



# **Czech Technical University in Prague**

**Curricula  
2020-2021**

**Faculty of Nuclear Sciences  
and Physical Engineering**

# **FACULTY OF NUCLEAR SCIENCES AND PHYSICAL ENGINEERING CZECH TECHNICAL UNIVERSITY IN PRAGUE**

**The Faculty of Nuclear Sciences and Physical Engineering (FNSPE)** was established in 1955, as part of the Charles University, but in 1959 became a new special faculty of the Czech Technical University in Prague. The establishment of the Faculty was connected with the beginning of a new era of the peaceful use of nuclear energy. A complex approach to all nuclear branches was intended, so specialists from universities, technological institutions, and industry were brought together to comply with this task. Later, newly developed areas of physics application, e.g. plasma and solid state physics, lasers, cosmic research were included in the Faculty curricula.

The characteristics of the Faculty activities developed during its history, and the most advanced areas of technological progress have always attracted its attention. Students with a special interest in mathematics were taught individually, and, subsequently, the study of mathematical engineering was established. In the last fifteen years the rapidly developing branches of mathematical and software engineering, interdisciplinary application to ecology, medicine, economy, archeology have been also evolved. The Faculty is equipped with several large research facilities, such as the VR-1 training nuclear reactor, scanning electron microscopes, high power laser systems, computational and advanced radiochemical laboratories, and satellite laser ranging station (Helwan, Egypt).

# ANNUAL ACADEMIC CALENDAR 2020 – 2021

**Beginning of academic year** Sep 21 2020

**End of academic year** Sep 19 2021

## Enrollment

Aug 26 – 28 2020	1st year of bachelor's program
Sep 1 – 3, 8 – 10, 15 - 17 2020	higher years
Sep 15 – 18 2020	preparatory week for new bachelor students

## Winter semester

Oct 6 2020	Commencement Ceremony for new students
Sep 21 2020 – Dec 18 2020	scheduled classes (13 weeks)
Dec 21 2020 – Jan 3 2021	winter holidays
Jan 4 2021 – Feb 14 2021	examination period

until Nov 30 2020	applications for February final examinations
until Jan 6 2021	theses submission for February final examinations
until Jan 21 2021	closure of results for February final examinations
Feb 1 – Feb 12 2021	February final examinations

## Summer semester

Feb 2 – 11 2021	enrollment to summer semester
Feb 15 – May 14 2021	scheduled classes (13 weeks)
May 17 – Jun 27 2021	examination period
Jun 28 – Aug 29 2021	summer holidays
Aug 30 – Sep 19 2021	extended examination period

until Mar 31 2021	applications for June final examinations
until May 3 2021	theses submission for June final examinations
until May 20 2021	closure of results for June final examinations
until May 31 2021	applications for September final examinations
until Jul 7 2021	theses submission for September final examinations
until Aug 11 2021	closure of results for September final examinations

May 31 – June 11 2021	June final examinations
Aug 30 – Sep 10 2021	September final examinations

Oct 20 2020 and June 28 2021	Graduation Days
May 12 2021	Rector's Day

## LIST OF DEPARTMENTS

<b>department</b>	<b>abbreviation</b>	<b>code</b>
Department of Mathematics	KM	01
Department of Physics	KF	02
Department of Human Sciences and Languages	KJ	04
Department of Solid State Engineering	KIPL	11
Department of Physical Electronics	KFE	12
Department of Materials	KMAT	14
Department of Nuclear Chemistry	KJCH	15
Department of Dosimetry and Application of Ionising Radiation	KDAIZ	16
Department of Nuclear Reactors	KJR	17
Department of Software Engineering	KSI	18

# DEGREE PROGRAM STRUCTURE

## ACCREDITED BACHELOR'S DEGREE PROGRAMS

<b>program</b>	<b>code</b>	<b>abbreviation</b>	<b>time extent</b>
Mathematical Engineering	B0541A170022	P_MIB	3
Applied Mathematical Stochastic Methods	B0541A170024	P_AMSMB	3
Nuclear and Particle Physics	B0533A110015	P_JCF	3
Physical Engineering	B0533A110016	P_FIB	3
Nuclear Chemistry	B0531A130028	P_JCHB	3
Decommissioning of Nuclear Facilities	B0588A110002	P_VJZPB	
Quantum Technologies		P_QTB	
Applied Analysis and Algebra		P_AAAB	

## ACCREDITED MASTER'S DEGREE PROGRAMS

<b>program</b>	<b>code</b>	<b>abbreviation</b>	<b>time extent</b>
Mathematical Engineering	N0541A170028	P_MIN	2
Mathematical Informatics	N0541A170031	P_MINFN	2
Mathematical Physics	N0533A110032	P_MFN	2
Applied Mathematical Stochastic Methods	N0541A170029	P_AMSMN	2
Nuclear Engineering	N0533A110041	P_JIN	2
Nuclear and Particle Physics	N0533A110030	P_JCFN	2
Physical Electronics	N0533A110043	P_FEN	
Solid State Engineering	N0533A110038	P_IPLN	2
Physical Engineering of Materials	N0533A110036	P_FIMN	2
Plasma Physics and Thermonuclear Fusion	N0533A110034	P_FPTFN	2
Nuclear Chemistry	N0531A130039	P_JCH	2
Decommissioning of Nuclear Facilities	N0788A110002	P_VJZPN	2
Quantum Technologies		P_QTN	2
Applied Analysis and Algebra		P_AAAN	2

# **MASTER'S DEGREE PROGRAMS**

open in the academic year 2020 - 2021

## NUCLEAR AND PARTICLE PHYSICS

**Area of education:** Physics 100 %

**Program coordinator:** doc. Dr. rer. nat. Mgr. Jaroslav Bielčík

**Specializations of the study program:**

- *The program has no specialization*

### Goals and Outcomes:

The master's degree course is oriented towards nuclear and elementary particle physics, these are the fields of study that bring fundamental knowledge about the structure of matter and basic interactions that are happening in the microworld. Many discoveries and knowledge from physics are already in our daily life and are used in many fields that are not just physics. The study plan that this programme offers is mainly based on advanced modules, such as quantum field theory, particle physics and system of modern detectors together with data analysis and data processing. These modules were chosen due to the needs of modern research in the field of nuclear and elementary physics, students then may further specialize by choosing one of the compulsory elective courses. Students can choose to do theoretical or experimental or accelerators.

The fundamentals of the specialized study are the following common theoretical modules. Such as Quantum field theory 1 and 2, Introduction to Theory of Electroweak Interactions and Introduction to Quantum Chromodynamics. These subjects are then supplemented by subjects of profiling basis such as Modern Detectors, Detector Systems and Data Acquisition together with the Statistical Data Analysis 1 and 2, which will acquaint students with modern technology and the industry. Students will attend a series of seminars 1-4 where they will be presenting their research together with talks about the latest news in physics. Students can specialize by choosing one of the three groups of compulsory elective courses. In the experimentally focused group E they complete the subjects Extreme states of matter and Physics of Ultrarelativistic Nuclear Collisions, in the theoretically focused group T they complete the General Theory of Relativity and in the instrumentally focused group I where they complete Accelerators 1 and 2.

The program emphasizes on modern methods of obtaining experimental data and their processing using computer technology, machine learning, and physical interpretation of experimental results, which is then formulated into theoretical models and possible practical applications for acquired data. Teaching is represented by the form of choice of optional subjects, work in specialized laboratories. There are preferred individual forms of teachings under a supervisor together with seminars. Students are involved in ongoing researches projects where they can contribute to their problem-solving skills and are slowly being prepared for modern collective forms of scientific work in an international group. Teaching takes place in close cooperation with non-faculty workplaces such as (Academy of Sciences of the Czech Republic, CERN Geneva, Brookhaven National Laboratory, GSI Darmstadt, etc.). It is, therefore, a comprehensive study program with interdisciplinary content, the aim of which is to prepare graduates for work in academia and industry.

### Graduate Profile:

*Knowledge:* Graduate will gain the most comprehensive possible knowledge of modern nuclear and particle physics, which will enable him to creatively participate in solving new interdisciplinary scientific and technical problems. The acquired knowledge covers all areas of nuclear, particle and quantum physics, detection methods, ionizing radiation detectors and accelerators. The graduate may directly continue in a follow-up doctoral study in the same or a related field.

*Skills:* Graduate will gain skills in the application of methods of modern physics in solving problems. The acquired skills will consist of preparation and implementation of experiments and subsequent processing of measurement results which then can be interpreted, this includes a comprehensive analysis of statistical and systematic errors. The graduate will also gain experience working in large international collaborations and the ability to present, communicate and defend the results obtained and, last but not least, will gain skills to participate in the preparation and construction of accelerators.

*Competence:* Graduates will find employment in industry, basic and applied research and the private sector thanks to the analytical way of work, the systematic approach given by the acquired knowledge and the ability to work with modern computer technology and machine learning methods. They can work in nuclear research institutions, healthcare or the automotive industry. They acquire the qualification of a physicist - researcher with a wide range of possible applications in research (basic, applied, strategic) and in development for technical practice. They will be prepared to solve physical problems using modern experimental techniques, process large-volume data and operate accelerators.



**State final examination:**

- defence of the diploma project
- oral examination in the general subject  
*Particle Physics*
- oral examination in the profile subject  
*Experimental Methods*
- oral examination in the profile subject with optional choice:  
*General Theory of Relativity*  
*Heavy Ion Physics*  
*Accelerators*

**PHYSICAL ELECTRONICS**

**Area of education:** Physics 100 %

**Program coordinator:** doc. Dr. Ing. Ivan Richter

**Specializations of the study program:**

- *Laser Physics and Technology*
- *Photonics*
- *Computational Physics*

**Goals and Outcomes:**

The master's degree multidisciplinary program of *Physical Electronics* is oriented towards classical and modern areas of physics, mathematics, and informatics. Specifically, these includes the fields that bring fundamental knowledge about, following the three specializations, laser physics and technique, photonics, and computer physics. The program leads graduates to applications of physical methods in natural-science and engineering practice, often with the help of modern computer technique. The program enables deeper focus in one of the following three specializations of modern applied physics. In the specialization *Laser physics and technology*, students are prepared in the areas and technical applications of coherent laser and charged particle beams and plasma physics. In the specialization *Photonics*, students are prepared in the modern areas of optics, photonics, and photonic nanostructures, including theoretical design, analysis, realization, characterization, and applications. In the specialization *Computational Physics*, students are equally acquired with knowledge of physical backgrounds of high-tech state-of-the-art technologies and modern informatics and computer systems. Deeper interconnection of modern physics, mathematics, and informatics, enables the program graduates to further increase their qualification to higher study degrees, and thus acting in the physical, natural-science, and technical practice, or application in science, research, and technical practice. Many discoveries and knowledge from these areas of applied physics are already applied in our daily life and are used in many surrounding fields. The study plans this program are based on advanced modules, either general or specific to each specialization, such as classical electrodynamic, physical optics, quantum electronics, quantum optics, nonlinear and statistical optics, laser technique, etc. These modules were chosen due to the needs of modern research in the fields of laser physics and technique, photonics, and computer physics.

The program emphasizes on modern methods of obtaining both theoretical and experimental data and their processing using current computer technology, and physical interpretation of experimental results, which is then formulated into theoretical models and possible practical applications. Mandatory courses in each specialization are amended by the form of choice of optional subjects, and work in specialized practical laboratories. Students are involved in ongoing researches projects where they can contribute to their problem-solving skills and are slowly being prepared for modern forms of scientific work. Teaching takes place in close cooperation with non-faculty workplaces such as the Academy of Sciences of the Czech Republic. It is, therefore, a comprehensive study program with interdisciplinary content, the aim of which is to prepare graduates for work in academia and industry.

**Graduate Profile:**

*Knowledge:* A graduate will gain the most comprehensive knowledge of fundamental physical, mathematical, and informatics fields which are, in dependence on the particular specialization, deepened in the areas of most important experimental methods and theoretical models of current laser physics and technique, photonics, and computer physics. This will enable the graduates to creatively participate in

solving new interdisciplinary scientific and technical problems in the related areas. The graduates may directly continue in a follow-up doctoral study in the same or a related field (Physical Engineering, Quantum Technologies, and others).

*Skills:* A graduate will gain skills in the application of methods of modern physics and engineering in solving realistic problems, with the help of modern computer technique. The acquired skills, using the methods and techniques of mathematics and physics, will enable solving realistic research and engineering problems in the areas of laser physics and technique, photonics, and computer physics. The graduate will also gain experience and skills to follow new trends in given areas, and quickly orient in multidisciplinary problems, analyze them and synthesize the results, together with the ability to present, communicate, and defend the results obtained.

*Competence:* Master graduates will find employment in industry, basic and applied research, and the private sector thanks to the analytical way of work, the systematic approach given by the acquired knowledge and the ability to work with modern computer technology and machine learning methods. They will be prepared to solve physical problems using modern theoretical and experimental techniques. They acquire the qualification of a physicist - researcher with a wide range of possible applications in research (basic, applied, strategic) and in development for technical practice. They can either continue in their studies in doctoral programs, or work in research laboratories, in the development, and test and / or product certificate centers, in metrology, and in various applications of laser and photonic techniques and technologies.

**State final examination:**

- defence of the diploma project
- oral examination in the general subject  
*Electrodynamics*
- oral examination in the profile subject with optional choice:  
*Optics and Quantum Electronics*  
*Computational Physics*
- oral examination in the profile subject with optional choice:  
*Laser Physics and Technology*  
*Photonics*  
*Numerical Methods in Applied Physics*  
*Physics of Laser Plasma and Inertial Fusion*

# Master's Degree Program

## Physical Electronics

### Specialization Laser Physics and Technology

1st year

Course	code	lecturer	win. sem.	sum. sem.	cr	cr
<i>Compulsory courses:</i>						
Electrodynamics 1, 2	12ELDY12	Limpouch, Richter	2+0 z, zk	4+0 z, zk	3	5
Computational Physics 1	12PF1	Klimo	2+0 zk	-	2	-
Research Project 1, 2	12VUFL12	Šiňor	0+6 z	0+8 kz	6	8
Optical Physics 1	12FOPT1	Richter	3+0 z, zk	-	3	-
Quantum Electronics	12KVEN	Richter	3+1 z, zk	-	5	-
Open Resonators	12OREZ	Kubeček	2+1 z, zk	-	4	-
Nonlinear Optics <sup>(1)</sup>	12NOP	Richter	-	3+1 z, zk	-	4
Laser Physics	12FLA	Šulc	-	4+0 z, zk	-	4
Solid-state, Diode and Dye lasers	12PDBL	Jelínková, Kubeček	-	2+0 z, zk	-	2
Computer Control of Experiments	12POEX	Čech, Vyhřídál	-	2+0 z	-	2
<i>Optional courses:</i>						
Statistical Optics	12SOP	Richter	2+0 z, zk	-	2	-
Geometrical Optics	12GOP	Dvořák	-	2+0 kz	-	2
Optical Spectroscopy	12OSP	Michl	-	2+0 kz	-	2
Quantum Optics <sup>(2)</sup>	12KOP	Richter	-	3+1 z, zk	-	5
Physics of Detection and Detectors of Optical Radiation	12FDD	Pína	2+0 zk	-	2	-
X-ray Photonics	12RFO	Pína	2 zk	-	2	-
Electronics 3	12EL3	Pavel	2+0 zk	-	2	-
Electronics Practicum 1, 2	12EP12	Pavel	0+2 kz	0+2 kz	3	3

(1) Grading in 12NOP possible after grading in 12FOPT1.

(2) Grading in 12KOP possible after grading in 12KVEN.

# Master's Degree Program

## Physical Electronics

### Specialization Laser Physics and Technology

2nd year

Course	code	lecturer	win. sem.	sum. sem.	cr	cr
<i>Compulsory courses:</i>						
Solid State Physics	11FYPL	Kalvoda	3+1 z, zk	-	4	-
Diploma Seminar 1, 2	12DSFE12	Jelínková	0+2 z	0+2 z	2	2
Master Thesis 1, 2	12DPFE12	Jelínková	0+10 z	0+20 z	10	20
Ultra-short Pulse Generation	12UKP	Jelínek, Kubeček	2+0 zk	-	2	-
Advanced Laser Technique Laboratory	12PPLT	Kubeček, Němec	0+4 kz	-	6	-
Gas and X-ray Lasers	12RGL	Jančárek	-	2+0 kz	-	2
<i>Optional courses:</i>						
Electronics for Lasers	12ELA	Pavel	2+0 zk	-	2	-
Advanced Laser Spectroscopy	12PLS	Michl	2+0 zk	-	2	-
Fourier Optics and Optical Signal Processing	12OZS	Kwiecien	3+0 z, zk	-	3	-
Laser in Medicine Practice	12PLM	Jelínková, Němec	-	4 kz	-	6
Advanced Optical Laboratory	12PPRO	Jančárek	0+4 kz	-	6	-
Fiber Lasers and Amplifiers	12VLS	Kubeček, Peterka	2+0 zk	-	3	-
Measurements Methods in Electronics and Optics	12MMEO	Pína	-	2+0 zk	-	2

# Master's Degree Program

## Physical Electronics

### Specialization Photonics

1st year

Course	code	lecturer	win. sem.	sum. sem.	cr	cr
<i>Compulsory courses:</i>						
Electrodynamics 1, 2	12ELDY12	Limpouch, Richter	2+0 z, zk	4+0 z, zk	3	5
Computational Physics 1	12PF1	Klimo	2+0 zk	-	2	-
Research Project 1, 2	12VUFL12	Šiňor	0+6 z	0+8 kz	6	8
Optical Physics 1	12FOPT1	Richter	3+0 z, zk	-	3	-
Quantum Electronics	12KVEN	Richter	3+1 z, zk	-	5	-
Statistical Optics	12SOP	Richter	2+0 z, zk	-	2	-
Selected Chapters of Modern Optics	12MODO	Kwiecien	2+0 z	-	2	-
Nonlinear Optics <sup>(1)</sup>	12NOP	Richter	-	3+1 z, zk	-	4
Quantum Optics	12KOP	Richter	-	3+1 z, zk	-	5
Computer Control of Experiments	12POEX	Čech, Vyhřídál	-	2+0 z	-	2
Optical Spectroscopy	12OSP	Michl	-	2+0 kz	-	2
<i>Optional courses:</i>						
Measurements Methods in Electronics and Optics	12MMEO	Pína	-	2+0 zk	-	2
Physics of Detection and Detectors of Optical Radiation	12FDD	Pína	2+0 zk	-	2	-
Solid-state, Diode and Dye lasers	12PDBL	Jelínková, Kubeček	-	2+0 z, zk	-	2
Nanochemistry	12NCH	Proška	2+0 zk	-	2	-
Preparation of Semiconductor Nanostructures	12PN	Hulicius	-	2+0 zk	-	2
Atomic Physics	12AF	Šiňor	4+0 z, zk	-	4	-
Molecular Nanosystems	11MONA	Kratochvílová	2+0 zk	-	2	-
Computational Physics 2	12PF2	Kuchařík	-	1+1 z, zk	-	2

(1) Grading in 12NOP possible after grading in 12FOPT1.

# Master's Degree Program

## Physical Electronics

### Specialization Photonics

2nd year

Course	code	lecturer	win. sem.	sum. sem.	cr	cr
<i>Compulsory courses:</i>						
Solid State Physics	11FYPL	Kalvoda	3+1 z, zk	-	4	-
Diploma Seminar 1, 2	12DSFE12	Jelínková	0+2 z	0+2 z	2	2
Master Thesis 1, 2	12DPFE12	Jelínková	0+10 z	0+20 z	10	20
Nanophysics	12NF	Šňor	1+1 zk	-	2	-
Fourier Optics and Optical Signal Processing	12OZS	Kwiecien	3+0 z, zk	-	3	-
Advanced Optical Laboratory	12PPRO	Jančárek	0+4 kz	-	6	-
Geometrical Optics	12GOP	Dvořák	-	2+0 kz	-	2
<i>Optional courses:</i>						
Advanced Laser Spectroscopy (1)	12PLS	Michl	2+0 zk	-	2	-
Gas and X-ray Lasers	12RGL	Jančárek	-	2+0 kz	-	2
Advanced Laser Technique Laboratory	12PPLT	Kubeček, Němec	0+4 kz	-	6	-
Integrated Optics	12INTO	Čtyroký	2+0 z, zk	-	2	-
Optical Sensors	12OSE	Homola	-	2+0 zk	-	2
X-ray Photonics	12RFO	Pína	2 zk	-	2	-
Ultra-short Pulse Generation	12UKP	Jelínek, Kubeček	2+0 zk	-	2	-
Fiber Lasers and Amplifiers	12VLS	Kubeček, Peterka	2+0 zk	-	3	-
Computer Simulation of Condensed Matter	11SIKL	Kalvoda, Sedlák	2+2 z, zk	-	4	-
Quantum Information and Communication	02KIK	Gábris, Jex	2+0 z	-	2	-
Surfaces and Boundaries	11POR	Kalvoda	-	2+0 zk	-	2

(1) Grading in 12PLS possible after grading in 12OSP.

# Master's Degree Program

## Physical Electronics

### Specialization Computational Physics

1st year

Course	code	lecturer	win. sem.	sum. sem.	cr	cr
<i>Compulsory courses:</i>						
Electrodynamics 1, 2	12ELDY12	Limpouch, Richter	2+0 z, zk	4+0 z, zk	3	5
Computational Physics 1	12PF1	Klimo	2+0 zk	-	2	-
Research Project 1, 2	12VUFL12	Šňor	0+6 z	0+8 kz	6	8
Differential Equations on Computer	12DRP	Liska	2+2 z, zk	-	5	-
Parallel Algorithms and Architectures	01PAA	Oberhuber	-	2+1 kz	-	4
Inertial Fusion Physics	12FIF	Klimo, Limpouch	3+1 z, zk	-	4	-
Computational Physics 2	12PF2	Kuchařík	-	1+1 z, zk	-	2
Finite Element Method	01MKP	Beneš	-	1+1 zk	-	3
Fundamentals of Laser-Plasma Physics	12ZFLP	Klimo, Pšikal	-	2+0 zk	-	2
Digital Image Processing	01DIZO	Flusser	-	2+2 zk	-	4
<i>Optional courses:</i>						
Object Oriented Programming	18OOP	Virus	0+2 z	-	2	-
Computer Simulations in Physics of Many Particles 1, 2	12SFMC12	Kotrla, Předota	3+1 z, zk	2+0 zk	4	2
Quantum Electronics	12KVEN	Richter	3+1 z, zk	-	5	-
Quantum Optics	12KOP	Richter	-	3+1 z, zk	-	5
Inertial Confinement Fusion	12PICF	Klír, Limpouch	-	2+0 kz	-	2
Variational methods	01VAM	Beneš	1+1 zk	-	3	-
Introduction to Mainframe	01UMF	Oberhuber	2 z	-	2	-
Mathematical Methods in Fluid Dynamics	01MMDY	Strachota	2+0 zk	-	2	-
Numerical Methods in Fluid Dynamics	01NMDT	Strachota	-	2+0 zk	-	2

# Master's Degree Program

## Physical Electronics

### Specialization Computational Physics

2nd year

Course	code	lecturer	win. sem.	sum. sem.	cr	cr
<i>Compulsory courses:</i>						
Solid State Physics	11FYPL	Kalvoda	3+1 z, zk	-	4	-
Diploma Seminar 1, 2	12DSFE12	Jelínková	0+2 z	0+2 z	2	2
Master Thesis 1, 2	12DPFE12	Jelínková	0+10 z	0+20 z	10	20
Atomic Physics	12AF	Šňor	4+0 z, zk	-	4	-
Robust Numerical Algorithms	12RNA	Váchal	1+1 z	-	2	-
<i>Optional courses:</i>						
Monte Carlo Method	18MMC	Virus	2+2 z	-	4	-
Mathematical Modelling of Non-linear Systems	01MMNS	Beneš	1+1 zk	-	3	-
Astrophysics	12ASF	Kulhánek	-	2+2 zk	-	4
X-ray Photonics	12RFO	Pína	2 zk	-	2	-
Mathematical Logic	01MAL	Cintula	2+1 z, zk	-	4	-
Laser Plasma as Source of Radiation and Particles	12LPZ	Nejdl	2+0 zk	-	2	-
Image Processing and Pattern Recognition 2	01ROZP2	Flusser	2+1 zk	-	4	-
Machine Learning 1	01SU1	Flusser	2+1 zk	-	3	-
Nonlinear Optics	12NOP	Richter	-	3+1 z, zk	-	4
Neural Networks and their Application	01NEUR1	Hakl, Holeňa	-	2+0 zk	-	2



# Master's Degree Program

## Nuclear and Particle Physics

1st year

Course	code	lecturer	win. sem.	sum. sem.	cr	cr
<i>Compulsory courses:</i>						
Quantum Field Theory 1, 2	02KTPA12	Jizba, Štefaňák, Zatloukal	4+2 z, zk	4+2 z, zk	8	8
Modern Detectors	02MTD	Adam	2+0 zk	-	2	-
Statistical Data Analysis 1, 2	02SZD12	Myška	2+2 z, zk	2+2 z, zk	4	4
Seminar 1, 2	02SE12	Bielčík	0+3 z	0+3 z	3	3
Research Project 1, 2	02VUJC12	Bielčík, Petráček	0+6 z	0+8 kz	6	8
Detector Systems and Data Acquisition	02SDSD	Broz	-	2+0 zk	-	2
<i>Required optional courses type A <sup>(1)</sup></i>						
Extreme States of Matter <sup>(2)</sup>	02EXSH	Bielčík, Šumbera	2+0 zk	-	2	-
Physics of Ultrarelativistic Nuclear Collisions <sup>(2)</sup>	02FUJS	Křížková- Gajdošová	-	2+0 zk	-	2
Accelerators 1, 2 <sup>(3)</sup>	02UC12	Krůs	2+0 zk	2+0 zk	2	2
General Theory of Relativity <sup>(4)</sup>	02GTR	Cimerman, Tomášik	2+2 z, zk	-	4	-
<i>Optional courses:</i>						
Workshop 2	02EJFS2	Bielčík	1 týden z	-	1	-
Special Practicum 1, 2	02SPRA12	Čepila	0+4 kz	0+4 kz	6	6
Seminar on Quark-Gluon Plasma 3, 4	02RQGP34	Bielčík, Bielčíková, Tomášik	2+0 z	2+0 z	1	1
Physics of Atomic Nuclei	02FAJ	Adam, Veselý	-	4+0 zk	-	4
Neutron Physics	02NF	Šaroun, Vacík	-	2+2 z, zk	-	4
Astroparticle Physics 1, 2	02ACF12	Vícha	2+0 zk	2+0 zk	2	2
Monte Carlo Method	18MMC	Virus	2+2 z	-	4	-
Object Oriented Programming	18OOP	Virus	0+2 z	-	2	-
Advanced C++	18PCP	Virus	-	2+2 z, zk	-	4
Neural Networks and their Application	01NEUR1	Hakl, Holeňa	-	2+0 zk	-	2

(1) At least one of the groups E, I or T must be enrolled.

(2) Course E

(3) Course I

(4) Course T

# Master's Degree Program

## Nuclear and Particle Physics

2nd year

Course	code	lecturer	win. sem.	sum. sem.	cr	cr
<i>Compulsory courses:</i>						
Fundamentals of Electroweak Theory	02ZELW	Bielčíková, Myška, Tomášik	3+2 z, zk	-	6	-
Seminar 3, 4	02SE34	Bielčík	0+3 z	0+3 z	3	3
Master Thesis 1, 2	02DPJC12	Bielčík, Petráček	0+10 z	0+20 z	10	20
Quantum Chromodynamics	02ZQCD	Bielčíková, Čepila, Tomášik	-	3+2 z, zk	-	6
<i>Optional courses:</i>						
Workshop 3	02EJFS3	Bielčík	1 týden z	-	1	-
Seminar on Quark-Gluon Plasma 5, 6	02RQGP56	Bielčík, Bielčíková, Tomášik	2+0 z	2+0 z	1	1
Materials in Experimental Nuclear Physics	02MAT	Škoda	2+0 zk	-	2	-
Nuclear Spectroscopy	02JSP	Wagner	-	2+2 z, zk	-	5
Computer Control of Experiments	17PRE	Kropík	2+1 z, zk	-	3	-
Matrix Lie Group Representations	02REP	Hrivnák	2+0 z	-	2	-
Applied Quantum Chromodynamics at High Energies	02AQCD	Nemčík	-	2+0 zk	-	2

## **EXPLANATORY NOTES**

for notations in the curriculum

The curriculum contains in each row

- course name
- shortcut used in the university database KOS
- name of the lecturer
- extent in the winter and summer semester
- credits in the winter and summer semester

In case the course spans over two semesters with different parts denoted by numbers, they can be contained in one row.

The extent of the course is indicated by number of teaching hours of the lecture + number of teaching hours of the exercise together with the indication of the grading (see later in this text). In case the teaching hours of the lecture and exercise are not distinguished, the course extent is indicated by one number.

# **POLICIES AND PROCEDURES FOR THE BACHELOR COURSES AND CONTINUATION MASTER COURSES AT THE FACULTY OF NUCLEAR SCIENCES AND PHYSICAL ENGINEERING (FNSPE) OF THE CZECH TECHNICAL UNIVERSITY (CTU) IN PRAGUE**

## **ACADEMIC YEAR 2020 - 2021**

The Policies and Procedures of the FNSPE of the CTU in Prague represent the fundamental document for the study programmes offered by this institution, complementing and specifying the requirements of the CTU Academic and Examination Statute. This document is binding on all academics and students. Study programmes of FNSPE are structured, offering not only the established engineering (i.e. master) courses but also undergraduate (i.e., bachelor) courses. The study programmes comprise various fields of study which may comprise various specialisations.

Compliant with the CTU Academic and Examination Statute, Sec.4, the undergraduate and master programmes study plans of fields and specialisations specify the required compulsory courses as well as optional courses recommended for the respective field of study.

## **Section 1**

### **Bachelor Programme (BP)**

1. Curricula in the Bachelor's Degree Programme contain compulsory, optional, and core-elective bachelor courses.
2. In the Bachelor Programme, it is not allowed to register for courses of the Continuation Master Programme with the exception given by Sec. 2, Par. 4 a., b, c.

## **Section 2**

### **Continuation Master Programme (MCP)**

1. Curricula in the Master's Degree Programme contain compulsory and optional master courses. In the Master Programme, it is not allowed to enrol into courses of the Bachelor's Degree Programme.
2. To be eligible for the MCP, (in terms of conditions set by law and the CTU Admission Procedure Rules), all applicants are required to have completed a Bachelor Programme in a related or identical field of study as well as to have successfully passed the entrance examination. However, student may be exempt from the examination on the Dean's recommendation.
3. If necessary, for the first two years, student on the MCP will have an individual curriculum, so as to attain the competences required for the completed Bachelor's Degree Course.
4. To transfer from the Bachelor Programme to the MCP, the following rules are imposed:
  - a. In the Bachelor's Degree Programme, it is possible to register for the courses in the recommended 1st year MCP programme provided the credits obtained do not exceed the total number of 30. Such credits must be obtained beyond the limit of 180 credits obtained in the Bachelor's Degree Course.
  - b. Provided student has graduated from a Bachelor Course at FNSP and transfers to the MCP, on application, courses listed in the recommended 1st year MCP curriculum can be counted for up to 30 credits if obtained beyond the mandatory minimum of 180 credits as required for the Bachelor Programme by the CTU Academic and Examination Statute.
  - c. The MCP will not recognize courses taken within the Bachelor Programme beyond those recommended by the programme of a given field/specialisation.

## Section 3

### Registration

1. Bachelor and Master Degree student will register for the winter semester prior to its beginning. The prerequisite for passage to summer semester is the fulfilment of conditions given by the CTU Academic and Examination Statute, and, upon doing so, student can register for the summer semester, prior to its beginning.
2. Students of higher Bachelor and Master Programmes will register for the following academic year courses upon having fulfilled conditions for passage to the following academic year given by the CTU Academic and Examination Statute.
3. To be eligible for registration to the following academic year, student will have obtained all the required end-of-unit assessments (“zápočet” in Czech , i.e. recognition of the current semester coursework and responsibilities) and passed all examinations in the re-registered (i.e. registered a second time) obligatory courses.
4. Student will register for each course in the electronic information system of the CTU and also enter the list of courses in their course record book (“index“in Czech), in order that they may function as their semester/year study schedule according to Par.1 and 2, respectively, in agreement with these procedures and the CTU Academic and Examination Statute. To register, the following rules are to be observed:
  - a. all students of respective fields, specialisations, or years of study will register for compulsory courses (see Sec. 4 and 5)
  - b. student will register for optional and core-elective courses according to their choice, taking into account the rules of the study schedule, in particular the sequence of courses, sometimes subject to and required by the field/specialisation study plans.
  - c. bachelor students of FNSPE CTU may register for optional courses of other bachelor fields offered at FNSP. Upon this, these courses are regarded as an optional part of student’s respective field of study curriculum. Student on the FNSPE Continuation Master Programme may register for optional courses offered by other fields of the Continuation Master Programme of FNSPE. Upon this, these courses are regarded as an optional part of student’s respective field of study curriculum.
5. Student must not register for the same course a second time if they have concluded it by examination or obtained a “zápočet“, as the case may be.
6. The number of years at university will be counted from the first registration for a given degree programme, including any deferrals. If, however, student has discontinued their study in the immediately preceding semester, conditions to be fulfilled are postponed towards the next registration.
7. Details on registration are gradually specified by notices of the Department of Student Affairs.

## Section 4

### Compulsory Courses

1. If in the course of their programme, a compulsory course is removed from the list, student is not required to complete it; if, however, the respective course is replaced by another compulsory course (and its title or extent is changed, its contents remaining unaltered), the student is obliged to take the new course (unless they have completed its previous version).
2. When included into the course list , the new course must be completed only by students studying no longer than the year of the recommended study plan. The decision as to which

course to take and pass is made by the head of the respective department guaranteeing the corresponding field of study..

## Section 5

### Measuring and Assessing Student's Academic Attainment

1. The main means for assessing and measuring student's academic attainment include the end-of-unit-assessment ("zápočet"), graded assessment ("klasifikovaný zápočet"), and examinations. The term "end-of-unit assessment only" ("samostatný zápočet") is used if the course is not concluded by an examination. Obtaining a "zápočet" is a prerequisite to be admitted to an examination preceded by such a "zápočet".
2. Examinations are usually administered during the respective semester examination period. Adequate number of evenly spread examination dates will be announced by the tutor in order that students may take the examination within the examination period. -
3. End-of-unit assessments and examinations may not be administered before student has completed the respective course. If registered for the course a second time, student may take the end-of-unit assessment or examination any time in the course of the academic year provided they have fulfilled all academic obligations to finish the course and the tutor gave their agreement..
4. Winter semester examinations and end-of-unit assessments may be administered during the summer semester or summer semester examination period. No examinations and tests for the end-of-unit assessment for the past academic year will be administered after commencement of the next academic year.
5. To take an examination, student will have registered for it and gained the end-of-term assessment (if required by the curriculum). If student has registered for an examination date and cannot be present for the examination on the chosen date, an apology must be made in advance. A belated apology is accepted for serious reasons of absence (mainly on health), but no later than 2 days after the examination date. The examiner will judge whether the excuse is legitimate. If student failed to be present for the examination and no apology was made in advance or was not accepted, the examination term expires and the examination is graded as "failure".
6. If student has not registered for any examination in the respective course within the examination period and has not made any arrangements as to the examination term with the examiner, the examination is graded as "failure".
7. The tutor's/examiner's obligation is to enter immediately the result/grade into the CTU electronic information system, student's course record book ("index"), and department's non-electronic registers. If student requests recognition of a course on the list of some other degree course or in cases given by notices concerning student on Bachelor or Continuation Master Courses, such entries may be the responsibility of the Department of Student Affairs.
8. The succession of courses is stated in the recommended time schedule of the programme and student will adhere to it for course registrations. Provided the courses run for more semesters or in succession, student cannot obtain an end-of-unit assessment only ("samostatný zápočet") or take an examination in a course scheduled for a later semester unless they have satisfied the requirements of the previous course. The eligibility requirements are specified by the head of the department responsible for the course.

9. Courses marked A or B are understood to comprise one course, as given by the Academic and Examination Statute of the CTU.

## **Section 6**

### **Languages**

1. As part of the Bachelor Programme, student will register for and pass examinations in two of the foreign languages offered in the curriculum. Foreign students – with the exception of Slovak students and those who passed an examination in Czech as part of their school-leaving examination - will register for Czech as their second foreign language.
2. Language courses, according to Par. 1 are offered in three to five semester cycles, the exception being students of Applied Informatics. The time schedule of these courses is part of the study programme.
3. According to Par. 2, each semester is a self-contained unit concluded by a “zápočet“. If student is admitted to the Bachelor Course again (i.e. registers for it a second time), the “zápočet“ is not recognized; however, student does not have to register for the parts of cycle he had already passed successfully. Semesters of the cycle follow the course sequence stated in Section 5, Par.8. Each semester is concluded by a “zápočet” only if student had obtained a “zápočet” for the previous semester course. The language programme cycle is concluded by an examination.
4. Language courses can be offered in several groups according to language competence. The level of course to be chosen rests with the student and takes into account their previous language training and results achieved. Transfers between courses are possible solely on tutor’s recommendation or student’s application, within two weeks of language course commencement, but not later.
5. Applied Informatics programme follows an extended language programme targeted at professional oral and written communication and includes also a second foreign language course of student’s choice. The time schedule of these courses is part of the curriculum of the specialisation. The bachelor project is submitted and defended in English. Upon choosing, and supposing they have satisfied criteria defined by the Department of Social Sciences and Languages, after 5 semesters of the Applied Informatics programme student can register for a state language examination.
6. Exceptions to compulsory training in more than two foreign languages are judged by the Department of Social Sciences and Languages on individual basis. Student can choose and register for a third language only if they had concluded the cycle of two languages as stated in Par.1 of this Section.
7. Details for language training are given in the binding regulations for language courses issued by the Department of Social Sciences and Languages.

## **Section 7**

### **Courses in Calculus, Linear Algebra, and Mathematics**

1. Fundamental courses in mathematics within the Bachelor Course curriculum are offered at three levels of difficulty marked A, B, and C, their course structure being given by the Bachelor Course curriculum. Level C is offered in the Mathematics course
2. Transfers from course Calculus A to Calculus B, or from course Linear Algebra A to course Linear Algebra B are subject to the recommendation of the examiner after the A level

examination. The examiner can inform student that their attainment satisfies the knowledge required for course B only. In such case, on student's agreement with the offer, the examiner has the right to enter the grade for course level B instead of the grade for course A into student's course record book and the electronic system..

3. On student's application and the Dean's consent, student can register for course A instead of course B.
4. Courses assigned A or B must be seen as two parts of one course, inclusive of the form they are concluded (according to the Academic and Examination Statute of the CTU, Sec.6) and of the number of retakes (according to the Academic and Examination Statute of the CTU, Sec.10) given by the sum of course A and course B passages. Student who has passed a course A examination may not register a second time for the same course B. After one registration for and successful passage of course B examination student may register for the same course A examination.
5. On student's application and the Dean's consent, student can transfer from course level A or B to course level C.

## **Section 8**

### **Bachelor Project, Research Project, and Master Thesis**

1. A compulsory part of the the Bachelor's Degree Course is the bachelor project defended by student as part of the State Final Examination. A compulsory part of the Continuation Master Course is a research project and master thesis. Student may not register for them while still registered for the Bachelor Course. The research project is defended before the board nominated by the respective department. Defence of the master thesis is part of the State Final Examination. The research project can be assigned only after student has defended their bachelor project .. The degree thesis can be assigned only after student has completed and successfully defended Research Project 2.
2. Departments will announce topics of bachelor projects, research projects, and master theses no later than end of the previous academic year. Bachelor projects and master theses are assigned to students by the Dean; research projects are assigned to students by the head of the department. The assignments can be used for two years.
3. The bachelor project, research project as well as master thesis assignment will include the title (both in Czech and English), the outline, recommended literature, the supervisor's name and affiliation, date of assignment, and date of submission. The assignment is assigned for two years.
4. The bachelor project, research project, and master thesis are assigned to student at the beginning of the winter and/or summer semester. It is the student's obligation to accept the work assignment within 30 days from the beginning of semester. If student fails to do so, the assignment is postponed until the next semester. Assignment of the bachelor project and master thesis at an extraordinary term is a prerogative of the Dean, whereas assignment of the research project at an extraordinary term is a prerogative of the head of the department.
5. The bachelor project and master thesis will include items required for bibliography (in Czech: the title, author's name field of study, type of work, supervisor, consulting tutor, abstract, and key words; in English : the title, author's name, abstract, key words), as well as work assignment in compliance with the principle of public access to bachelor projects and master theses according to the given standard.



6. Student will submit the bachelor project or master thesis to the respective department in three hard copies, bound, and electronically. If a proposal is presented to postpone public access to the bachelor project or master thesis (pursuant to Sec. 47b, par.4 of Act N.111 1998 Coll. on Higher Education as altered and amended), student will submit one copy more. The language of the thesis is English.
7. The bachelor project and the master thesis are assessed by the supervisor and reviewed by at least one reviewer. In their reviews they also suggest the final grade.
8. Bachelor projects and master theses are submitted by the date given in the time schedule of the academic year, taking also into account the dates of the State Final Examination, i.e. at least four weeks prior to the first day of the State Final Examination of the given field of study or specialisation.
9. If student fails to submit the bachelor project or the master thesis at the time agreed, which is usually one year, the assignment can still be used for the time period it is valid, as given in Par. 3, which is two years. If, however, student fails to observe the scheduled deadline as given in Par. 3 and the bachelor project or master thesis is submitted after the assignment validity has come to an end, a new assignment has to be given.
10. Supervisor's and reviewer's reports must be made available to student at least 5 days prior to the date of State Final Examination.
11. Technicalities of submitting the research project and defending it, as well as administering the "zápočet" are within responsibility of the head of the department, as well as the defence of the research project, usually held at two dates, namely after the end of the winter/ summer semester courses of the academic year.
12. Courses Research Project 1 and 2 and Master Thesis 1 and 2 run for two semesters. Thus, student cannot register for courses Research Project 1 and Research Project 2 in the same semester, and, likewise, for Master Thesis 1 and Master Thesis 2. These courses can be passed provided student meets the requirements given in the valid work assignment. The student obtains the work assignment in the semester they register for the first part of the course for the first time. Student may not register for the Master Thesis 1 course before the semester following their successful defence of Research project 2.

## **Section 9**

### **Study Visits Abroad**

1. As part of their Bachelor and Master Programme, student may spend some time on a study visit or bilateral agreement exchange programme abroad. These activities, as e.g. ERASMUS+ programme or ATHENS, are organized by the International Office at the CTU Rector's Office.
2. All study visits of Bachelor and Master Programme students follow the rules and regulations of the CTU and are recorded by the Department of Student Affairs of the FNSPE CTU in Prague. These rules also include conditions for study visits to be satisfied by students of the FNSPE CTU:
  - a. weighted grade average as set by the CTU Academic and Examination Statute, but not below 2.3 (for bachelor student applicant taking into account all courses passed so far, for master student applicant taking into account the average of the completed Bachelor Course)
  - b. English course completed by examination administered at the FNSPE CTU with grade not below "good" (= C).

- c. student on any type of degree course is eligible for 1 sojourn abroad not exceeding 2 semesters
  - d. the last semester spent abroad must not be the last semester of student's standard length of degree programme (except for the visit given in Par. 2e. below), supposing that they have met all academic obligations
  - e. MCP student's intention to work on some part of the master thesis or complete it abroad within their sojourn is to be confirmed by their department's consent given in writing and including the name of the assigned deputy supervisor of the thesis from the respective host institution, a statement confirming that both parties agreed on details concerning thesis supervision, and a written consent of the supervisor to the procedures agreed
  - f. student sojourning abroad can be signed in for the semester without being registered for a specific course
3. In compliance with the CTU's rules, arrangements for a study visit abroad comprise:
- a. student's study schedule approved of and recommended by the respective department and submitted to the Department of Student Affairs of the FNSPE CTU prior to the stay
  - b. assessment and evaluation of the study visit and programme taken abroad, credit and course transfer approved by the respective department and Department of Student Affairs of the FNSPE CTU in Prague
  - c. fulfilment of general requirements set by the CTU Academic and Examination Statute (i.e. gaining at least 20 credits transferred from the host university per semester).

## **Section 10**

### **Completion of Study Programme**

1. In compliance with the Academic and Examination Statute of the CTU in Prague, student will conclude their studies by having finished their study programme and passed the State Final Examination including defence of their master thesis or bachelor project.
2. To complete the Bachelor Degree study programme, student must have passed examinations in all compulsory courses of their respective programme (see Sections 4 and 5), having gained at least 180 credits.
3. To complete the Continuation Master Programme (MCP), student must have passed examinations in all compulsory and core-elective courses as stated in the respective programme (see Sec.4 and 5 and Sec.2, Par.1) and gained at least 120 credits (however, at least 180 credits in the three-year course in Radiological Physics).

## **Section 11**

### **State Final Examination**

1. Student is eligible to take the State Final Examination only if they have completed their study programme, gained the required number of credits, and submitted by the given date their bachelor project or master thesis.
2. State Final Examinations of the Bachelor's Degree Programme may be held at two terms, usually in September or in February, which is in accordance with the time schedule of the academic year, or at an extraordinary date subject to the respective department's request. Each department will announce the subjects set for the State Final Examination in the Bachelor's

Degree Programme by September 30th for the February term, and by January 31st for the September term, or no later than four months prior to an extraordinary term of the State Final Examination.

3. State Final Examinations of the Master Programme are held at two terms (usually in June or February) according to the time schedule of the academic year, or on an extraordinary term subject to the respective department's request. Each department will announce the subjects set for the State Final Examination in the Continuation Master Programme by September 30th for the February term, and by January 31st for the September term, or no later than four months prior to an extraordinary term.
4. Student's application for admission to the State Final Examination will include the optional subjects chosen for the examination. Applications for the February term are accepted by the end of November, and for the September term by the end of May, or no later than two months prior to the extraordinary term of State Final Examinations. The examination terms are given in the time schedule of the academic year. Applications submitted after the given date will not be considered.
5. If student did not take the State Final Examination in the academic year they had submitted the bachelor project or master thesis, the work submitted by student will be returned to them and respective review reports are no longer valid.
6. The examination follows the Rules of Procedure of the State Final Examination issued by the Dean.
7. The oral part of the State Final Examination in the Bachelor's Degree Programme will consist of one core subject out of the package of field/specialisation courses (with a possible option), and a subject of more detailed specialisation (with a possible option).
8. The oral part of the State Final Examination in the Continuation Master Programme will consist of two core subjects out of the package of field/specialisation courses (with a possible option) and a subject of more detailed specialisation (with a possible option).
9. In accordance with the Academic and Examination Statute of the CTU in Prague, student must take the State Final Examination, and, if such is the case, retake it, within one year and a half of the date they have satisfied all the other requirements of the study programme. The date is understood to be the last day of examination period of the last semester student was registered for courses of the programme of their field. Afterwards, this student still remains enrolled as a student until they have passed the last part of the State Final Examination; however, this period must not exceed one and a half year.

## **Section 12**

### **Termination of Studies**

1. By virtue of Sec. 56, Par. 1, Letter b) of Law No. 111/19898 of Coll., as amended, and Sec.34, Par. 7, Letter b) of the Academic and Examination Statute of CTU, these documents state the following conditions for terminating studies due to failure to satisfy the requirements and academic obligations following from the study programme and Academic and Examination Statute of the CTU in Prague:
  - failure to fulfil academic responsibilities and gain 15 credits after the first semester on the Bachelor Programme and 20 credits after the first semester on the Master Programme
  - failure to gain "zápočet" after second registration for a compulsory course

- failure to pass examination on second retake after second registration for a compulsory course
  - failure to pass examination after second registration for a compulsory course by the end of academic year
  - failure to satisfy eligibility conditions to register for the next academic year (semester)
  - failure to pass the State Final Examination within one and a half year of completing studies
  - failure to pass the State Final Examination within the maximum study period
  - failure to pass retaken State Final Examination
2. Other reasons for terminating studies:
- failure to register for academic year within given period without accepted excuse
  - failure to register for courses after period of deferral
  - transfer to other faculty
  - withdrawal from studies
  - expulsion from the CTU

### **Section 13**

#### **Temporary rules**

1. Within the transfer to the newly accredited fields of study programmes, in academic year 2020-2021 the first-year course structure of the recommended study programmes of the Bachelor and Continuation Master courses follows the new study programmes; however, the higher courses follow the course structure of the previously accredited fields, with the exception of the study programmes for Radiological Technology and Radiological Physics, whose second-year course structure follows the new recommended programmes.
2. In the following fields, the still existing programmes of all years of study, i.e. in Nuclear Engineering, Dosimetry and Applications of Ionizing Radiation, Applications of Software Engineering, Laser and Instrumentation Technology, and Physical Technology follow the previously accredited structure.
3. All special cases related to this transfer will be subject to the Dean's decision.

Professor Ing. Igor Jex, DrSc.

Dean