examination are applicants who achieved a secondary-school average 1,25 (an arithmetical average of grades in final reports for 1st, 2nd and 3rd year and the first half of the fourth year).

There were 148 applicants, 73 were admitted and 67 students enrolled.

## Follow-up Master Degree Programme Electrical, Electronic, Communication and Control Technology

The faculty has been providing education in the follow-up Master programme Electrical, Electronic, Communication and Control Technology in full-time form of study since academic year 2005/06 and in part-time form of study since academic year 2007/08.

In academic year 2014 there were 798 full-time students in the follow-up Master programme EECR-M, 394 in the first year of study and 404 in the sekond year of study. There were 173 part-time students in EECR-ML,108 first-year students and 65 second-year students.

In 2014 full-time programme was completed by 320 students, 13 in Biomedical and Ecological Engineering (M-BEI), 31 in Power Electrical Engineering (M-EEN), 47 in Electronics and Communications (M-EST), 28 in Electrotechnical Manufacturing and Management (M EVM), 42 in Cybernetics, Control and Measurement (M-KAM), 39 in Microelectronics (M-MEL), 30 in Power Electrical and Electronic Engineering (M-SVE) and 90 in Telecommunications and Informatics (M-TIT). Part-time study was completed by 59 students, 2 in Biomedical and Ecological Engineering (ML-BEI), 5 in Electronics and Communications (ML-EST), 12 in Electrotechnical Manufacturing and Management (ML EVM), 9 in Cybernetics, Control and Measurement (ML-KAM), 5 in Microelectronics (ML-MEL), 8 in Power Electrical and Electronic Engineering (ML-SVE) and 18 in Telecommunications and Informatics (ML-TIT).

The total number of applicants for study in the EECR programme (with paid application) was 687, 555 applicants for full-time programme (EEKR-M) and 132 for part-time programme (EEKR-ML). For academic year 2014/15 the maximum numbers of admissions approved by Academic Senate were 750 (full-time study) and 250 (part-time study). The written entrance examination contained 10 tasks approved by the Council of Study Programmes, two for each of the subjects Electrotechnical Engineering 1, Electrotechnical Engineering 2, Electronic

Components, Signals, Structures, Systems and Measurement in Electrical Engineering. The number of points to be achieved for each problem was 10, the total max. 100 points. The time limit was 75 minutes. As the number of applicants was lower than the number approved for admission, the Dean decided, in accordance with Admission Procedure Rules, about exemption from entrance examination and admission of all of them. On the announced date of entrance examination 26 June 2014 nearly all applicants enrolled. The second term of examination 8 July 2014 and Committee meeting scheduled for 21 August 2014 were cancelled. The total number of admissions was 576, 469 in full-time study and 107 in part-time study, 544 of them enrolled, 441 in full-time study and 103 in part-time study. All admitted were registered for the study areas they had selected. Numbers of applicants and admitted by study areas are in Table 2.

## Follow-up Master Degree Programme Biomedical Engineering and Bioinformatics

Since academic year 2010/11 the faculty has provided education in the full-time follow-up Master programme Biomedical Engineering and Bioinformatics BTBIO-F. In 2014 there were 137 students in this programme, 68 first-year students and 69 second-year students. Forty-one students completed the BTBIO-F programme in 2014.

The total number of students for admission in this programme was 91 (with paid application). The written examination contained 10 problems selected from two topic areas published on faculty websites. The topic areas were approved by the Council of Study Programmes. Every correct result yielded 10 points, 100 points for the whole examination. The timing was 75 minutes. As the number of applicants was lower than the number approved for admission, the Dean decided, in accordance with Admission Procedure Rules, about exemption from entrance examination. On announced entrance examination date 26 June 2014 nearly all applicants enrolled. The second term of entrance examination 8 July 2014 and Committee meeting scheduled for 21 August 2014 were cancelled. Seventy-seven applicants were admitted and 74 enrolled

## Lifelong Education and Self-Paid Study

The faculty participates in the system of lifelong education (Amendment to Act 111/98 Coll. on university education). Apart from a range of specialized courses for professionals, the faculty offers paid study of subjects in the Bachelor and follow-up Master programme EECR. Having completed the courses, the graduates will be admitted in a study programme without being required to pass entrance examination, and earned credits will be recognized. In 2014 there were 14 students in lifelong education programme.

There was one international student paying his fees in the follow-up Master programme EECR-MN.

Table 2: Numbers of applicants and admitted in study areas of follow-up Master programmes EECR-M and EECR-ML in 2013: Biomedical and Ecological Engineering (M-BEI, ML-BEI), Power Electrical Engineering (M-EEN, ML-EEN), Electronics and Communications (M-EST, ML-EST), Electrotechnical Manufacturing and Management (M-EVM, ML-EVM), Cybernetics, Automation and Measurement (M-KAM, ML-KAM), Microelectronics (M-MEL, ML-MEL), Power Electrical and Electronic Engineering (M-SVE, ML-SVE), Telecommunications and Informatics (M-TIT, ML-TIT)

| *Study area* | *Applicants* | *Admissions* | *Study area* | *Applicants* | *Admissions* |
|---|---|---|---|---|---|
| M-BEI | 41 | 29 | ML-BEI | 16 | 13 |
| M-EEN | 62 | 47 | ML-EEN | 12 | 8 |
| M-EST | 68 | 60 | ML-EST | 8 | 5 |
| M-EVM | 77 | 70 | ML-EVM | 20 | 17 |
| M-KAM | 83 | 73 | ML-KAM | 19 | 16 |
| M-MEL | 63 | 60 | ML-MEL | 15 | 13 |
| M-SVE | 56 | 51 | ML-SVE | 10 | 9 |
| M-TIT | 105 | 79 | ML-TIT | 32 | 26 |

Table 3: Numbers of students in Bachelor and Master programmes in the period 2010 - 2014

| **Programme** | **2010** | **2011** | **2012** | **2013** | **2014** |
|---|---|---|---|---|---|
| EEKR-B | 1998 | 1915 | 1868 | 1812 | 1716 |
| BTBIO-A | 279 | 290 | 285 | 263 | 230 |
| AJEI-H | 0 | 0 | 76 | 88 | 162 |
| AUDIO-J | 0 | 0 | 0 | 52 | 100 |
| **Bc. total** | **2277** | **2205** | **2229** | **2215** | **2208** |
| | | | | | |
| EEKR-M | 1200 | 1018 | 989 | 974 | 964 |
| BTBIO-F | 43 | 109 | 115 | 118 | 137 |
| **Mgr. total** | **1243** | **1127** | **1104** | **1092** | **1101** |
| **Total** | **3520** | **3332** | **3333** | **3307** | **3309** |

## Tuition Support

There has been a consistent effort at the FEEC to improve and use more extensively the information system for management of study affairs and to make relevant information accessible to students.

In 20114 regular assessment of the quality of teaching by students took place at the end of the winter and the summer semester using the BUT information system.

In support of tuition in full-time and part-time Bachelor and follow-up Master programmes innovated electronic texts (ET) and multimedia aids (MP) were created and are accessible on faculty websites.

# Science, Research and Doctoral Study

## Creative Activities, Science and Research

Academics and students are involved in basic and applied research in most specilizations of electrical engineering.

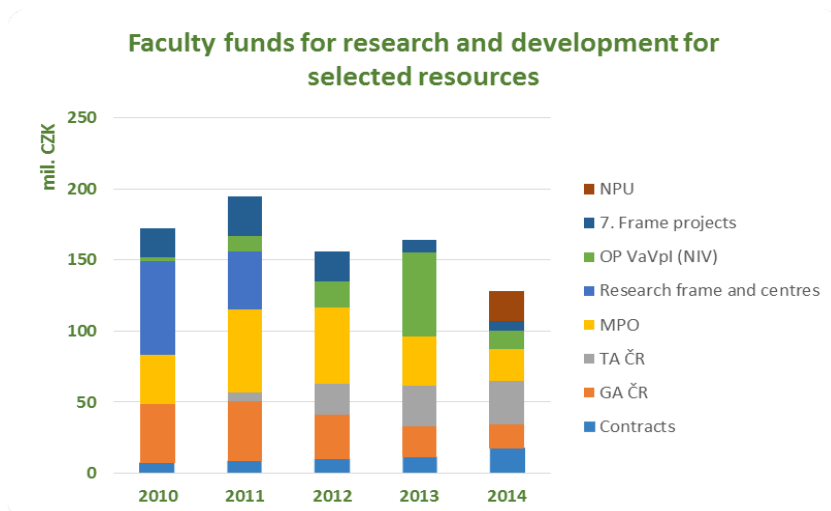
Research and development at FEEC is supported by the Ministry of Education and the major sources of funds are projects of the Czech Science Foundation, Technology Agency of the Czech Republic, Ministry of Industry and Trade, the National Sustainability Programme I etc. In the period 2011 - 2013 a major source of mainly investment funds was the Operational Programme 'Research and Development for Innovations' (OP VaVpI) for completion of two regional research centres CVVOZE and SIX.

On international level, the faculty researchers were involved in the 7th framework programme projects, and currently their attention is focused on preparation of projects within the programme Horizon 2020. The faculty prepares its own projects, and offers partnership in other projects.

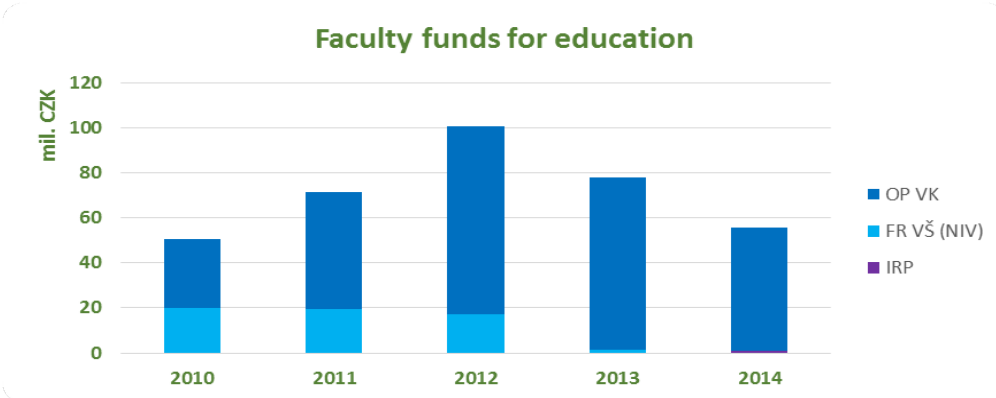
FEEC is also involved in applied research for industrial partners. Income from contracts in 2014 amounted to 17.5 mil. CZK, with important contribution from the regional research centres CVVOZE and SIX. Research is carried out on the basis of commercial contracts, and also as part of diploma theses and dissertations (specific research). All companies interested in cooperation with FEEC can contact us.

Education at FEEC was funded from institutional development projects and mainly OP VK projects.

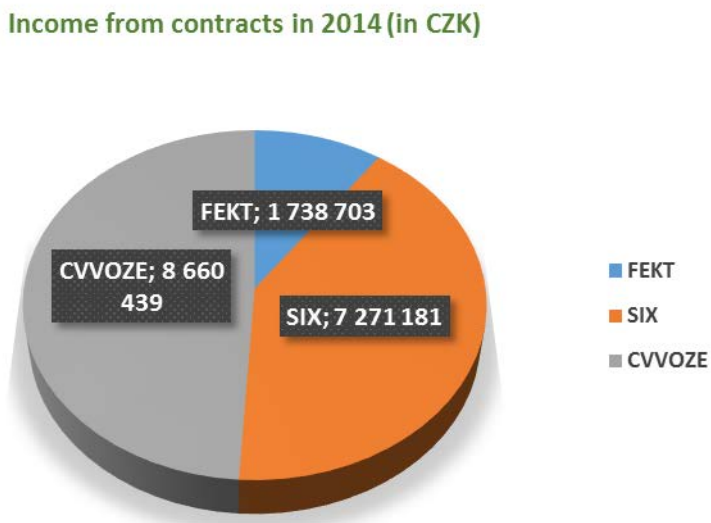
Original scientific and research results were published in three internal monographs and 137 papers in impact journals. FEEC was granted 15 national patents or utility samples.




Graph 2: FEEC funds for research and development from 2010 to 2014.




Graph 3: FEEC funds for education from 2010 to 2014.




Graph 4: Income from contracts in 2014

## Regional Research Centres

Two regional research centres continued their research and development activities.

**Centre for Research and Exploitation of Renewable Energy Sources (CVVOZE)**
(investigator Vladimír Aubrecht)

This research centre concentrates and coordinates research, development and innovation capacities for research on renewable energy sources. The research team focuses on chemical and photovoltaic energy sources, electrochemistry, electromechanics, electrotechnology, electrical drives, power electrical engineering, mobile robots and industrial electronics. In 2014 CVVOZE dealt with research in five research areas:

- optimization of electromechanical enery conversion
- chemical and photovoltaic energy sources

- generation, transmission, distribution and utilization of electrical energy
- automation and sensor technologies
- research of the switch-off process in switching device.

An important source of funding for research in 2014 was the project of National Sustainability Programme 'Energy in Conditions of Sustainable Development (EN-PUR)'.

The centre's activities are focused not only on basic research, but also on applications and acceleration of transfer of novel technologies into industrial use. All CVVOZE laboratories form a unique infrastructure that will undoubtedly attract important industrial partners whose production is closely connected with research carried out in the centre.

The leading workplaces of the centre are Laboratory of Switching Devices and Ultra High Voltage Laboratory located in Professor List Technology Park. These strategic laboratories are used for research and development of various power and high voltage electric devices and systems. The equipment can be used to simulate extreme short-circuit conditions in the network, lightning strike on lines etc. The unique laboratory equipment draws attention of many industrial companies. We have been offered contracts from SIEMENS, ABB, EATON, and from smaller Czech firms (DRIBO) and foreign firms (SEZ Krompachy - Slovakia, Techna Ltd. – Great Britain, Schaltbau - Austria). Research contracts for these laboratories in 2014 amounted to nearly 5 mil. CZK.

For more information on CVVOZE visit www.cvvoze.cz.

**Centre of Sensor, Information and Communication Systems (SIX)**
(investigator Zbyněk Raida)

The research centre SIX was established in 2010 as a joint initiative of FEEC departments involved in research and development of sensor systems, information and communication technologies. The aim was to interconnect research interests and utilize the synergy in work on extensive and complex research projects.

The involved departments offered to the centre their laboratories that were upgraded and extended in the period 2011 - 2013 owing to support from the operational programme 'Research and Development for Innovations'.

Last year was the first year of full operation of the centre without direct financial support from public sources. In comparison with 2013 the number of full-time jobs increased from 70 to 110, the number of trained Master graduates from 43 to 135 and Ph.D. graduates from 14 to 23. Income from research contracts increased from 5.24 mil. CZK in 2013 to 7.30 mil. CZK in 2014. Income from national and international projects increased from 31.6 mil. CZK in 2013 to 46.7 mil.CZK in 2014.

Within the framework of the National Sustainability Programme the centre SIX prepared an interdisciplinary project 'Research of Wireless Technologies (INWITE)'. There are five teams guided by tandems of professors from the Technical University of Vienna and Centre SIX. The same team proposed the project 'Advanced Wireless Technologies for Clever Engineering (ADWICE)' for programme HORIZON 2020. If it succeeds, it will be implemented by Austrian and Czech research teams in the period 2015 - 2022.

In 2015 we will focus on new research activities based on bilateral cooperation (Czech-Austrian and Czech-Korean Czech Science Foundation projects), projects of European Space Agency (ESA) and programme HORIZON 2020.

For more information visit

http://www.six.feec.vutbr.cz.

## Habilitations and Appointments to Professorship

In 2014 there were four appointments to associate professor:

**Doc. Ing. Radim Burget, Ph.D.**

Teleinformatics

**Doc. Ing. Kamil Říha, Ph.D.**

Teleinformatics

**Doc. Ing. Bohumil Garlík, CSc.**

Power Electrical and Electronic Engineering

**Doc. Ing. Zbyněk Bureš, Ph.D.**

Biomedical Engineering

There was no appointment to professorship in 2014.

## Doctoral Programme

In cademic year 2014/15 there are 375 students in the doctroral degree programme. Two of them enrolled in the study programme in English. Table 4 shows numbers of doctoral programme graduates over the last five years. The list of 2014 doctoral programme graduates can be found on FEEC websites, links *Study, Doctoral study programmes, Doctoral programme graduates.*

Tabulka 4: Numbers of Ph.D. students from 2010 to 2014

| *year* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|
| ***1.*** | 118 | **85** | **77** | **79** | **70** |
| ***2.*** | 76 | 96 | 82 | 62 | 62 |
| ***3.*** | 75 | 69 | 85 | 70 | 50 |
| ***4.*** | 64 | 71 | 64 | 77 | 57 |
| ***5.*** | 47 | 48 | 58 | 49 | 55 |
| ***6.*** | 7 | 43 | 37 | 46 | 38 |
| ***7.*** | 18 | 7 | 41 | 51 | 43 |
| ***total*** | **406** | **419** | **444** | **434** | **375** |

Table 5: Numbers of Ph.D. students by departments from 2010 to 2014

| | *2010* | *2011* | *2012* | *2013* | *2014* | *total* |
|---|---|---|---|---|---|---|
| ***UAMT*** | 1 | 0 | 3 | 2 | 1 | **7** |
| ***UBMI*** | 0 | 2 | 1 | 4 | 2 | **9** |
| ***UEEN*** | 0 | 4 | 0 | 1 | 5 | **10** |
| ***UETE*** | 1 | 2 | 0 | 1 | 4 | **8** |
| ***UMAT*** | 0 | 2 | 2 | 1 | 4 | **9** |
| ***UFYZ*** | 0 | 0 | 4 | 2 | 3 | **9** |
| ***UMEL*** | 0 | 3 | 3 | 4 | 8 | **18** |
| ***UREL*** | 7 | 8 | 7 | 8 | 10 | **40** |
| ***UTEE*** | 1 | 1 | 1 | 1 | 4 | **8** |
| ***UTKO*** | 3 | 4 | 7 | 4 | 11 | **29** |
| ***UVEE*** | 4 | 1 | 3 | 5 | 1 | **14** |
| ***total*** | **17** | **27** | **31** | **33** | **53** | **161** |

## Student Creative Activities

The 20th FEEC STUDENT EEICT 2014 conference was jointly organized with the Faculty of Information Technology on 24 April 2014. The abbreviation stands for the English words Electrical Engineering, Information and Communication Technology indicating the priority areas of research and education at the two faculties. There were 212 papers, 65 Bachelor, 90 Master and 57 Ph.D. papers. Nine posters were presented by secondary school students. The event was sponsored by Honeywell, ABB and ON Semiconductor.

The papers were defended before 25 expert committees including representatives of the sponsoring companies, academics and representatives of the club Students for Students. Seventy-five top or outstanding papers were awarded at the closing Ceremony. For more information visit FEEC websites, links *Research, Conference, Student EEICT.*

# External Relations and International Cooperation

## International Cooperation

International activities have been focused on promoting FEEC by presenting results of research projects at international conferences and participation in international research and education projects, placements of FEEC students at partner universities abroad, and offering tuition in English to international students.

Among our priorities is student and teacher mobility involving universities cooperating within the framework of European Commission programmes. FEEC is one of the most active. There has been good cooperation with the BUT Department of International Relations responsible for organization and economic support of mobility programmes, the Lifelong Learning Programme (LLP)/Erasmus and the follow-up programme Erasmus plus launched in academic year 2014/15. As a result, there were 46 placements of FEEC students of 191 months, and 23 teachers went for lecture stays of 25 weeks and a four-week training of four staff members (see Table 6). The extent of student and teacher mobility is stabilized. Reciprocally, 83 students came for placements of 378.5 months. Mobility figures for incoming and outgoing students in individual programmes in 2014 are in Table 7. Within the new programme Erasmus plus the Faculty concluded 65 contracts. The list of cooperating universities in in Table 9.

In 2014 funding was obtained for long-term international placements of students of all study programmes from the mobility Development programme of Ministry of Education in the amount of 570.000 CZK and from BUT mobility fund 148.200 CZK. Owing to this financial support 15 students could go for placements of 32.5 months.

Mobility figures for outgoing and incoming students in all programmes over the last 6 years are in Table 8. Mobility figures are comparable with the previous year. The total length of placements of outgoing students is 223 months. The incoming students placements amounted to 462.5 months.

The faculty supports cooperation of departments and academics with international institutions based on interfaculty and LLP-Erasmus and Erasmus plus, as well as newly concluded contacts. In 2014 the amount of 50.000 CZK was provided in support of such activities. Targeted international relations were financed by departments through projects of operational programmes. The funds were used to cover travel expenses of internationally recognised academics coming to short lecture stays at FEEC.

The Faculty invites renowned international experts to lectures, short-term lecture stays or short-term visits connected with research projects. Such visits help to increase the professional level of tuition and contribute to the general education of students and atmosphere of international environment in work on research projects.

Funding in the amount of 240.000 CZK for these activities was obtained from the Development Programme of Ministry of Education 2.5. Financial support was provided to 12 experts of the faculty, and 48.000 CZK was used to pay the expenses connected with the lecture stay of Prof. Leonid Berezansky from Ben-Gurion University of Negev, Israel and Leonard Janer, Ph.D. of Escola Universitária Politécnica de Mataró, Spain.

Discussed with some of the visiting experts was the potential joint preparation of consortium research projects funded by the European Commission or Joint technology initiatives, e.g. ENIAC and ARTEMIS.

The faculty obtained 415.000 CZK from the Ministry of Education Development Programme 2.4 ‘Support of International Cooperation of Brno University of Technology’ for cooperation of academics and Ph.D. students with international institutions and framework agreements.

Table 6: Student and teacher placements at international universities in the Socrates-Erasmus and Li-felongSocrates-Erasmus and Lifelong Learning Programme-Erasmus from 2010 to 2014

| *Activity Socrates (LLP)-Erasmus* | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|
| Srudents | 51 | 54 | 46 | 49 | 46 |
| Months | 167.5 | 224 | 215 | 201 | 191 |
| Lecture stays | 25 | 27 | 27 | 19 | 23 |
| Lecture weeks | 29 | 32 | 33 | 22 | 25 |
| Training | | | 1 | 2 | 4 |
| Training weeks | | | 2 | 2 | 4 |

Table 7: Student placements at FEEC and abroad by programmes, 2014 - summary

| *Activity* | *Arrivals* | | *Departures* | |
|---|---|---|---|---|
| | *Students* | *Months* | *Students* | *Months* |
| Socrates(LLP)-Erasmus | 75 | 344 | 46 | 191 |
| Inter-university contracts | 6 | 27 | - | - |
| Development programmes of Ministry of Education | - | - | 15 | 32.5 |
| Other mobility | 2 | 7,5 | 1 | 4 |

Table 8: Student placements at FEEC and abroad in all mobility programmes from 2010 to 2014

| | | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|
| ***Arrivals*** | Students | 74 | 86 | 100 | 109 | 83 |
| | Months | 285 | 298 | 432.5 | 462.5 | 378.5 |
| ***Departures*** | Students | 67 | 71 | 65 | 60 | 62 |
| | Months | 230 | 276 | 261 | 223 | 227.5 |

## External Relations

External relations are focused on promotion of faculty activities and providing updated and specific information on the study opportunities offered by the Faculty, study programmes and study areas. The newly structured websites, presentations and videopresentations as well as the faculty profile on the social network Facebook are targeted at the generation of our future students, secondary school and technical secondary school students. In this respect, an important role was played by the so called Roadshow – FEEC students popularizing technical science at secondary schools.

Very popular is the recently launched competition of four-person secondary-school teams Merkur perFEKT Challenge. The competition offered 8 topics which the teams arranged in priority order at registration. For capacity reasons only the first 48 applications could be accepted. This number was reached only one month after the call. Secondary schools from all over Moravia and part of Bohemia registered 200 students, including several girls, for the competition. The competition was conducted in an atmosphere of fair-play, and generally the performance and knowledge of students in areas such as electrical engineering, robotics, programming, etc. must be appreciated. In February 2015 the winners in individual areas competed in the superfinals, where the winner was the team *Čtyřproudou* representing Mensa Gymnázium o.p.s. Praha This year they are the owners of the challenge cup for the overall winner.

Increased attention was paid to the media, to presenting information on FEEC achievements in basic and applied research, development and cooperation with the industrial sector.

On FEEC websites, BUT portals and other subjects, information is given on research and education at FEEC departments and workplaces, habilitations and appointments to professorship, research and development projects of the Czech Science Foundation, Ministry of Trade and Industry, Ministry of Education and other projects including EU framework programmes. The websites are available in Czech and English.

As every year, the management attended the annual meeting of the Czech and Slovak faculties of electrical engineering and associated faculties held in Mikulov 20-22 May 2014. Exchange of experience and discussions on the current situation in education and research, solution of research projects, participation in European programmes and coordination of activities, research plans and centres and cooperation with universities in other countries were on the agenda.

The Faculty commemorated the tragic event on Kubínská Hola in 1968 when an avalanche killed 6 students of the then Electrotechnical Faculty, who were there on a ski course. Representatives of faculty management and of the town of Dolný Kubín honoured their memory at the memorial on Kubínská hola.

Close contacts have been maintained with industrial companies in the Brno region and other parts of the Czech Republic. These contacts are mainly based on cooperation with FEEC departments in specific research, expert's reports and consultancy. The major cooperating companies are E. ON Česká republika, a.s., ABB s.r.o., Veletrhy Brno, a.s., Siemens A. G., Honeywell s.r.o., T-Mobile Czech Republic, a.s., ON Semiconductor Czech Republic, AT&T Czech, EATON Czech Republic, Rockwell/Allen Bradley, Škoda Volkswagen Mladá Boleslav, Motorola Solutions, National Semiconductor, ČEZ, a.s., Linet, s.r.o., BD Sensors, s.r.o., Buchlovice, etc.

Close cooperation continued within the two regional centres CVVOZE and SIX. Cooperation was intensified during the preparation and launching of the project of the research centre of excellence 'CEITEC - Central European Institute of Technology', a joint project of six partners – four universities and two research institutes.

Another recent and significant contribution to cooperation with industrial partners is the Partner Programme constituting a platform for presentation of industrial companies, increased cooperation with research teams and theses projects.

Close cooperation of many years has been maintained with the Institute of Instrument Technology of Czech Academy of Sciences in Brno in research projects of joint interest. Members of the Institute's staff are part-time teachers at FEEC, in Master and Ph.D. programmes. Academy of Sciences can offer Ph.D. study based on contract with the faculty. Academic staff, mainly departments of mathematics and physics have cultivated long-term cooperation with secondary schools in the Brno region in preparing their students for studies at FEEC.

Table 9: Universities having Erasmus programme agreements with FEEC for academic year 2014/15

| **University** | **Country** |
|---|---|
| University of Applied Sciences Upper Austria<br>School of Engineering and Environmental Sciences | Austria |
| Technische Universität Wien- Vienna University of Technology<br>Faculty of Electrical Engineering and Information Technology | Austria |
| Kunstuniversität Graz (KUG) - University of Music and Performing Arts Graz | Austria |
| UMIT - Universität für Gesundheitswissenschaften, Medizinische Informatik und Technik | Austria |
| Technische Universität Graz | Austria |
| University of Applied Sciences Technikum Wien | Austria |
| KHLIM/Limburg Catholic University College | Belgium |
| KU Leuven<br>Faculty of Engineering Technology | Belgium |
| Technical University of Gabrovo | Bulgaria |
| Technical University of Sofia | Bulgaria |
| Technical University of Sofia<br>branch Plovdiv | Bulgaria |
| Hochschule RheinMain - RheinMain University of Applied Sciences | Germany |
| Technische Universität Dresden | Germany |
| Hochschule Augsburg - University of Applied Sciences | Germany |
| Universität Ulm | Germany |
| Friedrich-Alexander-Universität Erlangen-Nürnberg | Germany |
| Hochschule für Technik, Wirtschaft und Kultur Leipzig (Leipzig University of Applied Sciences) | Germany |
| Hochschule Furtwangen University | Germany |
| Aalborg Universitet | Denmark |
| Universitat Rovira i Virgili<br>School of Engineering | Spain |

| | |
|---|---|
| Universitat de Vic<br>Escola Politecnica Superior | Spain |
| Universidad de Cantabria | Spain |
| UNIVERSITAT POLITÉCNICA DE VALENCIA<br>Escuela Politécnica Superior de Alcoy (EPSA) | Spain |
| Universitat Politécnica de Valencia<br>Escuela Técnica Superior de Ingenieros de Telecomunicación | Spain |
| Universidad de Granada - Escuela Técnica Superior de Ingenierías Informática y de Telecomunicación (ETSIIT - UGR) | Spain |
| Universidad de Zaragoza | Spain |
| Universitat Politecnica de Catalunya<br>Mataró School of Technology | Spain |
| Universidad del País Vasco/Euskal Herriko Unibertsitatea | Spain |
| Universidad de Malaga<br>School of Industrial Engineering | Spain |
| Universitat de Valencia | Spain |
| UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA | Spain |
| Institut Supérieur d´Electronique de Paris (ISEP) | France |
| INSA Rennes Dpt Communication Systems and Network<br>Dpt Electronics and Computer Engineering | France |
| ESIEE PARIS | France |
| Institut Polytechnique de Grenoble | France |
| ESIGELEC Rouen<br>School of Engineering | France |
| ESIEE Amiens | France |
| Université Joseph Fourier<br>Polytech School of Engineering | Francie |
| Eastern Macedonia and Thrace Institute of Technology | Greece |
| TEI of Crete<br>Branch Chania | Greece |
| Seconda Universitá degli Studi di Napoli | Italy |
| University of Palermo | Italy |
| Vilnius Gediminas Technical University | Lithuania |
| University of Malta | Malta |

| | |
|---|---|
| POLITECHNIKA WROCLAWSKA<br>- WROCLAV UNIVERSITY OF TECHNOLOGY | Poland |
| AGH University of Science and Technology<br>Faculty of Computer Science, Electronics and Telecommunications | Poland |
| University of Porto<br>Faculty of Engineering | Portugal |
| Instituto Politécnico de Lisboa (IPL)<br>Instituto Superior de Engenharia de Lisboa (ISEL) | Portugal |
| Universidade Católica Portuguesa - Escola Superior de Biotecnologia | Portugal |
| Polytechnic Institute of Coimbra | Portugal |
| Universidade de Coimbra | Portugal |
| MALMÖ UNIVERSITY<br>Faculty of Technology and Society | Sweden |
| Aalto University<br>School of Electrical Engineering | Finland |
| Tampere University of Technology | Finland |
| University of Eastern Finland | Finland |
| Univerza v Novi Gorici/University of Nova Gorica | Slovenia |
| UNIVERSITY OF MARIBOR | Slovenia |
| Žilinská unikverzita v Žilině<br>Elektrotechnická fakulta<br>Fakulta humanitních vied | Slovakia |
| Technická univerzita v Košiciach<br>Fakulta elektrotechniky a informatiky | Slovakia |
| Yildiz Technical University<br>Dept. of Electronics and Communication Engineering<br>Dept. of Mathematics (Faculty of Sciences and Arts) | Turkey |
| T.C. Dogus University | Turkey |
| Bogazici University<br>Department of Electrical & Electronics Engineering | Turkey |
| Istanbul Teknik Universitesi | Turkey |
| Suleyman Demirel University | Turkey |
| University College London<br>Faculty of Engineering Sciences | Great Britain |

# Academic Senate

Academic Senate elections were held on 13-15 October 2014. Until then the members of Academic Senate were (membership in legislative committee – LK, pedagogical committee – PK, economic committee – EK, and represented department):

## Chair

Doc. Ing. Miloslav Steinbauer, Ph.D., EK, LK, UTEE

## Academic Staff Chamber

Ing. Ivana Jakubová, EK, LK, UREL, chair
Doc. Ing. Petr Baxant, Ph.D., EK, UEEN
RNDr. Petr Fuchs, Ph.D., EK, UMAT
Ing Petr Honzík, Ph.D., EK, UAMT
Doc. Ing. Jiří Mišurec, CSc., EK, UTKO
PhDr. Ludmila Neuwirthová, Ph.D., PK, UJAZ
Ing. Radovan Novotný, Ph.D., EK, LK, UMEL
Ing. Helena Polsterová, CSc., EK, PK, UETE
Doc. Ing. Miloslav Steinbauer, Ph.D., EK, LK, UTEE
RNDr. Naděžda Uhdeová, Ph.D., EK, LK, UFYZ
Ing. Martin Vítek, Ph.D., EK, UBMI
Doc. Ing. Pavel Vorel, Ph.D., EK, PK, UVEE

## Student Chamber

Bc. Tomáš Mejzlík, LK, PK, chair
Bc. Rastislav Červenák, PK
Bc. Juraj Jakubík, PK
Bc. Petr Jarchovský, EK, PK
Ing. Marián Klampár (since October), EK
Bc. Zuzana Moldříková, PK
Bc. Vojtěch Svatoš, EK
Ing. Martin Zukal (until October), EK

## Newly elected members of Academic Senate – 21 October 2014

### Chair

Doc. Ing. Miloslav Steinbauer, Ph.D.

### Academic Staff Chamber

Ing. Ivana Jakubová, EK, LK, UREL, chair
Doc. Ing. Bohuslav Bušov, CSc., EK, PK, UVEE
Ing. Petr Číka, Ph.D., EK, PK, UTKO
RNDr. Petr Fuchs, Ph.D., EK, UMAT
Ing. Petr Honzík, Ph.D., EK, LK, UAMT
Ing. Martin Jílek, EK, UJAZ
Doc. Ing. Petr Mastný, Ph.D., EK, PK, UEEN
Prof. Ing. Vladislav Musil, CSc., EK, LK, UMEL
Ing. Helena Polsterová, CSc., EK, UETE
Doc. Ing. Vlasta Sedláková, Ph.D., EK, PK, UFYZ
Doc. Ing. Miloslav Steinbauer, Ph.D., EK, LK, PK, UTEE
Ing. Martin Vítek, Ph.D. EK, LK, UBMI

### Student Chamber

Bc. Daniel Janík, EK, PK, chair
Bc. Martin Holčík, EK, LK
Bc. Juraj Jakubík, PK
Bc. Petr Jarchovský
Ing. Karel Sedlář, EK
Alexandra Šujanská, EK, PK
Bc. Michal Talába, EK, PK

Academic Senate held 11 regular meetings, with an average attendance of 82%. Discussions were always constructive, proposals were sent to members prior to the meeting for study and comments using the central electronic storage system also used for archiving of documents.

Academic Senate discussed novels of internal guidelines and standards Updating of the Long-term Intent of FEEC for 2011-2015 was dealt with and approved for 2014 as well as the Annual Report for 2013. The long time prepared amendment to Election Regulations and Rules of Procedure of Academic Senate were approved on 28 June 2014. Two constituencies (students and academic staff) and voting per rollam have been introduced.

The economic issues discussed and approved included economic report for 2013, proposal on the distribution of financial means in 2014 and proposal on the distribution of funds earned by teaching. Budget rules were discussed and drafted at several joint meetings of economic committee and faculty management.

In September, Věra Jakubová was proposed to take her second term as FEEC delegate in the Council for Higher Education for the period 2015-2017.

On 18 February 2014, the pedagogical committee organized a pedagogical conference where the main topics was the number of higher education institutions, the different forms of tuition in respect to their quality, tuition quality assessment, pros and cons of E-learning.

The election committee prepared the timetable and quidelines for Academic Senate FEEC elections and Academic Senate BUT elections, and prepared electronic voting in IS. A major problem appeared to be the list of voters due to multiple workloads. Despite these problems, elections passed in accordance with the rules and regulations, and the final report was issued.

Regular elections for Academic Senate FEEC were held on 13-15 October 2014 in accordance with the new Election Regulations and Rules of Procedure, for the first time in two constituencies. The voting was electronic in the BUT information systém

The turnout in academic staff constituency was 60.42 % and in the student constituency 17.39 %. The constituent meeting of the newly elected academic senate was held on 21 October 2014.


VUT

# Campus Development

The premises Technická 8 were reconstructed during 2014 with funding from the Operational Programme ´Research and Development for Innovations´ Priority Axis 4. After the reconstruction the technology at all faculty premises will be at the same level and it will be possible to use uniform control system. Similarly, technical support for instruction will be upgraded and unified. Completion of reconstruction is scheduled for the first half of January 2015.

## Computer Networks and Information Systems

Priority was given to:

- upgrading of servers and adaptation of facilities as a constant responsibility of OSIS,
- centralization of network administration services in connection with opening of Technická 12 and Professor List Technology Park
- network backup
- preparation and implementation of transition of files and directory services until now provided on the basis of Novell Netware products to Microsoft Active Directory. Hardware was purchased and installed: independent AD domain files and two (staff and student) servers with disk fields
- restructuring, innovation and administration of faculty websites in two languages
- full use of modern communication channels favoured by young generation, namely faculty profile on social network Facebook and Youtube channel.

## Information Systems and Services

Besides the economic system SAP, the faculty uses the BUT information system. Negotiations and analyses of individual modules of the BUT system and the setting of the information system in operation are in progress. The process will continue in 2015.

# Other

## Equal Opportunities

The consultancy centre for support of equal education opportunities continued its activities in 2014. The centre provided professional and personal consultancy for FEEC students, and organized promotion and information events for the public aimed at removing the barriers female students face when choosing careers in technical fields.

In 2014 the centre focused its attention on improving conditions for students with specific needs in terms of financial and operational support. The centre concentrates on integration of handicapped students in full-time and part-time study programmes at the Faculty, promotion of study opportunities, and individual approach to students with specific needs.

The Centre cooperated with the Department of Physics, the club Students for Students and members of faculty departments.

Contact: uhdeova@feec.vutbr.cz

## Institute of Experimental Technology

Institute of Experimental Technology centres its activities on innovation of education methods and quality of training of specialists, experts and professionals with contract research experience for the industrial sector.

The Institute was involved in two projects in 2014 - Institute of Experimental Technology 1 within the framework of a global project of South Moravian Region OP VK and Institute of Experimental Technology 2 – an individual Project in category Other, OP VK.

The project IET1 is targeted at increasing the interest of secondary school students in electrical engineering and improving conditions for teaching electrical engineering and physics, including exploitation of ICT in instruction. In 2014 the Institute organized informal popularization and motivation lectures at elementary and secondary schools. The staff also conducted projects for gifted secondary-school students and organized lectures for teachers. In laboratories, the students can carry out experiments and tasks supporting their basic knowledge.
The project IET2 provides training for researchers and specialists in their particular fields with the view of the latest requirements of IET´s industrial partners.

Close contacts with authorities in science and technology contribute to education of young researchers and create an innovative potential of the coming generation. Most IET team students enter a Ph.D. programme. The project Elektrovýzkumník (CZ.1.07/2.3.00/20.0175) supports research potential development.
In 2013 IET organized the competition *Microcontrollers are in* for individuals and teams from secondary schools and universities.

Management:
Director - Prof. Ing. Pavel Fiala, Ph.D.
IET1 coordinator – Ing. Jan Mikulka, Ph.D.
IET2 coordinator – Prof. Ing. Pavel Fiala, Ph.D.
members – UTEE staff, representatives of industrial partners IET1 (Siemens, s.r.o.) and IET2 (SVS FEM, s.r.o., Prototypa, a.s., ABB, s.r.o., Eaton Elektrotechnika, s.r.o.).

Address:
IET (UTEE), Technická 3082/12, 616 00 Brno
Phone: +420 541 146 281
Fax: +420 541 146276
E-mail: iet@feec.vutbr.cz

## Student Activities

Active at FEEC are two student organizations – the voluntary club Students for Students (SPS) and the Student Chamber of Academic Senate FEEC (SK AS FEKT), the student part of officially elected faculty body. Both organizations closely cooperate. The Student Chamber acts as an intermediary between faculty management and students, is involved in solutions of student problems, and instruction quality assessment to increase the quality of instruction. Activities of the club Students for Students are focused on leisure time. Its role is to enrich student life. The membership is voluntary, every student can apply, all those interested in student activities at FEEC and BUT. The activities are centred on:

1. Magazine e-FEKT

The student magazine is issued every second month. It offers information on current events at the Faculty. Moreover, technical, entertaining and many other articles can be found there.

2. Assistance

The club helps first-year students to adapt to life in the unfamiliar environment of the faculty, halls or residence and the town of Brno. Two years ago it started to offer information and help with getting to know people before the start of the winter semester in the so called Zaškolovák. To be able to find their way in the labyrinth of school corridors and get around the Down, the students are invited to the event PerFEKT start organized at a weekend before the start of the semester to meet each other, explore the premises and get some tips for places to go to in their free time.

3. Cultural activities

Social, cultural and educational events are organized for students. The biggest event last year was the 7th open-air festival - *Music from FEEC* (Hudba z FEKTu) staged at the faculty car park on 24 September 2014. The festival offered a rich programme, student amateur groups performed and competed, over 5,500 spectators came to see the Slovak band INEKAFE.

Sport-loving students were invited to take part in the fun race Run to 53. The task was to run the distance from school to the 53 bus stop in the shortest possible time. There were several student categories and, as every year, VIP management relays. Beating the strong rival from FAST, the FEEC host relay was the winner. A special category was the run of robots.

# Department of Control, Instrumentation and Measurement


## Doc. Ing. Václav Jirsík, CSc.

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## Professors

Prof. Ing. Pavel Jura, CSc.
Prof. Ing. Petr Pivoňka, CSc.
Prof. Ing. František Šolc, CSc.
Prof. Ing. Pavel Václavek, Ph.D.
Prof. Ing. Petr Vavřín, DrSc.
Prof. Ing. František Zezulka, CSc.

## Associate Professors

Doc. Ing. Ludvík Bejček, CSc.
Doc. Ing. Petr Beneš, Ph.D.
Doc. Ing. Petr Blaha, Ph.D.
Doc. Ing. Zdeněk Bradáč, Ph.D.
Doc. Ing. Petr Fiedler, Ph.D.,
Doc. Ing. Václav Jirsík, CSc.
Doc. Ing. Luděk Žalud, Ph.

## Lecturers

Mgr. Terezie Filipenská, Ph.D., Ing. Marie Havlíková, Ph.D., Ing. Zdeněk Havránek, Ph.D., Ing. Radovan Holek, CSc., Ing. Peter Honec, Ph.D., Ing. Petr Honzík, Ph.D., Ing. Karel Horák, Ph.D., Ing. Stanislav Klusáček, Ph.D., Ing. Pavel Kučera, Ph.D., Ing. Tomáš Macho, Ph.D., Ing. Petr Málek, CSc., Ing. Jan Pásek, CSc., Ing. Miloslav Richter, Ph.D., Ing. Soňa Šedivá, Ph.D., Ing. Radek Štohl, Ph.D, Ing. Libor Veselý, Ph.D.

## Ph.D. Students

Internal: Ing. Wassem Abdulrahman, Ing. Jakub Arm, Ing. Radek Baránek, Ing. Luděk Buchta, Ing. Vladimír Burlak, Ing. Martin Čala, Ing. Tomáš Florián, Ing. Lešek Franek, Ing. Petr Gábrlík, Ing. František Gogol, Ing. Ondřej Hynčica, Ing. Tomáš Hynčica, Ing. Adam Chromý, Ing. Aleš Jelínek, Ing. Tomáš Jílek, Ing. Miroslav Jirgl, Ing. Jan Klečka, Ing. Jan Klusáček, Ing. Vlastimil Kříž, Ing. Aleš Lebeda, Ing. Štefan Mišík, Ing. Lukáš Otava, Ing. Milan Papež, Ing. Stanislav Pikula, Ing. Daniel Piši,Ing. Lukáš Pohl, Ing. Ladislav Šťastný, Mgr. Martin Tůma, Ing. Martin Vágner

External: Ing. Tomáš Babinec, Ing. František Burian, Ing. Luděk Červinka, Ing. Pavel Číp, Ing, Michal Dobias, Ing. Jiří Fialka, Ing. František Gogol, Ing. Miroslav Graf, Ing. Václav Kaczmarczyk, Ing. Jaroslav Lepka, Ing. Stanislav Mašláň, Ing. Zbyněk Mynář, Ing. Petr Petyovský. Ing. Jan Pohl, Ing. Peter Rášo, Ing. Karel Stibor, Ing. Michal Šír, Ing. Miroslav Uher, Ing. Michal Vašina, Ing. Ivo Veselý, Ing. Dušan Zámečník.

## Administrative and Technical Staff

Ing. Luděk Anděra, Ing. František Burian, Ing. Martin Čala, Ing. Pavel Číp, Ing. Tomáš Florián, Ing. Ondřej Hynčica, Ing. Jan Klečka, Lenka Petrová, Ing. Petr Petyovský, Ing. Stanislav Pikula, Ing. Michal Šír, Ing. Miroslav Uher, Ing. Martin Vágner, Ing. Soběslav Valach, Ing. Ivo Veselý, Jan Vodička.

## Centre for Applied Cybernetics

Ing. Luděk Anděra, Ing. Tomáš Florián, Ing. Petr Honec, Ph.D., Ing. Karel Horák, Ph.D., Ing. Jan Klečka, Ing. Soběslav Valach.

## Main Interests

The department provides instruction in the Bachelor degree programme Automation and Measurement Technology and the follow-up Master degree programme Cybernetics, Automation and Measurement. Instruction and research are conducted by five specialized groups.

The main interest of the group involved in automatic control was robust and predictive electrical drives control. Research of nonlinear estimators for sensor-free drives control continued. The research outcomes have been applied within the international ENIAC project MotorBrain in cooperation with international industrial partners. Intensive research was carried out in theoretical probability filtration of dynamical systems, automatic setting algorithms of filter parameters with possible suppression of system model vagueness.

The group continued long-term cooperation with Freescale Semiconductor and Infineon Technologies in design of robust and predictive algorithms for AC drives control.

The group of measurement technology focuses on electrical and electronic measurements, virtual instruments in the LabView environment, sensors of non-electrical characteristics, measurements and evaluation of non-electrical characteristics with focus on vibrodiagnostics, thermodiagnostics, acoustic emission, flux and noise measurement.

The group involved in industrial automation deals with real-time embedded systems, wireless communication systems and industrial Ethernet with focus on operational safety and protection against external and internal errors, faults and attacks. Furthermore, the group deals with fault-tolerant systems and research of decentralized and distributed control and communication systems. Research is particularly centred on construction management, safety and authorization systems. The group closely cooperates with BD Sensors, Beta Control, Siemens, Rockwell Automation, Škoda Auto etc.

The group of artificial intelligence and robotics is involved in research of service mobile robotics. Research is mainly concerned with telepresence control of mobile robots in difficult terrain, self-localization in outer environment, in urban areas and inside buildings, design of highly reliable robotic systems for work under extreme conditions, and automatic map-making. Currently, the group is dealing with employment of elements of advanced optical scanning and virtual/extended reality in biomedical engineering, especially for cardio- and neuro-rehabilitation. Instruction encompasses introduction into stationary and mobile robotics and sections dealing with above mentioned research issues.

The long-term prime interest of the group dealing with computer vision is applied research and development of industrial and transport visual systems. The group cooperates with a number of commercial companies and university departments. Academics are involved in research project solution and research contracts, and provide instruction in signal and image processing and analysis, object recognition and reconstruction of bodies. A considerable part of the group deals with specialized hardware design on the basis of FPGA/DSP platforms for processing of extensive data files in real time. The computer vision group is also responsible for the project of Centre for Applied Cybernetics.

Research teams are involved in an OP VaVpI project CEITEC (Central European Institute of Technology), group Cybernetics for Materials Science involved in cutting-edge research on control, sensors, robotics and embedded systems.

The department's two laboratories are part of the Centre for Research and Utilization of Renewable Energy (CVVOZE). They focus on developing a smart grid model with different renewable sources to test grid stabilization algorithms, operation of certified rooms for vibration and climate testing, and training and test laboratories for safety control systems.

## Major achievements

The automatic control group completed the international project FP7 ENIAC 'MotorBrain - Nanoelectronics for Electric Vehicles Intelligent Failsafe PowerTrain'. A project outcome is the prototype of a novel drive for all-electric vehicle exhibited at the MobiliTec 2014 fair in Hannover.

The group of measurement technology involved in projects VaVPI made major investment in the development of laboratories for measurement of noise, vibrations and temperature. The Climate and Vibration Test Laboratory was accredited, and a new course was launched, dealing with analog processing of sensor signals.

The group of industrial automation was involved in several significant projects. The major outcomes of the project TA02010864 are ALG airflow control, HW control unit for BLDC motor and HW communication interface.

The group of artificial intelligence and robotics focused on the system for visual telepresence with high resolution and option to combine data from TOF proximity scanners, CCD sensors and thermovision cameras. The reconnaissance robotic system Orpheus designed for operation in hazardous environments was upgraded to the system Orpheus-X4.

The group of computer vision continued its participation in the prestigious project 'Centre for Applied Cybernetics'. The project was defended after 12 years of its existence and is still operating as a project of the Czech Technological Foundation within the framework of the Centre of Competence programme. Research is centred on sophisticated computer vision problems in traffic applications, driving assistance systems and industrial camera inspection systems. The group also deals with methods and devices for processing of large volumes of data on the basis of FPGA/DSP platforms, often containing prototype and patent data.

## Major Research Projects

**Centre of Applied Cybernetics – TA ČR ČR – CK TE01020197**

Investigator: Vladimír Kučera, investigator at ÚAMT Karel Horák

**Research, Design and Verification of the Operation of an Integrated System of Intelligent Parking (ISIP) – TA ČR – ALFA TA03030333**

Investigator: Petr Honec.

**Centre of Competence TA ČR – Advanced Sensors and Methods of Sensor Data Processing – TA ČR TE02000202**

Investigator: Antonín Platil, ČVUT, investigator at ÚAMT Petr Beneš

**MotorBrain - Nanoelectronics for Electric Vehicle Intelligent Failsafe PowerTrain - ENIAC 2010-1 270693**

Investigator: Pavel Václavek

**Research and Development of Motorized Ventilation for the Human Protection against Chemical Agents, Dust and Biological Agents – TAČR - TA02010864**

Investigator: Zdeněk Bradáč

## Selected Publications

CHROMÝ, A.; ŽALUD, L. Robotic 3D Scanner as an Alternative to Standard Modalities of Medical Imaging. *SpringerPlus.* 2014. 2(1). p. 1 - 10. ISSN 2193-1801.

HORÁK, K.; ČERVINKA, L. Visual Measurement of Material Segregation in Steel Wires. *Procedia Engineering.* 2014. 2014(69). p. 518 - 525. ISSN 1877-7058.

ABDULRAHMAN, W. Diagnosis of Liver Tumors Using Image Processing. *International Journal of Engineering Research and Technology (IJERT).* 2014. 3(4). p. 1 - 8. ISSN 2278-0181.

JELÍNEK, A.; ŽALUD, L. Alternativní model a detekce rezonance pro systém bezkontaktního přenosu elektrické energie. *Elektrorevue - Internetový časopis (http://www.elektrorevue.cz).* 2014. 16(3). p. 119 - 124. ISSN 1213-1539.

KAŇA, Z.; BRADÁČ, Z.; FIEDLER, P. Personal Navigation Algorithms Based on Wireless Networks and Inertial Sensors. *Journal of Electrical Engineering.* 2014. 65(4). p. 1 - 10. ISSN 1335-3632. (IF(2013)=0,42).

GÁBRLÍK, P.; KŘÍŽ, V.; VOMOČIL, J.; ŽALUD, L. The Design and Implementation of Quadrotor UAV. *Advances in Intelligent Systems and Computing.* 2014. 5(316). p. 47 - 56. ISSN 2194-5357.

PIKULA, S.; BENEŠ, P. A New Method for Interference Reduction in the Smoothed Pseudo Wigner-Ville Distribution. *International Journal on Smart Sensing and Intelligent Systems.* 2014. 2014(1). p. 599 - 603. ISSN 1178-5608.

KOŤOVÁ, M.; KOLÁŘOVÁ, J.; ŽALUD, L.; DOBŠÁK, P. Monitorování dechu pomocí tlakových senzorů. *Elektrorevue - Internetový časopis (http://www.elektrorevue.cz).* 2014. 16(5). p. 182 - 186. ISSN 1213-1539.

JIRGL, M.; JALOVECKÝ, R. Verification of Aircraft Longitudinal Model Using Flight Simulator. *Transport Means 2014Proceedings of 18th International Conference.* 2014. 18(1). p. 137 - 140. ISSN 2351-4604.

ŠOLC, F.; ZEZULKA, F.; VESELÝ, I.; SEKORA, J.; MÉZL, M.; ESCHLI, A.; PROVAZNÍK, I. The mathematical model of a LUNG simulator. *MEFANET Journal.* 2014. 2(2). p. 71 - 78. ISSN 1805-9171.

CHROMÝ, A.; ŽALUD, L. Novel 3D Modelling System Capturing Objects with Sub-Millimetre Resolution. *Advances in Electrical and Electronic Engineering - intenetový časopis(http://advances.utc.sk).* 2014. 12(5). p. 476 - 487. ISSN 1804-3119.

BARÁNEK, R.; ŠOLC, F. Model-Based Attitude Estimation for Multicopters. *Advances in Electrical and Electronic Engineering - intenetový časopis(http://advances.utc.sk).* 2014. 2014(5). p. 501 - 510. ISSN 1804-3119.

## Bachelor Degree Programme

Číslicová řídicí technika (prof. Ing. Petr Pivoňka, CSc.)

Databázové systémy (Ing. Radovan Holek, CSc.)

Elektronické měřicí systémy (Ing. Marie Havlíková, Ph.D.)

Měření fyzikálních veličin (doc. Ing. Petr Beneš, Ph.D.)

Měření v elektrotechnice (doc. Ing. Petr Beneš, Ph.D.)

Mikroprocesory (Ing. Tomáš Macho, Ph.D.)

Modelování a simulace (prof. Ing. Pavel Václavek, Ph.D.)

Moderní prostředky v automatizaci (doc. Ing. Václav Jirsík, CSc.)

Počítače a programování 1 (doc. Ing. Václav Jirsík, CSc.)

Počítače a programování 2 (doc. Ing. Václav Jirsík, CSc.)

Použití PC v měřicí technice (Ing. Zdeněk Havránek, Ph.D.)

Praktické programování v C++ (Ing. Miloslav Richter, Ph.D.)

Programovatelné automaty (Ing. Radek Štohl, Ph.D.)

Prostředky průmyslové automatizace (Ing. Radek Štohl, Ph.D.)

Řízení a regulace 1 (doc. Ing. Petr Blaha, Ph.D.)

Řízení a regulace 2 (prof. Ing. Pavel Václavek, Ph.D.)

Signály a systémy (prof. Ing. Pavel Jura, CSc.)

Subsystémy PC (Ing. Karel Horák, Ph.D.)

Výpočetní technika v automatizaci (prof. Ing. Petr Pivoňka, CSc.)

Základy robotiky (doc. Ing. Luděk Žalud, Ph.D.)

Zpracování a digitalizace analogových signálů (Ing. Zdeněk Havránek, Ph.D.)

Zpracování vícerozměrných signálů (Ing. Karel Horák, Ph.D.)

## Master Degree Programme

Aplikace počítačového vidění (Ing. Karel Horák, Ph.D.)

Automatizace procesů (prof. Ing. František Zezulka, CSc.)

Distribuované systémy a sítě (doc. Ing. Petr Fiedler, Ph.D.)

Elektronická měřicí technika (Ing. Soňa Šedivá, Ph.D.)

Embedded systems for industrial control (doc. Ing. Petr Fiedler, Ph.D.)

Fuzzy systémy (prof. Ing. Pavel Jura, CSc.)

Inteligentní a polovodičové snímače (doc. Ing. Petr Beneš, Ph.D.)

Inteligentní regulátory (prof. Ing. Petr Pivoňka, CSc.)

Logické systémy (Ing. Radovan Holek, CSc.)

Měření neelektrických veličin (doc. Ing. Ludvík Bejček, CSc.)

Modelování a identifikace (doc. Ing. Petr Blaha, Ph.D.)

Operační systémy a sítě (Ing. Tomáš Macho, Ph.D.)

Optimalizace regulátorů (prof. Ing. Petr Pivoňka, CSc.)

Optoelektronické snímače (doc. Ing. Ludvík Bejček, CSc.)

Počítače pro řízení (doc. Ing. Zdeněk Bradáč, Ph.D.)

Počítačové vidění (Ing. Karel Horák, Ph.D.)

Robotika (doc. Ing. Luděk Žalud, Ph.D.)

Robustní a algebraické řízení (doc. Ing. Petr Blaha, Ph.D.)

Sběr, analýza a zpracování dat (Ing. Marie Havlíková, Ph.D.)

Senzory neelektrických veličin (doc. Ing. Ludvík Bejček, CSc.)

Strojové učení (Ing. Petr Honzík, Ph.D.)

Systémy diskrétních událostí (prof. Ing. Pavel Václavek, Ph.D.)

Teorie dynamických systémů (doc. Ing. Petr Blaha, Ph.D.)

Umělá inteligence (doc. Ing. Václav Jirsík, CSc.)

## Doctoral Degree Programme

Vybrané kapitoly měřicí techniky (doc. Ing. Ludvík Bejček, CSc.)

Vybrané kapitoly řídicí techniky (prof. Ing. Petr Pivoňka, CSc.)

## Laboratories

**Laboratory of Automatic Control** (instruction in automatic control, physical models of controlled processes, Pavel Václavek)

**Laboratory of Electrical Measurement** (second-year study areas B-AMT, B-MET, B-SEE and part-time second-year study areas BK-AMT, BK-SEE, Marie Havlíková)

**Laboratory of Electronic Measurement** (instruction in Measurement in Electrical Engineering for first-year study areas M-AMT, M-EST, Soňa Šedivá)

**Laboratory of Intelligent Controllers** (instruction in control algorithms, physical models, design and verification of control algorithms on principles of artificial intelligence, Petr Pivoňka)

**Laboratory for Measurement of Non-Electrical Characteristics** (instruction in Measurement of Non-Electrical Characteristics and Sensors of Non-Electrical Characteristics, Petr Beneš)

**Laboratory of Airflow and Pressure Measurement** (airflow and pressure measurement – testing air track, Ludvík Bejček)

**Laboratory of Temperature Measurement** (infrared technology and contactless temperature measurement, Ludvík Bejček)

**Laboratory of Modern Methods** (control systems Siemens – Schneider – Modicon, research and instruction in computer control of physical models, instruction and development of software for control by programmable automatics – PLC, instruction and development of communication via Profibus and Profinet, Petr Fiedler)

**Optoelectronics Laboratory** (optical fiber sensors and optical methods for measurement of non-electrical characteristics, Ludvík Bejček)

**Laboratory of Computer Vision** (instruction, research and development of devices for image recording and methods of image processing and analysis for recognition and modelling of objects, Karel Horák)

**Laboratory of Process Automation** (CAK laboratory, research and development of communication technology for industrial applications including wireless communication technology, research of Real-Time Control systems and Fault-Tolerant systems, František Zezulka)

**Laboratory of Programmable Automatics** (control systems Rockwell, instruction and development of software for PLC of Rockwell, instruction and development of communication via DeviceNet and Ethernet IP, Radek Štohl)

**Laboratory of Robotics** (research and development of non-conventional drives and robotic soccer, Lukáš Kopečný, František Burian)

**Laboratory of Drives Control** (research of intelligent algorithms for control of electric drives, Pavel Václavek)

**Laboratory of PC Subsystems** (instruction, research and development of advanced peripheral devices and elements based on FPGA/DSP for real-time processing of large volumes of data, Soběslav Valach)

**Laboratory of Telepresence** (research and development of autonomous and remote control robots, Luděk Žalud)

**Laboratory of Embedded Systems** (instruction in embedded control systems and real-time operation systems, Zdeněk Bradáč)

**Laboratory of Vibrodiagnostics** (acoustic emission sensors and measurement, calibration, laser vibrodiagnostics, Petr Beneš)

**CVVOZE Laboratory of Automation** (safe control systems, experimental power grid, František Zezulka)

**CVVOZE Testing Laboratory** (accredited testing of machine, electrotechnical and electronic components, products and parts, ČSN EN 60068-2-xx tests (vibrations, shocks, cold, heat, moisture, combined, Petr Beneš)

# Department of Biomedical Engineering


## Prof. Ing. Ivo Provazník, Ph.D.

Head

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## Professors

Prof. Ing. Jiří Jan, CSc.
Prof. Ing. Ivo Provazník, Ph.D.
Prof. Ewaryst Tkacz, Ph.D., D.Sc.

## Associate Professors

Doc. Ing. Aleš Drastich, CSc.
Doc. Ing. Milan Chmelař, CSc.
Doc. Ing. Radim Kolář, Ph.D.
Doc. Ing. Jana Kolářová, Ph.D.
Doc. Ing. Jiří Kozumplík, CSc.
Doc. Ing. Jiří Rozman, CSc.

## Lecturers

RNDr. Mgr. Michal Bittner, Ph.D., Ing. Vratislav Čmiel, Ing. Oto Janoušek, Ph.D., Ing. Radovan Jiřík, Ph.D., Ing. Vratislav Harabiš, Ph.D., Ing. Jan Odstrčilík, Ph.D., Ing. Jiří Sekora, Ing. Lukáš Smital, Ph.D., Ing. Martin Vítek, Ph.D.

## PhD. Students

Ing. Layal Abo Khayal, Ing. Larisa Baiazitova, Ing. Jaroslav Balogh, Ing. Michal Bartoš, Ing. Karel Bubník, Ing. Mgr. Jan Cimbálník, Ing. Vratislav Čmiel, Ing. Jiří Dvořák, Ing. Lenka Dvořáková, Ing. Jiří Gazárek, Ing. Lucie Grossová, Ing. Jakub Hejč, Ing. Pavla Horáková (roz. Ronková), Ing. Jiří Chmelík, Ing. Martin Chrobák, Ing. Roman Jakubíček, Ing. Joshua Janů, Ing. Jan Kašpárek, Ing. Martin Klimek, Ing. Petr Klimeš, Ing. Pavlína Koščová, Ing. Markéta Koťová, Ing. Jiří Kratochvíla, Ing. Vladimíra Kubicová, Ing. Alena Kubičková (roz. Drkošová), Ing. René Labounek, Ing. Martin Lamoš, Mgr. Peter Langer, Ing. Pavel Leinveber, Ing. Ondřej Macíček, Ing. Pavlína Macková, Ing. Denisa Maděránková, Ing. Magdaléna Matejková, Ing. Martin Mézl, Ing. Jiří Nedvěd, Ing. Andrea Němcová, Ing. Tomáš Potočňák, Ing. Tereza Reichlová, Ing. Marina Ronzhina, Ing. Karel Sedlář, Ing. Jiří Sekora, Ing. Tomáš Slavíček, Ing. Vladimír Slávik, Ing. Ladislav Soukup, Ing. Ondřej Svoboda, Ing. Tomáš Šikner, Ing. Helena Škutková, Ing. Petra Štohanzlová (roz. Podlipná), Ing. Marie Tobolová, Ing. Šimon Vadják, Ing. Martin Valla, Ing. Petr Veselý, Ing. Petr Walek, RNDr. Bohuslav Zmek

## Administrative and Technical Staff

Doc. PharmDr. Petr Babula, Ph.D., Ing. Gabriela Petrovičová, Miroslava Prášilová, Hana Rýznarová, MUDr. Šárka Sekorová

## Main Interests

The department provides instruction in processing of signals and images, ecology, biomedical and ecological engineering, environmental studies, biomedical technology and bioinformatics Bachelor, Master and Ph.D. programmes.

The department is involved in basic and applied research of engineering principles in neuroscience, physiology, electrochemistry, botany, genetics, molecular biology and ecology. The main areas of interest are digital processing and analysis of especially cardiological signals, digital processing and analysis of medical images for different imaging modalities, mainly ultrasonography, MRI, CT, microscopy, phylogenetic, evolutionary and similarity analysis of genomic and proteomic data, metallothionein protein and mitochondrial DNA.

The department closely cooperates with the Opthalmological Clinic of Friedrich-Alexander-University Erlangen, Germany, University of Bergen, Norway, Philips Česká republika, Philips Nederland, MIKRO s.r.o., VUP Medical, a.s., MDT-Medical Data Transfer, s.r.o., Touchless Biometric Systems s.r.o., Smart Brain Sale, s.r.o., Institute of Scientific Instruments AVČR, Medical Faculty, Masaryk University in Brno, Mendel University in Brno, Veterinary Research Institute In Brno, High School of Chemical Technology in Prague, University Hospital Bohunice and University Hospital U sv. Anny, Brno.

The department cooperates with the International Clinical Research Centre (FNUSA-ICRC) dealing with non-invasive imaging methods in clinical and basic research, experimental electrophysiology and development of advanced rehabilitation technology. The department participates in the international project European regional cooperation AT – ČR (development of artificial lungs), national grant research projects GAČR (research of electrophysiology of the heart under load, research of nanotechnological and electrochemical tools for biochemical and molecular-biological studies, analysis of EEG and NMR imaging data in patients suffering from epilepsy, application of contrast magnetic resonance and ultrasonography imaging techniques in medical diagnostics), TAČR ALFA projects (development of artificial arteries with antibacterial effect). The department cooperates with the company Philips in the development of automated CT subtraction angiography of lower limbs. Along with the Faculty of Information Technology and the Department of Technology Transfer the department is involved in the OP VaVpI project 'BUT Safety and Protection' centred on biometric technology for the retina and iris.

## Major Achievements

In 2014 members of the department published numerous articles in scientific journals and presented papers at international conferences, with favourable response within the scientific community. One of the most signifiant achievement is the publishing of our first article in the journal Computerized Medical Imaging and Graphics with impact factor 1.496 and we co-authored a number of journal articles (Plos One, Chemosphere etc. Members of the department were awarded a national patent in neurodiagnostic technology, 2 industrial samples were registered and we created operational samples and authorized software.

The department continued extensive cooperation with University Hospital U sv. Anny Brno in a project of ICRC (International Clinical Research Center) in Biomedical Engineering supported by the Operational Programme 'Research and Development for Innovations'. The participating teams are Experimental electrophysiology (Ivo Provazník), Rehabilitation techniques (Jana Kolářová) and Ultrasonic imaging (Radim Kolář).

In the framework of the international project European Regional Cooperation AT – ČR, UBMI and Technikum Wien prepared a double-degree programme, which was approved by both universities, and launched in academic year 2014-15. In 2014 the first students were admitted. They worked on their diploma theses and were at placements at the partner institution.

## Major Research Projects

**Advanced Lung Research for Veterinary Medicine of Particles for Inhalation – European Regional Cooperation Program Austria – Czech Republic M00250**

Investigator: Ivo Provazník

**An Analysis of the Relationship between Electrical Processes and Blood Flow in Heart Chambers – GAČR P102/12/2034**

Investigator: Jana Kolářová

**Nano-Electro-Bio-Tools for Biochemical and Molecular-Biological Study of Eucaryotic Cells (NanoBioTECell) – GAČR P102/11/1068**

Investigator: Ivo Provazník

**Development and Innovation of Nanomaterials for Targeted Modification of Arterial Implants – TAČR TA01010088**

Investigator: Ivo Provazník

## Selected Publications


UPADHYAY, H.; DWIVEDI, G.; ROY, S.; SHARMA, A.; DAROKAR, M.; SRIVASTAVA, S. Phytol Derivatives as Drug Resistance Reversal Agents. *ChemMedChem.* 2014. 9(8). p. 1860 - 1868. ISSN 1860-7187.

MELUZÍN, J.; HUDE, P.; LEINVEBER, P.; JURÁK, P.; SOUKUP, L.; VIŠČOR, I.; ŠPINAROVÁ, L.; ŠTĚPÁNOVÁ, R.; PODROUŽKOVÁ, H.; VONDRA, V.; LANGER, P.; NĚMEC, P. The magnitude and course of exercise-induced stroke volume changes determine the exercise tolerance in heart transplant recipients with heart failure and normal ejection fraction. *Exp. Clin. Cardiol.* 2014. 20(1). p. 674 - 687. ISSN 1205-6626. (IF(2013)=0,758).

TOBOLOVÁ, M.; CHMELAŘ, M.; PROVAZNÍK, I.; ŘEZNÍČEK, Z.; KABEŠ, R.; BAŠTINEC, J. Testing the Effects of Micro-Pulse Stimulation on Blood Circulation Using the Thermodynamic Sensors. *Journal of Biosensors & Bioelectronics.* 2014. 5(147). p. 1 - 7. ISSN 2155-6210.

TKACZ, E.; PROVAZNÍK, I.; KOSTKA, P. Application of Advanced Spectral Analysis for Rehabilitation Progress Estimation Concerning Patients After Ischemic Brain Stroke. *International Journal of Bioscience, Biochemistry and Bioinformatics.* 2014. 2014(4). p. 82 - 85. ISSN 2010-3638.

KOLEK, J.; SEDLÁŘ, K.; PROVAZNÍK, I.; PATÁKOVÁ, P. Draft Genome Sequence of Clostridium pasteurianum NRRL B-598, a Potential Butanol or Hydrogen Producer. *Genome Announcements.* 2014. 2(2). p. 1 - 2. ISSN 2169-8287.

SOCHOR, J.; NEJDL, L.; RUTTKAY-NEDECKÝ, B.; BEZDĚKOVÁ, A.; LUKEŠOVÁ, K.; ZÍTKA, O.; CERNEI, N.; MAREŠ, P.; POHANKA, M.; ADAM, V.; BABULA, P.; BEKLOVÁ, M.; ZEMAN, L.; KIZEK, R. Investigating the influence of taurine on thiol antioxidant status in Wistar rats with a multi-analytical approach. *J APPL BIOMED.* 2014. 12(2). p. 97 - 110. ISSN 1214-021X. (IF(2013)=1,775).

CIMBÁLNÍK, J. High frequency oscillations are associated with cognitive processing in human recognition memory. *Brain; a journal of neurology.* 2014. ISSN 1460-2156.

DVOŘÁK, J.; ČMIEL, V. EEG biofeedback - návrh a realizace v prostředí LabVIEW. *Elektrorevue - Internetový časopis (http://www.elektrorevue.cz).* 2014. 2014(2). ISSN 1213-1539.

SOCHOR, J.; JUŘÍKOVÁ, T.; POHANKA, M.; ŠKUTKOVÁ, H.; BAROŇ, M.; TOMÁŠKOVÁ, L.; BALLA, Š.; KLEJDUS, B.; POKLUDA, R.; MLČEK, J.; TROJÁKOVÁ, Z.; ŠALOUN, J. Evaluation of Antioxidant Activity, Polyphenolic Compounds, Amino Acids and Mineral Elements of Representative Genotypes of Lonicera edulis. *MOLECULES.* 2014. 19(5). p. 6505 - 6524. ISSN 1420-3049. (IF(2013)=2,095).

ODSTRČILÍK, J.; KOLÁŘ, R.; TORNOW, R.; JAN, J.; BUDAI, A.; MAYER, M.; VODÁKOVÁ, M.; LAEMMER, R.; LAMOŠ, M.; KUNA, Z.; GAZÁREK, J.; KUBĚNA, T.; ČERNOŠEK, P.; RONZHINA, M.

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BÉBAROVÁ, M.; MATEJOVIČ, P.; PÁSEK, M.; ŠIMURDOVÁ, M.; ŠIMURDA, J. Dual effect of ethanol on inward rectifier potassium current IK1 in rat ventricular myocytes. *JOURNAL OF PHYSIOLOGY AND PHARMACOLOGY.* 2014. 65(4). p. 497 - 509. ISSN 0867-5910. (IF(2013)=2,72).

ALEKSANDRA, N.; TABEŃSKA-BOSAKOWSKA, E.; BATKO-KAPUSTECKA, J.; TKACZ, E.; STEFAN, B. Occlusal Equilibration in a Patient With Painful TMD After Orthodontic Treatment - Case Report. *International Journal of Latest Research in Science and Technology.* 2014. 2014 (3)(4). p. 138 - 143. ISSN 2278-5299.

VÍDEŇSKÁ, P.; RAHMAN, M.; FALDYNOVÁ, M.; BABÁK, V.; MATULOVÁ, M.; PRUKNER-RADOVCIC, E.; KŘÍŽEK, I.; SMOLE-MOZINA, S.; KOVAC, J.; SZMOLKA, A.; NAGY, B.; SEDLÁŘ, K.; ČEJKOVÁ, D.; RYCHLÍK, I. Characterization of Egg Laying Hen and Broiler Fecal Microbiota in Poultry Farms in Croatia, Czech Republic, Hungary and Slovenia. *PLOS ONE.* 2014. 9(10). p. e110076 (8 p.). ISSN 1932-6203. (IF(2013)=3,534).

SCHÄFER, S.; NYLUND, K.; SAVIK, F.; ENGJOM, T.; MÉZL, M.; JIŘÍK, R.; DIMCEVSKI, G.; GILJA, O.; TÖNNIES, K. Semi-automatic motion compensation of contrast-enhanced ultrasound images from abdominal organs for perfusion analysis. *COMPUTERS IN BIOLOGY AND MEDICINE.* 2014. -(-). p. 1 - 9. ISSN 0010-4825. (IF(2013)=1,475).

SOLAŘ, J.; ČMIEL, V. Localization of iron nanoparticles in intracellular organelles. *Elektrorevue - Internetový časopis (http://www.elektrorevue.cz).* 2014. 16(5). p. 156 - 158. ISSN 1213-1539.

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NĚMCOVÁ, A.; JANOUŠEK, O.; VÍTEK, M. Hodnocení únavy pomocí elektrookulografie. *Elektrorevue - Internetový časopis (http://www.elektrorevue.cz).* 2014. 16(5). p. 170 - 181. ISSN 1213-1539.

VÍDEŇSKÁ, P.; SEDLÁŘ, K.; LUKAC, M.; FALDYNOVÁ, M.; GERŽOVÁ, L.; ČEJKOVÁ, D.; ŠIŠÁK, F.; RYCHLÍK, I. Succession and Replacement of Bacterial Populations in the Caecum of Egg Laying Hens over Their Whole Life. *PLOS ONE.* 2014. 9(12). p. 1 - 14. ISSN 1932-6203. (IF(2013)=3,534).

ŠOLC, F.; ZEZULKA, F.; VESELÝ, I.; SEKORA, J.; MÉZL, M.; ESCHLI, A.; PROVAZNÍK, I. The mathematical model of a LUNG simulator. *MEFANET Journal.* 2014. 2(2). p. 71 - 78. ISSN 1805-9171.

## Bachelor Degree Programme

Algoritmizace a programování (doc. Ing. Jana Kolářová, Ph.D.)

Analýza biologických signálů (doc. Ing. Jiří Kozumplík, CSc.)

Bioelektrické jevy (doc. RNDr. Ing. Jiří Šimurda, CSc.)

Biochemie (prof. RNDr. Eva Táborská, CSc.)

Bioinformatika (prof. Ing. Ivo Provazník, Ph.D.)

Biostatistika (doc. RNDr. Ladislav Dušek, Ph.D.)

Číslicové zpracování a analýza signálů (prof. Ing. Jiří Jan, CSc.)

Číslicové zpracování signálů a obrazů (prof. Ing. Jiří Jan, CSc.)

Ekologie v elektrotechnice (doc. Ing. Jiří Rozman, CSc.)

Ekologie ve zdravotnictví (doc. Ing. Jiří Rozman, CSc.)

Elektronické systémy a měření (doc. Ing. Milan Chmelař, CSc.)

Lékařská diagnostická technika (doc. Ing. Radim Kolář, Ph.D.)

Modely v biologii a epidemiologii (Ing. Martin Vítek, Ph.D.)

Obecná biofyzika (prof. MUDr. Vojtěch Mornstein, CSc.)

Patologická fyziologie (prof. MUDr. Anna Vašků, CSc.)

Počítače a programování (prof. Ing. Ivo Provazník, Ph.D.)

Praktika z bioinformatiky (doc. Ing. Jana Kolářová, Ph.D.)

Radiologie a nukleární medicína (prof. MUDr. Vlastmil Válek, CSc.)

Silnoproudá a přístrojová elektrotechnika (doc. Ing. Milan Chmelař, CSc.)

Standardizace ve zdravotnictví (doc. Ing. Milan Chmelař, CSc.)

Terapeutická a protetická technika (doc. Ing. Jana Kolářová, Ph.D.)

Umělá inteligence v medicíně (doc. Ing. Jiří Kozumplík, CSc.)

Úvod do biologie člověka (prof. MUDr. Jindřich Vomela, CSc.)

Úvod do klinické medicíny (doc. MUDr. Miroslav Souček, CSc.)

Úvod do medicínské informatiky (prof. Ing. Ivo Provazník, Ph.D.)

Úvod do molekulární biologie a genetiky (doc. Ing. Petr Dvořák, CSc.)

Základy anatomie a histologie (doc. MUDr. Pavel Matonoha, CSc.)

Základy první pomoci (MUDr. Lukáš Dadák)

Zdravotnická etika (Mgr. Josef Kuře, Dr. phil.)

Zdravotnická legislativa a právo (doc. Ing. Jiří Rozman, CSc.)

Zobrazovací systémy v lékařství (doc. Ing. Aleš Drastich, CSc.)

## Master Degree Programme

Analýza a interpretace biologických dat (doc. Ing. Jiří Kozumplík, CSc.)

Analýza biologických sekvencí (prof. Ing. Ivo Provazník, Ph.D.)

Analýza biomedicínských obrazů (prof. Ing. Jiří Jan, CSc.)

Analýza signálů a obrazů (prof. Ing. Jiří Jan, CSc.)

Bioetika (Ing. Iva Pipalová)

Biofyzika (doc. RNDr. Ing. Jiří Šimurda, CSc.)

Biologie člověka (prof. MUDr. Jindřich Vomela, CSc.)

Diagnostika bio- a ekosystémů (doc. Ing. Milan Chmelař, CSc.)

Ekologické inženýrství (doc. Ing. Jiří Rozman, CSc.)

Evoluční algoritmy (doc. Ing. Jiří Kozumplík, CSc.)

Klasické zobrazovací systémy v medicíně a ekologii (doc. Ing. Aleš Drastich, CSc.)

Klinická fyziologie (prof. MUDr. Jindřich Vomela, CSc.)

Laboratorní technika v genomice a proteomice (doc. Ing. Jana Kolářová, Ph.D.)

Medicínské informační systémy (Ing. Miroslav Dvořák, CSc.)

Mikroskopická zobrazovací technika (doc. Ing. Radim Kolář, Ph.D.)

Modelování biologických systémů (Ing. Martin Vítek, Ph.D.)

Molekulární biologie (doc. PharmDr. Petr Babula, Ph.D.)

Multitaktní systémy (doc. Ing. Jiří Kozumplík, CSc.)

Návrh a provoz komplexních systémů (doc. Ing. Jiří Rozman, CSc.)

Počítačová podpora lékařské diagnostiky (prof. Ing. Ivo Provazník, Ph.D.)

Pokročilá analýza biologických signálů (doc. Ing. Jiří Kozumplík, CSc.)

Pokročilé metody v biostatistice (doc. RNDr. Ladislav Dušek, Ph.D.)

Programování v bioinformatice (doc. Ing. Jana Kolářová, Ph.D.)

Speciální lékařská a ekologická technika (doc. Ing. Jiří Rozman, CSc.)

Systémová biologie (prof. Ing. Ivo Provazník, Ph.D.)

Tomografické zobrazovací systémy (doc. Ing. Aleš Drastich, CSc.)

Úvod do environmentalistiky (Prof. RNDr. Hana Librová, CSc)

Vizualizace biomedicínských dat (Ing. Radovan Jiřík, Ph.D.)

Vyšší metody zpracování signálů (prof. Ing. Jiří Jan, CSc.)

Základy metodologie výzkumu (doc. Ing. Radim Kolář, Ph.D.)

Zdravotní péče (prof. MUDr. Jindřich Vomela, CSc.)

Zdravotní péče v mimořádných situacích (doc. MUDr. Vladimír Šrámek, Ph.D.)

Zdravotnické informační systémy (Ing. Miroslav Dvořák, CSc.)

## Doctoral Degree Programme

Moderní metody ve výzkumu elektrofyziologie (prof. MUDr. Marie Nováková, Ph.D.)

Moderní přístupy v analýze biomedicínských obrazů (doc. Ing. Radim Kolář, Ph.D.)

Nové trendy v analýze a klasifikaci biomedicínských dat (doc. Ing. Jiří Kozumplík, CSc.)

Pokročilá analýza rozsáhlých genomických dat (prof. Ing. Ivo Provazník, Ph.D.)

Pokročilé mikroskopické techniky v biologii (doc. PharmDr. Petr Babula, Ph.D.)

Vybrané problémy biomedicínského inženýrství (prof. Ing. Ivo Provazník, Ph.D.)

Vyšší metody zpracování a analýzy signálů a obrazů (prof. Ing. Jiří Jan, CSc.)

## Laboratories

**Laboratory of Electronics** (manufacturing and testing of electromechanical and electronic components for research and student projects, Jiří Sekora)

**Laboratory of Biophysics I and II** (instruction in Biophysics, Bioelectric Phenomena, research on electrophysiology of cells, Vratislav Čmiel)

**Laboratory of Biomedical Technology** (instruction in Design and Operation of Complex Systems, Electronic Systems and Measurement, experimental research and student projects, Jiří Sekora)

**Laboratory of Bionics** (instruction in Human Biology, Biophysics, Clinical Physiology, Healthcare, Therapeutic and Prosthetic Technology, experimental measurements for research and student projects, Oto Janoušek)

**Laboratory of Diagnostic Technology** (instruction in Medical Diagnostic Technology, Diagnostics of bio- and ecosystems, experiments for research and student projects, Vratislav Harabiš)

**Laboratory of Environmental Technology** (instruction in Special Medical and Ecological Technology, Ecology in Electrical Engineering, Ecology in Healthcare, experiments for research and student projects, Jiří Rozman)

**Laboratory of Functional Diagnostics** (instruction in Electronic Systems and Measurements, research of brain and muscle electrophysiology, Marina Ronzhina)

**Laboratory of Genomics and Proteomics I and II** (a clean environment for isolation and handling of biological samples, measurement and diagnostics of DNA, RNA and proteins, instruction in Molecular Biology, research on bioinformatics, Helena Škutková)

**Laboratory of Information Systems** (instruction in Evolution Algorithms, Medical Information Systems, Artificial Intelligence in Medicine, Bioinformatics, Algorithmization and Programming, Computers and Programming, Analysis of Biological Sequences, Bioinformatics Practice, Denisa Maděránková)

**Laboratory of Microscopy I and II** (instruction in Microscopic Imaging Technology, experiments for research and student projects, research on optical coherent tomography, Jan Odstrčilík)

**Laboratory of Rehabilitation Technology** (experimental measurements for research and students projects, research on rehabilitation technology, Marina Ronzhina)

**Laboratory of Ultrasound Tomography** (research and measurement of ultrasonographic data, calibration of devices and ultrasound probes, Vratislav Harabiš)

**Laboratory of Imaging Systems** (instruction in Introduction in Medical Informatics, Medical Information Systems, experiments for research and student projects, Radim Kolář)

**Laboratory of Image Processing** (instruction in Analysis of Biological Signals, Bioinformatics, Conventional Imaging Systems in Medicine, Advanced Analysis of BIological Signals, Analysis and Interpretation of Biological Data, Digital Processing of Signals and Images, Tomography Imaging Systems, Jiří Sekora)

**Laboratory of Signal Processing** (instruction in Programming in Bioinformatics, Computer Support for Medical Diagnostics, Introduction in Medical Informatics, Analysis of Signals and Images, Biomedical Data Visualization, Analysis of Biomedical Images, Models in Biology and Epidemiology, System BIology, Digital Signal Processing and Analysis, Martin Vítek)

# Department of Power Electrical Engineering


## Doc. Ing. Petr Toman, Ph.D.

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## Associate Professors

Doc. Ing. Petr Baxant, Ph.D.
Doc. Ing. Vladimír Blažek, CSc.
Doc. RNDr. Oldřich Coufal, CSc.
Doc. Ing. Jiří Drápela, Ph.D.
Doc. Ing. Bohumír Garlík, CSc.
Doc. Ing. Ilona Lázničková, Ph.D.
Doc. Ing. Petr Mastný, Ph.D.
Doc. Ing. Antonín Matoušek, CSc.
Doc. Ing. Jaroslava Orságová, Ph.D.
Doc. Ing. Jiří Raček, CSc.
Doc. Ing. Radek Škoda, Ph.D.
Doc. Ing. Petr Toman, Ph.D.

## Lecturers

Ing. Branislav Bátora, Ph.D., Ing. Jan Gregor, CSc., Ing. Karel Katovský, Ph.D., Ing. Michal Krbal, Ph.D., Ing. Jan Macháček, Ph.D., Ing. Martin Paar, Ph.D., Ing. Stanislav Sumec, Ing. Lukáš Radil, Ph.D., Ing. Jan Škoda, Ph.D., Ing. David Topolánek, Ph.D.

## Ph.D. Students

Ing. Almabrok Abdoalhade, Ing. Tomáš Bajánek, Ing. Tomáš Bartošík, Ing. Martin Belatka, Ing. František Bernáth, Ing. Mayada Daboul, Ing. Štěpán Foral, Ing. Miroslav Haluza, Ing. Nail Khisamutdinov, Ing. Marek Kopička, Ing. Jitka Matějková, Ing. Jan Morávek, Ing. Filip Novotný, Ing. Jan Novotný, Ing. Luděk Ondroušek, Mgr. Mikuláš Parma, Ing. Tomáš Pavelka, Ing. Jiří Pěcha, Ing. Jiří Pitron, Ing. Václav Prokop, Ing. Michal Ptáček, Ing. Jan Šlezingr, Ing. Martin Štefanka, Ing. Jaroslav Štěpánek, Ing. René Vápeník, Ing. Jan Varmuža, Ing. Michal Vrána, Ing. Kinan Wannous, Ing. Vojtěch Wasserbauer

## Administrative and Technical Staff

Ing. Filip Koval, Jitka Langerová, Lucie Langerová, Ing. Josef Šenk, CSc.

## Main Interests

The department provides instruction in the Bachelor programme Power Electrical and Electronic Engineering (B-SEE) in cooperation with the Department of Power Electrical and Electronic Engineering, and independently in the Master programme Power Electrical Engineering (M1-EEN). The offered courses are centred on conventional and renewable power sources, transmission and distribution of energy, electrical power utilization in light and heat sources, transient phenomena, solutions of system failures and liberalized energy market.

Research is focused on generation of electrical power in conditions of sustainable development

i.e. search for new ways of power generation from renewable sources and increasing operation efficiency of power sources, loss reduction and fast localization of network failures, impact of electrical appliances on electric energy quality, exploitation of hydrogen accumulation cycle in solar systems, load optimization in small variable-output power sources, optimization of the structure of power sources for services in conditions of liberalized market with electric energy, technical and technological limits of inter-state power distribution, analysis of major system failures and appropriate measures, analysis of connection into the network, design and implementation of protection systems for indoor and outdoor illumination and evaluation systems.

The department cooperates in research and graduate and postgraduate training with a number of companies, e.g. Skupina E. ON, Skupina ČEZ, ČEPS, a.s., ABB, s.r.o., EGÚ Brno, a.s., KMB Systems s.r.o., MEgA – Měřící Energetické Aparáty, a.s., Teplárny Brno, a.s., Siemens, s.r.o., etc. There has been long-term cooperation in research and instruction with departments of power electrical engineering at all Czech and Slovak technical universities.

Some department's laboratories are part of the CVVOZE centre where new Ultra-high Voltage Laboratories were established.

## Major Achievements

In 2014 the department was involved in research conducted by Centre for Research and Exploitation of Renewable Energy (CVVOZE). Members of the department participated in 1 MPO TIP project, 5 TAČR projects, 2 OP VK projects, an international project on cooperation with Texas A&M University Kontakt II and 37 projects on cooperation with industrial companies.

The major research project launched in 2014 is 'Energy in Conditions of Sustainable Development (EN-PUR)' financed from the National Sustainability Programme I, where the department is responsible for the research part 'Generation, Transmission, Distribution and Utilization of Electric Energy'.

The department organized '15th International Conference Electric Power Engineering 2014', with more than 150 participants from Europe and Asia.

Among our outstanding results published in reputable journals and presented at national and international conferences is the design of a new tool for measurement of voltage fluctuation, method for localization of ground connection in the distribution network, exact calculation of impedance of parallel massive conductors, calculation of thermodynamic properties of air with copper admixture at temperatures up to 4000 K. In 2014 we continued cooperation with E.ON Česká republika, s.r.o. dealing with issues of electric lines safety in the case of failures, and failure localization, with ČEZ Distribuce, a.s,, E.ON Distribuce, a.s. and PREdistribuce, a.s. in noise resistance of electrometers in the 2-150kHz band, and Lucis in development of new types of lighting devices. The department also cooperated with TU Graz and Aalto University of Technology in safety of electrical network in regard to contact voltage, and with Second University of Naples in quality assessment of electrical energy.

In terms of instruction, the most important is the project 'CENE-NET - Partnership in New Generation Nuclear Power Engineering' and a joint university project 'KISP – Complex Innovation of Study Programmes and Improvement of Instruction at FEEC BUT'.

## Major Research Projects

**Centre of Advanced Nuclear Technologies (CANUT) - TE01020455**

Investigator: Karel Katovský

**Dynamic Model of Distribution Network - TA03020523**

Investigator: Petr Toman

**A System of High Voltage Network Protection Using Current and Voltage Sensors with Standardized Digital Output IEC 61850-9-2 - TA03010444**

Investigator: Jaroslava Orságová

**Development of a Combined Failure Indicator - TA04021491**

Investigator: David Topolánek

**A Project of Planning, Preparation and Optimization of Energy Generation from Different Sources - TA04021196**

Investigator: Petr Mastný

## Selected Publications

KRBAL, M.; KRBALOVÁ, M.; BAXANT, P.; ŠKODA, J.; SUMEC, S. Světelné zdroje a ekologie. *Světlo.* 2014. 17(2). p. 48 - 51. ISSN 1212-0812.

VÁPENÍK, R. Rezonanční křivka v kompenzované síti vysokého napětí s nepřímo uzemněným uzlem. *Elektrorevue - Internetový časopis (http://www.elektrorevue.cz).* 2014. 2014(2). p. 67 - 72. ISSN 1213-1539.

AVRIGEANU, M.; AVRIGEANU, V.; BÉM, P.; FISCHER, U.; HONUSEK, M.; KATOVSKÝ, K.; MANAILESCU, C.; MRÁZEK, J.; ŠIMEČKOVÁ, E.; ZÁVORKA, L. Low energy deuteron-induced reactions on Fe isotopes. *PHYSICAL REVIEW C.* 2014. 89(4). p. 044613-1 (13 p.). ISSN 0556-2813. (IF(2013)=3,881).

COUFAL, O. Thermodynamic properties of reaction mixture of air and copper up to 4000K for 0.05 to 2MPa. *Journal of Physics D: Applied Physics.* 2014. 47(25). p. 1 - 12. ISSN 0022-3727. (IF(2013)=2,521).

COUFAL, O. Current density in two solid parallel conductors and their impedance. *ELECTRICAL ENGINEERING.* 2014. 96(3). p. 287 - 297. ISSN 0948-7921. (IF(2013)=0,347).

KRBAL, M.; SUMEC, S.; BAXANT, P.; ŠKODA, J. Světelné zdroje a svítidla pro pěstování rostlin. *Světlo.* 2014. 17(5). p. 48 - 51. ISSN 1212-0812.

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## Bachelor Degree Programme

Distribuce elektrické energie (doc. Ing. Petr Toman, Ph.D.)

Ekonomika a ekologie elektroenergetiky (Ing. Jan Macháček, Ph.D.)

Jaderně energetická zařízení (doc. Ing. Jiří Raček, CSc.)

Ochrany a jištění zařízení (doc. Ing. Petr Toman, Ph.D.)

Počítače a programování 2 (Ing. Stanislav Sumec, Ph.D.)

Počítačové modelování a simulace (doc. Ing. Petr Baxant, Ph.D.)

Projektování silových a datových rozvodů (Ing. Jan Macháček, Ph.D.)

Rozvodná zařízení (doc. Ing. Jaroslava Orságová, Ph.D.)

Strojní zařízení elektráren (Ing. Karel Katovský, Ph.D.)

Technická mechanika (doc. Ing. Ilona Lázničková, Ph.D.)

Užití elektrické energie (doc. Ing. Jiří Drápela, Ph.D.)

Výroba elektrické energie (doc. Ing. Petr Mastný, Ph.D.)

Výroba a distribuce elektrické energie (doc. Ing. Petr Toman, Ph.D.)

## Master Degree Programme

Aplikace elektrického oblouku (doc. Ing. Ilona Lázničková, Ph.D.)

Diagnostika v elektroenergetice (doc. Ing. Jiří Drápela, Ph.D.)

Distribuční a průmyslové sítě (doc. Ing. Jaroslava Orságová, Ph.D.)

Ekonomika elektroenergetiky (Ing. Jan Macháček, Ph.D.)

Elektrárny a teplárny (doc. Ing. Jaroslava Orságová, Ph.D.)

Elektrické stanice a vedení (doc. Ing. Jaroslava Orságová, Ph.D.)

Elektrotepelná technika (doc. Ing. Ilona Lázničková, Ph.D.)

Informační a řídicí systémy v elektroenergetice (doc. Ing. Petr Baxant, Ph.D.)

Integrované systémy chránění (doc. Ing. Petr Toman, Ph.D.)

Jaderné elektrárny (doc. Ing. Jiří Raček, CSc.)

Kvalita elektrické energie a EMC (doc. Ing. Jiří Drápela, Ph.D.)

Malé zdroje elektrické energie (doc. Ing. Petr Mastný, Ph.D.)

Nekonvenční přeměny (Ing. Lukáš Radil, Ph.D.)

Osvětlovací soustavy (Ing. Jan Škoda, Ph.D.)

Power Systems (doc. Ing. Petr Baxant, Ph.D.)

Projektování silových a datových rozvodů (Ing. Jan Macháček, Ph.D.)

Přechodné jevy (doc. Ing. Vladimír Blažek, CSc.)

Přenosové sítě (doc. Ing. Vladimír Blažek, CSc.)

Řízení elektrizačních soustav (doc. Ing. Petr Toman, Ph.D.)

Světelná technika (doc. Ing. Petr Baxant, Ph.D.)

Technika vysokých napětí (Ing. Michal Krbal, Ph.D.)

## Doctoral Degree Programme

Matematické modelování v elektroenergetice (doc. Ing. Petr Toman, Ph.D.)

Vybrané problémy z výroby elektrické energie (doc. Ing. Petr Mastný, Ph.D.)

## Laboratories

**Laboratory of Electrical Protection** (instruction in Distribution Facilities, Electrical Stations and Lines, Protection and Security of Facilities, Integrated Protection Systems, preparation of measurements in real networks, research, Jaroslava Orságová)

**Laboratory of Diagnostics** (instruction in Diagnostics in Power Electrical Engineering, research on diagnostics and measusrement, Jiří Drápela)

**Laboratory of Electric Energy Quality and Electromagnetic Compatibility** (instruction in Electric Energy Quality and EMC and Diagnostics in Power Electrical Engineering, Jiří Drápela)

**Laboratory of Appliance-Electrical Network Compatibility** (impact of appliances on the distribution network under different network conditions, Jiří Drápela)

**Laboratory of Heating Technology** (instruction in Electric Power Utilization and Electric Heating Technology, Ilona Lázničková)

**Laboratory of Light and Illumination Technology** (instruction in Light Technology, Illumination Systems, Testing of Light Sources and Fittings, research projects, Jan Škoda)

**Laboratory of Electrical Networks** (instruction in Electrical Power Distribution, Transmission Networks, Electrical Stations and Line Networks, Distribution and Industrial Networks, research projects, Petr Toman)

**Design Laboratory** (instruction in Design of Power and Data Distribution Systems, training and research on modern electroinstallations, Branislav Bátora)

**Laboratory of Electric Power Generation** (instruction in Electrical Power Generation, Power and Heating Plants, Small Sources of Electric Power, diploma theses, research projects in small sources of electric power, Petr Mastný)

**Laboratory of Ionizing Radiation** (instruction in Nuclear Power Facilities, Karel Katovský)

**Laboratory of Non-Conventional Energy Conversion** (instruction in Ecology in Power Engineering, Small Electrical Power Sources, Non-Conventional Energy Conversion, diploma theses and dissertations, research of fuel cells, Petr Mastný)

**Solar Energy Laboratory** (research of full solar energy exploitation, development and verification of operating models in real operation conditions, Petr Mastný)

**Ultra High Voltage Laboratories** (instruction in Distribution Facilities, Electrical Stations and Lines, High Voltage Technology, testing by superposed and pulse voltage, Jaroslava Orságová)

**Computer Laboratories** (2) (instruction in Computers and Programming 1 and 2, planning in power engineering, steady states and transient phenomena in electrification systems, Branislav Bátora)

# Department of Electrical and Electronic Technology


## Doc. Ing. Petr Bača, Ph.D.

Head

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## Professors

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Prof. Ing. Jiří Vondrák, DrSc.

## Associate Professors

Doc. Ing. Petr Bača, Ph.D.
Doc. Ing. Josef Jirák, CSc.
Doc. Ing. Jiří Maxa, Ph.D.
Doc. Ing. Vítězslav Novák, Ph.D.
Doc. Ing. Marie Sedlaříková, CSc.
Doc. Ing. Jiří Vaněk, Ph.D.

## Lecturers

Ing. Ondřej Čech, Ing. Petr Dvořák, RNDr. Andrea Fedorková, Ph.D., Ing. Martin Frk, Ph.D., Ing. Petr Křívík, Ph.D., Ing. Helena Polsterová, CSc., Ing. Zdenka Rozsívalová, Ing. Jiří Starý, Ph.D., Ing. Jiří Špinka

## Ph.D. Students

Ing. Ondřej Čech, Ing. Pavel Čudek, Ing. Petr Dvořák, Ing. Daniel Frýda, Ing. Tomáš Gottwald, Ing. Jiří Hudec, Ing. Josef Hylský, Ing. Chladil Ladislav, Ing. Ivan Jakubis, Ing. Michal Jahn, Ing. Martin Juračka, Ing. Michl Kadlec, Ing. Ondřej Kaválek, Ing. Tomáš Kazda, Ing. Miroslav Kunovjánek, Ing. Jiří Libich, Ing. Josef Máca, Ing. Michal Musil, Ing. Jiří Neoral, Ing. David Pléha, Ing. Marek Solčanský, Ing. Radek Stojan, Ing. Dávid Strachala, Ing. Lucie Šimonová, Ing. Jiří Šubarda, Ing. Jiří Tichý, Ing. Pavel Tošer, Ing. Sebastian Vaculík, Ing. Petr Vyroubal, Ing. Jana Zimáková

## Administrative and Technical Staff

František Chudáček, Ing. Kristýna Jandová, Ph.D., Ing. Petr Kahle, František Kořínek, Ing. Miroslav Zatloukal, Gabriela Dominiková, Martin Šturm

## Main Interests

The department provides instruction in electrotechnical materials, manufacturing processes and their control, printed circuit board and surface mount technology, diagnostics, testing and reliability of electrotechnical materials and processes, quality assurance, designs of systems and alternative electric power sources in the Bachelor and the Master programme Control and Communication Technology (EECR), in full-time and part-time form of study. Instruction in the subject Materials and Technical Documentation is provided to all first-year full-time and part-time students in the Bachelor programme Electrical, Electronic, Control and Communication Technology.

The research areas are electrotechnical, eletronic and optoelectronic materials and components, technologies, diagnostics and prognosis, electron microscopy, electrochemical power sources, lead and alkaline accumulators, development of new materials for lithium-ion batteries, electrocatalysts and ion-exchange membranes for fuel cells, thin-layer electrodes for electrochromic systems, photovoltaic systems, non-destructive diagnostics of defects and quality control, reliability and lifetime of solar cells, detection of signal electrons and methods of environmental scanning electron microscopy of atomic forces, lead-free soldering, quality and reliability of soldered joints, degradation and diagnostics of dielectric systems.

The department cooperates with a number of institutions – Technische Universität Wien, Padova University, Universität Ulm – Zentrum für Sonnenenergie und Wasserstoff-Forschung, École Polytechnique de Montréal, surface analysis workplace Nanolytics in Feldkirchen, Austria, Graphite AG Kropfmühl AG, Institute of Scientific Instruments AVČR, Institute of Inorganic Chemistry AVČR, Institute of Physical Chemistry AVČR, Institute of Macromolecular Chemistry AVČR, Bochemie Bohumín, EPRONA Rokytnice nad Jizerou, Elmarco Liberec, Solartec Rožnov pod Radhoštěm, ERD Praha, LINET Slaný, ENERG-SERVIS Brno, ČeMeBo Blansko, Honeywell Brno, ALPS Electric Czech Sebranice. The department also cooperates with INIFTA Universidad Nacional de La Plata, Argentina and Università degli Studi di Palermo, Italy in the programme KONTAKT.

## Major Achievements

The department coorganized the 35th international conference 'Nonconventional Sources of Electric Energy' in Blansko 21- 23 May 2014. The conference was organized in cooperation with the Czech Electrotechnical Society, group for chemical sources of electric energy. The department also organized the 15th international conference 'Advanced Batteries, Accumulators and Fuel Cells', 24-28 August 2014 under the auspices of Americal electrochemical group The Electrochemical Society ECS and BUT Brno.

Members of the department also participated in the meeting of Czech and Slovak colleagues, the 41th international conference 'Electrotechnology 2014', organized by the Department of Electrical and Electronic Technology, Czech Technical University Prague in Harrachov.

The project MŠMT ČR - Argentina (7AMB13AR008) 'Development of novel lithium-ion batteries for storage of electric energy' continued. The project included exchange stays of two BUT and two Argetinian researchers. The department launched the TACŘ project TA 04010085 'Flexible Autonomous Power Systems for Smart Textiles', focused on flexible electrodes for supercapacitors and accumulators. The department was the chief investigator of the project 'Specific Higher Education Research' at BUT (Materials and Technologies in Electrical Engineering II). Two members of the department visited Padova University, Professor Vita di Nota and TU Chemnitz.

Andrea Fedorková went for a one-month internship with INIFTA La Plata and Atomic centro Bariloche Argentina and a two-month internship with Institute ICN2 (CSIC), Barcelona.

In September we discussed with Dr. Marek Slavík of LITHIO s.r.o., Bratislava and prepared a project for call NMP17 Horizon 2020 'Post-lithium ion batteries for eletric automotive applications'. The project was submitted and is now undergoing the review process.

In cooperation with Institute of Scientific Instruments AVČR Brno we were working on the European project 'Support of Human Resources and Knowledge Transfer in Conditions of International Cooperation of Research Teams', Operational Programme, Priority Axis 7.2 'Tertiary Education, Research and Development'.

The department was visited by two researchers of Žilina University during the conference '35 NZEEEV Non-conventional sources of electric energy'. May 21-23. Doc. Ing. Dušan Kudelas, Ph.D. presented the paper 'Natural, Technical and Economic Conditions of Wind-Energy Utilization'. Doc. Ing. Zdeněk Dostál, CSc. presented the paper 'Electrochemical Accumulators for OZE'.

At the end of August (24-28) the department invited six international guests for the conference 'ABAF-15th – Modern Batteries, Accumulators and Fuel Cells' - Arnaldo Visintin of La Plata University, Argentina, Oumarou Savadogo of Montreal University, Boris Markovský of Bar-llan

University, Tel Aviv, Letitia Dubau of LEPMI Grenoble, Guenter Fafilek of TU Wien and Renata Oriňáková of P.J.Šafárik University in Košice to present their papers.

All papers were published in a special issue of Transactions of the Electrochemical Society.

The department cooperated with the University of West Bohemia in Plzeň in the European project 'Partnership in Electrical and Mechanical Engineering' of Operational Programme, Priority Axis 7.2 'Tertiary Education, Research and Development'.

The department was involved in 'National Sustainability Programme I' for support of research, experimental development and innovations within the framework of the European OP VaVpI project, Priorirty Axis 2 - 'Regional Research and Development Centres', 'Centre for Research and Utilization of Renewable Energy' (CVVOZE), research programme 2 – 'Chemical and Photovoltaic Energy Sources'.

We continued research and commercial activities in the accredited Testing Laboratory of CVVOZE where the department obtained accreditation for testing of VA characteristics of photovoltaic panels. In 2014 the services dealing with verification of the state and operability of photovoltaic power stations were used by over 20 companies. Analysis of a damaged photovoltaic panel, with unknown cause, was the most interesting case as the owner wished to make sure that such an event will not happen again.

## Major Research Projects

**A Bilateral Project MŠMT ČR – Argentina (7AMB13AR008) Development of New Lithium-Ions Batteries for Storage of Electric Energy.**

**Human Resources and Knowledge Transfer Support in International Research Cooperation – CZ.1.07/2.3.00/20.0103**

Investigator: Josef Jirák

**A Specific Research Project – Materials and Technologies for Electrical Engineering FEKT-S-11-7**

Investigator: Petr Bača

## Selected Publications


STOJAN, R.; VANĚK, J.; MALÝ, M. Progression of Silicon Solar Cells Luminescence Diagnostic Methods. *Universal Journal of Electrical and Electronic Engineering.* 2014. 2(1). p. 18 - 22. ISSN 2332-3299.

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MÁCA, J.; FRK, M.; ROZSÍVALOVÁ, Z.; SEDLAŘÍKOVÁ, M. Properties Of Sulfolane Base Aprotic Electrolytes. *PortugaliaeElectrochimica Acta.* 2014. 2013(6). p. 12 - 19. ISSN 1647-1571.

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DVOŘÁK, P.; CHLADIL, L. Gel Polymer Electrolyte. *ECS Transactions.* 2014. 63(1). p. 45 - 48. ISSN 1938-5862.

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## Bachelor Degree Programme

Diagnostika a zkušebnictví (doc. Ing. Josef Jirák, CSc.)

Elektrotechnické materiály a výrobní procesy (prof. Ing. Jiří Kazelle, CSc.)

Materiály a komponenty pro biomedicínu

(doc. Ing. Marie Sedlaříková, CSc.)

Materiály a technická dokumentace

(doc. Ing. Josef Jirák, CSc.)

Návrh a konstrukce elektrotechnických zařízení (doc. Ing. Vítězslav Novák, Ph.D.)

Návrhové systémy plošných spojů

(doc. Ing. Petr Bača, Ph.D.)

Plošné spoje a povrchová montáž (Ing. Jiří Starý, Ph.D.)

Počítačové projektování výrob, logistika a ekologie výroby (doc. Ing. Jiří Vaněk, Ph.D.)

Počítačová podpora technických a manažerských prací (doc. Ing. Jiří Maxa, Ph.D.)

Řízení a kontrola jakosti (Ing. Helena Polsterová, CSc.)

Řízení jakosti a metrologie (Ing. Helena Polsterová, CSc.)

Spolehlivost v elektrotechnice (Ing. Helena Polsterová, CSc.)

## Master Degree Programme

Alternativní zdroje energie (doc. Ing. Jiří Vaněk, Ph.D.)

Diagnostické metody v elektrotechnice

(doc. Ing. Josef Jirák, CSc.)

Ekologie výroby (doc. Ing. Petr Bača, Ph.D.)

Elektroizolační systémy (Ing. Helena Polsterová, CSc.)

Klimatotechnologie (Ing. Martin Frk, Ph.D.)

Materiály pro biomedicínské aplikace (doc. Ing. Marie Sedlaříková, CSc.)

Mechanical Desktop (doc. Ing. Jiří Maxa, Ph.D.)

Montážní a propojovací technologie (Ing. Jiří Starý, Ph.D.)

Obnovitelné zdroje energie (Ing. Petr Křivík, Ph.D.)

Počítačové návrhové systémy (Ing. Vítězslav Novák, Ph.D.)

Properties and Production of Electrotechnic Materials (doc. Ing. Josef Jirák, CSc.)

Řízení a správa dat (doc. Ing. Jiří Maxa, Ph.D.)

Spolehlivost a jakost (Ing. Helena Polsterová, CSc.)

Struktura a vlastnosti materiálů (doc. Ing. Josef Jirák, CSc.)

Technologické projektování a logistika (doc. Ing. Jiří Vaněk, Ph.D.)

Třírozměrné modelování a simulace (doc. Ing. Jiří Maxa, Ph.D.)

Výrobní procesy (prof. Ing. Jiří Kazelle, CSc.)

Základy spolehlivosti elektrotechnických výrob (Ing. Helena Polsterová, CSc.)

## Doctoral Degree Programme

Elektrotechnické materiály, materiálové soustavy a výrobní procesy (prof. Ing. Jiří Kazelle, CSc.)

Vybrané diagnostické metody, spolehlivost, jakost (doc. Ing. Josef Jirák, CSc.)

## Laboratories

**Laboratory of Alkaline Electrochemical Power Sources** (research and development on modern alkaline accumulators (Ni-Cd, Ni-MH) and oxygen-hydrogen fuel cells with alkaline or polymer electrolyte, Vítězslav Novák)

**Laboratory of Diagnostics of Photovoltaic Panels** (testing of photovoltaic panels and systems in precisely defined conditions, Jiří Vaněk)

**Laboratory of Diagnostic Methods** (diagnostics of materials and testing methods, experiments for semester projects, Bachelor and Master theses, Martin Frk)

**Laboratory of Electrical Diagnostic Methods** (diagnostic methods in electrical engineering and climatotechnology, experimental measurements of very small currents and diagnostics of electro-insulating fluids, Martin Frk)

**Laboratory of Electrode Materials 1,3** (preparation of specimen and electrode mass for Li-ion, Ni-Cd, Ni-MH and Ni-Zn batteries and supercondensors, thin-film deposition by chemical methods, preparation of polymer gel electrolytes, Marie Sedlaříková)

**Laboratory of Electrode Materials 2** (research and measurement of materials for electrochemical sources, mainly Li-ion, Ni-Cd, Ni-MH and Ni-Zn batteries, supercondensors and polymer gel electrolytes for Li-pol batteries, Marie Sedlaříková)

**Laboratory of Electrical Measurement** (diagnostic analysis of properties of dielectric materials, material specimen from commercial suppliers are measured by commonly used instruments, Helena Polsterová)

**Laboratory of Electrotechnical Materials 1** (analysis of electrotechnical materials, instruction in Materials and Technical Documentation and Electrotechnology for Faculty of Mechanical Engineering, Petr Křivík)

**Laboratory of Electrotechnical Materials 2** (computer modelling and measurement of parameters of semiconductor and dielectric materials, instruction in Electrotechnical Materials and Manufacturing, Material Structure and Properties, Zdenka Rozsívalová, Martin Frk)

**Laboratory of Photovoltaic Systems** (testing of electrical properties of photovoltaic cells, Jiří Vaněk)

**Laboratory of Microscopy Techniques** (research of systems for detection of signal electrons, specimen observations in scanning electrode microscope under higher pressure in specimen chamber (VP-SEM) and microscope of atomic forces (AFM), Josef Jirák, Pavel Čudek)

**Laboratory of Renewable Sources** (testing of electrical and mechanical properties of photovoltaic cells, laboratory instruction in Renewable Energy Sources and Alternative Energy Sources, Jiří Vaněk)

**Laboratory of Lead-Acid Accumulators 1,2** (research and development of new applications of lead-acid accumulators for hybrid electromobiles and as renewable energy storage, Petr Bača)

**Laboratory of Printed Circuit and Surface Mount Technology** (instruction in Printed Circuit and Surface Mount Technology, Jiří Starý)

**Laboratory of Soldering** (research and development of lead-free soldered connections reliability and surface wettability, instruction in Interconnection and Assembly Technology, Jiří Starý)

**Laboratory of Printed Circuits, PROTOCAD and Photoprocesses** (laboratory production of printed circuit boards and microsections, chemical coating analysis, laboratory instruction in Printed Circuits and Surface Mount Technology and Interconnection and Assembly Technology, Jiří Starý)

# Department of Physics


## Prof. Ing. Lubomír Grmela, CSc.

Head

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## Professors

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Prof. Ing. Pavel Koktavý, CSc., Ph.D.
Prof. RNDr. Ing. Josef Šikula, DrSc.
Prof. RNDr. Pavel Tománek, CSc.

## Associate Professors

Doc. RNDr. Milada Bartlová, Ph.D.
Doc. RNDr. Pavel Hruška, CSc.
Doc. Ing. Karel Liedermann, CSc.
Doc. Mgr. Jan Pavelka, CSc., Ph.D
Doc. Ing. Petr Sedlák, Ph.D.
Doc. Ing. Vlasta Sedláková. Ph.D.

## Lecturers

Ing. Jitka Brüstlová, CSc., RNDr. Pavel Dobis, CSc., Ing. Vladimír Holcman, Ph.D., Ing. Robert Macků, Ph.D., Ing. Pavel Škarvada, Ph.D., RNDr. Naděžda Uhdeová, Ph.D.

## Research Staff

Ing. Jiří Majzner, Ph.D., Ing. Pavel Tofel, Ph.D.

## Ph.D. Students

Ing. Faisel Inas Abuetwirat, Mgr. Naděžda Bogatyreva, Ing. Kamil Brož, Ing. Gabriel Cséfalvay, Mgr. Dinara Dallaeva, Ing. Michal Jurčík, Ing. Pavel Kaspar, Ing. Marián Klampár, Ing. Martin Kopecký, Ing. Tomáš Kuparowitz, Ing. Tomáš Pazderský, Ing. Alexander Podshivalov, Ing. Elena Prokopyeva, Ing. Milan Spohner, Ing. Jiří Šicner, Ing. Ondřej Šik, Ing. L'ubomír Škvarenina, Ing. Marek Vondra

## Administrative and Technical Staff

Mgr. Naděžda Bogatyreva, Ing. Gabriel Cséfalvay, Ing. Miloš Chvátal, Ing. Marián Klampár, Ing. Alexandr Knápek, Ph.D., Ing. Tomáš Palai-Dany, Ph.D., Miroslav Sadovský, Ing. Petr Sadovský, Ph.D., Ing. Ondřej Šik, Ing. Tomáš Trčka, Ing. Alena Václavíková, Radimír Vrba

## Main Interests

In 2014 the department provided tuition in basic courses of the Bachelor degree programme Physics 1 and Physics 2 (full-time and part-time study), Physics for students of information technology, Physics 1 and 2 for the programme Biomedical Technology and BIoinformatics, Physics for Audio Engineering, and Physics in Electrical Engineering (in English for the programme English in Electrical Engineering). The courses offered in the Master programme included Nanotechnology, Modern Physics, Solid Phase Physics and Non-Destructive Diagnostics, Physics of Dielectrics for FEEC, and Physical Optics for FIT. The courses Junctions and

Nanostructures and Spectroscopic Methods for Non-Destructive Diagnostics were offered in the doctoral study programme.

Assignments for Physical Practice and multimedia study materials were being updated for instruction in the computer room and for student self-study.

The department activities were centred on basic and applied research of the physical parameters of semiconductor and dielectric materials and components, and nanosensors. The main areas of interest were noise spectroscopy, local characterization with nanodistinction, measurement of nonlinearities, design of quality and reliability indicators and dielectric spectroscopy. Significant results were achieved in research on the characteristics of acoustic and electromagnetic emission sensors.

The department cooperated with European and Japanese laboratories in the field of noise spectroscopy and nanotechnology, and in research on dielectrics, with American universities in Orlando and Rapid City in nanometrology, and with leading Czech laboratories in the development and enhancement of the parameters of CdTe radiation detectors.

Contract research has been expanding. Our major partners have been the world leaders On Semiconductor, AVX, Kyocera and NEE, a.s.

Our top laboratory equipment includes the electron microscope LYRA with 1 nm distinction, alfa analyzer Novocontrol for measurement of dielectric spectra over 12 frequency orders, infrared spectrometer-Nicolet, workstation for experimental study of semiconductor and dielectric samples at low temperatures (up tp 10K), optical spectroscopy by SNOM, spectral analyzers of signals for an entire technical frequency band, the automatic meter of characteristics and nonlinearities Keithley 4200 and a vacuum system for research on autoemission cathodes in electron microscopy.

## Major Achievements

The department participated in the Regional Centre for Research and Development CZ.1.05/2.1.00/03.0072 'Centre for Sensor, Information and Communication Systems' (SIX) Our two laboratories were involved in the project: Laboratory of Noise, Dielectric Spectroscopy and Electromagnetic Emissons and Laboratory of Nanometrology.

We cooperated in the start-up project of excellence CZ.1.05/1.1.00/02.0068 STI CEITEC, groups 1-7 'Optoelectronic Characterisation of Nanostructures', with chief investigator Professor Lubomír Grmela. The project outcomes in 2014 were 3 publications in impact journals and one utility software.

The department was involved in two TAČR, one INGO, two Kontakt projects, one specific research BUT grant and five commercial contracts with industrial companies.

The TAČR projects focused on research on the surface defects of continuously cast billets, with Třinec Iron and Steel Works and VŠE Ostrava, and creation of a fuel cell on the basis of AFC technology, in cooperation with Baumann Technologie CZ.

The project for specific research involves the methodology of enhancing the quality of optoelectronic materials and components.

The commercial contracts dealt with DC-AC converters, characteristics of biophysical sensors and methods of non-destructive detection of technology defects in ceramic, tantalum and niobium condensers, and physical processes in supercapacitors.

Awareness of the doctoral study programme Physical Electronics and Nanotechnology has been raised and the number of incoming Ph.D. students has stabilized.

## Major Research Projects

**Low-Temperature Alkaline Fuel Cell with 5 kW Output for Stationary Applications – TAČR TA02020998**

Investigator: Lubomír Grmela

**Surface Quality Enhancement in Cast Billets – TAČR TA04010312**

Investigator: Lubomír Grmela

**Local Electronic and Optical Characteristics of Solar Cells – MŠMT LH11060**

Investigator: Pavel Tománek

**Centre of Sensor, Information and Communication Systems (SIX) – CZ.1.05/2.1.00/03.0072**

Co-investigators at UFYZ: Lubomír Grmela, Vladimír Holcman

**European Centre of Excellence CEITEC CZ.1.05/1.1.00/02.0068**

Group Leader 1-7 : Lubomír Grmela

## Selected Publications


KOKTAVÝ, P.; TRČKA, T.; KOKTAVÝ, B.; ŠTOUDEK, R. Detection of Inhomogeneities and Cracks in Composite Materials by the Method of Partial Discharges. *Key Engineering Materials (print).* 2014. 592-593(1). p. 549 - 552. ISSN 1013-9826.

TOFEL, P.; ŠKARVADA, P.; ŠIKULA, J.; CSÉFALVAY, G. Microstructure and Defects Evaluation of Varistors by Ultrasonic Waves in Low Frequency Range. *Key Engineering Materials (print).* 2014. 465(1). p. 688 - 691. ISSN 1013-9826.

HASSE, L.; BABICZ, S.; KACZMAREK, L.; SMULKO, J.; SEDLÁKOVÁ, V. Quality assessment of ZnO-based varistors by 1/f noise. *Microelectronics Reliability.* 2014. 54 (2014)(1). p. 192 - 199. ISSN 0026-2714. (IF(2013)=1,214).

ŠKARVADA, P.; TOMÁNEK, P.; ŠICNER, J. Influence of localized structural defects on the pn junction properties. *Key Engineering Materials (print).* 2014. 592-593(1). p. 441 - 444. ISSN 1013-9826.

TRČKA, T.; LÁNÍK, J.; MACKŮ, R. Comparing the Properties of Polypropylene Fibers Contained in Ordinary and Lightweight Concrete Using Three-Point Bending Tests with Stress Concentrator and Acoustic Emission Method. *Key Engineering Materials (print).* 2014. 592-593(1). p. 537 - 540. ISSN 1013-9826.

MACKŮ, R.; TRČKA, T.; HOLCMAN, V.; KOKTAVÝ, P. Experimental Studies of Excess Noise Sources in Concrete Based Materials as a Limiting Factor for Electromagnetic Emission Measurement. *Key Engineering Materials (print).* 2014. 592-593(1). p. 529 - 532. ISSN 1013-9826.

MACKŮ, R.; ŠICNER, J.; HOLCMAN, V.; KOKTAVÝ, P. Mechanical Induced Defects and Fractures in the Silicon Solar Cell Structure. *Key Engineering Materials (print).* 2014. 592-593(1). p. 533 - 536. ISSN 1013-9826.

ŠICNER, J.; ŠKARVADA, P.; MACKŮ, R.; KOKTAVÝ, P. Study of the Influence of Structural Defects on Properties of Silicon Solar Cells. *Key Engineering Materials (print).* 2014. 592-593(1). p. 449 - 452. ISSN 1013-9826.

DALLAEVA, D.; TOMÁNEK, P.; SAFARALIEV, G.; KARDASHOVA, G. High-Density Ceramic Materials on the Basis of Silicon Carbide. *Key Engineering Materials (print).* 2014. 592-593(592). p. 397 - 400. ISSN 1013-9826.

VONDRA, M.; CSÉFALVAY, G.; SEDLÁK, P. A FPGA-PC Based Acoustic Emission System with Logarithmic Preamplifier for Fracture Monitoring. *Key Engineering Materials (print).* 2014. 592-593(1). p. 541 - 544. ISSN 1013-9826.

CSÉFALVAY, G.; TRCKA, T.; VODÁK, O.; SEDLÁK, P. Using Acoustic Emission in Fracture Monitoring of Cementitious Composites. *Key Engineering Materials (print).* 2014. 592-593(592-593). p. 521 - 524. ISSN 1013-9826.

TOMÁNEK, P. Páté Fórum Optonika v rámci veletrhu AMPER. *Jemná mechanika a optika.* 2014. 59(3). p. 90 - 91. ISSN 0447-6441.

MACKŮ, R.; ŠICNER, J.; KOKTAVÝ, P.; TRČKA, T. Fracture related electromagnetic emission measurement and excess noise analysis of reinforced composites. *Procedia Materials Science.* 2014. 2014(3). p. 116 - 121. ISSN 2211-8128.

BARTLOVÁ, M.; BOGATYREVA, N.; AUBRECHT, V. Radiation Heat Transfer in Thermal Argon Plasma with Iron Vapor. *Plasma Physics and Technology.* 2014. 1(1). p. 8 - 10. ISSN 2336-2626.

ŘOUTIL, L.; VESELÝ, V.; KERŠNER, Z. Probabilistic Simulation of the Mechanical Response of a Pre-Stressed Railway Sleeper: Initiation and Propagation of Cracks During Static Test. *AMR - Advanced Materials Research.* 2014. 969(06). p. 298 - 301. ISSN 1662-8985.

ŠTEFKOVÁ, D.; TUPÝ, M.; SOTIRIADIS, K.; ŠAMÁRKOVÁ, K.; CHOBOLA, Z. High-temperature Degradation of Mortar Containing Rubber Aggregates and EVA Binder Evaluated by Impact-echo Method. *Applied Mechanics and Materials.* 2014. 2014(627). p. 272 - 275. ISSN 1660-9336.

KASPAR, P.; TOMÁNEK, P. Optické difúzní metody pro neinvazivní medicínskou diagnostiku. *Jemná mechanika a optika.* 2014. 59(8). p. 217 - 220. ISSN 0447-6441.

DALLAEVA, D.; TALU, S.; STACH, S.; ŠKARVADA, P.; TOMÁNEK, P.; GRMELA, L. AFM imaging and fractal analysis of surface roughness of AlN epilayers on sapphire substrates. *Applied Surface Science.* 2014. 312(312). p. 81 - 86. ISSN 0169-4332. (IF(2013)=2,538).

ŠKARVADA, P.; TOMÁNEK, P.; KOKTAVÝ, P.; MACKŮ, R.; ŠICNER, J.; VONDRA, M.; DALLAEVA, D.; SMITH, S.; GRMELA, L. A variety of microstructural defects in crystalline silicon solar cells. *Applied Surface Science.* 2014. 312(312). p. 50 - 56. ISSN 0169-4332. (IF(2013)=2,538).

JENIŠTA, J.; TAKANA, H.; NISHIYAMA, H.; KŘENEK, P.; BARTLOVÁ, M.; AUBRECHT, V. Quasi-laminar flow characteristics in hybrid-stabilized argon-water arc discharge for subsonic-supersonic regimes. *IEEE Transactions on Plasma Science.* 2014. 42(10). p. 2632 - 2633. ISSN 0093-3813. (IF(2013)=0,95).

DALLAEVA, D.; PROKOPYEVA, E.; TOMÁNEK, P.; GRMELA, L.; RAMAZANOV, S. Interferometry and Atomic force microscopy of substrates for optoelectronics proceeded by dry plasma etching. *Proceedings. The Computer Security Foundations Workshop III.* 2014. 2014(1). p. 283 - 287. ISSN 1063-6900.

PODSHIVALOV, A.; TRČKA, T.; KOKTAVÝ, P. Statistical characteristics of electromagnetic emission signals of mechanical loaded composite samples. *ElectroScope - http://www.electroscope.zcu.cz.* 2014. 2014(3). p. 1 - 5. ISSN 1802-4564.

BOGATYREVA, N.; BARTLOVÁ, M.; AUBRECHT, V.; HOLCMAN, V. P1-approximation for radiative transfer: application to SF6 + Cu arc plasmas. *CENTRAL EUROPEAN JOURNAL OF CHEMISTRY.* 2014. 2015 (13)(1). p. 502 - 508. ISSN 1895-1066. (IF(2013)=1,329).

DALLAEVA, D.; RAMAZANOV, S.; PROKOPYEVA, E.; BRÜSTLOVÁ, J.; TOMÁNEK, P. Lokální topografie optoelektronických substrátů připravených pomocí plazmového leptání. *Jemná mechanika a optika.* 2014. 59(11-12). p. 299 - 302. ISSN 0447-6441.

Tomas Kuparowitz, Vlasta Sedlakova, Arkadiusz Szewczyk, Lech Hasse, Janusz Smulko, Jiri Majzner,Petr Sedlak, Josef Sikula. Charge Redistribution and Restoring voltage of Supercapacitors. *ElectroScope - http://www.electroscope.zcu.cz.* 2014. 2014(3). p. 1 - 7. ISSN 1802-4564.

DALLAEVA, D.; RAMAZANOV, S.; PROKOPYEVA, E.; KASPAR, P.; TOMANEK, P. AFM Imaging of Natural Optical Structures. *Advances in Electrical and Electronic Engineering - intenetový časopis(http://advances.utc.sk).* 2014. 12(6). p. 639 - 643. ISSN 1804-3119.

DALLAEVA, D.; TOMÁNEK, P.; ŠKARVADA, P.; GRMELA, L. Realization of microscale detection and localization of low light emitting spots in monocrystalline silicon solar cells. *Proceedings of SPIE.* 2015. 9450(9450). p. 94501O-1 (7 p.). ISSN 0277-786X.

DALLAEVA, D.; RAMAZANOV, S.; RAMAZANOV, G.; AKHMEDOV, R.; TOMÁNEK, P. Characterizing SiC-AlN semiconductor solid solutions with indirect and direct bandgaps. *Proceedings of SPIE.* 2015. 9450(9450). p. 94501R-1 (6 p.). ISSN 0277-786X.

PROKOPYEVA, E.; KASPAR, P.; TOMÁNEK, P.; GRMELA, L. Optical properties of metal nanoparticles used in biosensors. *Proceedings of SPIE.* 2015. 9442(944217). p. 944217-1 (7 p.). ISSN 0277-786X.

DALLAEVA, D.; TOMANEK, P.; PROKOPYEVA, E.; KASPAR, P.; GRMELA, L.; SKARVADA, P. AFM imaging of natural optical structures. *Proceedings of SPIE.* 2015. 9442(9442). p. 944209-1 (8 p.). ISSN 0277-786X.

DALLAEVA, D.; RAMAZANOV, S.; PROKOPYEVA, E.; TOMÁNEK, P.; GRMELA, L. Local topography of optoelectronic substrates prepared by dry plasma etching process. *Proceedings of SPIE.* 2015. 9442(9442). p. 9442081 - 9442086. ISSN 0277-786X.

## Bachelor Degree Programme

Fyzika 1 (RNDr. Pavel Dobis, CSc.)

Fyzika 2 (doc. RNDr. Milada Bartlová, Ph.D.)

Fyzika pro H-AEI (doc. Ing. Karel Liedermann, CSc.)

Fyzika pro J-AUD (prof. Ing. Pavel Koktavý, CSc., Ph.D.

Fyzika pro informatiky (prof. Ing. Lubomír Grmela, CSc.)

Fyzikální semináře BFYS a BFY (Ing. Jitka Brüstlová, CSc.)

## Master Degree Programme

Fyzika pevné fáze (prof. Ing. Pavel Koktavý, CSc., Ph.D.)

Moderní fyzika (doc. Ing. Karel Liedermann, CSc.)

Fyzikální optika pro informatiky (doc. RNDr. Pavel Hruška, CSc.)

Nanotechnologie (prof. RNDr. Pavel Tománek, CSc.)

Nedestruktivní diagnostika a fyzika dielektrik (Ing. Vladimír Holcman, Ph.D.)

## Doctoral Degree Programme

Rozhraní a nanostruktury (prof. RNDr. Pavel Tománek, CSc.)

Spektroskopické metody pro nedestruktivní diagnostiku (doc. Ing. Karel Liedermann, CSc.)

## Laboratories

**Czech Electronic Noise Research Laboratory** (low-frequency noise, noise spectroscopy, development of non-destructive diagnostic methods and indicators of the reliability of materials and microelectronic components, research of sensors and acoustic and electromagnetic emission methods, Josef Šikula)

**Laboratory of Dielectric Relaxation Spectroscopy** (dielectric relaxation spectroscopy, monitoring of molecular dynamics of dielectric materials, Karel Liedermann)

**Laboratory of Physics** (instruction in Physics 1, Physics 2 and Physics for Information Technology, laboratory exercises for Physics of Solids and Non-Destructive Diagnostics of Materials, Semiconductors and Physics of Dielectrics, Pavel Dobis)

**Laboratory of Optical Nanometrology – SIX** (contactless investigation of local optical and electrical characteristics of optoelectronic and photonic structures with horizontal superresolution by scanning optical near field microscopy, Vladimír Holcman)

**Laboratory of Noise Diagnostics** (research of fluctuation processes in solids, mainly electronic components, electroinsulation and construction materials, diagnostics of semiconductor components and electroinsulation materials by partial charges using electromagnetic and acoustic emissions for diagnostics of fissures, Pavel Koktavý)

**Laboratory of Noise Dielectric Spectroscopy and Electromagnetic Emission – SIX** (experimental and theoretical research of stochastic processes and carrier transport as a basis for new advanced

technologies, nanosensorics, development of non-destructive diagnostics and modern methods of electronic components and structures lifetime estimation, Lubomír Grmela)

# Department of Languages


## Doc. PhDr. Milena Krhutová, Ph.D.

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## Associate Professors

Doc. PhDr. Milena Krhutová, Ph.D.

## Lecturers

PaedDr. Alena Baumgartnerová, PhDr. Petra Fiĺová,Ph.D., PhDr. Marcela Borecká, Mgr. Terezie Filipenská, Ph.D., Kenneth Froehling, M.A., Ing. Martin Jílek, Mgr. Miroslav Kotásek, Ph.D., Mgr. Petra Langerová, PhDr. Dagmar Malíková, Mgr. Jana Kopecká, PhDr. Ludmila Neuwirthová, Ph.D., Mgr. Šárka Rujbrová, Mgr. Pavel Sedláček, PhDr. Milan Smutný, Ph.D., Bc. Magdalena Šedrlová, Mgr. Agata Walek, Mgr. Marie Žouželková Bartošová

## Administrative and Technical Staff

Miroslava Purová

## Main Interests

The department provides instruction in professional English for all specializations in the Bachelor and Master programmes EECR, the Ph.D. programme and the interdisciplinarty programme BT-BIO. The courses are focused on professional English in electrical engineering and information-technology, social skills and competences in a professional language. The department launched an interdisciplinary Bachelor programme tailored for the professional language of various disciplines of electrical engineering and information technology – the theory of linguistics and specific language skills. The programme, which is unique in the Czech Republic, started in the academic year 2012/13 and this year the first graduates will receive the Bachelor degree. The programme equips the graduates with interdisciplinary knowledge and skillls required at the current job market. The subjects Introduction in Linguistics, Professional Style in Czech and English, Practical English 1-5, Grammar Structures, Discourse Analysis, Linguistics Pragmatics, Translation Exercises were introduced and instruction materials were created.

Research of English as a language of profession continued and its results have been gradually implemented in the teaching materials. Professional discourse analysis considered not only the pragmatic approach, but also the sociolinguistic approach taking into account the environment where English is used as first or second language.

## Major Achievements

In 2014 the department's activities centred on the new Bachelor programme 'English in Electrical Engineering and Informatics', mainly the third-year students who are the first to take the state examinations and defend their Bachelor theses. This required new instruction materials, rules and

regulations for the state examinations and choice of study areas. This programme, its targets and implementation were presented at the conference 'Languages and the Market: Competitiveness and Employability' in Estoril, Portugal, in the paper 'Linguistics as a Part of a Multidisciplinary Study Program'. Language courses created for this programme are based on long-term research on the specific discourse in English as a professional language of electrical engineering and information and communication technology. The research outcomes are implemented in the courses and in a highly specific methodology required for this type of instruction. From now on research will also focus on compounds in English for medicine, and the producer strategies in professional communication.

The department participated in the OPVK faculty project 'Complex Innovation of Study Programmes' and created instruction materials for subjects English for IT, English for Life etc. in the study programmes EECR and BT BIO.

We cooperated in the OPVK programme 'Internationalization of the Faculty of Physical Culture at Palacky University, Olomouc' where we provided methodical guidance. In 2014 the programme was completed.

## Selected Publications

VALIŠ, D.; ŽÁK, L.; WALEK, A.; PIETRUCHA-URBANIK, K. Selected mathematical functions used for operation data information. In *Safety, Reliability and Risk Analysis: Beyond the Horizon.* 2014. p. 1303 - 1308. ISBN 978-1-138-00123-7.

KOTÁSEK, M. Michael Awkward: Rasa, gender a politika čtení. *Aluze.* 2014. 2013/17(1). p. 18 - 30. ISSN 1803-3784.

KOTÁSEK, M. Trauma Freud: Sigmund Freud as Fictional Character in D. M. Thomass The White Hotel. *Bohemica litteraria. Masarykova univerzita AJ.* 2014. 2013/16(2). p. 69 - 81. ISSN 1213-2144.

KOTÁSEK, M. Portrét v souvislostech. *Ceska Literatura.* 2014. 62(2). p. 307 - 313. ISSN 0009-0468.

KOTÁSEK, M. Lucy Duggan: Mezi minulostí a přítomností. *Pandora.* 2014. 2013(26/27). p. 101 - 110. ISSN 1801-6782.

KOTÁSEK, M. Barry Murnane: Kafkova poetika smrti a psaní. *Pandora.* 2014. 2013(26/27). p. 111 - 119. ISSN 1801-6782.

## Bachelor Degree Programme

Praktická angličtina I (Mgr. Pavel Sedláček)

Úvod do lingvistiky (PhDr. Milan Smutný, Ph.D.)

Angličtina – mluvnická cvičení (PaedDr. Alena Baumgartnerová)

Jazyk odborného stylu v češtině a angličtině

(Mgr. Miroslav Kotásek, Ph.D.)

Jazyk jako diskurs ve vědě a technice (doc. PhDr. Milena Krhutová, Ph.D.)

Angličtina pro inženýry (PhDr. Ludmila Neuwirthová, Ph.D.)

Kulturní studia I (Mgr. Pavel Sedláček)

Angličtina pro bakaláře- mírně pokročilí 1 (PaedDr. Alena Baumgartnerová )

Angličtina pro bakaláře- mírně pokročilí 2 (PaedDr. Alena Baumgartnerová )

Angličtina pro bakaláře- středně pokročilí 1 (Mgr. Agata Walek)

Angličtina pro bakaláře- středně pokročilí 2 (Mgr. Pavel Sedláček)

Angličtina pro Evropu (PhDr. Milan Smutný, Ph.D.)

Etika podnikání (Ing. Martin Jílek)

Inženýrská pedagogika a didaktika (Ing. Martin Jílek)

Kultura projevu a tvorba textů (Ing. Martin Jílek)

Kurs profesní angličtiny pro elektroinženýrství a informatiku (PhDr. Milan Smutný, Ph.D.)

Laboratorní didaktika (Ing. Martin Jílek)

Manažerské účetnictví (Ing. Martin Jílek)

Němčina pro mírně pokročilé (Mgr. Pavel Sedláček)

Němčina pro pokročilé (Mgr. Pavel Sedláček)

Němčina pro začátečníky (Mgr. Pavel Sedláček)

Pedagogická psychologie (Ing. Martin Jílek)

Manažerské účetnictví (Ing. Martin Jílek)

Ruština pro mírně pokročilé (PaedDr. Alena Baumgartnerová)

Ruština pro začátečníky (PaedDr. Alena Baumgartnerová)

Španělština pro mírně pokročilé (PhDr. Marcela Borecká)

Španělština pro začátečníky (PhDr. Marcela Borecká)

## Master Degree Programme

Angličtina pro Evropu (PhDr. Milan Smutný, Ph.D.)

Angličtina pro život (Mgr. Pavel Sedláček, Kenneth Froehling, M.A.)

Etika podnikání (Ing. Martin Jílek)

Kultura projevu a tvorba textů (Ing. Martin Jílek)

Kurs profesní angličtiny pro elektroinženýrství a informatiku (PhDr. Milan Smutný, Ph.D.)

Manažerské účetnictví (Ing. Martin Jílek)

Němčina pro mírně pokročilé (Mgr. Pavel Sedláček)

Němčina pro pokročilé (Mgr. Pavel Sedláček)

Němčina pro začátečníky (Mgr. Pavel Sedláček)

Manažerské účetnictví (Ing. Martin Jílek)

Ruština pro začátečníky (PaedDr. Alena Baumgartnerová)

Španělština pro začátečníky (PhDr. Marcela Borecká)

## Doctoral Degree Programme

Angličtina pro doktorandy (PhDr. Dagmar Malíková)

Angličtina pro doktorandy FIT (doc. PhDr. Milena Krhutová, Ph.D.)

# Department of Mathematics


## Doc. RNDr. Zdeněk Šmarda, CSc.

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## Professors Emeriti

Prof. RNDr. Václav Havel, DrSc.

## Professors

Prof. RNDr. Josef Diblík, DrSc.
Prof. RNDr. Jan Chvalina, DrSc.

## Associate Professors

Doc. RNDr. Jaromír Baštinec, CSc.
Doc. RNDr. Dana Hliněná, Ph.D.
Doc. RNDr. Martin Kovár, Ph.D.
Doc. RNDr. Zdeněk Šmarda, CSc.

## Lecturers

RNDr. Petr Fuchs, Ph.D., Ing. Michal Fusek, Ph.D., Mgr. Irena Hlavičková, Ph.D., RNDr. Edita Kolářová, Ph.D., RNDr. Vlasta Krupková, CSc., Mgr. Michal Novák, Ph.D., RNDr. Zdeněk Svoboda, CSc., Mgr. Marie Tomšová, Mgr. Jiří Vítovec, Ph.D.

## Ph.D. Students

Mgr. Blanka Morávková, Mgr. Hana Halfarová, Alena Chernikava, Ganna Konstantinivna Piddubna, Mgr. Štěpán Křehlík, Ing. Marie Klimešová, Hanna Demchenko, Mgr. Jan Šafařík

## Administrative and Technical Staff

Eva Šimečková

## Main Interests

In 2014 the department provided instruction in courses for full-time and part-time Bachelor students (Mathematics 1, Mathematics 2, Mathematics 3, Selected Chapters in Mathematics i., II., Mathematics in Electrical Engineering), full-time and part-time Master students (Modern Numerical Methods, Matrix and Tensor Calculus, Random Processes, Differential Equations in Electrical Engineering, Probability, Statistics and Operations Research, Coding in Informatics). The department also provided instruction in two Ph.D. courses (Discrete Processes in Electrical Engineering, Probability, Stochastic Processes, Operations Research) and in a number of courses in the Bachelor programme at the Faculty of Information Technology.

Research was focused on discrete and continuous dynamical systems and was conducted on the basis of contracts with international partners - the team of Professor D. Khusainov, Institute of Dynamical System Modelling, Faculty of Cybernetics, Kiev State University, the team of Professor I. Dzalladova, Institute of Mathematics, Faculty of Information Systems and Technologies, Kiev National Economic University.

The department cooperates with leading world experts – Professor L. Berezansky, Beer-Sheva University, Israel, Professor Chr. Nowak, Techni-

cal University, Klagenfurt, Professir S. Stevic, Serbian Academy of Sciences, Belgrade.

Within the framework of programme Erasmus we started cooperation with the University of Nova Gorica, Slovenia, Eastern Macedonia and Thrace University, Greece and Yildiz Technical University, Turkey.

Research on dynamical systems was focused on investigation of slightly delayed planar linear discrete systems with constant coefficients and constant delays of arguments, design of new semi-analytical methods for solution of functional differential equations and partial differential equations.

Acitivies in fuzzy structures focused on fuzzy implications, their generation and characteristics, and on triangular norms (t-norms) and uninorms, mainly structures generated by t-norms, conjunctive uninorms, and their properties, particularly orders generated by t-norms, conjunctive uninorms, and their properties.

Research on topological structures centred on the topological characteristics of non-Lorentz causal structures in terms of quantum gravity. General metric characteristics of context and causal structures (frameworks) and examples of generating these structures in informatics and physics were examined.

Algebraic hyperstructures and their applications were studied with focus on ordered hyperstructures and hyperstructures generated from ordered-sets and their applications in the theory of differential operators of various types.

## Major Achievements

The department participated in 2 GAČR, 1 ESF OPVK 2.2, and 1 specific research projects.

The study of linear discrete systems with weak delay proved that the solution space of these systems is considerably smaller than anticipated (the so called glued solution). A general solution in the form of analytical formulas was constructed for each form of the Jordan matrix of elements without delay. The existence of a global attractor and non-oscillatory solution was proved for the non-linear population differential equation with quadratic nonlinearity.

In numerical applications, an iterative algorithm was designed to find the analytical forms of solutin for general and partial equations. The Newton-Kantorovič theorem was proved as well as the Smale theorem for the third order Newton method in a Banach space for non-linear equation solution including error estimation.

Software modules were generated, based on the characteristics of frameworks including the behaviour of data files for statistical description of discrete characteristics of examined systems.

Software was created for algorithms of differential equations solution for partwise constant arguments including solution algorithms for functional differential equations based on the differential transformation method.

Research on topological structures resulted in proving several theorems that enable generating of partial metrics in a formal context by means of a metrics on a set of attributes (or dually, on a set of objects). This enables better orientation in large formal contexts (incl. Databases) and design of effective algorithms. Necessary or sufficient conditions were set for the existence of the causal site from a randomly arranged set. By selecting the arrangement, it is possible to construct a causal relationship which is not a continuous poset and therefore could not be generated on a Lorentz variety, e.g. in the space that is governed by the model described by the general theory of relativity.

In 2014 the members of the department published 30 papers in impact journals Abstract and Applied Analysis, Applied Mathematics and Computation, Advances in Difference Equations, Nonlinear Dynamics and Systems Theory, Journal of Applied Mathematics, The Scientific World Journal, Information Sciences, Journal of Statistical Computation and Simulation, Analele Stiintifice Ale Universitatii Ovidius Constanta, Seria Matematica and Applied Mathematical Letters.

## Major Research Projects

**Innovation of Mathematics Instruction in Study Programmes at FEEC and FIT, BUT Brno – OPVK 2.2 CZ.1.07/2.2.00/15.0156**

Investigator: Zdeněk Šmarda

**Oscillatory and Asymptotic Characteristics of Differential Equations – GAČR 201/08/0469**

Investigator: Josef Diblík

**Representation of Dynamic Systems Solution, Numerical Algorithms – FEKT - S-14-2200**

Investigator: Zdeněk Šmarda

## Selected Publications

LIN, R.; ZHAO, Y.; ŠMARDA, Z.; KHAN, Y.; WU, Q. Newton-Kantorovich and Smale uniform type convergence theorem for a deformed Newton method in Banach spaces. *Abstract and Applied Analysis.* 2014. 2013(ID 923898). p. 1 - 8. ISSN 1085-3375. (IF(2013)=1,274).

MEDVEĎ, M.; POSPÍŠIL, M.; ŠKRIPKOVÁ, L. On exponential stability of nonlinear fractional multidelay integro-differential equations defined by pairwise permutable matrices. *APPLIED MATHEMATICS AND COMPUTATION.* 2014. 227(1). p. 456 - 468. ISSN 0096-3003. (IF(2013)=1,6).

BAŠTINEC, J.; BEREZANSKY, L.; DIBLÍK, J.; ŠMARDA, Z. On a delay population model with a quadratic nonlinearity without positive steady state. *APPLIED MATHEMATICS AND COMPUTATION.* 2014. 2014(227). p. 622 - 629. ISSN 0096-3003. (IF(2013)=1,6).

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FEČKAN, M.; POSPÍŠIL, M. Persistence of periodic orbits in periodically forced impact systems. *Mathematica Slovaca.* 2014. 64(1). p. 101 - 118. ISSN 0139-9918. (IF(2013)=0,451).

STEVIČ, S.; DIBLÍK, J.; ŠMARDA, Z. On periodic and solutions converging to zero of some systems of differential-difference equations. *APPLIED MATHEMATICS AND COMPUTATION.* 2014. 2014(227). p. 43 - 49. ISSN 0096-3003. (IF(2013)=1,6).

TOBOLOVÁ, M.; CHMELAŘ, M.; PROVAZNÍK, I.; ŘEZNÍČEK, Z.; KABEŠ, R.; BAŠTINEC, J. Testing the Effects of Micro-Pulse Stimulation on Blood Circulation Using the Thermodynamic Sensors. *Journal of Biosensors & Bioelectronics.* 2014. 5(147). p. 1 - 7. ISSN 2155-6210.

FARAZ, N.; KHAN, Y.; ŠMARDA, Z. A novel iterative scheme and its application to differential equations. *The Scientific World Journal.* 2014. 2014(ID 605376). p. 1 - 5. ISSN 1537-744X. (IF(2013)=1,219).

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DIBLÍK, J.; STAVROULAKIS, I.; CHATZARAKIS, G.; MILIARAS, G. Classification of neutral difference equations of any order with respect to the asymptotic behavior of their solutions. *APPLIED MATHEMATICS AND COMPUTATION.* 2014. 2014(227). p. 77 - 89. ISSN 0096-3003. (IF(2013)=1,6).

DIBLÍK, J.; IRIČANIN, B.; STEVIČ, S.; ŠMARDA, Z. Note on the existence of periodic solutions of a class of systems of differential-difference equations. *APPLIED MATHEMATICS AND COMPUTATION.* 2014. 2014(232). p. 922 - 928. ISSN 0096-3003. (IF(2013)=1,6).

KOVÁR, M.; CHERNIKAVA, A. On the Proof of the Existence of Undominated Strategies in Normal Form Games. *AMERICAN MATHEMATICAL MONTHLY.* 2014. 121(04). p. 332 - 337. ISSN 0002-9890. (IF(2013)=0,315).

DIBLÍK, J.; HALFAROVÁ, H. General explicit solution of planar weakly delayed linear discrete systems and pasting its solutions. *Abstract and Applied Analysis.* 2014. 2013(2013). p. 1 - 37. ISSN 1085-3375. (IF(2013)=1,274).

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DIBLÍK, J.; MORÁVKOVÁ, B. Representation of the solutions of linear discrete systems with constant coefficients and two delays. *Abstract and Applied Analysis.* 2014. 2014(1). p. 1 - 19. ISSN 1085-3375. (IF(2013)=1,274).

DIBLÍK, J.; VÍTOVEC, J. Asymptotic behavior of solutions of systems of dynamic equations on time scales in a set whose boundary is a combination of strict egress and strict ingress points. *APPLIED MATHEMATICS AND COMPUTATION.* 2014. 238(6). p. 289 - 299. ISSN 0096-3003. (IF(2013)=1,6).

FUSEK, M.; MICHÁLEK, J. Statistical analysis of type I multiply left-censored samples from exponential distribution. *JOURNAL OF STATISTICAL COMPUTATION AND SIMULATION.* 2014. 2014(5). p. 1 - 16. ISSN 0094-9655. (IF(2013)=0,713).

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CHVALINA, J.; MAYEROVÁ, Š. On certain proximities and preorderings on the transposition hypergroups of linear first-order partial differential operators. *Analele Stiintifice Ale Universitatii Ovidius Constanta, Seria Matematica.* 2014. 2014(22). p. 85; (19 p.). ISSN 1224-1784. (IF(2013)=0,23).

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HLINĚNÁ, D.; KRÁĽ, P.; KALINA, M. Pre-orders and Orders Generated by Conjunctive Uninorms. *Communications in Computer and Information Science.* 2014. 2014(444). p. 307 - 316. ISSN 1865-0929.

STEVIČ, S.; DIBLÍK, J.; IRIČANIN, B.; ŠMARDA, Z. On a solvable system of rational difference equations. *JOURNAL OF DIFFERENCE EQUATIONS AND APPLICATIONS.* 2014. 2014(20)(5-6). p. 811 - 825. ISSN 1023-6198. (IF(2013)=0,861).

DIBLÍK, J.; NOWAK, C.; SIEGMUND, S. A general Lipschitz uniqueness criterion for scalar ordinary differential equations. *Electronic Journal of Qualitative Theory of Differential Equations.* 2014. 34(2014). p. 1 - 6. ISSN 1417-3875. (IF(2013)=0,638).

RAJMIC, P.; HOŠEK, J.; FUSEK, M.; ANDREEV, S.; STECÍK, J. Simplified Probabilistic Modelling and Analysis of Enhanced Distributed Coordination Access in IEEE 802.11. *Computer Journal.* 2014. 57(11). p. 1 - 13. ISSN 1460-2067.

BAŠTINEC, J.; KHUSAINOV, D.; DEMCHENKO, H. Optimal control of the heating process without delay. *Bulletin Kiev University, series: physics and Mathematics.* 2014. 2014(1). p. 203 - 206. ISSN 1812-5409.

FEČKAN, M.; POSPÍŠIL, M. Note on fractional difference Gronwall inequalities. *Electronic Journal of Qualitative Theory of Differential Equations.* 2014. 2014(44). p. 1 - 18. ISSN 1417-3875. (IF(2013)=0,638).

DIBLÍK, J.; CHUPÁČ, R.; RŮŽIČKOVÁ, M. Existence of unbounded solutions of a linear homogenous system of differential equations with two delays. *DISCRETE AND CONTINUOUS DYNAMICAL SYSTEMS-SERIES B.* 2014. 19(2014). p. 2447 - 2459. ISSN 1531-3492. (IF(2013)=0,628).

DIBLÍK, J.; KÚDELČÍKOVÁ, M.; JANGLAJEW, K. An explicit coefficient criterion for the existence of positive solutions to the linear advanced equation. *DISCRETE AND CONTINUOUS DYNAMICAL SYSTEMS-SERIES B.* 2014. 19(2014). p. 2461 - 2468. ISSN 1531-3492. (IF(2013)=0,628).

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DIBLÍK, J.; FEČKAN, M.; POSPÍŠIL, M. On the new control functions for linear discrete delay systems. *SIAM JOURNAL ON CONTROL AND OPTIMIZATION.* 2014. 65(1). p. 1745 - 1760. ISSN 0363-0129. (IF(2013)=1,389).

DIBLÍK, J.; DZHALLADOVA, I.; RŮŽIČKOVÁ, M. Stabilization of company-s income modeled by a system of discrete stochastic equations. *Advances in Difference Equations.* 2014. 2014(2014). p. 1 - 8. ISSN 1687-1847. (IF(2013)=0,634).

DIBLÍK, J.; KÚDELČÍKOVÁ, M. New explicit integral criteria for the existence of positive solutions to the linear advanced equation $\dot x(t) = c (t) x (t + \tau)$. *APPLIED MATHEMATICS LETTERS.* 2014. 38(2014). p. 144 - 148. ISSN 0893-9659. (IF(2013)=1,48).

JÍROVÁ, A.; VÁVROVÁ, M.; FUSEK, M.; JÁROVÁ, K. Residues of selected organohalogen pollutants in the South Moravian rivers, Czech Republic. *Fresenius Environmental Bulletin.* 2014. 23(12B). p. 3410 - 3415. ISSN 1018-4619. (IF(2013)=0,527).

STEVIČ, S.; DIBLÍK, J.; IRIČANIN, B.; ŠMARDA, Z. Solvability of nonlinear difference equations of the fourth order. *Electronic Journal of Differential Equations.* 2014. 2014(264). p. 1 - 14. ISSN 1072-6691. (IF(2013)=0,419).

## Bachelor Degree Programme

Matematický seminář (RNDr. Petr Fuchs, Ph.D.)

Matematika 1 (RNDr. Edita Kolářová, CSc.)

Matematika 2 (prof. RNDr. Jan Chvalina, DrSc.)

Matematika 3 (Mgr. Irena Hlavičková, Ph.D.)

Vybrané partie z matematiky I. (doc. RNDr. Zdeněk Šmarda, CSc.)

Vybrané partie z matematiky II. (doc. RNDr. Zdeněk Šmarda, CSc.)

Matematika v elektrotechnice (RNDr. Petr Fuchs, Ph.D.)

## Master Degree Programme

Diferenciální rovnice a jejich použití v elektrotechnice (prof. RNDr. Josef Diblík, DrSc.)

Maticový a tenzorový počet (doc. RNDr. Martin Kovár, Ph.D.)

Moderní numerické metody (doc. RNDr. Jaromír Baštinec, CSc.)

Pravděpodobnost, statistika a operační výzkum (doc. RNDr. Jaromír Baštinec, CSc.)

Náhodné procesy (doc. RNDr. Jaromír Baštinec,CSc.)

Kódování v informatice (RNDr. Petr Fuchs, Ph.D.)

## Doctoral Degree Programme

Diskrétní procesy v elektrotechnice (prof. RNDr. Josef Diblík, DrSc.)

Statistika, stochastické procesy, operační výzkum (doc. RNDr. Jaromír Baštinec, CSc.)

## Laboratories

**Computer Laboratories** (2) (instruction in Computers and Programming 2, simulation of application mathematical thematic wholes using Matlab, Maple, Mathematica, Petr Fuchs)

**Computer Laboratory for Mathematical Modelling** (data simulation and processing using StatSoft and MapleSim, Michal Novák)

# Department of Microelectronics


## Doc. Ing. Jiří Háze, Ph.D.

Head

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## Professors

Prof. Ing. Dalibor Biolek, CSc.
Prof. Ing. Jaroslav Boušek, CSc.
Prof. Ing. Jaromír Brzobohatý, CSc.
Prof. Ing. René Kizek, Ph.D.
Prof. Ing. Vladislav Musil, CSc.
Prof. Ing. Radimír Vrba, CSc.

## Associate Professors

Doc. RNDr. Vojtěch Adam, Ph.D.
Doc. Ing. Lukáš Fujcik, Ph.D.
Doc. Ing. Jiří Háze, Ph.D.
Doc. Ing. Jaromír Hubálek, Ph.D.
Doc. Ing. Jaroslav Kadlec, Ph.D.
Doc. Ing. Fabian Khateb, Ph.D.
Doc. RNDr. Pavel Kopel, Ph.D.
Doc. Ing. Radek Kuchta, Ph.D.
Doc. Ing. Pavel Legát, CSc.
Doc. Ing. Josef Šandera, Ph.D.
Doc. Ing. Pavel Šteffan, Ph.D.
Doc. Ing. Ivan Szendiuch, CSc.
doc. RNDr. Libuše Trnková, CSc.
Doc. Ing. František Urban, CSc.
Doc. Ing. Radek Vlach, Ph.D.

## Lecturers

Ing. Martin Adámek, Ph.D., Ing. Edita Hejátková, Ing. Radim Hrdý, Ph.D., Ing. Vilém Kledrowetz, Ph.D., Ing. Radovan Novotný, Ph.D., Ing. Jan Pekárek, Ph.D., Ing. Jana Pekárková, Ph.D., Ing. Jan Prášek, Ph.D., Ing. Roman Prokop, Ph.D., Ing. Ondřej Sajdl, Ph.D., Ing. Jiří Stehlík, Ph.D., Ing. Cyril Vaško, Ing. Michal Pavlík, Ph.D.

## Research Workers

Ing. Pavel Neužil, Ph.D., Stella Vallejos Vargas, Dr.

## Ph.D. Students

Ing. Marek Bohrn, Ph.D., Ing. Martin Buršík, Ph.D., Ing. Ondřej Frantík, Ph.D., Ing. David Jaroš, Ing. Nabhan Khatib, Ph.D., Ing. Martin Magát, Ph.D., Ing. Ladislav Macháň, Ing. Milan Matějka, Ing. Barbora Mojrová, Ing. Michal Nicák, Ing. Alexandr Otáhal, Ing. Marián Pristach, Ph.D., Ing. Boleslav Psota, Ing. Jiří Pulec, Ing. Zdeněk Pytlíček, Ing. Michal Řezníček, Ing. Jiří Sedláček, Ing. Doaa Yahya, Ing. Jaromír Žák, Ing. Milan Holík, Ing. Martin Klíma, Ing. Vladimír Levek

## Administrative and Technical Staff

Jarmila Fučíková, Petra Jedličková, Ing. Jaroslav Jankovský, PhDr. Jarmila Jurášová, Ing. Petra Majzlíková, Ph.D., Mgr. Eva Martincová, Ph.D., Ing. Ondřej Hégr, Ph.D., Ing. Petr Kosina, Ph.D., RNDr. Michal Masařík, Ph.D., Ing. Břetislav Mikel, Ph.D., Bc. David Nejezchleb, Mgr. Michaela Pekarová, Petra Procházková Ph.D., Ying Xu, MBA, Mgr. Ondřej Zítka

## Main Interests

In 2014 the department provided instruction in basic subjects, mainly on electronic components, and circuits and subjects specialized in design of integrated circuits and microelectronic technology in the new system of Bachelor and follow-up Master degree programmes.

Basic and applied research was centred on investigation of integrated circuits, sensors and microelectronic technologies. The main areas of interest included:

- design of voltage, current and mixed mode circuits
- design of circuits with switched capacitors and switched currents,
- basic research of memristors, memcapacitors and meminductors
- MEMS structures design and CoventorWare simulation
- methods of signal evaluation for chemosensors, optosensors and biosensors, mainly of gases and toxic substances
- advanced component, surface and sensor technology
- microelectrodes modified by nanostructures (nanotubes, nanocolumns) using advanced nanotechniques
- simulation and evaluation of 3D linking systems reliability
- new methods of thixotropic material non-vacuum deposition in 3D circuits.
- reliability of lead-free solders
- advanced methods of semiconductor chips interconnection and packaging
- simulation of electronic kits and packages in ANSYS
- non-conventional application of thick films (sensors, attenuator, shielding, antennas etc).

The department closely cooperated (student exchanges) with Technical University in Sofia (Bulgaria), TU Ilmenau and IMMS Erfurt, Germany, and maintained research cooperation with Autoflug, Hamburg, Catalonia University Rovira i Virgili in Tarragona, research laboratory IMEC-KHBO in Belgium, UC Berkeley, UC San Diego, Politecnico Di Torino, and TU Dresden.

Wth Pbt Rožnov pod Radhoštěm, the department worked on new cleaning methods in electronics directly related to manufacture of modern cleaning equipment (with focus on cleaning after soldering and cleaning of templates). Prototypes of sensors developed on the principle of balance thermodynamics (cooperation with HIT s.r.o.) were tested. In cooperation with TU Wien new types of flow sensors were implemented by the LTCC.

With Fill Factory, Rožnov pod Radhoštěm (former Solartec) and the research centre ISC Konstanz, we started research on the effect of the surface structure of crystalline quartz cells on their properties.

## Major Achievements

The department's staff participated in 3 projects of the 7FP European programmes ARTEMIS JU and ENIAC JU, 3 GAČR, 3 MPO and 2 TAČR projects.

In June 2014 the department co-organized the international conference 'Electronic Devices and Systems EDS 2014' with participation of Czech and international experts. There were 60 papers on microelectronics and technology.

The group involved in microelectronic technology headed by Doc. Szendiuch and the company REHM (Dr. Bell) focused on lead-free solders and the influence of controlled atmosphere on the service life and long-term reliability of lead-free soldered connections. Cooperation with Pbt Rožnov and manufacturing companies in the TAČR project on cleaning methods continued in compliance with the requirements of environmen-

tal management. Another area of interest was modelling of thermal stress in soldered connections and packaging in ANSYS, including contacting and modelling of semiconductor chip connections. Commercial cooperation started. Design of a unique balance sensor conducted in the framework of a MPO project was completed. Prototypes were tested in industrial applications, and results were presented on Web of Science (ISI). The project 'Board on Board' (EU Euripides) supervised by the French company Thales centred on a new type of substrates on the basis of printed circuit boards in 3D configuration.

The team LabSensNano (Laboratory of Microsensors and Nanotechnology) led by Doc. Hubálek continued research and development of chemical sensors and biosensors for medical and environmental applications. The development of the 'Lab on a chip' technology continued so as the electrochemical deposition of on-chip quantum dots. The team was awarded one utility sample in nanotechnologies. Research results were published in several journals and presented at the Web of Science (ISI) conferences.

The team works on the design and manufacturing of a novel microbolometer with enhanced IR spectrum absorption by means of MEMS technology. Chips have been manufactured and prepared for testing.

The team working on custom integrated circuits led by Doc. Fujcik focused on the development of intelligent submicron structures and systems for modern microsensors and low-input and low-voltage applications. In the framework of the GAČR project P102/11/1379 a concept of small signal digitization was designed and implemented on chip. This integrated circuit is to be primarily used for MEMS microsensor signal processing in vibration diagnostics of rotating machines. A patent was awarded for this structure and results were published in impact journals.

The joint research team of the Department of Microelectronics, CROSS Zlín and NETWORK GROUP, s.r.o. continued work on a sensor for dynamic weighing of vehicles.

The department maintained cooperation with BD Sensors, s.r.o. on the development of a new low-pressure and vacuum pressure sensor.

Another area of cooperation with industrial partners centred on wireless networks and communication protocols with the aim to develop reliable identification systems based on wireless technology by MICRORISC s.r.o.

The team of Professor Biolek focused on basic research of so called memsystems, particularly memristors. The principal theoretical relationships between memristor definition links and its fingerprints in time domain were revealed, mainly the hysteresis loop in voltage-current coordinates. The memristor concept was generalized for other physical domains. Methods for memsystem modelling and computer simulation were developed and hardware emulators were constructed.

## Major Research Projects

**DeNeCoR Devices for Neurocontrol and Neurorehabilitation – ENIAC JU Project 7H13014 (FP7)**

Investigator: Radimír Vrba

**Memristive, Memcapacitive and Meminductive Systems: Basic Research, Modelling and Simulation – GAČR P102/10/1614**

Investigator: Dalibor Biolek

**Research and Development of Digitally Tunable Mixed Mode Integrated Circuits – GAČR 102/09/1628**

Investigator: Radimír Vrba

**VacuSense Research of Very Low Pressure and Vacuum Pressure Sensors with a Digital Interface for Configuration and Diagnostics – MPO ČR TIP FR-TI3/017**

Investigator: Radimír Vrba

**WIM Development of a Novel Sensor on the Basis of a Change in Characteristics of Optical Fibers for Application in Systems of High-Speed Dynamic Weighing of Vehicles – TA ČR TA01030859**

Investigator: Jaroslav Kadlec

## Selected Publications

KHATEB, F. Bulk-driven floating-gate and bulk-driven quasi-floating-gate techniques for low-voltage low-power analog circuits design. *AEU - International Journal of Electronics and Communications.* 2014. 2014 (68)(1, IF: 0.696). p. 64 - 72. ISSN 1434-8411. (IF(2013)=0,696).

KHATEB, F.; KUMNGERN, M.; VLASSIS, S.; PSYCHALINOS, C. Differential difference current conveyor using bulk-driven technique for ultra-low-voltage applications. *CIRCUITS SYSTEMS AND SIGNAL PROCESSING.* 2014. 2014 (33)(1, IF: 1.264). p. 159 - 176. ISSN 0278-081X. (IF(2013)=1,264).

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SZENDIUCH, I.; PSOTA, B. Simulace tepelných vlastností pouzder QFN a BGA. *Slaboproudý obzor.* 2014. 70(1). p. 2 - 6. ISSN 0037-668X.

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VEJMOLA, T.; ŠANDERA, J. Detekce poruch pájeného spoje. *SMT-info.* 2014. 75(75). p. 37 - 76. ISSN 1121-6947.

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CHUDOBOVÁ, D.; DOSTÁLOVÁ, S.; BLAŽKOVÁ, I.; MICHÁLEK, P.; RUTTKAY-NEDECKÝ, B.; SKLENÁŘ, M.; NEJDL, L.; KUDR, J.; GUMULEC, J.; TMEJOVÁ, K.; KONEČNÁ, M.; VACULOVIČOVÁ, M.; HYNEK, D.; MASAŘÍK, M.; KYNICKÝ, J.; KIZEK, R.; ADAM, V. Effect of Ampicillin, Streptomycin, Penicillin and Tetracycline on Metal Resistant and Non-Resistant Staphylococcus aureus. *International Journal of Environmental Research and Public Health.* 2014. 2014(3). p. 3233 - 3255. ISSN 1660-4601. (IF(2013)=1,993).

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## Bachelor Degree Programme

Analogové elektronické obvody
(prof. Ing. Dalibor Biolek, CSc.)

Diagnostika a testování elektronických systémů
(Ing. Michal Pavlík, Ph.D.)

Digitální obvody a mikroprocesory
(doc. Ing. Lukáš Fujcik, Ph.D.)

Elektronické součástky
(prof. Ing. Jaroslav Boušek, CSc.)

Návrh vakuových soustav pro technologie v mikroelektronice (doc. Ing. Josef Šandera, Ph.D.)

Mikroelektronické praktikum
(doc. Ing. Josef Šandera, Ph.D.)

Mikroelektronika a technologie součástek
(doc. Ing. Ivan Szendiuch, CSc.)

Mikrosenzory a mikromechanické systémy
(doc. Ing. Jaromír Hubálek, Ph.D.)

Modelování a počítačová simulace
(prof. Ing. Dalibor Biolek, CSc.)

Návrh a konstrukce elektronických přístrojů
(prof. Ing. Vladislav Musil, CSc.)

Návrh analogových integrovaných obvodů
(doc. Ing. Jiří Háze, Ph.D.)

Optoelektronika a optické komunikace
(doc. Ing. František Urban, CSc.)

Podnikatelské minimum
(doc. Ing. Pavel Legát, CSc.)

## Master Degree Programme

Analogové integrované obvody
(doc. Ing. Jiří Háze, Ph.D.)

Aplikovaná počítačová technika
(Ing. Radovan Novotný, Ph.D.)

Digitální integrované obvody
(doc. Ing. Pavel Štefan, Ph.D.)

Integrovaná optoelektronika
(doc. Ing. František Urban, CSc.)

Konstrukce a technologie elektronických zařízení
(prof. Ing. Vladislav Musil, CSc.)

Metody návrhu analogových integrovaných obvodů (Ing. Roman Prokop, Ph.D.)

Metody návrhu digitálních integrovaných obvodů
(doc. Ing. Lukáš Fujcik, Ph.D.)

Microelectronics in English
(prof. Ing. Jaromír Brzobohatý, CSc.)

Mikroelektronické prvky a struktury
(Ing. Ondřej Hégr, Ph.D.)

Modelování a simulace v mikroelektronice
(doc. Ing. Jaroslav Kadlec, Ph.D.)

Moderní technologie elektronických obvodů a systémů (doc. Ing. Ivan Szendiuch, CSc.)

Návrh elektronických přístrojů
(doc. Ing. Radek Kuchta, CSc.)

Nové obvodové principy pro návrh integrovaných systémů (doc. Ing. Fabian Khateb, Ph.D.)

Podnikatelské minimum
(doc. Ing. Pavel Legát, CSc.)

Praktické minimum podnikatele
(doc. Ing. Pavel Legát, CSc.)

Řízení jakosti
(Ing. Radovan Novotný, Ph.D.)

Teorie vzájemného převodu analogového a číslicového signálu (doc. Ing. Jiří Háze, Ph.D.)

Vakuová technika
(prof. Ing. Jaroslav Boušek, CSc.)

Výroba součástek a konstrukčních prvků
(doc. Ing. Ivan Szendiuch, CSc.)

## Doctoral Degree Programme

Mikroelektronické systémy
(prof. Ing. Vladislav Musil, CSc.)

Mikroelektronické technologie
(doc. Ing. Jaromír Hubálek, Ph.D.)

## Laboratories

**Laboratory of Electronic Components** (instruction in Electronic Components, Petr Kosina, Jaroslav Boušek). New measuring devices were provided by ON Semiconductor.

**Laboratory of Analogue Circuits and Microelectronic Practice** (instruction in Analogue Integrated Circuits and Microelectronic Practice, Jiří Háze, Josef Šandera)

**Laboratory of Microsensors and Nanotechnologies** (research laboratory of chemistry, chemical sensors and biosensors, development of electronic devices, electron microscopy and lithography, dispersive X-ray spectroscopy, Jaromír Hubálek)

**Laboratory of Microelectronic Mount Technology and Casing** (thick films, solder surface mount, lead-free soldering and casing, instruction in Microelectronics and Component Technology, Manufacturing of Components and Construction Elements, Modern Technology of Electronic Circuits and Systems, student projects, Ivan Szendiuch)

**Laboratory of Vacuum Technology** (research and development laboratory, Jaroslav Boušek, Josef Šandera)

**Laboratory of Microsensors** (instruction in Microsensors and Micromechanical Systems, biosensors, Jaromír Hubálek)

**Design Laboratory of Electronic Devices and Systems** (instruction in Digital Circuits and Microprocessors, Electronic Systems, student projects, Pavel Šteffan)

**Design Laboratory of Integrated Circuits** (instruction in Design of Analog Integrated Circuits and Design of Digital Integrated Circuits, student projects, Roman Prokop)

**Laboratory of Optoelectronics and Laser Technology** (instruction in Optoelectronics, student projects, František Urban)

**Computer Laboratory** (computer exercises for various subjects, self-study, Internet, David Nejezchleb)

**Laboratory for Semiconductor Components Characterization – Testing of Chips** (instruction in Manufacturing of Components and Construction Elements, student projects, Jaromír Hubálek)

# Department of Radioelectronics


## Doc. Ing. Tomáš Kratochvíl, Ph.D.

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## Professors Emeriti

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Prof. Ing. Václav Říčný, CSc.
Prof. Ing. Vladimír Šebesta, CSc.

## Professors

Prof. Ing. Lubomír Brančík, CSc.
Prof. Ing. Stanislav Hanus, CSc.
Prof. Ing. Miroslav Kasal, CSc.
Prof. Dr. Ing. Zdeněk Kolka
Prof. Ing. Aleš Prokeš, Ph.D.
Prof. Dr. Ing. Zbyněk Raida
Prof. Ing. Milan Sigmund, CSc.
Prof. Ing. Otakar Wilfert, CSc.

## Associate Professors

Doc. Ing. Tomáš Frýza, Ph.D.
Doc. Ing. Tomáš Kratochvíl, Ph.D.
Doc. Ing. Jaroslav Láčík, Ph.D.
Doc. Ing. Roman Maršálek, Ph.D.
Doc. Ing. Jiří Petržela, Ph.D.
Doc. Ing. Jiří Šebesta, Ph.D.

## Lecturers

Ing. Viera Biolková, Ing. Jiří Dřínovský, Ph.D., Ing. Lucie Hudcová, Ph.D., Ing. Ivana Jakubová, Ing. Michal Kubíček, Ph.D., Ing. Martin Slanina, Ph.D., Dr. techn. Ivan Starkov, Ing. Martin Štumpf, Ph.D., Ing. Tomáš Urbanec, Ph.D.

## Research Workers

Ing. Jiří Blumenstein, Ph.D., Dr. Techn. Vojtěch Derbek, Ing. Tomáš Götthans, Ph.D., Ing. Petr Kadlec, Ph.D., Ing. Tomáš Mikulášek, Ph.D., Ing. Michal Pokorný, Ph.D., Ing. Ladislav Polák, Ph.D., doc. RNDr. Jitka Poměnková, Ph.D., Ing. Aleš Povalač, Ph.D., Ing. Jan Puskely, Ph.D., Ing. Vladimír Šeděnka, Ph.D., Ing. Roman Šotner, Ph.D.

## Ph.D. Students

Ing. Nawfal Al-Zubaidi R-Smith, Ing. Radek Balada, Ing. Peter Barcík, Ing. Libor Boleček, Ing. Aleš Dobesch, Ing. Vladimír Hebelka, Ing. Patrik Hubka, Ing. Ondřej Kaller, Ing. Edward Kasem, Ing. Eva Klejmová, Ing. Lukáš Klozar, Ing. Martin Kotol, Ing. David Krutílek, Ing. Jan Křístel, Ing. Zenon Kuder, MSc., Ing. Jan Kufa, Ing. Martin Kufa, Ing. Pavel Kukolev, Ing. Jiří Lambor, Ing. Demian Lekomtcev, Ing. Tobiáš Malach, Ing. Roman Mego, Ing. Jiří Miloš, Ing. Michal Mrnka, Ing. Juraj Poliak, Ing. Martin Pospíšil, Ing. Miroslav Staněk, Ing. Lenka Tejmlová, Ing. Petr Vašina, Ing. Jan Vélim, Ing. Josef Vychodil, Ing. Ondřej Zach, Ing. Filip Záplata, Ing. Tomáš Žák

## Administrative and Technical Staff

Ing. Josef Báňa, Ing. Philip Bělohlávek, Bohuslava Raidova, Petra Šípová, Aleš Vanžura, Jaroslav Voráč

## Main Interests

Research is focused on modern electronic circuits, novel signal processing methods, microwave circuits and antennas. Our areas of interest are mobile, satellite and optical communications, digital television technology and video technology, microprocessor technology, low-frequency and audio electronics, and electromagnetic compatibility (EMC).

In 2014 research was financed through 4 projects of the Czech Science Foundation (GA ČR) and 6 projects of the Technology Agency of the Czech Republic (TA ČR). The department was involved in 4 projects of the Ministry of Industry (MPO ČR), 1 project of the Ministry of Interior (MV ČR) and 3 internal grants of Brno University of Technology. The department staff participated in 2 European projects FP7 STREP and CATRENE EU, 6 projects of international cooperation COST and contracts for international partners (Volkswagen AG, CISC Semiconductor GmbH) and over 20 contracts with Czech companies.

Research results are immediately incorporated in Bachelor, Master and doctoral degree programmes. Upgrading of the educational process was supported by the ESF development projects and the operational programme OP VK, co-financed by the Ministry of Education.

The department cooperates with many organizations and societies. Staff members are engaged in the committee of the Czech and Slovak section of IEEE and Radioengineering Society There has been active cooperation with the Czech Electrotechnical Society. The department supports activities of the Student Section of IEEE at Brno University of Technology and Radioclub OK2KOJ, and is a collective member of the international organization AMSAT.

## Major Achievements

The department participates, in cooperation with Departments of Telecommunications, Microelectronics, Theoretical and Experimental Electrical Engineering and Physics, in the regional 'Centre of Applied Research SIX' (Centre of Sensor, Information and Communication Systems). The centre has been in operation since 2013, and besides institutional support it uses national and European grants to employ research staff and Ph.D. students. Research teams of the centre's two sections – microwave technology and wireless technology – participate in several TA ČR projects on applied research, and in projects of the European Agency CATRENE.

In 2014 the department joined international activities of COST (IC1101 Optical Wireless Communications - An Emerging Technology (OPTIC-WISE), IC1102 Versatile, Integrated, and Signal-aware Technologies for Antennas (VISTA), IC1003 European network on quality of experience in multimedia systems and services (QUALINET), IC 1105 3D content creation, coding and transmission over future media networks (3D-ConTourNet) and IC1004 Cooperative Radio Communications for Green Smart Environments.

The department was involved in national basic and applied research projects, in an international project CATRENE CORTIF (Coexistence of RF Transmissions in the Future) and the FP7 STREP nanoCOPS (Nanoelectronic Coupled Problems Solutions) project.

Cooperation with Volkswagen AG and CISC Semiconductor GmbH continued.

## Major Research Projects

**Agile RF Transceivers and Front-Ends for Future Smart Multi-Standard Communications Applications (ARTEMOS) – FP7 ENIAC JU 270683-2**

Investigator: Tomáš Kratochvíl

**Nanoelectronic Coupled Problems Solutions (nanoCOPS) – European project FP7 STREP 619166**

Investigator: Tomáš Kratochvíl

**Research into Wireless Channels for Intra-Vehicle Communication and Positioning – national basic research project GA ČR č. 13/38735S**

Investigator: Aleš Prokeš

**Electromagnetic Structures in Millimeter Wave Band for Biomedical Research – GAČR GAP102/12/1274**

Investigator: Zbyněk Raida

**Intelligent Infrastructure for Modern City – national applied research project TA ČR č. TA02030845**

Investigator: Zdeněk Kolka

## Selected Publications


CHANDRA, A.; DAS, P. Location management in cellular mobile networks. *IEEE Potentials.* 2014. 33(1). p. 37. ISSN 0278-6648.

KADLEC, P.; RAIDA, Z. Multi-objective self-organizing migrating algorithm applied for design of electromagnetic components. *IEEE Antennas & Propagation Magazine.* 2014. 55(6). p. 50 - 68. ISSN 1045-9243. (IF(2013)=1,152).

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## Bachelor Degree Programme

Analogové elektronické obvody
(prof. Ing. Lubomír Brančík, CSc.)

Elektromagnetická kompatibilita
(Ing. Jiří Dřínovský, Ph.D.)

Elektromagnetické vlny, antény a vedení
(prof. Dr. Ing. Zbyněk Raida)

Elektronické praktikum (Ing. Ivana Jakubová)

Impulzová a číslicová technika
(doc. Ing. Tomáš Frýza, Ph.D.)

Komunikační systémy
(prof. Ing. Aleš Prokeš, Ph.D.)

Mikroprocesorová technika a embedded systémy
(doc. Ing. Tomáš Frýza, Ph.D.)

Mikrovlnná technika
(doc. Ing. Jaroslav Láčík, Ph.D.)

Moderní bezdrátová komunikace
(doc. RNDr. Jitka Poměnková, Ph.D.)

Napájení elektronických zařízení
(Ing. Michal Kubíček, Ph.D.)

Návrh analogových filtrů
(doc. Ing. Jiří Petržela, Ph.D.)

Nízkofrekvenční a audio elektronika
(doc. Ing. Tomáš Kratochvíl, Ph.D.)

Počítače a programování 1
(doc. Ing. Jiří Šebesta, Ph.D.)

Počítače a programování 2
(doc. Ing. Jiří Šebesta, Ph.D.)

Počítačové řešení elektronických obvodů
(prof. Dr. Ing. Zdeněk Kolka)

Počítačové řešení komunikačních subsystémů
(Ing. Petr Kadlec, Ph.D.)

Rádiové a mobilní komunikace
(prof. Ing. Stanislav Hanus, CSc.)

Rádiové přijímače a vysílače
(prof. Ing. Aleš Prokeš, Ph.D.)

Signály a soustavy
(prof. Ing. Milan Sigmund, CSc.)

Vysokofrekvenční technika
(Ing. Tomáš Urbanec, Ph.D.)

Základy optických komunikací a optoelektronika
(Ing. Lucie Hudcová, Ph.D.)

Základy televizní techniky
(prof. Ing. Stanislav Hanus, CSc.)

## Master Degree Programme

Advanced radio communication systems
(doc. RNDr. Jitka Poměnková, Ph.D.)

CAD v mikrovlnné technice
(prof. Dr. Ing. Zbyněk Raida)

Digitální televizní a rozhlasové systémy
(doc. Ing. Tomáš Kratochvíl, Ph.D.)

Kvantová a laserová elektronika
(Ing. Lucie Hudcová, Ph.D.)

Mikrokontrolery pro přístrojové aplikace
(Ing. Aleš Povalač, Ph.D.)

Návrh antén a rádiových spojů
(doc. Ing. Jaroslav Láčík, Ph.D.)

Počítačové a komunikační sítě
(prof. Dr. Ing. Zdeněk Kolka)

Počítačové systémy a jejich aplikace
(Ing. Aleš Povalač, Ph.D.)

Programovatelné logické obvody
(Ing. Michal Kubíček, Ph.D.)

Radiofrekvenční identifikace
(Dr. Techn. Vojtěch Derbek)

Radioelektronická měření
(Ing. Jiří Dřínovský, Ph.D.)

Radiolokační a radionavigační systémy
(doc. Ing. Jiří Šebesta, Ph.D.)

Směrové a družicové spoje
(prof. Ing. Miroslav Kasal, CSc.

Softwarové rádio
(doc. Ing. Roman Maršálek, Ph.D.)

Systémy mobilních komunikací
(Ing. Martin Slanina, Ph.D.)

Teorie elektronických obvodů
(doc. Ing. Jiří Petržela, Ph.D.)

Teorie rádiové komunikace
(doc. Ing. Roman Maršálek, Ph.D.)

Videotechnika a multimediální technika
(Ing. Martin Slanina, Ph.D.)

## Doctoral Degree Programme

Moderní digitální bezdrátová komunikace
(prof. Ing. Milan Sigmund, CSc.)

Návrh moderních elektronických obvodů
(prof. Dr. Ing. Zdeněk Kolka)

## Laboratories

**Laboratory of Analog Electronic Circuits** (instruction in analog electronics, Ivana Jakubová, Lubomír Brančík, Jiří Petržela)

**Laboratory of Electromagnetic Compatibility EMC** (research and instruction in EMC and pre-certifying tests of interference and resistance according to European norms, Jiří Dřínovský)

**Laboratory of Low-Frequency Applications** (research and instruction in audio technology, low-frequency electronics and power supply systems for electronic devices, Tomáš Kratochvíl, Michal Kubíček)

**Laboratory of Signals and Digital Technology** (research and instruction in signals and digital technology, Viera Biolková, Milan Sigmund, Tomáš Frýza)

**Laboratory of Microprocessor Technology** (research and instruction in microprocessor and microcomputer technology, Tomáš Frýza, Aleš Povalač)

**Laboratory of Communication Systems** (research and instruction in communication systems, data transmission and digital radio communication, Aleš Prokeš,

**Laboratory in Optoelectronics and Photonics** (research and instruction in optoelectronics, photonics and optical communications, Otakar Wilfert, Lucie Hudcová)

**Laboratory of TV and Video Technology** (research and instruction in digital TV and video technology, Tomáš Kratochvíl, Martin Slanina)

**Laboratory of Microwave Technology** (research and instruction in microwave technology and special electronic components, Tomáš Urbanec, Jiří Dřínovský)

**Laboratory of Mobile Communication** (research and instruction in mobile wireless communication, Stanislav Hanus, Martin Slanina)

**Laboratory of Antennas and Electromagnetic Field** (research and instruction in EM fields, antennas and design of radio links, Jaroslav Láčík, Tomáš Mikulášek)

**Laboratory of Radio Relay and Satellite Communication** (research and instruction in radio and satellite communication, radiolocation and navigation, Miroslav Kasal)

**Laboratory for Student Research** (student projects, theses, self-study, Jiří Šebesta)

**Electronic Technology Laboratory** (dry and wet techniques for printed circuit boards, photographic production of patterns, Aleš Vančura, Jaroslav Voráč)

**Computer Laboratories** (two laboratories for computer-aided exercises in circuits, signals and systems, special areas of radioelectronics and communication technology, Josef Báňa)

**Research Laboratory of Experimental Satellite Communication** (research and development of subsystems for satellite communication and navigation, telemetric and command stations of experimental AMSAT satellites, Miroslav Kasal)

**Research Laboratory of Numerical Methods** (applied electromagnetism and electromagnetic field modelling, Zbyněk Raida, Petr Kadlec, Michal Pokorný)

**Research Laboratory of Optical Communications** (research in measurement, testing and design of light-transmitting and atmospheric optical connectors, Otakar Wilfert, Lucie Hudcová)

**Research Laboratory of Signal Processing** (digital radio communication and methods for digital signal processing, Roman Maršálek)

# Department of Telecommunications


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Doc. Ing. Dan Komosný, Ph.D.
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Doc. Ing. Ivo Lattenberg, Ph.D.
Doc. Ing. Jiří Mišurec, CSc.,
Doc. Ing. Vít Novotný, Ph.D.
Doc. Ing. Kamil Říha, Ph.D.
Doc. Ing. Vladislav Škorpil, CSc.
Doc. Ing. Václav Zeman, Ph.D.

## Lecturers

Ing. Hicham Atassi, Ph.D., Ing. Miroslav Balík., Ph.D., Ing. Vladimír Červenka, Ph.D., Ing. Petr Číka, Ph.D., Ing. Radim Číž, Ph.D., Mgr. Radka Havlíková, Ing. Jan Hajný, Ph.D., Ing. Pavel Hanák, Ph.D., Ing. Jan Jeřábek, Ph.D., Ing. Norbert Herencsár, Ph.D., Ing. Jiří Hošek, Ph.D., Ing. Jan Jeřábek, Ph.D., Ing. Martin Koutný, Ph.D., Ing. Ondřej Krajsa, Ph.D., Ing. David Kubánek, Ph.D., Ph.D., Ing. Lukáš Malina, Ph.D., Ing. Zdeněk Martinásek, Ph.D., Ing. Jiří Mekyska, Ph.D., Ing. Petr Mlýnek, Ph.D., Ing. Libor Potúček, Ph.D., Ing. Jiří Přinosil, Ph.D., Mgr. Pavel Rajmic, Ph.D., Ing. Jiří Schimmel, Ph.D., Ing. Petr Sysel, Ph.D., Ing. Pavel Šilhavý, Ph.D., Ing. Milan Šimek, Ph.D., Ing. Ondřej Šmirg, Ing. Petr Vychodil

## Research, Technical and Administrative Staff

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## Ph.D. Students

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Jan Karásek, Ing. Hasan Khaddour, Ing. Jiří Kouřil, Ing. Dominik Kovář, Ing. Radko Krkoš, Ing. Aleš Křupka, Ing. David Kurc, Ing. Petra Lambertová, Ing. Lukáš Langhammer, Ing. Petr Ležák, Ing. Jakub Lněnička, Ing. Ondřej Lutera, Ing. Václav Mach, Ing. Tomáš Mácha, Ing. Nermin Makhlouf, Ing. Lukáš Malina, Ing. Jan Mašek, Ing. Pavel Mašek, Ing. Jiří Mekyska, Ing. Ivan Míča, Ing. Jiří Minář, Ing. Ľubomír Mráz, Ing. Jakub Müller, Ing. Petr Münster, Ing. Luboš Nagy, Ing. Bohumil Novotný, Ing. Yara Omran, Ing. Kristián Orlovský, Ing. Václav Oujezský, Ing. Tomáš Pelka, Ing. Josef Polák, Ing. Michal Polívka, Ing. Radek Pospíšil, Ing. Pavel Reichert, Ing. Aleš Roček, Ing. Martin Rosenberg, Ing. Lukáš Růčka, Ing. Vladimír Schindler, Ing. Michal Skořepa, Ing. Jiří Sobek, Ing. Jiří Sobotka, Ing. Peter Stančík, Ing. Ivo Strašil, Ing. Martin Sýkora, Ing. Jakub Šedý, Ing. Radim Šifta, Ing. Ondřej Šmirg, Ing. Jan Špiřík, Ing. Jan Šporik, Ing. Vladimír Tejkal, Ing. Michal Trzos, Ing. Václav Uher, Ing. Pavel Vajsar, Ing. Lukáš Verner, Ing. Lukáš Vlček, Ing. Petr Vychodil, Ing. Ján Zátyik, Ing. Martin Zukal

## Main Interests

The department has been developing the Bachelor programme study area Teleinformatics and the Master programme study area Telecommunication and Information Technology. Instruction seeks balance of all areas of communications, includes computer systems and network, design of network applications in different programming languages. Students are instructed in design of analog and digital circuits, microprocessors and signal processors and their applications. They can specialize in multimedia informatics, i.e. digital processing of speech, music or images. There is a follow-up Ph.D. study area Teleinformatics.

Another Bachelor programme is Audio Engineering where instruction is provided jointly with Janáček Academy of Music and Performing Arts in Brno. It is an interdisciplinary programme preparing specialists in sound technology, sound signal processing and studio recording who will also possess knowledge of music and arts. The Master degree programme has been prepared and accreditation is expected in 2015.

Accreditation was obtained in 2014 for the study programme Safety in Information Technology. It is centred on safety of information and communication technologies (ICT), i.e. security of networks and Internet. The students will learn how to configurate and manage extensive computer infrastructures and test computer network resistance by means of ethical hacking. The programme includes interesting and attractive subjects in cryptography of programming or network operational systems, economics and software legislative. It is an interdisciplinary programme provided jointly with Faculty of Law, Masaryk University in Brno and Faculty of Management, Brno University of Technology. The graduates will be able to find jobs not only in purely technical positions, but also commercial, consultancy or management positions.

The department has been successful in obtaining funding from various educational and research programmes. In 2014 our research and development teams were involved in projects relating to basic and applied research yielding more than 44 m CZK. A research team has been very successful in providing up-to-date multimedia services via mobile and wireless networks. Several members of the team are involved in industrial research of the programme of Ministry of Industry and Trade and Technology Agency ČR. Close cooperation continued with companies GiTy a.s., Webnode s.r.o., Saturn Holešov, 2N Telekomunikace, MegA, a.s. - Měřicí Energetické aparáty, TTC telekomunikace. The department also participated in projects conducted with commercial companies T-Mobile, Honeywell, and Telekom Austria and was involved in activities of the ‘Centre of Sensor, Information and Communication Systems’.

## Major Achievements

The main research interests of the department are converged information and communication systems focused on multimedia informatics, and also electronic systems for medical technology. In 2014 research was targeted at the following issues:

- cryptographic protection of communication and information systems, data networks and electronic archives protection. Design and

implementation of algorithms for digital processing of speech and music signals for telecommunication and multimedia applications, embedded systems for acoustic signal processing, and software for these systems

- communication systems for crisis management in cities and municipalities (e.g. monitoring of pollution and snow loads on roofs), agricultural activity (soil retention monitoring, landslides)
- development of electronic devices for medical data transmission and processing, design and implementation of algorithms for processing and analysis of biomedical signals (NMR and CT tomography and ultrasound) and 3D modelling of parts of human body for diagnostics and surgery
- research and development of telemetric systems, remote data collection systems, systems for wireless sensor networks, networks for industrial data collection and control (smart grids of power plants, waterworks, transportation, etc.)
- design and optimization of algorithms for digital processing of signals (digital filters, signal detection, spectral analysis, etc.), implementation of algorithms for digital signal processing in signal processors and microcontrollers
- design of optical networks and industrial applications, measurement and monitoring of optical networks
- research and design of systems of speech and image processing, protected archiving of multimedia systems, evaluation of emotions in speech and mimics using genetic programming.

## Major Research Projects

**Research of Cryptographic Primitives for Secure Authentication and Protection of Digital Identity – GAČR GP14-25298P**

Investigator: Jan Hajný

**Integration Server with Cryptographic Protection – MPO FR-TI4/647**

Investigator: Kamil Vrba

**Research and Development of a Technology for Detection of Emotions in Unstructured Data – MPO FR-TI4/151**

Investigator: Zdeněk Smékal

**Localization and Classification of Vibrations by Using an Optical Fiber Sensor over Large Distances – MPO FR-TI4/696**

Investigator: Vít Novotný

**TeleCalmPlus: The Smoke in the Chimney – An Intelligent Sensor-Based Telecare Solution for Homes – IVF-NSC Project No.21280013**

Investigator: Milan Šimek

## Selected Publications

RAJMIC, P.; PRŮŠA, Z. Discrete Wavelet Transform of Finite Signals: Detailed Study of the Algorithm. *International Journal of Wavelets Multiresolution and Information Processing.* 2014. 12(1). p. 1450001-1 (38 p.). ISSN 0219-6913. (IF(2013)=0,694).

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## Bachelor Degree Programme Teleinformatics

Analogová technika (prof. Ing. Kamil Vrba, CSc.)

Analýza signálů a soustav (prof. Ing. Zdeněk Smékal, CSc.)

Architektura sítí (doc. Ing. Vít Novotný, Ph.D.)

CISCO akademie I, (doc. Ing. Dan Komosný, Ph.D.)

CISCO akademie II, V, (Ing. Milan Šimek, Ph.D.)

CISCO akademie III, (Ing. Jan Jeřábek, Ph.D.)

CISCO akademie IV, (doc. Ing. Radim Burget, Ph.D.)

Číslicové filtry (Ing. Petr Sysel, Ph.D.)

Číslicové zpracování signálů (doc. Ing. Jiří Mišurec, CSc.)

Datová komunikace (Ing. Pavel Šilhavý, Ph.D.)

Elektroakustika (Ing. Jiří Schimmel, Ph.D.)

Hardware počítačových sítí (doc. Ing. Jaroslav Koton, Ph.D.)

Komunikační technologie (Ing. Jan Jeřábek, Ph.D.)

Konstrukce elektronických zařízení (prof. Ing. Kamil Vrba, CSc.)

Objektově orientované programování (doc. Ing. Ivo Lattenberg, Ph.D.)

Multimediální služby (Ing. Petr Číka, Ph.D.)

Počítače a programování 1 (doc. Ing. Ivo Lattenberg, Ph.D.)

Počítače a programování 2 (Ing. Jiří Přinosil, Ph.D.)

Praktikum z informačních sítí (Ing. Petr Číka, Ph.D.)

Přenosová média (prof. Ing. Miloslav Filka, CSc.)

Přístupové a transportní sítě (doc. Ing. Vladislav Škorpil, CSc.)

Síťové operační systémy (doc. Ing. Dan Komosný, Ph.D.)

Studiová a hudební elektronika (Ing. Jiří Schimmel, Ph.D.)

Zabezpečovací systémy (doc. Ing. Karel Burda, CSc.)

Vysokorychlostní komunikační systémy (doc. Ing. Vladislav Škorpil, CSc.)

Základy kryptografie (Ing. Jan Hajný, Ph.D.)

Základy počítačové sazby a grafiky (Mgr. Pavel Rajmic, Ph.D.)

## Bachelor Degree Programme Audio Engineering

Analogová technika (prof. Ing. Kamil Vrba, CSc.)

Analýza signálů a soustav (prof. Ing. Zdeněk Smékal, CSc.)

Audio technika v angličtině (prof. Ing. Zdeněk Smékal, CSc.)

Číslicové zpracování signálů (doc. Ing. Jiří Mišurec, CSc.)

Dějiny hudby 20. stol. (prof. PhDr. Miloš Schnierer, JAMU)

Dějiny jazzu (MgA. Jan Dalecký, JAMU)

Dějiny populární hudby (prof. PhDr. Miloš Schnierer, JAMU)

Elektroakustika (Ing. Jiří Schimmel, Ph.D.)

Hudba v nových médiích (Mgr. Martin Flašar, Ph.D., JAMU)

Hudební režie (MgA. Petr Řezníček)

Hudební teorie (MgA. Edgar Mojdl, JAMU)

Hudební teorie v angličtině (prof. Ing. Zdeněk Smékal, CSc.)

Interaktivní technologie (MgA. Tomáš Hrůza, FaVU)

Konstrukce elektronických zařízení (prof. Ing. Kamil Vrba, CSc.)

Kurz klasické a počítačové notografie (MgA. Edgar Mojdl, JAMU)

Návrh a konstrukce zvukové techniky (doc. Ing. Jiří Mišurec, CSc.)

Počítače a programování 1 (doc. Ing. Ivo Lattenberg, Ph.D.)

Počítače a programování 2 (Ing. Jiří Přinosil, Ph.D.)

Objektově orientované programování (doc. Ing. Ivo Lattenberg, Ph.D.)

Praktikum z informačních sítí (Ing. Petr Číka, Ph.D.)

Rozbor skladeb (doc. MgA. Jaroslav Šťastný, Ph.D., JAMU)

Studiová a hudební elektronika (Ing. Jiří Schimmel, Ph.D.)

Studiová praxe (MgA. Jaroslav Zouhar, JAMU)

Tvorba umělého zvuku, jeho zpracování a řízení (Ing. MgA. Mgr. Dan Dlouhý, Ph.D., JAMU)

Úvod do hry na bicí nástroje (Ing. MgA. Mgr. Dan Dlouhý, Ph.D., JAMU)

Vybavení elektroakustického studia (MgA. Mgr. Ondřej Jirásek, Ph.D., JAMU)

Základy hudební akustiky (RNDr. Lubor Přikryl, JAMU)

Základy instrumentace (MgA. Edgar Mojdl, JAMU)

Základy počítačové sazby a grafiky (Mgr. Pavel Rajmic, Ph.D.)

Zvukové aspekty interpretace (MgA. Mgr. Ondřej Jirásek, Ph.D., JAMU)

## Master Degree Programme Telecommunication and Information Technology

Bezpečnost informačních systémů (doc. Ing. Karel Burda, CSc.)

CISCO akademie I, (doc. Ing. Dan Komosný, Ph.D.)

CISCO akademie II, V, (Ing. Milan Šimek, Ph.D.)

CISCO akademie III, (Ing. Jan Jeřábek, Ph.D.)

CISCO akademie IV, (doc. Ing. Radim Burget, Ph.D.)

Číslicové zpracování akustických signálů (Ing. Miroslav Balík, Ph.D.)

Číslicové zpracování signálů (prof. Ing. Zdeněk Smékal, CSc.)

Moderní počítačová grafika (Mgr. Pavel Rajmic, Ph.D.)

Komunikační prostředky mobilních sítí (doc. Ing. Vít Novotný, Ph.D.)

Kryptografie v informatice (doc. Ing. Václav Zeman, Ph.D.)

Moderní síťové technologie (Ing. Jaroslav Koton, Ph.D.)

Multimédia (Ing. Petr Číka, Ph.D.)

Návrh, správa a bezpečnost počítačových sítí (doc. Ing. Karel Burda, CSc.)

Optické sítě (prof. Ing. Miloslav Filka, CSc.)

Počítače a jejich periferie (Ing. Miroslav Balík, Ph.D.)

Počítačem podporovaná řešení inženýrských problémů (doc. Ing. Jiří Mišurec, CSc.)

Pokročilé komunikační techniky (Ing. Jan Jeřábek, Ph.D.)

Pokročilé techniky zpracování obrazu (doc. Ing. Kamil Říha, Ph.D.)

Bezdrátové senzorové sítě (Ing. Milan Šimek, Ph.D.)

Signálové procesory (Ing. Petr Sysel, Ph.D.)

Služby telekomunikačních sítí (doc. Ing. Vladislav Škorpil, CSc.)

Teoretická informatika (doc. Ing. Radim Burget, Ph.D.)

Teorie sdělování (Ing. Radim Číž, Ph.D.)

Vyšší techniky datových přenosů (doc. Ing. Václav Zeman, Ph.D.)

Vzájemný převod A/D signálů (prof. Ing. Kamil Vrba, CSc.)

Zabezpečovací systémy (doc. Ing. Karel Burda, CSc.)

Zpracování řeči (prof. Ing. Zdeněk Smékal, CSc.)

Telekomunikační a informační systémy (Ing. Pavel Šilhavý, Ph.D.)

## Doctoral Degree Programme

Aplikovaná kryptografie (doc. Ing. Karel Burda, CSc.)

Moderní síťové technologie (doc. Ing. Vít Novotný, Ph.D.)

## Laboratories

**Laboratory of Circuit Technology (**research of analogue current-mode circuits, Kamil Vrba)

**Laboratory of Converged Networks** (research and instruction in modern data communication networks and services, 2G - 4G mobile telecommunication networks and systems for data network provision of voice and multimedia services, Vít Novotný, Pavel Šilhavý)

**Laboratory of Digital Music Studio** (instruction and research in real-time multichannel audio signal processing on PCs and embedded systems, Jiří Schimmel)

**Laboratory of Electroacoustics and Studio Technology** (anechoic chamber, instruction and research in measurement of electroacoustic converters, identification and analysis of sound sources, space acoustics, analysis and synthesis of sound fields, Jiří Schimmel)

**Acoustic Laboratory** (research in sound effects, multichannel sound systems, 3D audio, conference audio systems, Jiří Schimmel)

**Laboratory of Network Technologies** (instruction in network technologies, research of switch and indicator management, analysis of stationary and wireless local computer networks operation, modelling of algorithms used in modern data networks, Jaroslav Koton)

**Laboratory of Multimedia Services** (research in design and multimedia communication services including multimedia data digital processing, Petr Číka)

**Laboratory of Data Transmission** (instruction in data communication and research in data transmission, modulation methods and error-protection codes, esp. for xDSL and PLC systems, modelling of access network and end device characteristics, Pavel Šilhavý)

**Laboratory of Design Systems** (instruction of programming languages, modelling of communication systems, telecommunication networks and electronic circuits, research in modern communication technologies, design of electronic devices, Radim Číž)

**Laboratory of Sensor Networks and Signals** (instruction and research in sensor networks based on the IEEE 802.15.4 standard, analysis of Zigbee and 6lowPAN protocols, sensor units configuration, data transmission and wireless network management, microcontrollers Atmel AVR, Milan Šimek)

**Laboratory of Telecommunication Systems** (instruction in Telecommunication Systems, research of error-free transmission of messages, modelling of anti-error code systems, Václav Zeman)

**Laboratory of Analogue Circuits and Mutual Analogue-Digital Conversion** (instruction and research of analogue circuits and mutual analogue-digital converters, David Kubánek)

**Laboratory of Communication Systems** (instruction and research in access and transportation networks, transportation and connection systems, converged telecommunication and computer networks, high-speed systems and telecommunication network services, Vladislav Škorpil)

**Laboratory of Transmission Networks** (research in FPGA and high-rate multimedia data transmission up to 100 Gb/s, Vladislav Škorpil)

**Laboratory of Acoustic Signal Processing** (design, optimization and implementation of algorithms for speech and acoustic signal processing, optimization of algorithms for multi-core computing systems, instruction in Digital Acoustic Signal Processing, computers and their peripherals, Miroslav Balík)

**Laboratory of Multimedia Signals** (research and development of multimedia embedded devices with ARM, Harvard architecture and VLIW architecture digital signal processors, optimization of algorithms for real-time digital signal processing, instruction in Signal Processors, Digital Filters and Digital Signal Processing, Petr Sysel)

**Research and Instruction Laboratory of Safety Systems** (research and development of cryptographic methods for communication and information systems, research and development of electronic protection systems, Karel Burda)

**Telepresence Studio** (research and development in videoconferencing and telepresenting services, Petr Číka)

# Department of Theoretical and Experimental Electrical Engineering


## Doc. Ing. Pavel Fiala, Ph.D.

Head

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## Professors Emeriti

Prof. Ing. Libor Dědek, CSc.

## Professors

Prof. Ing. Karel Bartušek, DrSc.
Prof. Ing. Jarmila Dědková, CSc.
Prof. Ing. Pavel Fiala, Ph.D.
Prof. Ing. Eva Gescheidtová, CSc.
Prof. dr hab. inż. Jan Sikora

## Associate Professors

Doc. Ing. Petr Drexler, Ph.D.
Doc. Ing. Radek Kubásek, Ph.D.
Doc. Ing. Jiří Sedláček, CSc.
Doc. Ing. Miloslav Steinbauer, Ph.D.

## Lecturers

Ing. Tibor Bachorec, Ph.D., Mgr. Přemysl Dohnal, Ing. Martin Friedl, Ing. Michal Hadinec, Ph.D., Ing. Radim Kadlec, Ph.D., Ing. Tomáš Kříž, Ing. Petr Marcoň, Ph.D., Ing. Jan Mikulka, Ph.D., Ing. Zdeněk Roubal, Ing. Zoltán Szabó, Ph.D., Ing. Robert Urban, Ph.D.

## Ph.D. Students

Mouin Al Khaddour, Ing. Martin Čáp, Ing. Michal Hanzelka, MBA, Ing. Jiří Chytil, Ing. Radim Kořínek, Ing. Pavel Křepelka, Ing. Ksenia Ostanina, Ing. Michaela Pokludová, Ing. Martin Valla, Ing. Eliška Vlachová – Hutová

## Administrative and Technical Staff

Ing. Ivo Běhunek, Ph.D., Eva Cupáková, Alena Javůrková, doc. Ing. Petr Koňas, Ph.D., Ing. Taťána Krajčírovičová, Ing. Dušan Nešpor, Ph.D.

## Main Interests

The department provides instruction in all undergraduate and postgraduate programmes targeted at education in the major areas of electrical engineering through understanding of the basic principles of electrical engineering, safety issues, measurement of electrical and non-electrical characteristics with focus on special applications and modelling of electromagnetic fields. Bachelor, Master and Ph.D. theses deal with the current and long-term research interests of the department. Instruction is provided in up-to-date laboratories, computer laboratories and a re-

search laboratory for students' work on their diploma theses. Research is conducted in laboratories with top equipment for magnetic measurements, light technology and low-level measurements. There are laboratories of pulse sources and microwave devices and a laboratory of electrooptics and laser technology. In recent years the department' s research activities have been centred on wideband signal processing, noise spectroscopy and special applications of metamaterial structures for nuclear magnetic resonance and electron microscopy, processing of magnetic resonance and electrical tomography signals. Generally, research is centred on design of special measuring methods, signal processing and evaluation and is supported by grant projects and contract cooperation with the industrial sector.

The department is closely connected with the Institute of Experimental Technology established in 2008 and based on educational and research outcomes of the department's staff. The Institute offers an innovative approach to education, giving the students opportunities to participate in real industrial projects. The students work in teams including research workers, university and secondary school students. Every year the department organizes professional competitions, e.g. 'Microcontrollers are in'.

## Major Achievements

Basic research was focused on wideband signal processing, noise spectroscopy, special applications of metamaterial structures for NMR and electron microscopy. Applied research was focused on evaluation of NMR images.
In 2014 the department was awarded a patent - 'Cleaning of solidified towers by means of explosion technology for the detonation system designed to remove deposits of calcium chloride and other substances from the towers'. A patent application was submitted – 'Dynamic allocation and utilization of a radio frequency spectrum for a cognitive system of data transfer over a strong interference area via pulse sources'.
Cooperation continues in contract research with Thermo Sanace, s.r.o. on acoustic and optical methods for detection of wood destroying pests and methods for dendrochronological dating of construction wood. With TES, s.r.o. we work on detection and localization of partial charges in electric power converters with liquid dielectric.An outcome of our cooperation with TSE, s.r.o. was the design of infrared heater for newborn bed and its numerical simulation. The company ZEZ SILKO, s.r.o., cooperated in the design of pulse condenser, including the design of methods for measuring preparations. Another achievement was a numerical model for analysis of magnetic, thermal and mechanical deformation fields for innovation of the magnetic circuit of an actuator for IMI International, s.r.o. - Norgren CZ. A model of an induction flowmeter, including magnetic measurements in the laboratory of non-destructive defectoscopy was designed for Badger Meter Czech Republic, s.r.o. The department organized a course of theoretical electrical engineering for ABB, s.r.o.
The long-term cooperation programme with PROTOTYPA, a.s. dealt with research on special methods for measurement of single processes. The department continued research cooperation with Technische Universität Wien, and participated in the centres SIX and CVVOZE.

## Major Research Projects

**Devices for Neurocontrol and Neurorehabilitation DeNeCoR - 7H13014**

Co-investigators: Pavel Fiala, Martin Čáp

**Increasing the Potential of Human Resources for Research and Development in Electrical Engineering – MŠMT CZ.1.07/2.3.00/20.0175**

Investigator: Miloslav Steinbauer

**Study of Metabolism and Localization of Primary Brain Tumour by MR Imaging Techniques – GAČR 102/12/1104**
Investigator: Eva Gescheidtová

**Research of Electromagnetic Materials and Metamaterials Using Numerical and Imaging Methods – GAČR 13-09086S**

Investigator: Pavel Fiala

## Selected Publications

MUSIL, M.; PLÉHA, D.; KUNOVJÁNEK, M. Membranes for Alkaline Accumulators. *ECS Transactions.* 2014. 48(1). p. 319 - 323. ISSN 1938-5862.

FIALA, P.; NEŠPOR, D.; DREXLER, P. Principal tests and verification of a resonance-based solar harvester utilizing micro/nano technology. *Microsystem Technologies.* 2014. 20(4-5). p. 845 - 860. ISSN 0946-7076. (IF(2013)=0,952).

KŘEPELKA, P.; PEREZ-RODRIGUEZ, F.; BARTUŠEK, K. BACTERIAL PATTERN IDENTIFICATION IN NEAR-INFRARED SPECTRUM. *Informatyka, Automatyka, Pomiary w Gospodarce i Ochronie Środowiska.* 2014. 2014(3). p. 58 - 60. ISSN 2083-0157.

CHYTIL, J. Practical realizaton of Ideal Diode Full-wave Rectifer. *Informatyka, Automatyka, Pomiary w Gospodarce i Ochronie Środowiska.* 2014. 2014(4). p. 81 - 84. ISSN 2083-0157.

BARTUŠEK, K.; NEŠPOR, D.; DOKOUPIL, Z. Comparing Saddle, Slotted-tube and Parallel-plate Coils for Magnetic Resonance Imaging. *Measurement Science Review.* 2014. 14(1). p. 171 - 176. ISSN 1335-8871. (IF(2013)=1,162).

## Bachelor Degree Programme

Bezpečná elektrotechnika (Ing. Radim Kadlec, Ph.D.)

Elektrotechnický seminář (doc. Ing. Miloslav Steinbauer, Ph.D.)

Elektrotechnika (doc. Ing. Steinbauer Miloslav, Ph.D.)

Elektrotechnika 1 (doc. Ing. Jiří Sedláček, CSc.)

Elektrotechnika 2 (doc. Ing. Jiří Sedláček, CSc.)

Elektrotechnika pro audioinženýrství (doc. Ing. Petr Drexler, Ph.D.)

Měření v elektrotechnice (BMVA - prof. Ing. Karel Bartušek, DrSc., HMVA – Ing. Jan Mikulka, Ph.D.)

Měření v elektrotechnice pro audio inženýrství (prof. Ing. Karel Bartušek, DrSc.)

Seminář C++ (prof. Ing. Pavel Fiala, Ph.D.)

Počítačové modelování elektrotechnických zařízení a komponentů (prof. Ing. Pavel Fiala, PhD.)

Vybrané partie základů elektrotechniky v angličtině (Ing. Petr Marcoň, Ph.D.)

## Master Degree Programme

Bezpečná elektrotechnika (Ing. Radim Kadlec, Ph.D.)

Bezpečnost zařízení (doc. Ing. Miloslav Steinbauer, Ph.D.)

Elektrické instalace (Ing. Radim Kadlec, Ph.D.)

Modelování elektromagnetických polí (prof. Ing. Jarmila Dědková, CSc.)

## Doctoral Degree Programme

Numerické úlohy s parciálními diferenciálními rovnicemi (prof. Ing. Pavel Fiala, Ph.D.)

Speciální měřicí metody (prof. Ing. Karel Bartušek, DrSc.)

## Laboratories

**Laboratory of Electrical Measurements** (instruction in Measurements in Electrical Engineering, Zoltán Szabó)

**Laboratory of Electrical Engineering** (instruction in Electrical Engineering 1 and 2, Martin Friedl)

**Laboratory of Electrical Engineering and Electrical Installations** (Electrical Engineering Seminar, Electrical Installations, Radim Kadlec)

**IET Laboratory** (instruction laboratory, Miloslav Steinbauer)

**Computer Laboratory of Electrical Engineering** (instruction in Electrical Engineering 1 and 2, Miloslav Steinbauer)

**Computer Laboratory** (Electrical Engineering Seminar, Computers and Programming 2, Electromagnetic Field Modelling, Seminar C++, Miloslav Steinbauer)

**Seminar Laboratory** (Miloslav Steinbauer)

**Research Laboratory of Magnetic Measurement** (research laboratory of magnetic measurement, Zdeněk Roubal)

**Research Laboratory of Light Technology** (measurement of the parameters of light sources, Zdeněk Roubal)

**Restricted Access Laboratory** (basic and applied research of numerical methods, Pavel Fiala)

**Laboratory of Low-Level Measurement** (Zdeněk Roubal)

**Research Laboratory for Student Theses** (research laboratory for students, Martin Friedl)

**Research Laboratory of Printed Circuit Boards** (development of printed circuit boards, Zoltán Szabó)

**Research Laboratory for Prototype Development** (research laboratory for doctoral students, Martin Friedl)

**Research Laboratory of Pulse Sources and Microwave Devices** (basic research of pulse sources, low-noise measurements, shielded laboratory, semi-anechoic laboratory, Pavel Fiala)

**Research Laboratory of Electro-Optics and Laser Technology** (optoelectronic measuring methods, Petr Drexler)

# Department of Power Electrical and Electronic Engineering


## Ing. Ondřej Vítek, Ph.D.

Head

Technická 3082/12
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## Professors

Prof. RNDr. Vladimír Aubrecht, CSc.
Prof. Ing. Vítězslav Hájek, CSc.
Prof. Ing. Jiří Skalický, CSc.

## Associate Professors

Doc. Ing. Bohuslav Bušov, CSc.
Doc. Ing. Bohumil Klíma, Ph.D.
Doc. Ing. Čestmír Ondrůšek, CSc.
Doc. Dr. Ing. Miroslav Patočka,
Doc. Ing. František Veselka, CSc.
Doc. Ing. Pavel Vorel, Ph.D.

## Lecturers

Ing. Radoslav Cipín, Ph.D., Ing. Dalibor Červinka, Ph.D., Ing. Petr Dohnal, Ph.D., Ing. Petr Huták, Ph.D., Ing. Marcel Janda, Ph.D., Mgr. Petr Kloc, Ph.D., Ing. Ivo Pazdera, Ph.D. Ing. Petr Procházka, Ph.D., Ing. Jiří Valenta, Ph.D., Ing. Ondřej Vítek, Ph.D.

## Ph.D. Students

Ing. Jan Bárta, Ing. Radim Běloušek, Ing. Jan Bulín, Ing. Lukáš Dostál, Ing. Petr Chorovský, Ing. Petr Fajkus, Ing. Rostislav Huzlík, Ielyzaveta Ishkova, Ing. Josef Kadlec, Ing. Jiří Klíma, Ing. Jan Knobloch, Ing. Pavel Koníček, Ing. Martin Mach, Ing. Zbyněk Makki, Ing. Jan Martiš, Ing. Aleš Mikulčík, Ing. Lukáš Mišinger, Ing. Tomáš Nevřivý, Ziad Nouman, Ing. Jan Pígl, Ing. Martin Prudík, Mousa Sattouf, Ing. Petr Španěl, Ing. Adam Vašíček, Ing. Vojtěch Vetiška, Ing. Eva Vítková, BA., Ing. Mgr. Elena Zotova

## Administrative and Technical Staff

Ing. Zdeněk Feiler, Ph.D., Zdeněk Liška, Josef Němec, Alena Šmídková

## Main Interests

The department provides instruction in the study area Power Electrical and Electronic Engineering in the Bachelor and Ph.D. programmes and in the study areas Power Electrical Engineering and Power Electronics in the Master degree programme. Instruction is focused on the theory and construction of electrical machines and devices, CAD systems including solutions for electromagnetic and thermal fields and optimization methods for construction designs. The design, size, control and dynamics of electromechanical systems are the subject of instruction in electrical drives. Another area of interest is power electronics including DC/DC pulse converters (switching sources), DC/AC alternators, rectifiers etc. Attention is paid to the theory of regulation and digital control.

In basic research, the department deals with theoretical modelling of radiation energy transport

in thermal plasma. In applied research, electrical machines, power electronics, electrical drives and devices are in the focus of interest. Research is centered on low-voltage machines used in automotive industry, synchronous machines with permanent magnets, asynchronous and DC machines. The department staff are experienced in development of special machines such as starter generators, controlled magnetic bearings and levitation systems. Activities centered on power exploitation for electric arc extinction in low- and high-voltage devices. Research was also focused on power converters of extreme parameters, optimal regulation of electrical drives aimed at loss minimization in traction drives, implementation of ultracapacitors, accumulators and fuel cells in the system of traction drives.

The department cooperates with a number of universities, e.g., SPGU St Petersburg, TU Pskov, TU Omsk, TU Gliwice, TU Delft, TU Žilina, MU Brno, and industrial companies and institutions, e.g. JSC Electrocontact (Kineshma-RF), Siemens Elektromotory Drásov, OEZ Letohrad, APS Světlá nad Sázavou, ATAS Náchod, EMP Slavkov u Brna, JULI Motorenwerk Moravany, VUES Brno a.s., IVEP Brno, ŠLP Křtiny a.s. etc.

## Major Achievements

The department was awarded a patent on precision current transformers.

On 20 August 2014 the first flight of the BUT airplane VUT 051 RAY driven by accumulators took place. The airplane was developed in cooperation of our department and the Institute of Aerospace Engineering of the Faculty of Mechanical Engineering. In cooperation with ŠLP Křtiny of Mendel University Brno we developed and tested the unified control system for forest cableways Larix.

The compact drive kit developed in the framework of project TA01011060 received the Golden Amper Award at the exhibition Amper 2014.

## Major Research Projects

**Redesign of High-Voltage High-Power Synchronous Generators – FR-TI3/457**

Investigator: Čestmír Ondrůšek

**Innovation of Forest Cableways Larix – TA02021320**

Investigator: Bohumil Klíma

**Research and Development of Lightweight Vehicles Compact Power Axes with an Integrated Electric Drive – TA01011060**

Investigator: Pavel Vorel

**Research and Development of an Insulation System of Small Electric Machines - FR-TI4/104**

Investigator: Vítězslav Hájek

**Synchronous Motors with Fractional Slot Winding for Use in Lift Trucks - FR-TI4/675**

Investigator: Vítězslav Hájek

## Selected Publications

ČERVINKA, D.; VOREL, P. Impact of Fast-Chargers for Traction Batteries on Distribution Network. *ECS Transaction.* 2014. 48(1). p. 223 - 230. ISSN 1938-6737.

KUZDAS, J.; VOREL, P. Parasitic Effects in Power Circuits of High Power Battery Chargers. *ECS Transaction.* 2014. 48(1). p. 231 - 236. ISSN 1938-6737.

VOREL, P.; ČERVINKA, D. High-Power Charger for SUPER-EL Electric Passenger Car. *ECS Transaction.* 2014. 48(1). p. 237 - 244. ISSN 1938-6737.

HADAŠ, Z.; VETIŠKA, V.; HUZLÍK, R.; SINGULE, V. Model-based design and test of vibration energy harvester for aircraft application. *Microsystem Technologies.* 2014. 20(4-5). p. 841 - 853. ISSN 0946-7076. (IF(2013)=0,952).

CIPÍN, R.; KADLEC, J.; HUTÁK, P.; KLÍMA, B. Battery System for the Airplane VUT 051 RAY. *ECS Transaction.* 2014. 48(1). p. 217 - 222. ISSN 1938-6737.

VESELKA, F.; VRABEC, V. První série ručního nářadí s inovovaným kluzným kontaktem. *Electro.* 2014. 2014(1). p. 44 - 46. ISSN 1210-0889.

PROCHÁZKA, P.; PAZDERA, I.; BENCALÍK, K. Usage of the Fuel Cell-Powered Electric Drive in Aviation. *ECS Transactions.* 2014. 48(1). p. 207 - 214. ISSN 1938-5862.

KAZKAZ, M.; SATTOUF, M. Effects of Air Temperature, Mean Radiant Temperature and Air Velocity On The Globe Temperature and Operative Temperature. *international journal of energy and environment.* 2014. 2014(8). p. 74 - 79. ISSN 2308-1007.

VESELKA, F. Zlepšení provozních vlastností stejnosměrného motoru V160L 64. *Elektrotechnika v praxi.* 2014. 2014(7-8). p. 6 - 11. ISSN 0862-9730.

VESELKA, F. Posouzení komutačních schopností kartáče nové konstrukce. *Elektrotechnika v praxi.* 2014. 2014(9-10). p. 28 - 35. ISSN 0862-9730.

JENIŠTA, J.; TAKANA, H.; NISHIYAMA, H.; KŘENEK, P.; BARTLOVÁ, M.; AUBRECHT, V. Quasi-laminar flow characteristics in hybrid-stabilized argon-water arc discharge for subsonic-supersonic regimes. *IEEE Transactions on Plasma Science.* 2014. 42(10). p. 2632 - 2633. ISSN 0093-3813. (IF(2013)=0,95).

BOGATYREVA, N.; BARTLOVÁ, M.; AUBRECHT, V.; HOLCMAN, V. P1-approximation for radiative transfer: application to SF6 + Cu arc plasmas. *CENTRAL EUROPEAN JOURNAL OF CHEMISTRY.* 2014. 2015 (13)(1). p. 502 - 508. ISSN 1895-1066. (IF(2013)=1,329).

MIŠINGER, L.; VESELKA, F. Improvement of operating characteristics in slidingcontact with Teflon added material. *ElectroScope - http://www.electroscope.zcu.cz.* 2014. 8(1). p. 1 - 5. ISSN 1802-4564.

## Bachelor Degree Programme

Informatika v silnoproudé elektrotechnice (Ing. Marcel Janda, Ph.D.)

Výkonová elektronika (doc. Dr. Ing. Miroslav Patočka)

Elektrické přístroje (doc. Ing. Bohuslav Bušov, CSc.)

Elektrické stroje (doc. Ing. Čestmír Ondrůšek, CSc.)

Teorie řízení (Ing. Petr Huták, Ph.D.)

Elektrické pohony (Ing. Dalibor Červinka, Ph.D.)

Automobilová elektrotechnika (prof. Ing. Vítězslav Hájek, CSc.)

Řídicí elektronika (doc. Dr. Ing. Miroslav Patočka)

Elektrické stroje 2 (Ing. Ondřej Vítek, Ph.D.)

Inspekční a revizní činnost (doc. Ing. František Veselka, CSc.)

Mikroprocesorová technika v pohonech (doc. Ing. Bohumil Klíma, Ph.D.)

Počítačová podpora konstruování (Ing. Marcel Janda, Ph.D.)

## Master Degree Programme

Dynamika elektromechanických soustav (doc. Ing. Čestmír Ondrůšek, CSc.)

Technika výkonových měničů (doc. Dr. Ing. Miroslav Patočka)

Počítačové modelování v silnoproudé elektrotechnice (Ing. Marcel Janda, Ph.D.)

Řízení dynamických soustav (Ing. Petr Huták, Ph.D.)

Laboratoře elektrických strojů a přístrojů (Ing. Marcel Janda, Ph.D.)

Průmyslová elektronika (doc. Ing. Pavel Vorel, Ph.D.)

Střídavé pohony (doc. Ing. Bohumil Klíma, Ph.D.)

Elektrické mikropohony (Ing. Ondřej Vítek, Ph.D.)

Elektrické regulované pohony (prof. Ing. Jiří Skalický, CSc.)

Navrhování výkonových měničů (doc. Dr. Ing. Miroslav Patočka)

Laboratoř elektrických pohonů (Ing. Dalibor Červinka, Ph.D.)

Adaptivní a optimální řízení pohonů (prof. Ing. Jiří Skalický, CSc.)

Diagnostika a jištění elektrických zařízení (Ing. Jiří Valenta, Ph.D.)

Projektové řízení inovací (doc. Ing. Bohuslav Bušov, CSc.)

Řídicí členy v elektrických pohonech (doc. Ing. Pavel Vorel, Ph.D.)

Stavba a výroba elektrických přístrojů (doc. Ing. Bohuslav Bušov, CSc.)

Mikropočítačové řízení elektrických pohonů (doc. Ing. Bohumil Klíma, Ph.D.)

## Doctoral Degree Programme

Vybrané statě z elektrických strojů a přístrojů (doc. Ing. Čestmír Ondrůšek, CSc.)

Vybrané statě z výkonové elektroniky a elektrických pohonů (prof. Ing. Jiří Skalický, CSc.)

## Laboratories

**Laboratory of Electrical Machines** (research on commutation of electrical machines, measurement of medium-power output, magnetic bearings, automated measurements, Ondřej Vítek)

**Laboratory of Mechatronics** (Ondřej Vítek)

**Laboratory of Electrical Machines** (switching devices, Bohuslav Bušov)

**Laboratory of Holographic Interferometry** (optical stand for holographic interferometry, e.g. diagnostics of rotating machine vibrations, Marcel Janda)

**Laboratory of Electrical Drives** (electrical drives with focus on independent traction, Dalibor Červinka)

**Laboratory of Power Electronics** (research in pulse converters of different outputs, Petr Procházka)

**Laboratory of High-Current Electronics** (research on DC/DC converters, alternators and low-voltage brushless drives, Dalibor Červinka)

**Laboratory of Dynamic Properties of Electrical Machines** (experimental analysis of transient performances in electrical machines, Ondřej Vítek)

**Laboratory of Control Electronics** (Pavel Vorel)

**Laboratory of Microprocessor Technology** (Bohumil Klíma)

**Laboratory of Microelectromechanical Systems** (Rostislav Huzlík)

**Laboratory of Power Electronics 2** (Pavel Vorel)

**Research and Development Laboratory** (Petr Procházka)