# MODULE DESCRIPTION

| Module title | Module code |
|---|---|
| Physics for informatics | |

| Lecturer(s) | Department where the module is delivered |
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| **Coordinator:** prof. habil. dr. Antanas Feliksas Orliukas<br><br>**Other:** | Department of Radiophysics<br>Faculty of Mathematics and Informatics<br>Vilnius University |

| Cycle | Type of the module |
|---|---|
| First | Optional |

| Mode of delivery | Semester or period when the module is delivered | Language of instruction |
|---|---|---|
| Face-to-face | 4 semester | Lithuanian |

| Prerequisites |
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| **Prerequisites:** Mathematics for Software Engineering III, Mathematical logic |

| Number of credits allocated | Student's workload | Contact hours | Self-study hours |
|---|---|---|---|
| 5 | 130 | 60 | 70 |

**Purpose of the module: programme competences to be developed**

Module aim is for students to convey the basic patterns and descriptions, which combine mechanics, molecular structure, solid state, electromagnetic radiation, atomic and nuclear physics units.

***Generic competences:***

- Communication and collaboration *(GK1).*

***Specific competences:***

- Knowledge and skills of underlying conceptual basis *(SK4).*
- Technological and methodological knowledge and skills, professional competence *(SK6).*

| Learning outcomes of the module: students will be able to | Teaching and learning methods | Assessment methods |
|---|---|---|
| Understand and review the basic physics regularities associated with the movement of bodies in space, time, thermodynamic processes, current transfer characteristics of solids as well as the phenomena of radiation, discuss on these topics and employ the knowledge in practice. | Problem oriented teaching with demonstrations and projective techniques. | Two reference works and final exam in written form. |

| Content: breakdown of the topics | Contact hours | | | | | | | Self-study work: time and assignments | |
|---|---|---|---|---|---|---|---|---|---|
| | Lectures | Tutorials | Seminars | Practice | Laboratory work (LW) | *Tutorial during LW* | **Contact hours** | **Self-study hours** | **Assignments** |
| **Mechanics:** | | | | | | | | | 1. The main characteristics of moving bodies dimension derived units of measure definitions.<br>2. Galileo transformations. Lorenz transformations. Relative space and time.<br>3. Newton's laws, gravity force, motion content (pulse), work, power, kinetic energy, potential energy.<br>4. Laws of the pulce, pulce momentum and energy conservation.<br>5. Quantum numbers: the fundamental "n" orbital "l", the magnetic orbital "$m_l$" magnetic spin "$m_s$". Pauli schedule. Total max electronic states denomination number. The shells symbols: K, L, M, N, O, P, Q.<br>The shell electrons s, p, d, f subgroups.<br>6. The I-III thermodynamic laws.<br>7. The crystalline and amorphous status of solids, deformation, Hooke's law, Young's modulus, thermal expansion.<br>8. The fluid viscosity, Stokes experiment, irrigation, capillarity.<br>9. Real and ideal gases. Claudius, Clapeyron-Mendeleev equation, isothermal, isobaric, isochoric processes. |
| 1.Basic moving body characteristics:<br>a) the characterization of bodies in space and time, speed, acceleration, angular velocity, angular acceleration,<br>b) the classic and relativistic movements, | 2 | | | | | | **2** | **3** | |
| c) Galileo transformations. Lorentz transformations, | 2 | | | | | | **2** | **2** | |
| d) dynamic of the mechanical principles, | 2 | 0.5 | | | | | **2.5** | **4** | |
| e) conservation laws. | 3 | 0.5 | | | | | **3.5** | **4** | |
| **Molecular Physics:** | | | | | | | | | |
| a) structure of materials, | 3 | 0.5 | | | | | **3.5** | **4** | |
| b) laws of thermodynamics, | 3 | 0.5 | | | | | **3.5** | **4** | |
| c) properties of solid-state materials, | 3 | 0.5 | | | | | **3.5** | **4** | |
| d) liquids, | 2 | 0.5 | | | | | **2.5** | **4** | |
| e) gases. | 2 | 0.5 | | | | | **2.5** | **4** | |
| **The electrical conductivity of the materials:** | | | | | | | | | |
| a) the metals in electric field, | 2 | 0.5 | | | | | **2.5** | **4** | 10. Rikke, Mandelstam-Papaleksi, Stewart-Thomson, Drude-Lorentz, Wideman-Franco, Joules-Lenz works. |
| b) the semiconductors and dielectrics in electric field, | 1 | 0.5 | | | | | **1.5** | **2** | 11. Intrinsic and extrinsic semiconductors, band models, Fermi level, the principle of Paul. Polar and non-polar dielectrics. |
| c) ferroelectrics, | 2 | 0.5 | | | | | **2.5** | **3** | 12. Polarization phenomena of |

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| | | | | | | | | | ferroelectric, hysteresis loop, permittivity, phase transitions. |
| d) diamagnetic, paramagnetic, ferromagnetic in magnetic field, | 2 | 0.5 | | | | | **2.5** | **4** | 13. Magnetic field , permeability, magnetic domains, permeability dependence on the magnetic field magnitude. Bohr magneton. |
| e) superionics, | 3 | 0.5 | | | | | **3.5** | **4** | 14. Frenkel, Schottky point defects, mass and charge transfer supeionic materials |
| f) superconductors. | 2 | 0.5 | | | | | **2.5** | **3** | 15. Low and high-temperature superconductivity. Resistivity anomalies. |
| **The applications of solid state materials** | 5 | 0.5 | | | | | **5.5** | **6** | 16. Fuel cells, solid-state power batteries. gas sensors, electric capacitors (ionistors), $O_2$ gas pumps, electrolyzes, electrochromic displays, memory cells, Lillie's neural model. |
| **Thermal radiation** | 5 | 0.5 | | | | | **5.5** | **6** | 17. Kirchhoff's law of thermal radiation, and the Stefan Boltzmann works Vino's law of thermal radiation, Planck and Rayleigh thermal radiation patterns. |
| **Basics of the atomic and nuclear physics** | 3 | 0.5 | | | | | **3.5** | **4** | 18. Bohr's postulates. Nuclear fission and synthesis. The mass defect, nuclear binding energy. $\alpha$ - decay, $\beta^-$ decay, $\beta^+$ decay, electronic catch, $\gamma$ - radiation. |
| **Space irradiation** | 1 | | | | | | **1** | **1** | |
| Reference works in written form | | | | | | | **2** | | |
| Exam in written form | | | | | | | **2** | | |
| **Total** | **48** | **8** | | | | | **60** | **70** | |

| Assessment strategy | Weight % | Deadline | Assessment criteria |
|---|---|---|---|
| The first reference work in written form | 25% | The seventh week of semester | Control work combines the issues that were discussed during lectures about mechanics, molecular physics and current transfer characteristics in solids. |
| The second reference work in written form | 25% | Fourteenth week of the semester | Control work combines the issues that were discussed about solid-state functional elements application, thermal radiation effects, atomic and nuclear physics regularities. |
| Final exam in written form | 50% | During exam session | The student during the exam accurately formulates the physically regularities and describes them in mathematical terms. |

| Author | Publishing year | Title | Number or volume | Publisher or URL |
|---|---|---|---|---|
| **Required reading** | | | | |
| A.F.Orliukas | 2013 | Slides of the lectures | | www.vu.lt |
| V.Grivickas, A.F.Orliukas, A.Žindulis, S.Tamulevičius | 2008 | Materials science (in Lithuanian) | | Progresus, Vilnius, www.progresus.lt |
| J.D.Cutnell, K.W.Johnson | 2007 | Physics | | Southern Illinois University at Carbondale www.wiley.com/college/cutnell |

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| V.Matvejevas | 1982 | Mechanics and relativity theory (in Lithuanian) | | www.ebooks.vgtu.lt.reeder/fizika/379 |
| A.F. Orliukas | 2004 | Superionic conductors (in Lithuanian) | | VUL, http://www.leidykla.vu.lt |
| J.D.Cutnell, K.W.Johnson | 2006 | Essentials of Physics | | Southern Illinois University at Carbondale, www.wiley.com/college/cutnell |
| **Recommended reading** | | | | |
| P. Brazdžiūnas | 1965 | Physics IV (in Lithuanian) | | Mokslas, Vilnius, www.rfk.ff.vu.lt/doc/fizika_informatikams.ppt |
| T.Kudo, K.Fueki | | Solid State Ionics | | KODANSHA, VCH www.amazon.co.uk |