

**UNIVERSITY OF BUCHAREST****FACULTY OF PHYSICS****Master studies in the field of: Physics****MASTER'S DEGREE PROGRAM: Atomic Physics, Nuclear Physics, Elementary Particles, Astrophysics and Applications (APNPEPAA)****Type of education: full-time****Duration - 4 semesters/120 ECTS****„Physics of the atom, nucleus, elementary particles, Astrophysics and applications”****CURRICULUM****I-st year of study**

C = course; L = laboratory session; S = seminar; E = examination; V = viva voce exam; T = test; Ob.xxx = compulsory course; Op.xxx = elective course

| No .                         | Code   | Courses  | 1-st Semester<br>C L/S V | ECTS<br>Sem. I | 2-nd semester<br>C L/S V | ECTS<br>Sem. II |
|------------------------------|--------|--|--------------------------|----------------|--------------------------|-----------------|
| 1.                           | Ob.401 | Interactions of ionizing radiations with the matter  | 2 2 E                    | 6              |                          |                 |
| 2.                           | Ob.402 | Biostatistics and medical informatics  | 2 2 E                    | 6              |                          |                 |
| 3.                           | Ob.403 | Elective Course I1x(DI1-DI4)   | 2 2 E                    | 5              |                          |                 |
| 4.                           | Op.404 | Elective course I2x (DI1-DI4)  | 2 2 E                    | 5              |                          |                 |
| 5.                           | Op.405 | Statistic analysis for experimental data and methods for computing and simulation                        | 2 2 E                    | 5              |                          |                 |
| 6.                           | Ob.406 | Radiation sources, dosimetry and radiological protection   |                          |                | 2 2 E                    | 6               |
| 7.                           | Ob.407 | Neural networks and applications   |                          |                | 2 2 E                    | 6               |
| 8.                           | Ob.408 | Elements of cosmology and astroparticle physics. Extreme states of nuclear matter. Models and processes. |                          |                | 2 2 E                    | 5               |
| 9.                           | Op.409 | Elective course I3x (DI1-DI4)  |                          |                | 2 2 E                    | 5               |
| 10.                          | Op.410 | Elective course I4x (DI1-DI4)  |                          |                | 2 2 E                    | 5               |
| 11.                          | Ob.411 | Research activity  | 3 V                      | 3              | 3 V                      | 3               |
| <b>Hours per week / ECTS</b> |        |  | <b>23 5E, 1V</b>         | <b>30</b>      | <b>23 5E, 1V</b>         | <b>30</b>       |

**DI1-DI5 package of elective courses**

| DI1-DI5        | No | Code               | Course  |
|----------------|----|--------------------|---|
| <b>DI1-DI5</b> | 1  | Op.I1_1<br>Op.I1_2 | - Spectroscopic techniques to investigate atomic, molecular and nuclear systems<br>- Magnetic nuclear resonance             |
|                | 2  | Op.I2_1<br>Op.I2_2 | - Physical principles of imaging. Applications<br>- Bioinformatics. Methods and algorithms                                  |
|                | 3  | Op.I3_1<br>Op.I3_2 | - Models for nuclear structure, nuclear and photonuclear reactions<br>- Experimental physics for heavy ions at low energies |
|                | 4  | Op.I4_1<br>Op.I4_2 | - Radionuclides and medium radioactivity<br>- Nuclear physics applications for life sciences and medicine                   |

## II-nd year

C = course; L = laboratory session; S = seminar; E = examination; V = viva voce exam; T = test; Ob.xxx = compulsory course; Op.xxx = elective course

| No. | Code                         | Courses   | 1-st Semester<br>C L/S V   | ECTS<br>Sem.I    | 2-nd semester<br>C L/S V | ECTS<br>Sem. II |
|-----|------------------------------|---|----------------------------|------------------|--------------------------|-----------------|
| 12. | Ob 501                       | Nuclear and elementary particles physics phenomenology at high energy                 | 2 2 E                      | 6                |                          |                 |
| 13. | Ob. 502                      | Nuclear fission and fusion, nuclear reactors, nuclear energetics and waste management | 2 2 E                      | 6                |                          |                 |
| 14. | Op. 503                      | Elective course II1-x(DII1....DII4)   | 2 2 E                      | 5                |                          |                 |
| 15. | Op 504                       | Elective course II2-x(DII1....DII4)   | 2 2 E                      | 5                |                          |                 |
| 16. | DF1                          | Facultative course 1  | 2 1 V                      | 3                |                          |                 |
| 17. | DF2                          | Facultative course 2  | 2 1 V                      | 3                |                          |                 |
| 18. | Op.505                       | Elective course II3-x(din DII1....DII4)   |                            |                  | 2 2 E                    | 5               |
| 19. | Op.506                       | Elective course II4-x(from DII1....DII4)  |                            |                  | 2 2 E                    | 5               |
| 20. | Ob. 507                      | Research activity. Writing of dissertation paper.                                     | 7 V                        | 8                | 15 V                     | 20              |
|     | <b>Hours per week / ECTS</b> |   | <b>23 4E, 1V<br/>+6 2C</b> | <b>30<br/>+6</b> | <b>23 2E, 1V</b>         | <b>30</b>       |

### *DII1-DII4 package of elective courses*

| DII1-DII4        | No | Code                  | Course   |
|------------------|----|-----------------------|--|
| <b>DII1-DII4</b> | 1  | Op.II1_1<br>Op.II.1_2 | - Detection methods for atom physics, nuclear physics, elementary particles and astrophysics<br>- Large experiments in nuclear and elementary particles physics and astrophysics |
|                  | 2  | Op.II2_1<br>Op.II2_2  | - Atomic and molecular systems properties. Experimental models and techniques<br>- Atomic and molecular clusters   |
|                  | 3  | Op.II3_1<br>Op.II3_2  | - Study of nuclear, astrophysics and cosmology processes with plasma physics<br>- Lasers, plasma and acceleration methods of ions. Applications for ELI-NP experiment            |
|                  | 4  | Op.II4_1<br>Op.II4_2  | - Experimental relativistic nuclear physics<br>- Anomalous states and phase transitions in nuclear matter  |

### *Facultative courses DF*

| Nr.crt | Code | Course   |
|--------|------|--|
| 1.     | DF.1 | - Important simulation codes and experimental data analysis using ROOT framework   |
| 2      | DF.2 | - Cosmological implications of elementary particles properties   |
| 3      | DF.3 | - Radioactive beams, bosonic condensate and new types of nuclei  |
| 4      | DF.4 | - Present experimental problems in atomic and molecular physics, nuclear physics, elementary particle physics and astrophysics |
| 5      | DF.5 | - Complements of nuclear and photonuclear reactions  |

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