English topics for the doctoral program "Electrical Engineering and Information Technology" for the academic year 2023/24				
No.	**Supervisor**	**Topic**	**Annotation**	**depart.**
1	doc. Ing. Tomáš Blecha, Ph.D.	**Advanced electronic components and systems for high frequency applications**	The topic is focused on the issue of electronic components, elements, and systems realized by advanced technologies and materials with respect to their high-frequency properties. The research will also focus on carbon allotropes (carbon nanotubes, graphene) and their use for electronic elements and sensors. Research in this area may have an overlap in printed electronic components, smart applications, the Internet of Things and Services (IoT and IoS).	KET
2	doc. Ing. Tomáš Blecha, Ph.D. / assistant supervisor doc. Ing. Josef Pihera, Ph.D.; Ing. Petr Kašpar, Ph.D.	**Internet of Things and special sensors for diagnostics of HV systems and equipment**	The topic is focused on the diagnostics of high voltage systems and devices using IoT. It is assumed to use special sensors for sensing the appropriate variables necessary to determine the condition of the monitored device. Individual sensors or sensor systems will be designed for IoT compatibility, which also ensures long-term monitoring of the monitored system and on-line transmission of measured data. Emphasis will be placed on diagnostics of insulation systems operating in AC or DC power systems. The topic will also cover the analysis and evaluation of data obtained with respect to the life of the monitored equipment.	KET
3	Ing. Petr Burian, Ph.D.	**Hardware acceleration of data processing in domain of pixel particle detectors**	Pixel particles detectors (of ionizing radiation) are used in wide scope of domains – physics experiments, material research or medical imaging methods. However, in recent years we have been facing challenges with increasing amount of produced data by these detectors. Purely software processing becomes demanding, hence a hardware acceleration of evaluating algorithms could be good solution in this domain. The focal point of this PhD topic should be analyses of methods and algorithms using for an evaluation of pixel particles detectors and search of approaches for their suitable implementation by the hardware (mainly in FPGA device or GPUs). This implementation can build powerful triggering system that can be able to distinguish useful and useless data and make physics experiments more efficient. Student's active involvement in the scientific community and his participation in experiments on particle accelerators (CERN, DESY, LANSCE - Los Alamos) is assumed.	KEI
4	Ing. Petr Burian, Ph.D.	**Generic platform for pixel detector readout systems working in harsh radiation environment**	The main of this PhD topic is design of generic pixel detector readout system able to work in an area with higher level of a radiation. Such system could become the solution for data acquisition in large experimental facilities (for instance LHC, SPS at CERN). There are also needs for data processing with high transfer rate (in the order of tens of Gbps) and integration into existing measuring chains.	KEI
5	doc. Ing. Pavel Drábek, Ph.D.	**Application of modern semiconductor devices**	New topologies of power electronic converters using of modern semiconductor devices based on the Silicon Carbide and Galium Nitrid (WBG). Design of new control circuits and control algorithms. The use of modern WBG components offers a significant reduction in conductivity losses and especially switching losses, which allows the design of inverters with a very high power density, currently about 100kW / l. The trend of power converters with high power density is currently used significantly in electrical mobile devices (cars, aircraft, traction, etc.). The use of modern WBG components brings new problems in the field of EMC interference and it is necessary to address these aspects in the design of inverters.	KEV
6	doc. Ing. Pavel Drábek, Ph.D.	**Modern power engineering networks (e.g. SMART GRIDs)**	Research and design of new concepts of infrastructure and electrical equipment of modern electrical networks (so-called SMART GRIDs). These are the equipment of modern transport systems, including electrical equipment of substations, power and charging stations with regard to integration and connection to modern electricity networks, especially with the requirement for energy recuperation, symmetrization of distribution system and the possibility of parallel cooperation of multiple sources (vision of the so-called endless over-head line).	KEV
7	doc. Dr. Ing Vjaceslav Georgiev / assistant supervisor Ing. Jan Zich Ph.D. MBA	**Circuits with high time granularity and its setting for use in nuclear instrumentation**	The aim of this work is to compile a comprehensive overview of methods and circuit solutions enabling the design and construction of tunable circuits in the picosecond and subpicosecond spectrum. Potentially suitable methods will be experimentally verified and evaluated in the form of specific circuit solutions. The work will also include the application of selected types of circuits in high-energy physical experiments taking place on accelerator particles. The expected outputs can include, for example, the construction of advanced coincidence or synchronization circuits.	KEI
8	doc. Dr. Ing Vjaceslav Georgiev	**Fast Time Multiplex for data processing of more detector outputs as pixelated PMT by one fast AD converter**	A date processing from detestor systems with very fine time resolution and lower hit range of arbitrary events. The data processing should be done i a fast logic especially in FPGAs. Main usage for High Energy Physics.	KEI
9	doc. Ing. Tomáš Glasberger, Ph.D.	**Control of multiphase power semiconductor converters**	The thesis deals with research of suitable topologies and control of multiphase power electronics converters. The algorithms will be designed and optimized by selected criteria, e.g. quality of output quantities, influence on the load, losses in the circuit, fault tolerant operation. The algorithms will be based particularly on PWM methods, model predictive control or other optimal control methods.	KEV
10	doc. Ing. Tomáš Glasberger, Ph.D.	**Control of multilevel power semiconductor converters**	The thesis deals with research of new topologies and control of medium-voltage power electronics converters. The topologies and the algorithms respectively will be designed and optimized by selected criteria, e.g. distortion of output quantities, influence on the grid or load, losses in the circuit topologies with utilization of deterministic and stochastic method, genetic algorithms etc.	KEV
11	prof. Ing. Aleš Hamáček, Ph.D. / assistant supervisor Ing. Silvan Pretl, Ph.D.	**Elastic and structural electronics based on additive technology**	The topic is focused on research in the field of new technological and material approaches to the realization of electronic systems with unique functional properties. In particular, elements and systems exhibiting mechanical flexibility and stretchability for applications in wearable electronics, interactive communication and control interfaces (HMIs) and structural elements with directly integrated electronic functions will be the subject of research. Specifically, the use of new types of functional materials applied by 2D and 3D additive manufacturing techniques in hybrid electronic systems will be addressed.	KET

English topics for the doctoral program "Electrical Engineering and Information Technology" for the academic year 2023/24				
No.	**Supervisor**	**Topic**	**Annotation**	**depart.**
12	doc. Ing. Karel Hruška, Ph.D. / assistant supervisor Ing. Jan Laksar, Ph.D.	**Advanced Electrical Machines with Exceptionally Variable Parameters**	The electrical machines with high power density have, due to their high electromagnetic usage, exceptionally variable equivalent circuit parameters on load of the machine. The target of this work is development of tools for the purpose of analysis of the magnetic circuit of the machine for variable load and calculation of equivalent circuit parameters. The verification of developed tool will be performed using finite element method and through measurement of several machines.	KEV
13	prof. Ing. Pavel Karban, Ph.D. / assistant supervisor Ing. Petr Kropík, Ph.D.	**Neural network accelerators for microcontrollers**	The topic aims to use neural network accelerators on a microcontroller platform for machine learning applications and data recognition from various types of physical sensors. The research will focus on using high-level programming languages for microcontrollers, the principles of edge computing, and offline programming to achieve a reliable deployment of the machine learning model on the microcontroller. The aim of these procedures will be the immediate interpretation of the data obtained by the sensors and the minimization of latency and reduction of the load on the transmission path to the Internet. The use of high-level languages will be the basis for the abstraction of the computational part from a specific type of hardware and ensuring the robustness, stability, and portability of the developed solutions.	KEP
14	prof. Ing. Pavel Karban, Ph.D.	**Numerical models of physical systems based on surrogate schemes**	Research will be focused on the use of surrogate models such as kriging, random trees or neural networks in advanced design of electrical equipment. The aim of this work is to replace a generally complex and computationally demanding model with a simplified, but still sufficiently accurate, surrogate model. The obtained results will be experimentally verified on a suitable application.	KEP
15	doc. Ing. Vladimír Kindl, Ph.D.	**Wireless power transfer**	The dissertation will deal with the electromagnetic design of coupling elements for wireless power transmission systems and the analysis of suitable compensation topologies. The attention will also be paid to the design of electromagnetic shielding and maximizing transmission efficiency.	KEV
16	doc. Ing. Tomáš Komrska, Ph.D.	**Multiphase Systems for Electric Drives in Transportation**	The aim of the project is research and development of new electric drive systems in transportation using multiphase electric motors and multiphase power semiconductor converters. Research will focus on increasing power density, torque and efficiency. The use of these technologies is expected in personal electric or hybrid vehicles, in public transport, in shipping or aviation.	KEV
17	doc. Ing. Tomáš Komrska, Ph.D.	**Advanced Pulse Width Modulation Techniques for Control of Power Converters**	The aim of the project is research and development of advanced pulse width modulation techniques for the control of power converters, optimally exploiting the degrees of freedom of the system. The research will focus mainly on techniques for achieving the maximum output voltage at the minimum dc voltage of the inverter. The use of these technologies is expected mainly in multiphase and multilevel converters for transportation and power systems.	KEV
18	doc. Ing. Tomáš Komrska, Ph.D.	**Traction Power Converters for Vehicles with Increased Traction Battery Voltage**	The increased voltage of traction batteries (almost 1 kV) in modern electric and hybrid vehicles deteriorates switching losses and electric motor losses. The aim of the project is research and development of power traction converters for electric and hybrid passenger vehicles, minimizing the effects of increased traction battery voltage and enabling increased efficiency of electric drive.	KEV
19	doc. Ing. Tomáš Komrska, Ph.D.	**Control of Power Converters for Earth Fault Compensation in Medium-Voltage Distribution Power Grids**	The aim of the project is to find optimal control algorithms for active earth fault compensation systems in medium-voltage distribution power grids, where the compensation current or part of it is generated by a power converter. The main attention will be paid to minimization of the residual current of the fault.	KEV
20	doc. Ing. Tomáš Komrska, Ph.D.	**Application of machine learning in power electronics and electric drives**	The goal of the project is research and application of machine learning algorithms in the field of power electronics and electric drives. The main attention will be paid to the area of identification and control.	KEV
21	doc. Ing. Václav Kotlan, Ph.D	**Advanced numerical techniques for automatic calibration and design of computer models**	The aim of the work is to observe new in the use of advanced numerical techniques such as surrogate models or neural networks and optimization with the aim of use in the design phase of the model and its automatic calibration based on verification.	KEP
22	doc. Ing. Václav Kotlan, Ph.D	**Using advanced numerical techniques in the process of identifying material characteristics)**	The aim of this work is to develop a methodology for identifying missing or incorrect material characteristics of metallic materials. It includes the involvement of advanced techniques such as optimization tools, physical descriptions of state changes and model calibration.	KEP
23	Ing. Zdeněk Kubík, Ph.D.	**Modelling and simulation in electromagnetic compatibility**	The topic is focused on numerical methods and their applications for solving of problems in the electromagnetic compatibility. Expected problems: parasitic electromagnetic coupling, grounding, filtering, shielding, circuit and construction topology.	KEI
24	Ing. František Mach, Ph.D.	**Magnetically guided robots and machines**	Proof-of-concept research will aim at the magnetic field interaction with composite elastic materials. From the theoretical point of view, the research will be lead towards the production processes of magnetic elastomers and their characterization concerning mechanical properties. The obtained results will be used for the development of electromechanical systems in applications in robotics and automation.	KEP
25	doc. Ing. David Pánek, Ph.D.	**Design of electromechanical systems for production using 3D printing technology**	The aim of the work is to research the possibilities of using the potential of 3D printing of metal materials to optimize the properties of electromechanical systems. The work will include research into the material properties of printed materials (creation of anisotropy, simultaneous printing of multiple materials), especially with regard to the conduction of electric current and magnetic flux.	KEP
26	doc. Ing. David Pánek, Ph.D.	**Estimation and modeling of material properties**	The work will be aimed at modeling material properties using stochastic processes on the basis of experimental data. The goal is to include these models into analysis using the Finite Element Method so that the result also contains information about uncertainties in material parameters.	KEP

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No.	**Supervisor**	**Topic**	**Annotation**	**depart.**
27	doc. Ing. Roman Pechánek, Ph.D.	**Improved design approaches for modern electrical machines including additive manufacturing possibilities with an emphasis on the economy of design**	The main point of this research should be the development of improved design approaches to design more ecology and economy-friendly machines. Currently, machines are developed for specific application piece by piece, focusing on modular and scalable designs, design and manufacturing costs can be reduced. The usage of additive manufacturing and prototyping allows for production-optimized topologies. And focusing on modern machines without expensive rare earth magnets is a way of producing cheaper and greener electrical propulsion systems.	KEV
28	doc. Ing. Roman Pechánek, Ph.D.	**Digital Twins in Industry and modern Electrical Drives systems**	Industry 4.0 is leading to lowering costs due to decreasing human-related manufacturing problems and lower operating costs. The aim of this research is to develop Multiphysical mathematical models of electrical machines suitable for renewable energy sources, e-mobility and etc. Work will is mainly based on the modeling and testing of electrical machines, programming, and computing of Multiphysical models.	KEV
29	doc. Ing. Roman Pechánek, Ph.D.	**New cooling concept of high power density machines suitable for future smart green E-mobility**	The main focus of this research is to develop a new cooling system for high-power-density electrical machines. As a Spray cooling, High-temperature supra-conductivity, Liquid direct cooling systems, using phase changes of cooling method. Applicable in future electrical propulsion systems in avionics, Electric Mobility Decarbonization, and for more fault-tolerant machines. Another direction of the research could be high-speed electrical machines and related topics for example magnetic machine bearings, flywheels, etc.	KEV
30	prof. Ing. Zdeněk Peroutka, Ph.D.	**New Concepts of Drive Units for Electric Vehicles and Cars**	This project should discover new concepts of drive units for electric vehicles. The application of these technologies is expected predominantly in both public transportation vehicles (mainly in traction vehicles and e-buses) and new concepts of passenger cars and utility vehicles. This research will be significantly focused on the utilization of high-speed and multi-phase drives.	KEV
31	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing. Štěpán Janouš, Ph.D.	**Control of New Generation of Electric Vehicles Drives**	The aim of this project is to discover optimal control of new concepts of ac motor traction drives. The research will be focused on the optimal control theory, while the main attention is going to be paid to the predictive control strategies. The research will also find the solution for difficult traction-specific problems, such as traction drive stability, interaction of the drive with its environment, noise.	KEV
32	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor: doc. Ing. Jakub Talla, Ph.D.	**Models of Electric Drives and Their Utilization for Control and Fault Diagnostics**	The aim of this project is a formulation of new mathematical models of ac electrical machines and drives, identification of their parameters and their utilization for control and/or fault diagnostics.	KEV
33	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor doc. Ing. Václav Šmídl, Ph.D. et Ph.D.	**Smart Drives**	The aim of this project is definition of new class of electric drives and complex mechatronic systems with higher level of embedded intelligence. The main application of investigated technologies is expected in the fields of robotics, servo-drives, machine tools, and special manipulators and actuators. This research will be focused on new control and parameter identification strategies especially for ac motor drives (e.g. AI, stochastic approaches, optimal control).	KEV
34	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing. Martin Jára, Ph.D.	**Resonant/soft-switchning converters**	This project should discover new topologies of power electronics converters with high power density. The main attention is paid to resonant/soft-switching converters. The research in the project deals with both power circuit solution, including methods for design optimization, and control of proposed converters. The proposed technologies are going to be applied especially in the auxiliary drives of vehicles/cars and wireless power transfer.	KEV
35	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing. Martin Jára, Ph.D.	**New technologies and materials for high power density converters**	The aim of this project is research of new technologies and identification of new materials for design of high power density power electronics converters. The part of the research is optimization of converter design utilizing new devices (SiC, GaN, etc), new materials for passive components, new construction designs, and control strategies. The results of this research are going to be applied in the fields of transportation, airspace, power supplies and charging technologies.	KEV
36	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing. Martin Jára, Ph.D.	**New generation of low-voltage circuit brakers with power semiconductors**	The aim of this project is research of new generation of low-voltage circuit brakers employing power electronics devices for current interruption. In this application, the power semiconductor operates out of the safe operating area (SOA). Hence, the extensive experimental qualification of power electronics chips under above mentioned hard operating conditions will be a part of this research. The use of the investigated device is being considered in both dc and ac systems in the new generation of HCB and SSCB.	KEV
37	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor: Ing. Jan Molnár, Ph.D.	**New Construction Designs for Power Electronics Convereters**	The aim of this project is proposal of new construction designs and concepts of cooling systems of power electronics converters. The project includes the research into the appropriate power electronics devices characterization, definition of measuring techniques and validation of investigated models. The project contains both theoretical simulations and experimental validation of proposed solutions.	KEV
38	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor doc. Ing. Tomáš Komrska, Ph.D.	**E-routers: Control and Interoperability of New Generation of Distribution Grids**	The aim of the project is to research new technologies, devices, principles and contol algorithms for future electric distribution power grids with a high content of so-called e-routers (energy-routers). The main attention is paid to hybrid and fully electronic solutions. The project solution will include interoperability between ac grids and dc microgrids, coupling between dc microgrids, protections, switching elements, sensors and new services for digitization.	KEV
39	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Dr. Ing. Jan Přikryl	**Smart City: New Technologies for City Transportation**	This project will propose new technologies for transportation optimization in a city, including optimization of vehicle fleet, lines, or necessary transport and power distribution infrastructure. Another possible goal will be the research of smart urban technologies to support individual electromobility, especially in relation to the development and usage of charging infrastructure. The formulation of mathematical models and modeling and simulations of above defined problems is going to be a part of this project. The proposed technologies will be verified on data collected in Pilsen and they can also be implemented in the city of Pilsen.	KEV
40	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing. Jan Michalík, Ph.D.	**Matrix and Current-Source Converters**	The project aims to research control algorithms of matrix converters and current-type converters. The primary attention will be paid to selected topologies of indirect variants of matrix converters, modern control algorithms, multilevel converters, and the issue of active LC filter damping.	KEV

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No.	**Supervisor**	**Topic**	**Annotation**	**depart.**
41	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing. Martin Sirový, Ph.D.	**Optimization of Energy Efficiency, Flexibility and Dynamics of Thermal Power and Heating Plants**	The project targets to research of new concepts to improve the operational capacities of power plants and heat power plants in order to reduce the self energy consumption, increase the control range and / or increase the dynamics of the source, and improve the lifetime and reliability of the source. The solution includes the development of conceptual design and simulation verification of the proposed solution using state of the art technologies for energy storage and advanced energy management techniques with respect to successful integration in power grids with high penetration of unpredictable sources.	KEV
42	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing. Martin Sirový, Ph.D.	**Energy Storage Systems Optimization**	The purpose of the project is a development of an optimal system design and control of energy storage systems with a focus on both the battery systems and indirect electricity accumulation systems (especially hydraulic, mechanical, pneumatic and hydrogen systems). The solution assumes research of the application potential of individual technologies and their combinations for the target application areas - energy, community energy, industry, transportation - as well as a detailed elaboration of the system design for selected applications, including the design of control and development of related software tools for the evaluation of technical-economic parameters.	KEV
43	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing. Martin Janda, Ph.D.	**Traction Drive Interactions with its Environment**	The aim of this project is research of unwanted interactions of traction drive with its environment (such as electric or electromechanical interactions, conductive currents, noise). This project is going to analyze these problems and should propose solutions for mitigation of these effects.	KEV
44	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing. Martin Janda, Ph.D.	**Advanced tools for simulation of electric and hybrid vehicles**	The aim of the project is research in the field of simulation of electric and hybrid vehicles especially of public transport and development of corresponding SW tools, which will enable e.g. design of energy storages configuration on the vehicle and development of vehicle power management algorithms. The developed algorithms will be used in superior transport simulators and will enable to optimize energy management within the supply grid.	KEV
45	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing. Martin Janda, Ph.D.	**Impact of Wide Bandgap Power Electronics Devices based Converters on Traction Motor**	The aim of this project is research into an impact of voltage-source converters using wide bandgap power electronics devices (mainly medium-voltage SiC) on supplied traction motor. Design and validation of detailed mathematical models for simulations and extensive experimental study are parts of this research project.	KEV
46	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor Ing.Vojtěch Blahník, Ph.D.	**Smart grid and microgrid power converters**	The aim of the project is research of new topologies and control of power electronics converters used in smart grids and microgrids. The project is focused on cooperation of converters in smart grids, investigating both converter protection and grid protection during fault conditions. The goal is to utilize the advantages of power electronics converters also in the grids with mixed sources.	KEV
47	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor: Ing. Tomáš Košan, Ph.D.	**Accelerated Computations in Electric Drives and Power Electronics**	The aim of the project is research in hardware accelerators of selected parts of control algorithms and models of complete physical devices. Research can be divided into several topics such as: processing of control algorithms with use of multi-core microcontroller and specialized computational accelerators, special computational accelerators realized in the field programmable gate array (FPGA) and real-time modeling of drives using FPGA.	KEV
48	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor: Ing. Tomáš Košan, Ph.D.	**Modular Converters and Their Control**	The aim of this project is research into the topologies and control of modular converters. The main attention will be paid to optimal power circuit design, optimization of necessary sensors, and solutions of converter critical operating states.	KEV
49	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor: Ing. Jiří Cibulka, Ph.D.	**Diagnostics of Synchronous Generators**	The aim of this project is research into diagnostics (i.e. identification and prediction of faults) of synchronous generators. The main attention will be paid to detection of field excitation faults, predominantly in case of brushless excitation systems.	KEV
50	prof. Ing. Zdeněk Peroutka, Ph.D. / assistant supervisor: doc. Ing. Miroslav Byrtus, Ph.D.	**Active vibration attenuation of high-speed controlled drives**	Development of methodology for drive vibration quantification, which arises as a consequence of electromechanical interaction and development of methodology for choosing a suitable method for vibration attenuation. The complex methodology development will be supported by implementing phenomenological models of electromechanical systems, especially drives including electromechanical interaction. Further, the sensitivity analysis will be carried out for design parameters from the following areas, structural (geometric and material parameters, coupling parameters), electro-magnetic, control (strategies, control methods). The sensitivity analysis will be followed by the optimization of undesirable vibration and operational states. The developed methodology will serve for the design of suitable diagnostics parameters and can be part of the drive control system.	KEV
51	doc. Ing. Josef Pihera, Ph.D.	**New diagnostic attempts for partial discharges**	The topic of the dissertation is the study and development of new diagnostic procedures and sensors for data acquisition of partial discharges in dielectric systems of machines and equipment. The main focus is on new procedures for obtaining useful partial discharge signals in insulating systems using new sensors. The output of the dissertation will be new monitoring and diagnostic and evaluation procedures suitable for assessing the condition of insulation systems.	KET
52	doc. Ing. Josef Pihera, Ph.D.	**Optical methods for the detection of partial discharges**	The topic of the dissertation is the study and development of new diagnostic procedures and sensors for data acquisition of partial discharges in dielectric systems of machines and equipment. The main focus is on new procedures for obtaining useful partial discharge signals in insulating systems using optical sensors and transducers. The output of the dissertation will be new monitoring and diagnostic and evaluation procedures suitable for assessing the condition of insulation systems.	KET
53	doc. Ing. Josef Pihera, Ph.D.	**Materials resistant to partial discharges in high voltage steepness applications**	The topic of the dissertation is the study and development of new materials resistant to partial discharges at dielectric interfaces in applications with high voltage steepness. The main focus is on the characterization of these materials from a dielectric point of view. In particular, their resistance to partial discharges. The output of the dissertation will be new dielectric materials resistant to steep transients and partial discharges.	KET

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No.	**Supervisor**	**Topic**	**Annotation**	**depart.**
54	doc. Ing. Josef Pihera, Ph.D.	**Materials for conductive and semiconducting layers for dielectrics**	The dissertation topic will be the development of promising variants of materials for use in the form of conductive and semiconducting layers in the insulation systems. The focus will be on functional materials with controlled properties in terms of electrical, thermal, and mechanical parameters. The dissertation's output will be new or modified materials suitable for use in the technology of dielectrics.	KET
55	doc. Ing. Josef Pihera, Ph.D.	**Effect of longitudinal interfaces on dielectric degradation**	The focus of the dissertation will be to investigate the influence of longitudinal interfaces in dielectric composites on the propagation of degradation mechanisms along these interfaces. The influence of individual phases and parts of the composite on the overall properties will be studied. Both experimental verification and theoretical methods will be used to describe the behaviour of the system at the interfaces of these phases. The output of the dissertation will be the design of an insulating system that resists degradation mechanisms propagating along the interfaces in composites.	KET
56	doc. Ing. Radek Polanský, Ph.D. /Assistant supervisor doc. Ing. Tomáš Blecha, Ph.D.; Ing. Petr Kadlec, Ph.D.	**Electrical insulating composites with innovative functionalities**	The dissertation will focus on fiber-reinforced composites with electrical insulating properties, which, in addition to their basic functional properties, also provide other innovative functionalities enabling their in-situ diagnostics. Such materials can be created by incorporating various active and passive electrical components made using different conductive, semiconductive, and resistive yarn structures that have long been developed at the Department of Materials and Technology. Part of the dissertation will be the optimization of currently used technologies, development of new material structures and their characterization, long-term aging tests, etc.	KET
57	doc. Ing. Radek Polanský, Ph.D. /Assistant supervisor Ing. Pavel Prosr, Ph.D.	**Perspective electrical insulating materials for additive manufacturing**	Additive manufacturing, especially 3D printing, is one of the fundamental parts of the Industry 4.0 concept. Even structural elements of complex geometric shapes with unique properties can be produced at relatively low costs with its help. Additive manufacturing could bring significant benefits also in the field of electrical insulation materials. The dissertation will aim to find suitable candidate materials for the additive manufacturing of electrical insulation structures, creating innovative processes for their production and characterization of mechanical, dielectric, and structural properties of input materials and manufactured structural elements.	KET
58	Ing. Radek Soukup, Ph.D.	**Flexible Electronics and Smart Textiles**	The goal of this work is research of new technologies, interconnection structures, electronic components and advanced functional blocks for flexible electronics and smart textiles. The topic also includes R&D of the technology of creating detachable and permanent interconnecting structures, encapsulation for smart textiles, and as well as R&D of conductive linear and flat textiles with the possibility of selective insulation of conductive tracks.	KET
59	Ing. Radek Soukup, Ph.D.	**Textile Sensors, Elements and Technologies for Electronic Textiles**	This topic aims to research new textile sensors, elements, and electrode structures for smart textiles, particularly for so-called electronic textiles (e-textiles), including the development of interconnection structures and the necessary technologies, which can also be based on a combination of textile and printing techniques. The topic also includes research on hybrid integration and encapsulation of SMD components and/or electronic modules into flat and linear textiles.	KET
60	doc. Ing. František Steiner, Ph.D.	**Reliability and diagnostics of interconnection structures of electronic assemblies**	The dissertation thesis deals with the reliability of electronic assemblies and the diagnostics of the influence of materials, technologies, and the environment on the properties of interconnection structures. It is the research of new materials, technologies, components, and substrates. It includes the application of new diagnostic methods using modelling and simulation to diagnose these structures.	KET
61	doc. Ing. František Steiner, Ph.D.	**Risk aspects of technological and diagnostic processes**	The topic of the dissertation thesis is focused on methods and tools of risk management. It includes determining suitability for use in technological and diagnostic processes. It is the research of new procedures, the proposal of the methodology and its verification using implemented risk management tool.	KET
62	doc. Ing. Václav Šmídl, Ph.D. et Ph.D.	**Model identification in electrical engineering**	Mathematical models are being increasingly used to design electrical devices and their control algorithms. However, the model represents a real device only when its parameters are properly selected. In simple devices, the parameters can be directly measured, however this become problematic with increasing complexity of the device. For example, thermal networks have distributed parameters and many parameters of electrical machines depend on the operation state. Modern estimation methods can estimate parameters of non-linear models as well as models with missing measurements. The main objective of this work is to find a structure of the model, its uncertainty and measurement uncertainty that is suitable for application of estimation methods for a chosen device. Suitable devices are machines, converters and their components.	KEV
63	doc. Ing. Václav Šmídl, Ph.D. et Ph.D.	**Neural networks in models for electrical engineering**	Classical approaches to design of model for electrical engineering build model from the first principles, such as the laws of physics. However, such approach typically requires knowledge of all system parameters with high accuracy. The classical neural networks allow to represent arbitrary function and thus model response of a system from large number of measurements, which is also impractical. Novel neural architectures are based on reduced expressive power that allows to estimate only a subset of functions (e.g. only those from arithmetical operations) which greatly reduce the number of required experiments. The aim of this work is to investigate the use of these architectures in selected applications, such as models of drives, power electronics or complex systems.	KEV
64	doc. Ing. Václav Šmídl, Ph.D. et Ph.D.	**Optimizing machine design using artificial intelligence**	Design of machines is a complicated process utilizing experience of the designer supported by numerical methods. New methods of optimization of complex multidimensional problems are being developed in the artificial intelligence domain. The aim of this work to learn the recent AI methods and apply them to a suitable machine design problem. The focus will be on method aiming to minimize the number of runs of numerical software.	KEV

English topics for the doctoral program "Electrical Engineering and Information Technology" for the academic year 2023/24				
No.	**Supervisor**	**Topic**	**Annotation**	**depart.**
65	doc. Ing. Václav Šmídl, Ph.D. et Ph.D.	**Gradient methods for optimization of switching patterns**	Contemprary convertors are controlled by swicthing sequnces that are generated according to the opretaing condition. The usual puls-width modulation becomes sub-optimal in cases that require control f inner states, such as capacitor voltage balancing in multi-level converters. This task can be formalized os optimal planning for which many optimization methods have been developed. The latest methods use heuristics that are automatically optimized for the given problem. The aim of this work is application of tehse methods to control of multi-phase convertors.	KEV
66	Ing. Jiří Švarný, Ph.D.	**Optical fiber sensors**	The work deals with contemporary optical fiber sensors used in various applications for detection and measurement of physical quantities and chemical and biological substances. The work will be focused on design and implementation of specialized measuring optoelectronic devices for the sensors based on optical fiber.	KET
67	doc. Ing. Jakub Talla, Ph.D.	**Electric power distribution grids variables identification**	This work is focused on the study of actual and new concepts of electric power distribution grids variables identification such as: fault type identification, faulty feeder identification, single-pole ground fault distance identification, robust grid capacity identification. The work will be mainly focused on the active identification based on the power converters and their control (testing signal generation and signal processing).	KEV
68	doc. Ing. Jakub Talla, Ph.D.	**Control of power electronic converters in microgrids and electric power distribution grids with a high ratio of RES**	The aim of this work is to study existing and new concepts of power converts control in microgrids and grids with a high ratio of renewable energy sources (RES). The main focus will be on power grids with a high ratio of electronic power converters, especially converter interactions, grid forming algorithms, their behaviour in dynamic grid states (e.g. power ratio change) and in faults (interactions with protections, new concepts of protections, etc.).	KEV
69	doc. Ing. Jakub Talla, Ph.D.	**Control algorithms of power electronic converters suitable for SOC and FPGA implementations**	The aim of the work is to develop new control algorithms using HW acceleration in programmable logic arrays (FPGAs, SOCs) and ASICs. FPGA and SOCs control systems significantly change the view of the efficiency of control algorithms and enable massive amounts of parallel operations to be performed efficiently. This work is mainly focused on the development of digital twins of real systems (electric drives, power converters, electrical grids), their implementation in FPGAs and the use of digital twins in the control and identification of real systems.	KEV
70	prof. Ing. Pavel Trnka, Ph.D.	**Study of the space charge in composite dielectrics**	The scope of the doctoral thesis is the polarization mechanisms taking place in dielectric materials, their study, and their description. The measurement and simulation of the electric field inside dielectric composites, measurement of space charge using the PEA method, measurement of the current responses in the time and frequency domain and depending on physical parameters, design of a suitable microstructure of composite with the aim to reduce space charge, parametric analysis and setting up principles of composite insulations for use in the high voltage technic concerning the formation of space charge.	KET
71	prof. Ing. Pavel Trnka, Ph.D.	**Management systems diagnostics of electrical machines**	The topic of the dissertation is a conceptual design of a system of work with diagnostic data obtained by a combination of online diagnostic systems and offline methods. Creating a system for data analysis, comparing the results of diagnostic surveys online and offline. Proposal of methodology for determining the final statement. Research related to this topic will include the study of multiparametric degradation processes taking place in various subsystems of electrical machines and their responses in online and offline diagnostic systems and their subsequential modeling.	KET
72	prof. Ing. Pavel Trnka, Ph.D.	**Development of new electrical insulating liquids**	The aim of this dissertation is the design and development of electrical insulating liquids of the new generation. These fluids should not only meet the electrical requirements but also the requirements for environmental safety, sustainable development, and economic requirements. Besides, these fluids must demonstrate higher fire safety while maintaining appropriate viscosity and pour point. An integral part of the work is the study of other important parameters such as oxidation stability, incorporation of nanoparticles, etc.	KET
73	prof. Ing. Pavel Trnka, Ph.D. /Assistant supervisor Ing. Jaroslav Hornak, Ph.D.	**Sustainable Insulation Materials for HV Applications**	This thesis aims to analyze the current status of problematic aspects of existing insulation materials in terms of their negative impacts on the environment and human health. The thesis will also present possible ways of recycling and reusing insulation materials, accompanied by experimental results supporting/refuting these approaches. The key output of the thesis will be the design, synthesis, and verification of a sustainable HV material meeting selected material (electrical, mechanical, structural) and environmental parameters and conditions.	KET
74	prof. Ing. Pavel Trnka, Ph.D. /Assistant supervisor Ing. Jaroslav Hornak, Ph.D.	**Insulation Materials with Increased Operational Resistance**	This work aims to analyze the current state of problematic aspects of existing insulation materials in terms of their resistance to selected degradation factors (thermal, electrical, and chemical stability) and their combinations. Based on the investigations carried out, the thesis will further present possible ways of modification of materials for selected electrical applications to increase their operational resistance. The key output of the thesis will be the design, synthesis, and verification of insulating material for HV applications meeting selected material (electrical, mechanical, structural) and environmental parameters and conditions.	KET