# CONTENT

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ IG/04 | **Course name:** Acquirement of Internal Grant |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 10 | |
| **Recommended semester/trimester of the course:** 6., 8. | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 141 | |

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ PVS/04 | **Course name:** Author's patents, discoveries, software |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 2 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:**<br>Patent filed, invention, software product created. | |
| **Learning outcomes:**<br>The PhD student demonstrates the ability to create an innovative product in a given scientific field, or with impact on an interdisciplinary scale or in technical practice. | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 46 | |
| abs | n |
| 100.0 | 0.0 |
| **Provides:** | |
| **Date of last modification:** 08.11.2022 | |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. | |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ CM/04 | **Course name:** Citation in monograph |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 20 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 1

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ CZC/04 | **Course name:** Citation in scientific journal published abroad |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 10 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**

Total number of assessed students: 74

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ CDC/04 | **Course name:** Citation in scientific journal published in the country of residence |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 5 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**

Total number of assessed students: 4

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ SCI/04 | **Course name:** Citation registered in Science Citation Index |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 20 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**

Total number of assessed students: 298

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ SMPR/04 | **Course name:** Co-worker of project supported by international grant schemes |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 15 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:**<br>Membership in the research team of an international project. | |
| **Learning outcomes:**<br>Active involvement by solving a specific task within a team of international project solvers. The PhD student demonstrates the ability to work in a team, take responsibility for the assigned task, adhere to the time schedule and fulfill the project outputs. The PhD student gains personal experience from the implementation of an international project, participation in its key stages, creation of measurable outputs, grant funding of science | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 113 | |

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** | |
| **Date of last modification:** 08.11.2022 | |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. | |

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ SDPR/04 | **Course name:** Co-worker of project supported by national grant schemes |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 2 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 616

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ POCF/13 | **Course name:** Computational Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 4 **Per study period:** 56
**Course method:** present

**Number of ECTS credits:** 8

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
To successfully complete the course, it is necessary for the student to demonstrate a sufficient degree of understanding of the principles of selected advanced computational methods. Lectures are organized in blocks, with a selection of topics reflecting the needs of currently registered students. The course ends with a final oral exam, the completion of which is conditioned by the submission of the project electronically and with the attached computer program. The credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (2 credits), project work (2 credits), individual consultations (1 credit), and exam (1 credit). The minimum limit for completing the course is to obtain at least 50% of the total score.

**Learning outcomes:**
To acquaint students with modern methods of computational physics and their application to various physical and non-physical systems. Students have the opportunity to get acquainted with modern Monte Carlo methods and methods of molecular dynamics, developed for demanding simulations of complex systems using parallel programming, as well as their various interdisciplinary applications.

**Brief outline of the course:**
1. Modern Monte Carlo methods for application to problematic complex systems with rugged energy surfaces. Multicanonical methods. Parallel tempering method (replica exchange). Calculation of density of states and free energy using the Wang-Landau method. Massively parallelized Wang-Landau replica exchange method for petaflop supercomputers.
2. Molecular Dynamics. Advanced concepts of computer simulation techniques used in statistical physics and their importance for understanding physical systems. Approach of molecular dynamics and its application in problems of statistical physics. Cellular automata for lattice gas. Problems of dynamics.
3. Other models and applications. Sociophysical models based on spin models. Galam's models. Voting model in hierarchical systems. Group decision model. Dynamics of opinion formation. Sznajd's model and its applications. Applications of statistical physics approaches in modeling spatio-temporal data. Time series predictions and digital image processing. Geostatistical applications.

**Recommended literature:**
Basic literature:

LANDAU, D.P., BINDER, K.: A Guide to Monte Carlo Simulations in Statistical Physics, Cambridge Univ. Press, 5-th edition, 2021.
BOTTCHER, L., HERRMANN, H.J., Computational Statistical Physics, Cambridge Univ. Press, 2021.
BINDER, K., HEERMANN, D.W., Monte Carlo simulation in statistical physics, Springer-Verlag, Berlin, 2002.
HAILE, J.M., Molecular dynamics simulations, John Wiley & Sons. INC., New York, 1992.
KAMBERAJ, H., Molecular Dynamics Simulations in Statistical Physics: Theory and Applications, Springer Nature Switzerland AG, 2020.
VAN KAMPEN, N.G., Stochastic processes in physics and chemistry, North-Holland, 1990.
CHAKRABARTI, B.K. et al. (Editors), Econophysics and sociophysics: Trends and perspectives, Wiley-VCH, 2006.
GALAM, S., Sociophysics: A Physicist's Modeling of Psycho-political Phenomena, Springer, 2012.

**Course language:**

**Notes:**

**Course assessment**
Total number of assessed students: 11

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** prof. RNDr. Milan Žukovič, PhD.

**Date of last modification:** 16.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ODZP/14 | **Course name:** Defence of Doctoral Thesis |
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**Course type, scope and the method:**
**Course type:**
**Recommended course-load (hours):**
**Per week: Per study period:**
**Course method:** present

**Number of ECTS credits:** 30

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
The Dissertation thesis is the result of the student's own scientific research. It must not show elements of academic fraud and must meet the criteria of correct research practice defined in the Rector's Decision no. 21/2021, which lays down the rules for assessing plagiarism at Pavel Jozef Šafárik University in Košice and its constituents. Fulfillment of the criteria is verified mainly in the process of supervising and in the process of the thesis defense. Failure to do so is grounds for disciplinary action.

**Learning outcomes:**
The Dissertation thesis has elements of a scientific work and the student demonstrates extensive mastery of the theory and professional terminology of the field of study, acquisition of knowledge, skills and competences in accordance with the declared profile of the graduate of the field of study, as well as the ability to apply them in an original way in solving selected problems of the field of study. The student demonstrates the ability of independent scientific work in terms of content, formal and ethical aspects. Further details of the Dissertation thesis are determined by Directive no. 1/2011 on the essential prerequisites of final theses and by the Study Rules of Procedure at UPJŠ in Košice for doctoral studies.
The doctoral student demonstrated the ability and readiness for independent scientific and creative activity in the field of study of philology in accordance with the expectations of the relevant qualification framework and the profile of the graduate.

**Brief outline of the course:**

**Recommended literature:**

**Course language:**

**Notes:**

**Course assessment**
Total number of assessed students: 104

| N | P |
|---|---|
| 0.96 | 99.04 |

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| **Provides:** |
| **Date of last modification:** 08.11.2022 |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

**COURSE INFORMATION LETTER**

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ MDU/04 | **Course name:** Detection Methods and Experiments on Large Colliders |

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 4

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Conditions for continuous evaluation:
1. Presence at the lectures as specified by the rules of study and indicated by the lecturer.
2. Activity at seminars.
Conditions for the final evaluation:Research work on a selected topic.
Conditions for the successful course completion:
1. Active presence at lectures.
2. Fulfillment of the conditions of continuous and final evaluation at more than 90% level.
Credit evaluation of the course: direct teaching, individual consultations, self-study (1 credit), practical activities – research work (2 credits), evaluation (1 credit).

**Learning outcomes:**
The student can demonstrate sufficient knowledge about the physics principles and measurement methods in the high energy and particle physics in large experiments with particle accelerators. Aqcuired knowledge can be actively used during the physics analysis of the real experimental data.

**Brief outline of the course:**
1. Passage of radiation through matter.
2. Gaseous detectors: principles of operation, ionization chamber, proportional chamber, spark chamber, streamer chamber, MWPC, drift chamber, TPC.
3. Scintillation detectors: Geiger and Marsden experiments, scintillation detectors, photomultipliers.
4. Calorimeters: calorimetry in the high energy physics, electromagnetic calorimeters, Rossi-Heitler model of the electromagnetic shower, electromagnetic showers, practical realization of electromagnetic calorimeters, energetic resolution of electromagnetic calorimeters.
5. Hadron calorimeters: hadron showers, electromagnetic and hadronic shower components, calorimeter response, compensation, energy resolution.
6. Cherenkov radiation detectors: Cherenkov radiation, differential Ch. detectors, RICH.
7. Transition radiation detectors.
8. Semiconductor detectors: conduction, semiconductors, P-N junction, microstrip detectors, pixel detectors, drift detectors.
9. Time of flight method.

10. Muon detectors: multiple scattering, Branson plane.
11. Photoemulsion detectors.
12. Experiments at large accelerators. ALICE experiment at LHC at CERN.

**Recommended literature:**

Dorin N. Poenaru and Walter Greiner: Experimental Techniques in Nuclear Physics, Walter de Gruyter, Berlin-New York, 1997
Kleinknecht k.:Detectors for particle radiation, Cambridge University press,1986
S. Tavernier, Experimental Techniques in Nuclear and Particle Physics, Springer-Verlag Berlin Heidelberg, 2010

**Course language:**
slovak or english

**Notes:**

**Course assessment**
Total number of assessed students: 9

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** RNDr. Ivan Králik, CSc.

**Date of last modification:** 19.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ DZS/14 | **Course name:** Dissertation examination |
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**Course type, scope and the method:**
**Course type:**
**Recommended course-load (hours):**
**Per week: Per study period:**
**Course method:** present

**Number of ECTS credits:** 20

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Obtaining required number of credits as given by the study plan.

**Learning outcomes:**
Evaluation of competences of the student according to his/her scientific profile.

**Brief outline of the course:**
Presentation of the results in the thesis for disertation exam, responding to referee´s comments, answering questions of exam committee. Two questions are selected subsequently from one compulsory and one optional subject, respectively. The subjects are selected by guarantee of the program according to the study plan and scientific profile of the student. The third question addresses the current state of work on dissertation thesis.

**Recommended literature:**

**Course language:**
english

**Notes:**

**Course assessment**
Total number of assessed students: 133

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:**

**Date of last modification:** 03.05.2015

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/DPSD/14 | **Course name:** Distributed data processing |
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**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 4

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Term project, evaluation.
Credit evaluation of the course: direct teaching, individual consultations and self-study (1 credit), practical activities – term project (2 credits), evaluation (1 credit). Minimum limit for completion of the course is to obtain at least 51% of the total evaluation.

**Learning outcomes:**
Lectures on parallel data processing on analysis farms.

**Brief outline of the course:**
Introduction to batch systems and network storage.
Generate multiple events using event generator and run multiple simulations on cluster.
Analyze these data to produce physics results.
Merge these results when analysis is done.

**Recommended literature:**
https://www.gnu.org/software/bash/
http://www.adaptivecomputing.com/products/open-source/torque/
http://root.cern.ch/drupal/
http://xrootd.org/
https://eos.readthedocs.org/en/latest/

**Course language:**
English

**Notes:**

**Course assessment**
Total number of assessed students: 9

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** RNDr. Martin Vaľa, PhD.

**Date of last modification:** 18.11.2021

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| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ VPBP/04 | **Course name:** Elaboration of reviewer report |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 2 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 23 | |

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/EFVE/04 | **Course name:** Electronics for Nuclear Physics |
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**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 5

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**

**Learning outcomes:**
To show the basics methods of data acquisition in the recent high energy physics experiments.

**Brief outline of the course:**
Signals from detectors, data flow. Electronics for high energy physics, basics. Front-end and calibration electronics. Selection of interactions - trigger.

**Recommended literature:**
Grupen Claus: Particle Detectors, Cambridge University Press, 1999

**Course language:**

**Notes:**

**Course assessment**
Total number of assessed students: 4

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** doc. RNDr. Jozef Urbán, CSc.

**Date of last modification:** 03.05.2015

**Approved:** prof. RNDr. Milan Žukovič, PhD.

**COURSE INFORMATION LETTER**

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ VPKF2/13 | **Course name:** Energetic particles and heliosphere |

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 4

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Literature search and compilation on one particular subject selected. Concluding work.
Credit evaluation of the course: direct teaching,
individual consultations and self-study (1 credit), practical activities – concluding work (2 credits), evaluation (1 credit).

**Learning outcomes:**
To acquaint with the know edge of selected physical processes in the inner and outer heliosphere.

**Brief outline of the course:**
1. Introduction. Radial structure of the Sun. 2. Sun atmosphere. Solar flares. Acceleration of particles in eruptions. Solar neutrons and gamma radiation. 3. Solar wind. Interplanetary magnetic field. Corotion interaction areas. 4. Plasma waves in the interplanetary environment. Three-dimensional structure of the heliosphere. 5. Active processes in the Sun. Eruptions and outbursts of coronal matter. Shock waves. 6. Solar radio emissions. Thermal emission. Microwave domain. Radio emissions after eruptions and disturbances in the interplanetary environment. 7. Energy particles in the heliosphere. Populations and resources. Solar energy particles. 8. Transport of particles in the interplanetary field. Theoretical foundations. Spatial diffusion. Diffusion in the space of pitch angles. Diffusion in the space of momentum. 9. Interactions of waves and particles in the heliosphere. Transport equations. 10. Observations of particle propagation in the interplanetary environment. Comparison with experiment. 11. Acceleration of particles on shock waves - theoretical models. 12. Particles on shock waves in the interplanetary environment. 13. Galactic cosmic rays and modulation models.

**Recommended literature:**
R. Schwenn, E. Marsch (editors), Physics of the Inner Heliosphere II, Particles, Waves and Turbulence, Springer Verlag, 1991
Reames, D. V., Particle acceleration at the Sun and in the heliosphere, Space Science Reviews, vol. 90, pp. 413–491, 1999. doi:10.1023/A:1005105831781.
K. Scherer, H. Fichtner, E. Marsch, The Outer Heliosphere: Beyond the Planets, Copernicus Gesellschaft e.V., 2000
Lee, M.A., Mewaldt, R.A., and Giacalone, J., Shock Acceleration of Ions in the Heliosphere, 2012, Space Science Reviews, 173, 247. doi:10.1007/s11214-012-9932-y.

Marius S. Potgieter, Solar Modulation of Cosmic Rays, Living Reviews in Solar Physics volume 10, Article number: 3 (2013)

**Course language:**

**Notes:**

**Course assessment**
Total number of assessed students: 3

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** RNDr. Pavol Bobík, PhD.

**Date of last modification:** 18.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

**COURSE INFORMATION LETTER**

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ VPKF1/13 | **Course name:** Energetic particles and magnetospheres |

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 4

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Literature search and compilation on one particular subject selected. Concluding work.
Credit evaluation of the course: direct teaching,
individual consultations and self-study (1 credit), practical activities – concluding work (2 credits), evaluation (1 credit).

**Learning outcomes:**
To acquaint with the know edge of selected physical processes in magnetosphere, especially that of Earth.

**Brief outline of the course:**
1. Particle drifts and the first adiabatic invariant. Guiding center approach. Homogeneous magnetic field. 2. Drifts of zero, first and second order. The first adiabatic invariant. Particle drift at the geomagnetic equator. 3. Oscillating motion between mirror points. Particle capture. Equation of parallel motion with respect to a lineof force. Energy equation. 4. Drift envelopes. The second adiabatic invariant. 5. Drift of particles in a dipole magnetic field. 6. Monitoring of drift envelopes in a real model of a geomagnetic field. 7. Effects of external forces on particles near the equatorial plane. 8. Periodic drift movement. Drift envelopes in a time-dependent magnetic field. 9. Third adiabatic invariant. Influence of ring current on the path of particles near the equator. 10. Effect of sudden compressions and adiabatic expansions of the magnetosphere. 11. Distribution of trapped particles. Directional flow. 12. Distribution functions of particles in the magnetosphere. 13. Mapping of trapped particles in the inner magnetosphere. Coordinates B-L. 14. Disruption of adiabatic invariants. Diffusion mechanisms. 15. Coordinates and distribution functions used. 16. Diffusion equation. Radial diffusion. Angular diffusion in a symmetric field. Combined radial and angular diffusion.

**Recommended literature:**
Roederer, J., Dynamics of Geomagnetically Trapped Radiation, Springer, 1970
M.G. Kivelson and C.T. Russell, Introduction to Space Physics, Cambridge University Press, 1995
J. P. Eastwood, H. Hietala, G. Toth, T. D. Phan & M. Fujimoto , What Controls the Structure and Dynamics of Earth’s Magnetosphere?, Space Science Reviews volume 188, pages251–286, 2015

S. E. Milan, L. B. N. Clausen, J. C. Coxon, J. A. Carter, M.-T. Walach, K. Laundal, N. Østgaard, P. Tenfjord, J. Reistad, K. Snekvik, H. Korth & B. J. Anderson, Overview of Solar Wind–Magnetosphere–Ionosphere–Atmosphere Coupling and the Generation of Magnetospheric Currents, Space Science Reviews volume 206, pages547–573, 2017

**Course language:**

**Notes:**

**Course assessment**
Total number of assessed students: 3

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** RNDr. Pavol Bobík, PhD.

**Date of last modification:** 18.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** CJP/ AJD1/07 | **Course name:** English Language for PhD Students 1 |
|---|---|

**Course type, scope and the method:**
**Course type:** Practice
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 2

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Completion of e-course English for PhD Students (lms.upjs.sk), consultations (1-3).
Written assignments - Professional/Academic CV, Short Academic Biography.

**Learning outcomes:**
The development of students´ language skills - reading, writing, listening, speaking, improvement of their linguistic competence - students acquire knowledge of selected phonological, lexical and syntactic aspects, development of pragmatic competence - students can efectively use the language for a given purpose, with focus on Academic English and English for specific/professional purposes, level B2.

**Brief outline of the course:**
Specific aspects of academic and professional English with focus on correct pronunciation, vocabulary development (noun and verb collocations, phrasal verbs, prepositional phrases, word-formation, formal/informal language, etc.), selected aspects of English grammar (prepositions, grammar tenses, passive voice, etc.), academic writing (professional/academic CV, Short Academic Biography).

**Recommended literature:**
Moore, J.: Oxford Academic Vocabulary Practice. OUP, 2017.
Kolaříková, Z., Petruňová, H., Timková, R.: Angličtina v akademickom prostredí – cvičebnica. Košice, Vydavateľstvo ŠafárikPress, 2021.
Tomaščíková, S., Rozenfeld, J. Developing Academic English in Speaking and Writing. Vydavateľstvo ŠafárikPress, 2021.
McCarthy, M., O´Dell, F.: Academic Vocabulary in Use. CUP, 2008.
Štepánek, L., J. De Haff a kol.: Academic English-Akademická angličtina. Grada Publishing, a.s., 2011.
Armer, T.: Cambridge English for Scientists. CUP, 2011.
lms.upjs.sk

**Course language:**
English, level B2 according to CEFR

**Notes:**

**Course assessment**
Total number of assessed students: 738

| N | Ne | P | Pr | abs | neabs |
|---|---|---|---|---|---|
| 0.0 | 0.0 | 48.1 | 0.0 | 51.9 | 0.0 |

**Provides:** PhDr. Helena Petruňová, CSc., Mgr. Zuzana Kolaříková, PhD.

**Date of last modification:** 16.09.2022

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** CJP/ AJD2/07 | **Course name:** English Language for PhD Students 2 |
| **Course type, scope and the method:**<br>**Course type:** Practice<br>**Recommended course-load (hours):**<br>**Per week:** 2 **Per study period:** 28<br>**Course method:** present | |
| **Number of ECTS credits:** 3 | |
| **Recommended semester/trimester of the course:** 2. | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:**<br>Test, oral exam in accordance with the exam requirements (https://www.upjs.sk/filozoficka-fakulta/cjp/doktorandi-upjs/) | |
| **Learning outcomes:**<br>The development of students´ language skills - reading, writing, listening, speaking, improvement of their linguistic competence - students acquire knowledge of selected phonological, lexical and syntactic aspects, development of pragmatic competence - students can efectively use the language for a given purpose, with focus on Academic English and English for specific/professional purposes, level B2. | |
| **Brief outline of the course:**<br>Academic communication (self-presentation, presenting at scientific meetings and conferences). Specific aspects of academic and professional English with focus on vocabulary development (formality, academic word-list), English grammar (passive voice, nominalisatio), language functions (expressing opinion, cause/effect, presenting arguments, giving examples, describing graphs/charts/schemes, etc.). Cross-language interference. | |
| **Recommended literature:**<br>Moore, J.: Oxford Academic Vocabulary Practice. OUP, 2017.<br>Kolaříková, Z., Petruňová, H., Timková, R.: Angličtina v akademickom prostredí (cvičebnica). UPJŠ Košice, 2021.<br>Tomaščíková, S., Rozenfeld, J. Developing Academic English in Speaking and Writing. Vydavateľstvo ŠafárikPress, 2021.<br>McCarthy, M., O´Dell, F.: Academic Vocabulary in Use. CUP, 2008.<br>Štepánek, L., J. De Haff a kol.: Academic English-Akademická angličtina. Grada Publishing, a.s., 2011.<br>Armer, T.: Cambridge English for Scientists. CUP, 2011. | |
| **Course language:**<br>B2 level according to CEFR | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 729

| N | Ne | P | Pr | abs | neabs |
|---|---|---|---|---|---|
| 0.27 | 0.0 | 93.83 | 1.1 | 4.8 | 0.0 |

**Provides:** PhDr. Helena Petruňová, CSc., Mgr. Zuzana Kolaříková, PhD.

**Date of last modification:** 10.03.2022

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ ESH/09 | **Course name:** Extremal States of Matter |

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 4

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Literature search and compilation on one particular subject selected. Concluding work.
The credit evaluation of the course: direct teaching, individual consultations and self-study (1 credit), practical activities – concluding work (2 credits), evaluation (1 credit).

**Learning outcomes:**
The main goal of lectures is introduction to matter extremal states topic.

**Brief outline of the course:**
1. Inroduction to basic
2. Plasma
3. Quark-hadrons phase transition
4. Short introduction to modern cosmology
5. Space expansion
6. Simple cosmological models
7. Big hot explosion
8. Phase transitions in early space
9. Elements nucleosynthesis and origin of light elements
10. Compact stars
11. Dark matter, dark energy
12. Inflation space

**Recommended literature:**
1. Andrew Liddle, An introduction to modern cosmology, Chichester, UK: Wiley (1998) 129 str.
2. Joseph Silk, The Big Bang
3. Jean Letessier, Johan Rafelski: Hadrons and quark-gluon plasma, Camb. Monogr.Part. Phys. Nucl. Phys. Cosmol. 18: 1-397, 2002.
4. K.Yaki, T. Hatsuda, Y.Miake, Quark-gluon plasma: From big bang to little bang. Camb. Monogr.Part. Phys. Nucl. Phys. Cosmol. 23: 1-446, 2005.

**Course language:**

**Notes:**

| **Course assessment**<br>Total number of assessed students: 3 | |
|---|---|
| N | P |
| 0.0 | 100.0 |
| **Provides:** RNDr. Ivan Králik, CSc., RNDr. Pavol Bobík, PhD. | |
| **Date of last modification:** 19.11.2021 | |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. | |

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ DKZU/04 | **Course name:** Home Conference with Foreign Participation |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 4 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 320 | |

| abs | n |
|---|---|
| 100.0 | 0.0 |

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|---|
| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ NEM/04 | **Course name:** Implementation of new experimental methodology |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 15 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 91 | |

| abs | n |
|---|---|
| 100.0 | 0.0 |

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|---|
| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ MK/04 | **Course name:** International Conference |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 6 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 485

| abs | n |
|---|---|
| 100.0 | 0.0 |

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|---|
| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ UFRJZ/09 | **Course name:** Introduction to Physics of Relativistic Nuclear Collisions |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 5

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
written test and thesis, exam

**Learning outcomes:**
Acquisition of basic knowledges from the high-energy heavy ion physics.

**Brief outline of the course:**
Heavy ion collisions from intermediate to ultra-relativistic energies are covered in this lecture. After the introductory part, including kinematics, cross sections, geometry and centrality of nuclear collisions, the fragmentation processes, multiplicities, longitudinal and transverse momentum spectra of secondary particles are discussed. The next part covers a wide range of subjects from strangeness production and heavy flavors through creation of antinuclei and hypernuclei in nuclear collisions to hadron femtoscopy. Some selected phenomena connected with possible production of the dense and hot nuclear matter (quark-gluon plasma) are introduced. Finally, collective flows, charmonium suppression, di-lepton mass spectra, direct photons and production of particles with high transverse momenta are presented.
1. Introduction
2. Basic overview of the phenomenology of heavy ion collisions
3. Introduction to relativistic kinetic theory
4. Relativistic Boltzmann transport equation
5. Equation of state
6. Relativistic fluid dynamics
7. Simple models
8. Measurable quantities
9. Scaling in hydrodynamic model
10. Direct solution of the kinetic equation
11. Search for quark-gluon plasma
12. Relation to astrophysics

**Recommended literature:**
1. J. Bartke, Introduction to Relativistic Heavy Ion Physics, World Scientific Publishing Co. Pte. Ltd., Singapore, 2009.
2. R. Vogt, Ultrarelativistic Heavy-Ion Collisions, Elsevier, 2007.

3. J. Letessier, J. Rafelski: Hadrons and quark-gluon plasma, Camb. Monogr. Part. Phys. Nucl. Phys. Cosmol. 18: 1-397, 2002.

**Course language:**
slovak and english

**Notes:**

**Course assessment**
Total number of assessed students: 11

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** doc. RNDr. Adela Kravčáková, PhD.

**Date of last modification:** 13.09.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ USM/04 | **Course name:** Introduction to Standard Model |
| **Course type, scope and the method:**<br>**Course type:** Lecture<br>**Recommended course-load (hours):**<br>**Per week:** 2 **Per study period:** 28<br>**Course method:** present | |
| **Number of ECTS credits:** 5 | |
| **Recommended semester/trimester of the course:** 2. | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:**<br>Knowledge of the subject at a sufficient level, exam.<br>Credit evaluation of the course takes into account the following student workload: direct teaching and individual consultations (2 credits), self-study (2 credits), evaluation (1 credit). | |
| **Learning outcomes:**<br>The student learns basic facts about development of the theory of weak interactions. | |
| **Brief outline of the course:**<br>1. Basic properties of the beta dacay and the first attempt to explain observed phenomena. A hypothetical particle neutrino.<br>2. Revolutionary Fermi theory of the beta decay.<br>3. Parity conservation in weak interaction. The experimental proof of parity violation in the beta decay.<br>4. A general form of the weak interaction Hamiltonian.<br>5. Experimetal determination of all free parameters of the weak interaction Hamiltonian. | |
| **Recommended literature:**<br>1. J. Hořejší: Introduction to electroweak unification (World Scientific, Singapore 1994);<br>czech version: Elektroslabé sjednocení a stromová unitarita (Karolinum, Praha 1993).<br>2. P. Renton: Electroweak interactions (Cambridge Univ. Press, Cambridge 1990).<br>3. Francis Halzen, Alan D. Martin: Quarks and Leptons, John Wiley&Sons; in russian: F.Helzen, A.D.Martin: Kvarki i leptoni, Mir, Moskva, 1987.<br>4. Cheng T.P., Li L.F.: Gauge theory of elementary particle Physics, Claredon Press, Oxford, 1984. | |
| **Course language:**<br>slovak and english | |
| **Notes:** | |

| **Course assessment**<br>Total number of assessed students: 18 | |
|---|---|
| N | P |
| 0.0 | 100.0 |
| **Provides:** prof. RNDr. Michal Hnatič, DrSc., RNDr. Ivan Králik, CSc. | |
| **Date of last modification:** 18.11.2021 | |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. | |

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ ZKC/04 | **Course name:** Journals Registered by Current Contets Database |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 20 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 537

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ ZNC/04 | **Course name:** Journals not registered in the Current Contents Connect database and published abroad |

**Course type, scope and the method:**
**Course type:**
**Recommended course-load (hours):**
**Per week: Per study period:**
**Course method:** present

**Number of ECTS credits:** 5

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**

**Learning outcomes:**

**Brief outline of the course:**

**Recommended literature:**

**Course language:**

**Notes:**

**Course assessment**
Total number of assessed students: 69

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:**

**Date of last modification:**

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ DNC/04 | **Course name:** Journals not registered in the Current Contents Connect database and published in the country of residence |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 5 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**

Total number of assessed students: 25

| abs | n |
|---|---|
| 100.0 | 0.0 |

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|---|
| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ DKC/04 | **Course name:** Journals registered in the Current Contents Connect database and published in the country of residence |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 15 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 9

| abs | n |
|---|---|
| 100.0 | 0.0 |

| |
|---|
| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/DK/04 | **Course name:** National Conference |
|---|---|

**Course type, scope and the method:**
**Course type:**
**Recommended course-load (hours):**
**Per week: Per study period:**
**Course method:** present

**Number of ECTS credits:** 2

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation in the home conference.

**Learning outcomes:**
By actively participating in the national scientific conference, the PhD student demonstrates a high degree of ability to identify, evaluate, and apply correct scientific methods or research methodology in his scientific field. He demonstrates the ability to reflect on a specific scientific problem by using the latest approaches and applying them critically. Demonstrates competence in using existing theories and concepts in an innovative way, as well as generating new original scientific knowledge and communicating research results to a wider audience using adequate means and through the Slovak language.

**Brief outline of the course:**

**Recommended literature:**

**Course language:**

**Notes:**

**Course assessment**
Total number of assessed students: 168

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:**

**Date of last modification:** 08.11.2022

**Approved:** prof. RNDr. Milan Žukovič, PhD.

**COURSE INFORMATION LETTER**

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ NZ/04 | **Course name:** Non-reviewed collections of papers and monographs published abroad or in the country of residence |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 2 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 114 | |

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

**COURSE INFORMATION LETTER**

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ DCK/14 | **Course name:** Particle detection by calorimetric methods |

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 4

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Knowledge of the subject at a sufficient level, evaluation. The credit evaluation of the course takes into account the following student workload: direct teaching (1 credit), self-study (2 credits) and evaluation (1 credit).

**Learning outcomes:**
Special lectures oriented towards particle calorimetry.

**Brief outline of the course:**
Interactions of particles with matter:
electrons, protons, charged particles, photons, muons.
Energy loss, range.
Interactions at high energy.
Calorimeters:
Principles of Calorimetry.
Electromagnetic and Hadronic Showers.
Shower Profiles and Containment.
Electromagnetic calorimeters.
Hadronic calorimeters.
Free electron drift velocities in liquid ionization chamber.
Types of Calorimeters:
Compensating and non-compensating.
Total Absorption, Sampling, homogeneous
Scintillation, Ionization, Cherenkov.
Signal Detection.
Shower shapes in hadron calorimeters.
Fluctuations in hadronic energy measurements.
Position resolution in the calorimeters.
Shower maximum detectors.
Signal read-out, processing, calibration of readout electronics. Physics calibration of electromagnetic and hadron calorimeters, jet reconstruction, determination of missing energy and that of the jet energy scale. (Getting from calorimetry to physics results).

Energy and position resolution in calorimetry.

**Recommended literature:**
http://indico.cern.ch/getFile.py/access?contribId=24&resId=0&materialId=slides&confId=44587
http://pdg.lbl.gov/2013/reviews/contents_sports.html
http://indico.cern.ch/getFile.py/access?contribId=24&resId=0&materialId=slides&confId=44587
http://www.slidefinder.net/c/calorimetry_energy_measurements_prof_robin/252b_lecture8/27257380
http://www.kip.uni-heidelberg.de/atlas/seminars/WS2009_JC/compensation1

**Course language:**
English

**Notes:**

**Course assessment**
Total number of assessed students: 0

| N | P |
|---|---|
| 0.0 | 0.0 |

**Provides:** doc. RNDr. Dušan Bruncko, CSc., RNDr. Pavol Stríženec, CSc.

**Date of last modification:** 18.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ PK/04 | **Course name:** Plasma in Space |
| **Course type, scope and the method:**<br>**Course type:** Lecture<br>**Recommended course-load (hours):**<br>**Per week:** 2 **Per study period:** 28<br>**Course method:** present | |
| **Number of ECTS credits:** 5 | |
| **Recommended semester/trimester of the course:** 1. | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:**<br>Literature search and compilation on one particular subject selected. Final examination.<br>Credit evaluation of the course: direct teaching and<br>individual consultations (1 credit), self-study (1 credits), practical activities – iterature search and compilation (2 credits), evaluation (1 credit). | |
| **Learning outcomes:**<br>To acquaint with the specifics of plasma formations in space. | |
| **Brief outline of the course:**<br>1. Differences of matter in cosmic plasma formations from solids, liquids and gases. 2. Distribution function, description of particles in 6D phase space, relation of distribution function and measured flow characteristics. 3. Basic equations for the description of the flow of energetic particles in cosmic plasma. 4. Geomagnetic field. 5. Development of geomagnetic field in the past. IGRF models. 6. Geomagnetic disturbance. Geomagnetic activity indices. The main areas of the Earth's magnetosphere. 7. Particles trapped in magnetic field traps. Description using adiabatic invariants. Disorders of movement and dumping of particles into the upper atmosphere. 8. Atmospheric layers. Influence of cosmic rays on the atmosphere. Radiation doses at different heights and their changes. 9. Propagation of radio waves and the state of the Earth's ionosphere. 10. Plasma of the solar wind. Concentration, flow rate and temperature. The influence of the solar wind on the immediate vicinity of the Earth. 11. Basic data on solar flares. Models of acceleration in eruptions. Classification of eruptions. 12. Plasma and magnetic field in the solar system. Discharges of coronal substance. 13. What is space weather, how is it monitored and what are the prediction methods. | |
| **Recommended literature:**<br>1. Rossi B., Olbert S.: Introduction to the Physics of Space, ruský preklad, Moskva, 1974.<br>2. George K. Parks, Physics of Space Plasmas, 2004, Westview Press<br>3. Paul M. Bellan, Fundamentals of Plasma Physics, Cambridge University Press, 2006<br>4. Current materials published in cosmic physics. | |
| **Course language:** | |
| **Notes:** | |

| **Course assessment**<br>Total number of assessed students: 3 | |
|---|---|
| N | P |
| 0.0 | 100.0 |
| **Provides:** RNDr. Pavol Bobík, PhD. | |
| **Date of last modification:** 19.11.2021 | |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. | |

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ VYS/04 | **Course name:** Presentation in Seminar |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 2 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 383

| abs | n |
|---|---|
| 100.0 | 0.0 |

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|---|
| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

**COURSE INFORMATION LETTER**

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ KCHD/04 | **Course name:** Quantum Chromodynamics |

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 5

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Knowledge of the subject at a sufficient level, exam. The credit evaluation of the course takes into account the following student workload: direct teaching (2 credits), self-study (2 credits) and evaluation (1 credit).

**Learning outcomes:**
Lectures are oriented on explanation of the strong interaction on the base of first principles, their description and analysis of both elastic and deep-inelastic scattering of hadrons and leptons. Determination of the color is introduced, which is basic quantum number for strongly interacting particles and fundamental physical principle on which quantum chromodynamics (QCD) is constructed. Basic features of this theory are explaned and it is demonstrated its application for calculation cross sections of typical interacting processes in presence of mesons and baryons.

**Brief outline of the course:**
1. The concept of color as the basic quantum number of hadrons and the basic principle for formulating a fundamental theory for strongly interacting particles.
2. Color special unitary calibration group SUc (3).
3. Quarks and gluons as SUc multiplets (3).
4. Partons, cross sections, formfactors (basic knowledge).
5. Deep-elastic scattering of electrons on a proton. Neutrino scattering on a nucleon. Summation rules.
6. Additive parton model.
7. The concept of structural function. Bjorken scaling.
8. Quantum chromodynamics as a theory of strong interactions and its Lagrangian.
9. Feynman graphs in momentum representation.
10. Binding constant for QCD and asymptotic freedom.
11. Confinement of quarks and gluons.
12. QCD within the standard model.

**Recommended literature:**
Cheng T.P., Li L.F.: Gauge theory of elementary particle Physics, Claredon, Press, Oxford, 1984.
Yndurain F.J.: Quantum chromodynamics. An introduction to the theory of Quarks and gluons, Springer-Verlag, Berlín, 1983;

Francis Halzen, Alan D. Martin: Quarks and Leptons, John Wiley&Sons, 1984

**Course language:**
slovak and english

**Notes:**

**Course assessment**
Total number of assessed students: 21

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** prof. RNDr. Michal Hnatič, DrSc.

**Date of last modification:** 18.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

| | |
|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ RMU/12 | **Course name:** Radiobiological Modeling of the Effect of Ionizing Radiation |
| **Course type, scope and the method:**<br>**Course type:** Lecture<br>**Recommended course-load (hours):**<br>**Per week:** 2 **Per study period:** 28<br>**Course method:** present | |
| **Number of ECTS credits:** 4 | |
| **Recommended semester/trimester of the course:** 1. | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:**<br>To review biophysical and statistical models for evaluation of biological equivalent dose (BED) of ionizing radiation based on the type of dosing and timig of the therapy as well as on the type of biological object (tumor, healthy tissue. To describe the linear-quadratic model, Lyman model for predictive determination of complications (NTCP) and the Poisson model for the determination of tumor control probability ( TCP). | |
| **Brief outline of the course:**<br>Classification of tissue damage by ionozing radiation – outputs of experimental and clinical radiobiology. Stochastic a deterministic effects of ionozing radiation. Immediate and retarded effects of ionozing radiation. Radiation damage of the malignant and normal tissue – therapeutic ratio. Tumor reaparation, repolulation, redistribution, and reoxygenization. Linear-quadratic model and the biological equivalent dose. Volume factor in the radiotherapy – dose-volume histograms ( DVH). Lymanov-Kutcher-Burman model of complication propabilityNTCP. Recommandations of the QUANTEC project for the appreciation of the retarded effects prediction. The Poisson model for the determination of tumor control probability - TCP. BioGray – an SW tool for the TCP/NTCP predictive modeling. Optimalization of the radiation treatment applying 3D CT/MR , DVH and fractionation. | |
| **Recommended literature:**<br>1. Dale R.G,Jones B. : Radiobiological Modelling in Radiation Oncology, London 2007<br>2. Steel G.G.et al.: Basic Clinical Radiobiology,London 2002<br>3. Matula P. Prínos rádiobiologického modelovania v radiačnej onkológii , Habilitačná práca. TU, Trnava 2008<br>4. Šlampa P., Petera J.: Radiační onkológie Galen Karolinum Praha 2007 | |
| **Course language:** | |
| **Notes:** | |

| **Course assessment**<br>Total number of assessed students: 1 | |
|---|---|
| N | P |
| 0.0 | 100.0 |
| **Provides:** doc. RNDr. Pavol Matula, CSc. | |
| **Date of last modification:** 03.05.2015 | |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. | |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ RZ/04 | **Course name:** Reviewed International or National Proceedings |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 5 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 280

| abs | n |
|---|---|
| 100.0 | 0.0 |

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|---|
| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ VDM/11 | **Course name:** Selected Detection Methods of Nuclear Radiaton |
| **Course type, scope and the method:**<br>**Course type:** Lecture / Practice<br>**Recommended course-load (hours):**<br>**Per week:** 2 / 2 **Per study period:** 28 / 28<br>**Course method:** present | |
| **Number of ECTS credits:** 5 | |
| **Recommended semester/trimester of the course:** 2. | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:**<br>Written work and its presentation, preparation and measurement of selected laboratory tasks, exam. Credit evaluation of the subject: direct teaching and consultations (1), self-study (1), practical activities- lab. tasks (2), evaluation (1), total 5 credits. Minimum limit for completion of the course is to obtain at least 51% of the total evaluation. | |
| **Learning outcomes:**<br>To extend the theoretical and experimental knowledge about current detection methods and selected detection systems. Gaining knowledge in the preparation of laboratory tasks and experiments in nuclear physics. | |
| **Brief outline of the course:**<br>General Charateristics of Detectors.<br>Detectors: ionization, scintillation, semiconductor.<br>Pulse Signals in Nuclear Electronics. Signal Transmission.<br>Electronics for Pulse Signal Processing.<br>Pulse Height Selection and Coincidence.<br>Laboratory practice from selected detection methods. | |
| **Recommended literature:**<br>1. W.R.Leo, Techniques for Nuclear and Particle Physics Experiments, Springer Verlag, 1994<br>2.J.R.Cooper, K.Randle, R.S. Sokhi: Radioactive Releases in the Environment, Impact and Assessment, J.Wiley &Sons, Ltd., 2003<br>3.R.L. Murray, Nuclear Energy, An Introduction to the Concepts, Systems and Aplications of Nuclear Processes, 6th Edition, Elsevier, 2009<br>4. S.N.Ahmed, Physics & Engineering of Radiation Detection, Elsevier, 2015 | |
| **Course language:**<br>Slovak and English | |
| **Notes:** | |

| **Course assessment**<br>Total number of assessed students: 9 | |
|---|---|
| N | P |
| 0.0 | 100.0 |
| **Provides:** doc. RNDr. Janka Vrláková, PhD. | |
| **Date of last modification:** 22.11.2021 | |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. | |

**COURSE INFORMATION LETTER**

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ VKJSF/04 | **Course name:** Selected Topics from Nuclear and Subnuclear Physics |

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 4 **Per study period:** 56
**Course method:** present

**Number of ECTS credits:** 10

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
preparation of a paper draft using several selected key publications
Credit distribution:
lectures + consulting: 37 hours - 2 credits
preparation the paper draft + study: 95 hours - 5 credits
writing the paper draft: 56 hours - 3 credit

**Learning outcomes:**
Gain knowledge on the heavy ion experimental programme at CERN SPS accelerator leading to the discovery of the kvark-gluon plasma. Gain knowledge on heavy-ion programme at RHIC collider at BNL and at CERN LHC.

**Brief outline of the course:**
I. block (1.-6. week):
1. Ultrarelativistic heavy ion collisions. Introduction. Discovery of QGP.
2. SPS accelarator, heavy ion beams and the key experiments at CERN.
3. NA44 experiment.
4. NA45 experiment.
5. NA49 experiment.
6. NA50 experiment.
7. WA97 and NA57 experiments.
8. WA98 experiment.
9. Ingredients of the CERN QGP.
10. Claim of discovery.
II. block (7.-12. week):
1. Experiment STAR at RHIC.
2. Discovery of Ridge structure.
3. Indication of Mach cone.
4. Elliptical flow at RHIC.
5. Jet quenching.
6. QGP signatures at CERN LHC.
7. Possible signatures in small systems at ALICE experiment.

Applied, medical physics:
General part: Rutherford scattering, nuclear phenomenology, nuclear models, nuclear radiation, use of nuclear physics, energy losses in matter, particle detection, accelerators, elementary particle properties, symmetry, discrete transformations, neutral kaons, oscillations and CP violation, Standard model.
Special part: Nuclear reactions, biological effects of radiation, industrial and analytical applications, nuclear medicine.

**Recommended literature:**

1. Griffiths D.: Introduction to Elementary Particle, WILEY-VCH, 4th Reprint, 2010
2. Bettini A.: Introduction to Elementary Particle Physics, Cambridge Univ. Press, Reprinted 2010
3. Perkins D.H.: Introduction to High Energy Physics, Cambridge University Press, 2000
4. Slugeň V. a iní: Jadrovo-energetické zariadenia, STU Bratislava, 2003
5. Fernow R.: Introduction to Experimental Particle Physics, Cambridge University Press, 1986
6. Das A., Ferbel T.: Introduction to Nuclear and Particle Physics, (2nd Edition), World Scientific Publishing Co. Pte. Ltd., Singapore, 2003
7. Lilley J.S.: Nuclear Physics - Principles and Application, J. Wiley & Sons, Ltd., Chichester, 2001
8. Ashok Das, Thomas Ferbel, Introduction to Nuclear and Particle Physics, (2nd Edition), 2003, World Scientific Publishing Co. Pte. Ltd., Singapore, ISBN 981-238-744-7.
9. John.S. Lilley, Nuclear Physics - Principles and Aplications, 2001, John Wiley& Sons, Ltd., Chichester, ISBN-0 471 97935 X, ISBN-0 471 97936 8.

**Course language:**
slovak and english

**Notes:**

**Course assessment**
Total number of assessed students: 26

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** doc. RNDr. Marek Bombara, PhD., doc. RNDr. Janka Vrláková, PhD., RNDr. Ivan Králik, CSc.

**Date of last modification:** 22.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ VKTF/04 | **Course name:** Selected Topics from Theoretical Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 4

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Knowledge of the subject at a sufficient level. The credit evaluation of the course takes into account the following student workload: direct teaching and individual consultations (2 credits), self-study (1 credit) and evaluation (1 credit).

**Learning outcomes:**
The aim is a short renewal of master course and application of quantum field theory in physics of elementary particles and in macroscopic systems with infinite number of degrees of freedom.

**Brief outline of the course:**
1. Lectures cover wide sphere of problems of high energy physics and statistical physics. Specific applications are carried out for basic theories of elementary particles – Quantum electrodynamics (QED), Quantum Chromodymanics (QCD), standard model (SM) and for some models of unified theory of elementary particles.
2. Application of quantum field theory to the classical physics is concentrated on explanation of connection between the quantum field and statistical fluctuations of classical fields, generating functional of Green functions of quantum fields and statistical sum, on the Feynman graphs and perturbative technique in statistical physics

**Recommended literature:**
1. Bogoljubov N.N., Shirkov D.V.: Vvedenie v teoriju kvantovannich polej, Nauka (1957, 1973, 1984)
2. L.Rajder: Kvantovaja teorija pola, Moskva, Mir (1987)
3. Amit D.J., Field theory , the Renormalization Group, and Critical Phenomena,, McGraw-Hill (1978)
4. Zinn-Justin J.: Quantum Field Theory and Critical Phenomena, Claredon Press, Oxford (1989, 1993)
5. Vasiliev A.N. : Kvantovopolevaja renormgruppa v teorii kritičeskogo povedenia i stochastičeskoj dinamike, Izd. Peterburgskogo instituta jadernoj fiziky, Sankt Peterburg (1998)

**Course language:**
slovak and english

**Notes:**

| **Course assessment**<br>Total number of assessed students: 1 | |
|---|---|
| N | P |
| 0.0 | 100.0 |
| **Provides:** prof. RNDr. Michal Hnatič, DrSc. | |
| **Date of last modification:** 18.11.2021 | |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. | |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ SSOL/04 | **Course name:** Self-motivated Study on Scientific Literature |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 2 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 195

| N | P |
|---|---|
| 0.0 | 100.0 |

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|---|
| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ SJSF1a/04 | **Course name:** Seminar from Nuclear and Subnuclear Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 3

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation in seminars, presentation at a seminar. The credit evaluation of the course takes into account the following student workload: practical activity - preparation of the contribution and its presentation (3credits).

**Learning outcomes:**
To bring the topical problems, methodics and tools of high energy physics to the students.

**Brief outline of the course:**
Department seminar - selected topical problems of the nuclear and subnuclear physics.

**Recommended literature:**

**Course language:**
Slovak and English

**Notes:**

**Course assessment**
Total number of assessed students: 22

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Janka Vrláková, PhD.

**Date of last modification:** 22.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ SJSF1b/04 | **Course name:** Seminar from Nuclear and Subnuclear Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 3

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation in seminars, presentation at a seminar. The credit evaluation of the course takes into account the following student workload: practical activity - preparation of the contribution and its presentation in English (3credits).

**Learning outcomes:**
To bring the topical problems, methodics and tools of high energy physics to the students.

**Brief outline of the course:**
Department seminar - selected topical problems of the nuclear and subnuclear physics.

**Recommended literature:**

**Course language:**
Slovak and English

**Notes:**

**Course assessment**
Total number of assessed students: 22

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Janka Vrláková, PhD.

**Date of last modification:** 22.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ SJSF2a/04 | **Course name:** Seminar from Nuclear and Subnuclear Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 3

**Recommended semester/trimester of the course:** 3.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation in seminars, presentation at a seminar. The credit evaluation of the course takes into account the following student workload: practical activity - preparation of the contribution and its presentation (3credits).

**Learning outcomes:**
To bring the topical problems, methodics and tools of high energy physics to the students.

**Brief outline of the course:**
Department seminar - selected topical problems of the nuclear and subnuclear physics.

**Recommended literature:**

**Course language:**
Slovak and English

**Notes:**

**Course assessment**
Total number of assessed students: 20

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Janka Vrláková, PhD.

**Date of last modification:** 22.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ SJSF2b/04 | **Course name:** Seminar from Nuclear and Subnuclear Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 3

**Recommended semester/trimester of the course:** 4.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation in seminars, presentation at a seminar. The credit evaluation of the course takes into account the following student workload: practical activity - preparation of the contribution and its presentation in English (3credits).

**Learning outcomes:**
To bring the topical problems, methodics and tools of high energy physics to the students.

**Brief outline of the course:**
Department seminar - selected topical problems of the nuclear and subnuclear physics.

**Recommended literature:**

**Course language:**
Slovak and English

**Notes:**

**Course assessment**
Total number of assessed students: 20

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Janka Vrláková, PhD.

**Date of last modification:** 22.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ SJSF3a/04 | **Course name:** Seminar from Nuclear and Subnuclear Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 3

**Recommended semester/trimester of the course:** 5.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation in seminars, presentation at a seminar. The credit evaluation of the course takes into account the following student workload: practical activity - preparation of the contribution and its presentation (3credits).

**Learning outcomes:**
To bring the topical problems, methodics and tools of high energy physics to the students.

**Brief outline of the course:**
Department seminar - selected topical problems of the nuclear and subnuclear physics.

**Recommended literature:**

**Course language:**
Slovak and English

**Notes:**

**Course assessment**
Total number of assessed students: 16

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Janka Vrláková, PhD.

**Date of last modification:** 22.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ SJSF3b/04 | **Course name:** Seminar from Nuclear and Subnuclear Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 3

**Recommended semester/trimester of the course:** 6.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation in seminars, presentation at a seminar. The credit evaluation of the course takes into account the following student workload: practical activity - preparation of the contribution and its presentation in English (3credits).

**Learning outcomes:**
To bring the topical problems, methodics and tools of high energy physics to the students.

**Brief outline of the course:**
Department seminar - selected topical problems of the nuclear and subnuclear physics.

**Recommended literature:**

**Course language:**
Slovak and English

**Notes:**

**Course assessment**
Total number of assessed students: 15

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Janka Vrláková, PhD.

**Date of last modification:** 22.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ SJSF4a/04 | **Course name:** Seminar from Nuclear and Subnuclear Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 3

**Recommended semester/trimester of the course:** 7.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation in seminars, presentation at a seminar. The credit evaluation of the course takes into account the following student workload: practical activity - preparation of the contribution and its presentation (3credits).

**Learning outcomes:**
To bring the topical problems, methodics and tools of high energy physics to the students.

**Brief outline of the course:**
Department seminar - selected topical problems of the nuclear and subnuclear physics.

**Recommended literature:**

**Course language:**
Slovak and English

**Notes:**

**Course assessment**
Total number of assessed students: 13

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Janka Vrláková, PhD.

**Date of last modification:** 22.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ SJSF4b/04 | **Course name:** Seminar from Nuclear and Subnuclear Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 3

**Recommended semester/trimester of the course:** 8.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation in seminars, presentation at a seminar. The credit evaluation of the course takes into account the following student workload: practical activity - preparation of the contribution and its presentation in English (3credits).

**Learning outcomes:**
To bring the topical problems, methodics and tools of high energy physics to the students.

**Brief outline of the course:**
Department seminar - selected topical problems of the nuclear and subnuclear physics.

**Recommended literature:**

**Course language:**
Slovak and English

**Notes:**

**Course assessment**
Total number of assessed students: 13

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Janka Vrláková, PhD.

**Date of last modification:** 22.11.2021

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/MSF/04 | **Course name:** Simulation of Experiments and Processes in Subatomic Physics |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 5

**Recommended semester/trimester of the course:** 1.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Term project, its presentation, evaluation.
The credit evaluation of the course takes into account the following student workload: direct teaching (1 credit), self-study (1 credit), practical activities - project, tasks (2 credits) and evaluation (1 credit). The minimum limit for completing the course is to obtain at least 51% of the total score.

**Learning outcomes:**
To introduce the students into the simulation of experiments and to the available programming tools.

**Brief outline of the course:**
The role of simulation in physics. Probability theory and mathematical statistics. Frequently used distributions in physics. The Monte Carlo methods. Random number generators and their realisations. Programming tools used in high energy physics experiments simulation (e.g. GEANT, PYTHIA).

**Recommended literature:**
.Hudson: Lectures on Elementary statistics and probability, CERN 63-29, 1963
D. Hudson: Maximum likehood and Least square theory, CERN 64-18,1964
Manuály modelovacích programov
A.G. Frodersen, O.Skjeggestad, H.Tofte: Probability and statistics in particle physics, Universitetsforlaget, Bergen-Oslo-Tromso, 1978

**Course language:**

**Notes:**

**Course assessment**
Total number of assessed students: 17

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** RNDr. Martin Vaľa, PhD.

**Date of last modification:** 18.11.2021

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| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** Dek. PF UPJŠ/JSD/14 | **Course name:** Spring School for PhD Students |
|---|---|

**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week: Per study period:** 4d
**Course method:** present

**Number of ECTS credits:** 2

**Recommended semester/trimester of the course:**

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Active participation in the Spring School of PhD students of UPJŠ.

**Learning outcomes:**
By actively participating in the Spring School of PhD Students of UPJŠ, the PhD student demonstrates a high level of ability to process the issues of his dissertation for a multidisciplinary audience with an emphasis on clarifying the motivation, scientific problem, processing methodology and own contribution to the solution of the selected topic. The PhD student demonstrates the ability to professionally discuss various research topics, present his own positions and accept a plurality of opinions. Demonstrates the ability to communicate research results to a wider professional audience with adequate means and through the Slovak language.

**Brief outline of the course:**
1. Interdisciplinary lectures from the fields of medicine, natural sciences, law, public affairs, humanities. Lecturers - top foreign or national experts from the mentioned fields.
2. Scientific lectures in sections created within related disciplines. Lecturers - top experts from UPJŠ from the mentioned fields.
3. Scientific contributions of PhD students in sections of related fields.
4. Panel discussions on the issue of PhD studies and current trends in the development of scientific disciplines at UPJŠ.

**Recommended literature:**
Proceedings of the Spring School of Doctoral Students.

**Course language:**

**Notes:**

**Course assessment**
Total number of assessed students: 187

| abs | n |
|---|---|
| 100.0 | 0.0 |

**Provides:** doc. RNDr. Marián Kireš, PhD.

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| **Date of last modification:** 08.11.2022 |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ ZSP/04 | **Course name:** Study Stay Abroad |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 2 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 265 | |
| abs | n |
| 100.0 | 0.0 |
| **Provides:** | |
| **Date of last modification:** | |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. | |

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ SLNZ/09 | **Course name:** Study of Lepton-Nucleon Collisions |
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**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 5

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**

**Learning outcomes:**
To review the results of lepton-nucleon collision studies.

**Brief outline of the course:**
The lectures are concentrated on the analysis of relativistic leptons (electron, positron, and neutrinos) collisions with nucleons (protons and neutrons) and based on these results to study the internal structure of hadrons, mainly that of the proton. Determination of the proton (neutron, pion) structure functions and the extraction of parton structure functions in the proton.To study the photon structure function and analysis of diffractive processes in lepton-nucleon collisions.

**Recommended literature:**
1. Dušan Bruncko: Štúdium leptónovo-nukleónových zrážok (Study of lepton-nucleon collisions)
http://home.saske.sk/~bruncko/img/paper/skripta.pdf
http://home.saske.sk/~bruncko/img/paper/skripta.ps

**Course language:**

**Notes:**

**Course assessment**
Total number of assessed students: 1

| N | P |
|---|---|
| 0.0 | 100.0 |

**Provides:** doc. RNDr. Dušan Bruncko, CSc., RNDr. Ivan Králik, CSc.

**Date of last modification:** 03.05.2015

**Approved:** prof. RNDr. Milan Žukovič, PhD.

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ VPSV/04 | **Course name:** Supervision of Student's Scientific Activity |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 6 | |
| **Recommended semester/trimester of the course:** 6., 8. | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 19 | |

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ VBP/04 | **Course name:** Supervisor/consultant of bacelor thesis |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 6 | |
| **Recommended semester/trimester of the course:** 6., 8. | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 44 | |

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ PPC/04 | **Course name:** Teaching activities |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 1 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 268

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ PPC/04 | **Course name:** Teaching activities |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 1 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |

**Course assessment**
Total number of assessed students: 268

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

**University:** P. J. Šafárik University in Košice

**Faculty:** Faculty of Science

| **Course ID:** ÚFV/ PSU/04 | **Course name:** Tools for Data Analysis and Processing |
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**Course type, scope and the method:**
**Course type:** Lecture
**Recommended course-load (hours):**
**Per week:** 2 **Per study period:** 28
**Course method:** present

**Number of ECTS credits:** 4

**Recommended semester/trimester of the course:** 2.

**Course level:** III.

**Prerequisities:**

**Conditions for course completion:**
Student will make a root macro for data analysis related to the student's research area.
The results will be presented at a final seminar.
Credit distribution:
lectures + consulting: 37 hours - 2 credits
study + preparation for the final seminar: 37 hours - 2 credits

**Learning outcomes:**
Extending the knowledge of the modern statistical data processing, archivation and visualisation of experimental and theoretical data, basic knowledge of the work with object oriented applications for analysis and data visualisation - ROOT and GRID.

**Brief outline of the course:**
I. block (1.-9. week):
Selected topics from methods of experimental data analysis in physics, particle physics and from programming of basic physical applications in GRID and ROOT environment.
II. block (10-12.week):
Data analysis in particle physics, data fitting, error propagation, statistical and systematic uncertainties.

**Recommended literature:**
An Object Oriented Data Analysis Framework, http://root.cern.ch.
GridCafe, http://gridcafe.web.cern.ch/gridcafe/
Wikipedia article on the World Community Grid: Contains additional links for each project being conducted on the World Community Grid.
A Gentle Introduction to Grid Computing and Technologies (pdf). Retrieved on 2005-05-06, http://www.buyya.com/papers/GridIntro-CSI2005.pdf

**Course language:**

**Notes:**

| **Course assessment**<br>Total number of assessed students: 11 | |
|---|---|
| N | P |
| 0.0 | 100.0 |
| **Provides:** RNDr. Pavol Bobík, PhD., doc. RNDr. Marek Bombara, PhD. | |
| **Date of last modification:** 21.11.2021 | |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. | |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ POVK/04 | **Course name:** Work in Organizing Committee of Conference |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 2 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 100 | |

| abs | n |
|---|---|
| 100.0 | 0.0 |

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| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |

## COURSE INFORMATION LETTER

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|---|---|
| **University:** P. J. Šafárik University in Košice | |
| **Faculty:** Faculty of Science | |
| **Course ID:** ÚFV/ PDS/18 | **Course name:** Writing Dissertation Work |
| **Course type, scope and the method:**<br>**Course type:**<br>**Recommended course-load (hours):**<br>**Per week: Per study period:**<br>**Course method:** present | |
| **Number of ECTS credits:** 0 | |
| **Recommended semester/trimester of the course:** | |
| **Course level:** III. | |
| **Prerequisities:** | |
| **Conditions for course completion:** | |
| **Learning outcomes:** | |
| **Brief outline of the course:** | |
| **Recommended literature:** | |
| **Course language:** | |
| **Notes:** | |
| **Course assessment**<br>Total number of assessed students: 22 | |

| N | P |
|---|---|
| 0.0 | 100.0 |

| |
|---|
| **Provides:** |
| **Date of last modification:** |
| **Approved:** prof. RNDr. Milan Žukovič, PhD. |