III. INFORMATION ON DEGREE PROGRAMMES – The Department of Physics

III.A. General description

The Chair of Physics came into existence in 1991 affiliated at the Faculty of Civil and Environmental Engineering. In 2004, the Chair of Physics was set apart from the Faculty of Civil and Environmental Engineering. Currently, Department of Physics is a part of Faculty of Mathematics and Applied Physics.

The academic staff of the Department of Physics consists of 27 persons, including 3 full and 5 associate professors and 13 academic teachers with Ph.D degree, 3 university teachers with a M.A. degree and 3 technicians with a M.Sc. degree. There are six laboratories to develop didactic, research and technical activities at the Chair.

Research work at the Department

- kinetics of phonons and their interaction with low-dimensional conducting structures in semiconductors, propagation of acoustic waves and mechanical properties of crystalline solids;
- interaction of sonic and ultrasonic waves with dispersions;
- experimental studies of molecular dynamics of materials with glassy phase;
- experimental studies of structure and physical properties of selected biological and synthetic biopolymers;
- experimental studies of properties of ferroelectrics and dielectrics;
- application of the light diffraction patterns for the examination of mechanical properties of fibers;
- theory of patterns propagation;
- mathematical methods in quantum mechanics and the theory of magnetism;
- spintronics;
- muonic atoms and molecules in crystalline solids.

III.A.1 Qualifications awarded

Specialisation: Physical Principles of Diagnostics and Measurements (intramural and extramural studies for engineer’s title). The studies last 3.5 academic years (7 semesters)

The aim of the Physical Principles of Diagnostics and Measurements is to educate qualified users of modern measuring and diagnostic devices. The graduates of this specialisation receive thorough knowledge within the core subjects (mathematics, physics), as well as selected technical disciplines (computer engineering, electronics, engineering graphics, automatics fundamentals, technical diagnostics, intelligent measurement systems, digital circuit engineering and microprocessor systems).

Study program for the course of Technical Physics fulfills the criteria recommended by the FEANI.

Necessary conditions to obtain the B.Sc. degree in the Technical Physics are as follows: to complete the subjects included in programme (350 ECTS credits), to complete industrial trainings, to prepare and defend B.Sc. thesis.

III.A.2 Admission requirements

Every year about 60 high school and vocational school graduates are approved to begin their studies at the Chair of Physics.

Polish students entering the higher education system are required to have completed 12 years of school education, passed the final exams (to obtain the General Certificate of Education) and passed an entrance qualification procedure. As the official language of instruction at the University is Polish, all the foreign candidates willing to follow complete schedule of courses have to prove their language competency. To facilitate this applicants are offered one-year-long Polish courses in Łódź at any level of proficiency.

ECTS students do not have any special requirements besides those required by the SOCRATES Programme – Higher Education – Erasmus. For ECTS students instruction and examination in English language can be admitted for individual subjects with the Dean’s consent.
III.A.3 Educational and professional goals

The course syllabus has been devised so as to acquaint students with physical phenomena used both in measuring devices and diagnostic methods. It also provides students with the knowledge necessary to find, select and retrieve information from a variety of different sources and to put it into practice. The completion of the course syllabus gives students an in-depth comprehension of technical issues and enables them to communicate effectively with engineers of other specialisations.

The ability to operate computer programmes for canvassing and processing of the measurement data, the skills needed to administer general purpose computer networks, as well as the knowledge of programming languages will allow the graduates to satisfy future job requirements.

The graduates of this specialization will find employment in a variety of manufacturing enterprises, industrial plants, medical centers, specialist laboratories, and in a number of institutions of state administration.

III.A.4 Access to further study

The graduates of the B.Sc. course in Technical Physics have possibilities to take the lateral extension courses, post-graduate university studies in physics, applied physics (e.g. medical physics) or related disciplines.

III.A.5 Courses structure diagrams with credits

The study plans for B.Sc. courses in Technical Physics (TP) are presented in tables enclosed. Tables are described by symbols in the way that gives information about courses and successive years of study. Subjects are described by: symbols of the subject (key for the subject designation: A – generic, B – basic, and C – specialist subject), name of the individual subjects, type of classes (L – lectures, C – theoretical classes, Lb – laboratory, P – project) and number of hours per week, Z – number of ECTS credits. The letter “E” means that the examination is obligatory.

Technical Physics

L - lectures C - classes, Lb - laboratory, P - projects, E - examination, Z - ECTS credit

Year of studies I

<table>
<thead>
<tr>
<th>Subject Symbol</th>
<th>Subject</th>
<th>Semester 1</th>
<th>Semester 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-MB</td>
<td>Introduction to Engineering</td>
<td>L 2 C 3 Lb P 3</td>
<td></td>
</tr>
<tr>
<td>B-FF</td>
<td>Experimental Physics: Mechanics</td>
<td>2 2 2 E 7</td>
<td></td>
</tr>
<tr>
<td>B-FF</td>
<td>Experimental Physics: Thermodynamics</td>
<td>2 2 E 6</td>
<td></td>
</tr>
<tr>
<td>B-FF</td>
<td>Experimental Physics: Electromagnetism</td>
<td>2 2 2 E 7</td>
<td></td>
</tr>
<tr>
<td>B-FM</td>
<td>Differential Calculus and Integral Calculus</td>
<td>4 2 E 7</td>
<td></td>
</tr>
<tr>
<td>B-FF</td>
<td>Algebra and analytic geometry</td>
<td>4 4 E 7</td>
<td></td>
</tr>
<tr>
<td>B-FF</td>
<td>Basic computer applications</td>
<td>1 4 6</td>
<td></td>
</tr>
<tr>
<td>B-FF</td>
<td>Basic of computer networks and database servers</td>
<td>2 1 1 3</td>
<td></td>
</tr>
<tr>
<td>B-MK</td>
<td>Engineering Graphic</td>
<td>1 2 3</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Mathematical Methods of Physics</td>
<td>3 3 E 7</td>
<td></td>
</tr>
<tr>
<td>B-FF</td>
<td>Programming</td>
<td>1 3 3</td>
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</tr>
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</table>

Year of studies II

<table>
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<tr>
<th>Subject Symbol</th>
<th>Subject</th>
<th>Semester 3</th>
<th>Semester 4</th>
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</thead>
<tbody>
<tr>
<td>A-DJ</td>
<td>English Language</td>
<td>3 3 3</td>
<td>3 3 3</td>
</tr>
<tr>
<td>A-DF</td>
<td>Physical Education</td>
<td>2 0 2</td>
<td>0 0 0</td>
</tr>
<tr>
<td>B-FF</td>
<td>Geometric Optics and Wave Theory of Light</td>
<td>1,3 1 2 E 6</td>
<td></td>
</tr>
<tr>
<td>B-FF+EP</td>
<td>Basics of Electrotechnics and Electronics</td>
<td>2 1 1 E 6</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Numerical methods</td>
<td>2 2 2 E 7</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Selected Problems of Acoustic</td>
<td>1 1 1 4</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Measurement Engineering</td>
<td>2 2 4</td>
<td></td>
</tr>
<tr>
<td>A-ZE</td>
<td>Introduction to Macro and Microeconomics</td>
<td>2 1 2</td>
<td></td>
</tr>
<tr>
<td>A-FF</td>
<td>Fundamentals of Anatomy and Human Physiology – selected issues</td>
<td>2 3</td>
<td></td>
</tr>
<tr>
<td>B-EP</td>
<td>Electronic Circuits</td>
<td>2 1 3 E 6</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Introduction to Quantum Mechanics</td>
<td>4 4 E 8</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Introduction to Atomic and Molecular Physics</td>
<td>2 2 E 8</td>
<td></td>
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### Year of studies III

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<tr>
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<th>Subject</th>
<th>Semester 5</th>
<th>Semester 6</th>
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</thead>
<tbody>
<tr>
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<td></td>
<td>L  C  Lb  P</td>
<td>Z  L  C  Lb  P  Z</td>
</tr>
<tr>
<td>A-DJ</td>
<td>English language</td>
<td>4 2 2 2</td>
<td>2 2 2 2</td>
</tr>
<tr>
<td>C-FF</td>
<td>Introduction to Statistical Physics</td>
<td>2 2 E 6</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Nuclear Physics, Elementary Particles and Dosimetry</td>
<td>2 2 1 E 5</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Quantum Electronics</td>
<td>2 2 E 6</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Lasers and their Application, Nonlinear Optics</td>
<td>2 1 2 E 5</td>
<td></td>
</tr>
<tr>
<td>C-MI</td>
<td>Some problems of Technical Diagnostic</td>
<td>2 1 3</td>
<td></td>
</tr>
<tr>
<td>C-MI</td>
<td>Automatics</td>
<td>1 2 3</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Introduction to Solid State Physics</td>
<td>3 2 1 E 6</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Introduction to Physics of Continuous Media</td>
<td>2 2 E 5</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Computer modelling</td>
<td>1 1 3 3</td>
<td></td>
</tr>
<tr>
<td>A-CB</td>
<td>Principles of the Molecular Cell Biology</td>
<td>2 2 2</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Physical Methods in Technology and Medicine</td>
<td>2 2 1 E 6</td>
<td></td>
</tr>
<tr>
<td>C-MI</td>
<td>Smart Measurement Systems</td>
<td>2 1 3</td>
<td></td>
</tr>
<tr>
<td>C-MI</td>
<td>Digital technique and microprocessors</td>
<td>2 1 3</td>
<td></td>
</tr>
</tbody>
</table>

### Year of studies IV

<table>
<thead>
<tr>
<th>Subject Symbol</th>
<th>Subject</th>
<th>Semester 7</th>
<th>Semester 8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L  C  Lb  P</td>
<td>Z  L  C  Lb  P  Z</td>
</tr>
<tr>
<td>C-FF+EP</td>
<td>Cryogenics</td>
<td>2 2 E 6</td>
<td></td>
</tr>
<tr>
<td>C-FF</td>
<td>Seminary and preparation of BSc thesis</td>
<td>3 24</td>
<td></td>
</tr>
</tbody>
</table>

### III.A.6 Final examination

To grant the professional title of Master of Science in the Technical Physics it is necessary to complete the study programme, to prepare and defend M.Sc. thesis. During a defense of master’s thesis the final oral examination is carried out.

### III.A.7 Examination and assessment regulations

There are several methods of assessing what the students learnt during the classes’ period. The teacher has to inform the students about ways of assessment and to set a date of examination or/and tests for that particular course at the beginning of each course.

The teacher can determine the mode of assessment, by choosing one of the following: written or/and oral examination, written assignment with oral discussion, presentation of the report related to laboratory work, defense of student’s project, written test, training period, seminar. These modes of assessment can be single used or combined with others.

The Polish grading system is based on a scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>very good</td>
<td>5</td>
</tr>
<tr>
<td>good plus</td>
<td>4,5</td>
</tr>
<tr>
<td>good</td>
<td>4</td>
</tr>
<tr>
<td>satisfactory plus</td>
<td>3,5</td>
</tr>
<tr>
<td>satisfactory</td>
<td>3</td>
</tr>
<tr>
<td>fail</td>
<td>2</td>
</tr>
</tbody>
</table>

The ECTS grading system is on a scale of “2” to “5” combined with quality definitions. The cut-off point to successfully complete a course in this scale is the grade “3” defined as satisfactory.

### III.A.8 ECTS Faculty coordinator

Anetta Szynal-Liana, Ph.D., e-mail: aszynal@prz.edu.pl
III.B. Description of individual course

**Technical Physics**

<table>
<thead>
<tr>
<th>Course title:</th>
<th>Course – No.</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Engineering</td>
<td>C-MB</td>
<td>1 Semester</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Type:</th>
<th>Hours/Week/WS/SS</th>
<th>Number of credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>(2 L)/WS</td>
<td>3</td>
</tr>
</tbody>
</table>

**Lecturer:**
Łukasz N. Węsierski, Associate Professor

**Institute/Department:**
Department of Fluid Mechanics and Aerodynamics
al. Powstańców Warszawy 8, 35-959 Rzeszów, Poland
Phone/fax: (0-48) (17) 856 16 08; e-mail: lukwes@prz.edu.pl

**Status of the course in the study program:**
Obligatory course.

**Course description:**

**Objectives of the course:**
Student should obtain some knowledge on the essence of engineering, its development, production processes, and assimilate technical terms.

**Teaching methods:**
Lectures supported by slides, transparencies and films.

**Prerequisites:**
None

**Teaching aids:** Scripts, books.

**Assessment method:** Oral presentation of a report and discussion.

**Registration for course:** No

---

**Experimental Physics: Mechanics**

<table>
<thead>
<tr>
<th>Course title:</th>
<th>Course code:</th>
<th>Semester:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Physics: Mechanics</td>
<td>B-FF</td>
<td>1 Semester</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course type:</th>
<th>Hours/week/WS/SS:</th>
<th>Number of credits:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture+Classes+Laboratory</td>
<td>(2L+2C+2Lb)/WS</td>
<td>7</td>
</tr>
</tbody>
</table>

**Lecturer:**
Krystyna Chlędowska, Ph.D.

**Institute/Department:**
Department of Physics
al. Powstańców Warszawy 6, 35-042 Rzeszów, Poland

**Type of subject:**
Compulsory course.

**Level of course:**
Basic.

**Teaching methods:**
Lectures supported by presentation, films and demonstrations of physical experiments, calculation exercises and laboratory.

**Language of instruction:**
Polish

**Prerequisites:**
Basic knowledge of physics and mathematics is necessary.

**Objectives of the course:**
The student should obtain knowledge of fundamentals of physics and its practical applications. Student should be able to design, perform and elaborate physical experiments and to draw conclusions.

**Course contents:**
1. **World of physics:** • models • point particle • ideal gas • solid body • hypothesis and theories • postulates.
2. **Physical quantities and their units**: scalar quantities • vectors quantities and vector analysis • frames of reference.

3. **Kinematics**: linear and curvilinear motions • equation of motion • quantities characterizing these motions • radius vector • displacement vector • acceleration vector • tangential and centripetal accelerations • angular velocity • angular acceleration • equation of trajectory • path.

4. **Dynamic of material point**: forces • Newton’s law of motion • inertial and noninertial reference systems • momentum • gravitational forces • electromagnetic forces • nuclear forces • Galileo’s principle of relativity • inertial forces – centrifugal and Coriolis • equations of motion • motion of objects with varying masses.

5. **Gravitational field**: Newton’s law of universal gravitation • Kepler’s laws

6. **Work, power and energy**: kinetics energy • work • power • potential energy • conservation of energy • conservation of momentum • mass center of material points system.

7. **Dynamics of solid body**: angular momentum • torque • II Newton’s law for rotational motion • conservation of angular momentum • moment of inertia • Steiner theorem • tensor of momentum • rotational kinetic energy • mass center • motion in the mass center system • precession • gyroscope.

8. **Harmonic motion**: simple harmonic motion • damped oscillations • forced oscillations and resonance • anharmonic oscillations.

9. **Wave motions**: differential equation of wave • phase velocity • interference • beats • velocity of wave group • dispersion • standing wave.

10. **Relativity theory**: Lorentz transformation of space and time • relativistic phenomena • length contraction • time dilation • simultaneity • addition of velocities • space-time • relativistic momentum and energy • mass and energy.

Assessment methods:
calculation exercises – a two tests on the semester laboratory – constant and project-work evaluation lecture – written examination
Course title: Algebra and Analytic Geometry  
Course No.: B-FF  
Semester: 1 semester

Course type: Lecture + Classes  
Hours/Week/WS/SS: (4L+4C)/WS  
Number of credits: 7

Lecturer: Tadeusz Lulek, Professor

Institute/Department: 
Department of Physics  
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland  
Phone: (017) 865 14 63, (017) 865 19 43

Status of the course in the study Program: 
Obligatory course.

Course description: 

Objectives of the course: 
The student should obtain some fundamental knowledge of modern algebra and its most characteristic applications in physics.

Teaching method: Lectures supported by tutorials.

Prerequisites: 
Secondary school level, Secondary-school Certificate.

Teaching aids: Scripts and books containing the topics of the course.

Examination method: Written and oral examinations. Permanent evaluation.

Registration for course: No.

Registration for examination: With lecturer upon appointment.

Remarks: Lecture is suitable for studies of technical physics, as well as engineering.

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Course title: Basic computer applications  
Course – No.: B-FF  
Semester: 1 Semester

Course Type: Lecture + Laboratory  
Hours/Week/WS/SS: (1L+4Lb)/WS  
Number of credits: 6

Lecturer: Czesław Jasiukiewicz, Associate Professor

Institute/Department: 
Department of Physics  
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland  
Phone No./fax: (048) (17) 854 11 14, e-mail: czjas@prz.edu.pl

Status of the Course in the study Program: 
Compulsory course.

Course description: Lecture: 
The purpose of this course is to provide an introduction to the basic computer applications, which are of extraordinary importance for using computers and computer networks. We will focus upon the basic knowledge and experience in this field.

Objectives of the Course: 
To show how to use computer and computer networks. To obtain an elementary experience in using Windows and Linux systems. An introduction to the Microsoft Office, Matlab/Simulink and MC Origin packages.

Teaching methods: 
Lectures and computer laboratory classes.

Prerequisites: Non.

Teaching aids: Textbooks and computer programs.

Assessment method: 
Practical (with a computer) tests.

Registration for course: No.

Registration for examination: No.
Course title: Experimental Physics – Thermodynamics
Course – No.: B-FF
Semester: 2 Semester
Course Type:

<table>
<thead>
<tr>
<th>Lectures + Classes</th>
<th>Hours/Week/WS/SS:</th>
<th>Number of credit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2L+2C)/SS</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Lecturer: Krystyna Chłedowska, Ph.D.

Institute/Department:
Department of Physics
al. Powstańców Warszawy 6, 35-042 Rzeszów, Poland
Phone No./fax: (048) 17 865 18 31, e-mail: kch@prz.edu.pl

Status of the Course in the study Program: Compulsory course.

Course description:

Lecture and problems classes:
1. Basic knowledge: thermodynamics and statistical physics, mass and dimension of molecules, thermodynamic state of the system, the ideal gas, internal energy, the first law of thermodynamics, work done by a gas, temperature, specific heats of ideal gas, changing of the system, Boyle-Mariotte, Charles and Gay-Lussac laws, equation of the adiabatic process, polytropic process, real gas, barometric formula.
2. Molecular physics: introduction to motion, probability, particle thermal motion, particle collision with the wall, gas pressure, average particles energy, Maxwell distribution, experimental test of Maxwell distribution, Boltzmann distribution, Perrin's method of establishing Avogadro's number, macro state and microstate, thermodynamic probability, entropy.
3. Thermodynamics: laws of thermodynamics, Carnot cycle, thermodynamics temperature scale, entropy of an ideal gas, change of entropy for melting, thermodynamics potential, internal and free energies.
4. Liquid state of matter: liquid structure, surface tension and pressure, liquid and solid state boundary phenomena, capillarity.
5. Phase equilibrium: evaporation and condensation, equilibrium liquid and saturated vapour, critical state, melting and crystallization, Clausius-Clapeyron equation, triple point and phase diagram.

Objectives of the Course: Student should obtain knowledge of theoretical background and practical methods to describe of the effects of work, heat and energy on a system. Thermodynamics is an introduction to statistical physics.

Teaching methods: Lectures supported by slides and transparencies. Classes supported by examples of numerical calculation.

Prerequisites: Basic knowledge of physics and mathematics.

Teaching aids: Scripts referring to the actual topics, textbooks.

Assessment method: Written test during semester.

Registration for course: No.

Registration for examination: According to the schedule.

Course title: Experimental Physics – Electromagnetism
Course – No.: B-FF
Semester: 2 Semester
Course Type:

<table>
<thead>
<tr>
<th>Lecture + Classes + Laboratory</th>
<th>Hours/Week/WS/SS:</th>
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</tr>
</thead>
<tbody>
<tr>
<td>(2L+2C+2Lb)/SS</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

Lecturer: Henryk Herba, Ph.D.

Institute/Department:
Department of Physics
al. Powstańców Warszawy 6, 35-040 Rzeszów, Poland
e-mail: herba@prz.edu.pl

Status of the Course in the study Program: Compulsory course.

Course description:

Course Type:

Teaching methods: The course includes a combination of teaching methods such as lecture, problem solving discussions and laboratory learning.

Prerequisites: Knowledge of secondary school-level course.

Recommended Reading

Assessment method: Written test and oral questioning during semester.

Registration for course: No.

Registration for examination: According to the schedule.
Course title: Basics of computer networks and database servers
Course – No.: B-FF
Semester: 2 Semester
Course Type: Lecture + Laboratory + Projects
Hours/Week/WS/SS: (2L+1Lb+1P)/SS
Number of credit: 3
Number of credit:

Lecturer: Andrzej Bąk, Ph.D.

Institute/Department:
Department of Physics
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland
Phone No. (048) (17) 854 18 30, e-mail: sowa@prz.edu.pl

Status of the Course in the study Program: Obligatory.

Course description:
Lecture:
First Steps Into Linux/Unix, Computer Networks (types of computer networks, topology, protocols - TCP/IP), Electronic Mail (structure of a mail message, MIME, email servers, protocols) File servers (FTP, SAMBA), HTTP Servers (Apache), Database Servers (MySQL), Relational databases (SQL, MySQL), SQL (Structured Query Language), HTML (HyperText Markup Language), PHP (Hypertext Preprocessor).

Objectives of the Course:
The student should obtain basic knowledge concerning computer networks and database servers. The student should also gain the skill of creating database-driven web sites by using a server-side scripting language (PHP) and MySQL database server.

Teaching methods:
Lectures supported by computer presentation and laboratory, on-line teaching resources.
Prerequisites: Basic computer knowledge.
Teaching aids: Textbooks and computer programs.
Assessment method:
Completion of the laboratory is based on positive notes from project of database-driven web site.
Registration for course: No.
Registration for examination: No.

Course title: Engineering Graphic
Course – No.: B-MK
Semester: 2 Semester
Course Type: Lecture + Laboratory
Hours/Week/WS/SS: (1L+2Lb)/SS
Number of credit: 3

Lecturer: Bogdan Kozik, Ph.D., Eng.

Institute/Department:
Department of Machine Design
al. Powstańców Warszawy 8, 35-959 Rzeszów, Poland
Phone/fax: (0-48) (17) 865 16 42, e-mail: bogkozik@prz.edu.pl

Status of the course in the study program:
Obligatory course of the study program.

Course description:
Lecture:
The principles of preparation of drawings. The formats of drawing sheets, the scale, the drawing lines, the lettering. Orthographic representation. Views and sections of objects. Dimensioning. Dimensional tolerance, tolerances of form and of position. Temporary fastening and permanent joint. Engineering drawings of machine units. Assembly drawings. Graphic symbols used on diagrams.
Laboratory:
- making orthogonal projection, engineering drawings based on pictorial representation, assembly drawings and on models,
- learning AutoCAD 2006 PL (2D) program and applying it in engineering drawings.

Objectives of the course:
To obtain a fundamental understanding of engineering graphics. This understanding includes the interpretation of technical engineering drawings, and the drawing standards which are common to industry drawings.
To make engineering drawings on the basis of the above.
To obtain working knowledge of AutoCAD 2006 PL.
Teaching methods: Lectures supported by slides and transparencies.
Prerequisites: Basic knowledge of descriptive geometry.
Teaching aids: Scripts, computer program, standards.
Assessment method: Written tests based on the lecture contents. Assignments on sheet drawings and in AutoCAD.
Registration for course: No.
Registration for examination: According to the schedule.
<table>
<thead>
<tr>
<th>Course title:</th>
<th>Mathematical Methods of Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course – No.:</td>
<td>C-FF</td>
</tr>
<tr>
<td>Semester:</td>
<td>2 Semester</td>
</tr>
</tbody>
</table>

**Course Type:** Lecture + Classes  
**Hours/Week/WS/SS:** (3L+3C)/SS  
**Number of credit:** 7

**Lecturer:** Barbara Lulek, Associate Professor

**Institute/Department:**  
Department of Physics  
al. Powstańców Warszawy  6, 35-959 Rzeszów, Poland  
Phone (017) 865 14 63, (017) 865 19 43

**Status of the Course in the study Program:** Compulsory course


**Objectives of the Course:** Student should achieve some elementary knowledge on mathematical methods applied in contemporary physics and gain an experience in typical mathematical routines, together with their physical meaning and computational abilities.

**Teaching methods:** Lectures supported by slides and transparencies. Tutorials supported by examples of numerical calculation.

**Prerequisites:** Secondary school level, Secondary school Certificate.

**Teaching aids:** Scripts referring to the actual topics, textbooks.

**Assessment method:** Written and oral examination. Permanent evaluation.

**Registration for course:** No.

**Registration for examination:** with lecturer upon appointment, within the schedule.

<table>
<thead>
<tr>
<th>Course title:</th>
<th>Programming</th>
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<tbody>
<tr>
<td>Course – No.:</td>
<td>B-FF</td>
</tr>
<tr>
<td>Semester:</td>
<td>2 Semester</td>
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</table>

**Course Type:** Lecture + Laboratory  
**Hours/Week/WS/SS:** (1L+3Lb)/SS  
**Number of credit:** 3

**Lecturer:** Czesław Jasiukiewicz, Associate Professor

**Institute/Department:**  
Department of Physics  
al. Powstańców Warszawy  6, 35-959 Rzeszów, Poland  
Phone No./fax: (048) (17) 854 11 14, e-mail: czjas@prz.edu.pl

**Status of the Course in the study Program:** Compulsory course

**Course description:** Lecture: The purpose of this course is to provide an introduction to the computer programming using programming language C, which is of extraordinary importance for the performing calculations and computer simulations of the physical processes. We will focus upon the basic knowledge and experience in writing computer programs.

**Objectives of the Course:** To show how to write computer programs in C, design computing algorithms, writing program codes, using programming libraries and applying the graphics.

**Teaching methods:** Lectures and computer laboratory classes.

**Prerequisites:** Informatics: basic knowledge of Windows and Linux systems.

**Teaching aids:** Textbooks and computer programs.

**Assessment method:** Pass laboratory exercises during semester.

**Registration for course:** No.

**Registration for examination:** No.

**Recommended Reading**

Core Texts:  
Course title: Geometric Optics and Wave Theory of Light.
Course – No.: B-FF
Semester: 3 Semester
Course Type: Lecture + Classes + Laboratory
Hours/Week/WS/SS: (1L+1C+2Lb)/WS
Number of credits: 6

Lecturer: Jan Domin, Ph.D.
Institute/Department: Department of Physics
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland
Phone No./fax: (048) (17) 865 13 94, e-mail: spjanusz@prz.edu.pl
Status of the Course in the study Program: Compulsory course
Laboratory: Lasers. Elements of photometry. Creation of an image by human eye, binocular vision, sensitivity for colours, defects of a vision. Laboratory according to proposed scheme of topics.
Objectives of the Course: Students will:
– to understand the principles of operation with the optical systems,
– to evaluate the optical parameters for the systems,
– to set up the simple systems,
– to make the simple corrections for some optical systems.
Teaching methods: Lectures supported by slides and transparencies, problem classes, laboratory, on-line teaching resources.
Prerequisites: Mathematics:
A basic working knowledge of differential calculus, linear algebra, and geometry.
Physics background:
Should include the understanding of basic physics and elementary optics.
Recommended Reading:
Assessment method: Regular 15-min. tests, attendance and activity at the laboratory, final written examination.
Registration for course: No.
Registration for examination: According to the schedule.

Course title: Basics of Electrotechnics and Electronics
Course – No.: B-FF+EP
Semester: 3 Semester
Course Type: Lecture + Classes + Laboratory
Hours/Week/WS/SS: (2L+1C+1Lb)/WS
Number of credits: 6

Lecturer: Henryk Herba, Ph.D.
Institute/Department: Department of Physics
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland
e-mail: herba@prz.edu.pl
Status of the Course in the study Program: Compulsory course
Course description:
- Direct-current (DC) circuit calculations.
- Alternating-current (AC) circuit calculations.
- Transformer.
- Basic knowledge of three-phase current.
- Passive elements of electronic systems and their properties.
- Systems with passive elements: voltage dividers, filters.
- Some modern vacuum electronic elements.
- Physical properties of semiconductor elements and the principles of their functioning.
- Basic working principles of diodes and transistors.
- Other semiconductor elements: unijunction transistor, triac, thyristor.
- Optoelectronic elements.
- Integrated circuits – typology and technology.
Objectives of the Course: Students acquire academic and practical knowledge in the field of electrotechnics and basic electronic circuits.
Teaching methods: The course includes a combination of teaching methods such as lecture, problem solving discussions and laboratory learning.
Prerequisites: Previous knowledge acquired during the first year of studies.
Recommended Reading:
2. P. Horowitz, W. Hill, *Developments in the field of electronics have constituted one of the great success stories of this century...*, Cambridge University Press, 2001.
Assessment method: Written test and oral questioning during semester.
Registration for course: No.
Registration for examination: According to the schedule.
Course title: Numerical methods  
Course – No.: C-FF  
Semester: 3 Semester  
Course Type: Lecture + Classes + Laboratory  
Hours/Week/WS/SS: (2L+2C+2Lb)/WS  
Number of credit: 7  

Lecturer: Czesław Jasiukiewicz, Associate Professor  
Institute/Department: Department of Physics, al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland  
Phone No./fax: (048) (17) 854 11 14, e-mail: czjas@prz.edu.pl  
Status of the Course in the study Program: Compulsory course  
Course description: Lecture: The purpose of this course is to provide an introduction to the numerical methods, which are of extraordinary importance for the performing calculations and computer simulations of the physical processes. We will focus upon the basic knowledge and experience in writing computer programs.  
Objectives of the Course: To show how to create algorithms for the numerical calculations and write appropriate computer routines and programs. The course includes the basic knowledge about numerical methods concerning linear and non-linear equations, interpolation and extrapolation, numerical differentiation and integration, eigenproblems, ordinary differential equations and elementary algorithms of linear and non-linear optimization.  
Teaching methods: Lectures, problems classes and computer laboratory classes.  
Prerequisites: Informatics: A basic knowledge of Windows and Linux systems. Programming in C. Mathematics: A basic working knowledge of calculus, linear algebra, ordinary differential equations and Fourier transform.  
Teaching aids: Textbooks and computer programs.  
Assessment method: Pass laboratory exercises during semester. One 90-minute final written examination.  
Registration for course: No.  
Registration for examination: According to the schedule.  
Recommended Reading  
Core Texts:  
1. G. Dahlquist, A. Bjork, Numerical methods, Prentice-Hall, 1974  

Course title: Selected Problems of Acoustics  
Course – No.: C-FF  
Semester: 3 Semester  
Course Type: Lecture + Classes + Laboratory  
Hours/Week/WS/SS: (1L+1C+1Lb)/WS  
Number of credit: 4  

Lecturer: Henryka Czyż, Associate Professor  
Institute/Department: Department of Physics  
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland  
Phone No./fax: (048) (17) 865 14 63, e-mail: hczyz@prz.edu.pl  
Status of the Course in the study Program: Compulsory course for Physical methods in technology and medicine  
Course description: Lecture: Acoustics is a branch of physics that studies sound, namely mechanical waves in gases, liquids, and solids. The application of acoustics in technology is called acoustical engineering. Acoustics is characterized by its reliance on combinations of physical principles drawn from other sources; and that the primary task of modern physical acoustics is to effect a fusion of the principles normally adhering to other sciences into a coherent basis for understanding, measuring, controlling, and using the whole gamut of vibrational phenomena in any material. Divisions of acoustics: acoustical measurements and instrumentation, aeroacoustics, architectural acoustics, biomedical acoustics, environmental noise, physiological acoustics, physical acoustics, speech communication, structural acoustics and vibration, ultrasonics, musical acoustics. Students study a general description of the areas of applications of acoustic waves to technology and medicine.  
Project: No.  
Objectives of the Course: Student should obtain knowledge of theoretical background of acoustics and of applying acoustic waves in modern technology, medicine and measurements. Student should understand the most important processes occurring in an acoustic field and be able for active participation in the laboratory.  
Teaching methods: Lectures supported by slides and transparencies.  
Prerequisites: Background should include a basic understanding of mechanics, waves and of advanced mathematics.  
Teaching aids: Textbooks and computers programs.  
Assessment method: Written test during semester.  
Registration for course: No.  
Registration for examination: According to the schedule.  
Recommended Reading  
Core Text  
F.V. Hunt, Origins in Acoustics, Yale University Press, 1978  
Supplementary Text(s)  
Course title: Measurement Engineering  
Course-No: C-FF  
Semester: 3 Semester

Course type: Lecture+Classes  
Hours/Week/WS/SS: (2L+2C)/WS  
Number of credit: 4

Lecturer: Mariusz Trybus, Ph.D., Eng.

Institute/Department: Department of Physics, al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland
Phone: (017) 865 14 63

Status of the course in the study program: Optional course of the study programs for all engineer and master degree faculties, excluding Electrotechnics and Computer Science Department students.

Course description: General description of metrology problems from the beginning of the measurements history. Relation between quantitative properties and numbers, measurement errors and its definitions, mathematical model of accidental errors. Probability distributions in various models of errors. Measurement as the sampling process. Measurement uncertainty of A,B and AB type – philosophy of the uncertainty. Functional relations describing measurement results – modeling. Interpolation and extrapolation of measurement data. Analog signal processing in measurements (elements of analog measurement system). Digital measurement techniques (AC/CA converters and other elements of digital measuring systems). Computer as the most important element of measurement system and data processing. Examples of selected measurements of physical parameters, together with sample data processing and uncertainty calculations.

Objectives of the course: The student should obtain theoretical and practical knowledge of measurement design, conduction and data processing (prediction of measurement problems related with physical phenomena, process modeling, calculation of uncertainty, extrapolation and interpolation of data, visualization of obtained results).

Teaching methods: Lectures supported by multimedia presentations.

Prerequisites: Basic knowledge of mathematics, statistics and physics are demanded.

Teaching aids: Preselected parts of multimedia presentation (in notes form) will be distributed among participants of the course.

Assessment method: Examination in written form upon appointed terms.

Registration for course: Yes.

Registration for examination: Yes, personally to lecturer or by the Chair Secretary.

Remarks: This lecture should develop technical and metrological thinking about physical processes in surrounding environment. It should also help to understand an analytical form of the nature perception.

Recommended Reading:
Choice; The Theory of Production; Perfect and Imperfect Markets; The Theory of Enterprises; Costs and Revenues in the Enterprise; Technical and Economical Optimum of Production; Monopoly, Monopolistic Competition and Oligopoly; Equilibrium of the Monopoly, Oligopoly and Monopolistic Competition; Alternative Theories of the Enterprise; Markets of Production Factors; Labour Market and Capital Market; Failures of the Market and the Inevitable Interference of the State.

Exercises:
Production Possibilities Curve; Market – Demand, Supply and Price; The Price and Income Elasticity of Demand and Price Elasticity of Supply; The theory of Consumer Choice; The Function of Production; The Theory of Enterprises; The Models of Market Competition; The Technical and Economical Optimum of Production; The Enterprise in the Conditions of Perfect and Imperfect Competition; Alternative Theories of Enterprises; Labour Market and Wages; Capital and Money Market; Stock Market; Failures of Market and the Necessary Interference of the Government.

Objectives of the course:
Students should obtain knowledge concerning the Laws of National Market; The European Union and Global Economy.

Teaching methods:
Lectures supported by transparencies.

Prerequisites:
The basics of mathematical knowledge and logical thinking.

Teaching aids:
Textbooks and presentations.

Assessment method:
Problems-class assignments (35%), regular 15 min. tests (35%).

Registration for course:
No.

Registration for examination:
According to schedule.

Recommended Reading
Core Text:
**Course title:** Introduction to Quantum Mechanics  
**Course – No.:** C-FF  
**Semester:** 4 Semester

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<th>Course Type:</th>
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<td>8</td>
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</tbody>
</table>

**Lecturer:** Tadeusz Paszkiewicz, Professor

**Institute/Department:**  
Department of Physics  
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland  
Phone No./fax: (048) (17) 854 11 14, e-mail: tapasz@prz.edu.pl

**Status of the Course in the study Program:** Compulsory course

**Course description:** Lecture:  
Topics include quantum mechanics of polarized and unpolarized light, various systems of finite number of states, spin-1/2, time-dependent and time-independent, Schrödinger equation, Dirac formulation, one-dimensional systems, tunneling, quantum wells, Bloch theorem, magnetic effects, systems of many particles and density matrices.

**Objectives of the Course:**  
- The course focuses on those aspects of quantum theory that are of particular relevance to applied physics. It is intended to give students a working knowledge of quantum mechanics at a level sufficient to illuminate the operation of standard and advanced quantum devices,
- Application of the principles of quantum mechanics to unfamiliar problems,
- Problem-solving, in lecture examples, problems classes and tutorials,
- Students are required to meet deadlines for completion of work for problems classes and must therefore develop appropriate time-management strategies.

**Teaching methods:**  
Lectures and problems classes, on-line teaching resources.

**Prerequisites:**  
*Mathematics:* A basic working knowledge of differential calculus, and linear algebra.  
*Physics background:* Basic knowledge of quantum physics and electromagnetism.

**Teaching aids:** textbooks and computer programs, presentations  
**Assessment method:** Problems-class assignments (35%), regular 15 min. tests (35%), one 90-minute written examination (30%).  
**Registration for course:** No.  
**Registration for examination:** According to the schedule.

**Recommended Reading:**  

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**Course title:** Introduction to Atomic and Molecular Physics  
**Course – No.:** C-FF  
**Semester:** 4 Semester

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<tr>
<th>Course Type:</th>
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<tbody>
<tr>
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<td>(2L+2C)/SS</td>
<td>8</td>
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</table>

**Lecturer:** Jan Domin, Ph.D.

**Institute/Department:**  
Department of Physics  
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland  
Phone No./fax: (048) (17) 854 13 94, e-mail: spjanusz@prz.edu.pl

**Status of the Course in the study Program:** Compulsory course

**Course description:** Lecture:  
Schrödinger equation for hydrogen-like atoms and quantum numbers describing the discret atomic states and also probable transitions. Magnetic momenta for atoms, elements of spin theory. Zeeman and Stark effects. Models of multielectron systems, space quantisation, Paschen notation of atomic terms, Pauli principle, periodic classification of elements, Hund’s rules.

**Laboratory:** Born-Oppenheimer approximation for molecular models, spectral image of quantum properties of molecules. Quantum numbers for molecular systems-Hund cases.

**Objectives of the Course:** Students will: to understand the fundamental quantum properties of the atoms, to apply the particular atoms models for several categories of the existing atoms, identify the spectral image of the observed atoms in connection with the quantum numbers and selection rules, understand the quantum properties of the molecules, identify the allowed energies of molecules in their spectral images, understand the possible couplings in molecules.

**Teaching methods:** Lectures supported by slides and transparencies, problem classes, on-line teaching resources.

**Prerequisites:**  
*Mathematics:* A basic working knowledge of differential calculus, linear algebra, and geometry.  
*Physics background:* Should include the understanding of basic physics and quantum mechanics.

**Assessment method:** Examination in the written form.  
**Registration for course:** No.  
**Registration for examination:** According to the schedule.
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<tr>
<th>Course title:</th>
<th>Course – No.:</th>
<th>Semester:</th>
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<tbody>
<tr>
<td>Electronic Circuits</td>
<td>B-EP</td>
<td>4 Semester</td>
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<tr>
<td>Lecture + Classes + Laboratory</td>
<td>(2L+1C+3Lb)/SS</td>
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</table>

Lecturer: Andrzej Kolek, Associate Professor

Institute/Department: Department of Electronics Fundamentals
ul. W. Pola 2, 35-959 Rzeszów, Poland
Phone No./fax: (048) (17) 854 11 14, e-mail: akolekn@prz.edu.pl

Status of the Course in the study Program: Compulsory course


Objectives of the Course: Students will:
– acquire a fundamental understanding of elementary electronic circuits,
– be able to design simple electronic circuits,
– use electronic equipment in measurement systems.

Teaching methods: Lectures supported by slides and transparencies, problem classes, laboratory, on-line teaching resources.

Prerequisites: Mathematics: A basic working knowledge of differential calculus, Fourier and Laplace transforms, complex numbers. Circuit Theory: Ability to analyse dc and ac networks in time and frequency domain. Ability to analyse nonlinear circuits.

Electronic Devices: Principles of operation of semiconductor diodes, bipolar and unipolar transistors. Basic characteristics. Large and small signal models

Teaching aids: Books: any book in analog and digital electronics e.g. R. B Northrop "Analog Electronic Circuits", S. Soclof "Design and application of analog integrated circuits"

Assessment method: Regular 15-min. tests, attendance and activity at the laboratory, final written examination.

Registration for course: No.

Registration for examination: According to the schedule.

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<tr>
<th>Course title:</th>
<th>Course – No.:</th>
<th>Semester:</th>
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<tbody>
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<td>Introduction to Statistical Physics</td>
<td>C-FF</td>
<td>5 Semester</td>
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<tr>
<td>Lecture + classes</td>
<td>(2L+2C)/WS</td>
<td>6</td>
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</tbody>
</table>

Lecturer: Tadeusz Paszkiewicz, Professor

Institute/Department: Department of Physics
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland
Phone No./fax: (048) (17) 854 11 14, e-mail: tapasz@prz.edu.pl

Status of the Course in the study Program: Compulsory course

Course description: Lecture: The course develops a unified treatment of statistical mechanics and thermodynamics, which emphasizes the statistical nature of the laws of thermodynamics and the atomic nature of matter. Prominence is given to the Gibbs distribution, leading to a simple treatment of quantum statistics. Undergraduate students of physics will find this a stimulating account of the basic physics and its applications. Only an elementary knowledge of kinetic theory and atomic physics, as well as the rudiments of quantum theory, are presupposed for an understanding of this course.

Objectives of the Course: By the end of the course successful students are expected to be able to: utilize the terms and basic methods of statistical physics; derive expressions for the variation of various properties of macroscopic amounts of material; appreciate the different statistics arising from distinguishable and indistinguishable particles and relate these to the behavior of solids and gases; calculate and manipulate partition functions; analyze the distinction between Fermi-Dirac, Bose-Einstein and Maxwell-Boltzmann statistics, and the origin of these differences; summarize non-classical behaviors such as Electron Degeneracy pressure and Bose-Einstein Condensation.

Teaching methods: Lectures and problems classes, on-line teaching resources.

Prerequisites: Mathematics: A basic working knowledge of differential calculus, linear algebra, statistics and geometry. Physics background: Basic knowledge of quantum physics and thermodynamics, and probability

Teaching aids: textbooks and computer programs, presentations

Assessment method: Problems-class assignments (35%), regular 15 min. tests (35%), one 90-minute written examination (30%).

Registration for course: No.

Registration for examination: According to the schedule.

Recommended Reading
Charles Kittel, Elementary Statistical Physics, Dover Pubns, ISBN: 0486435148

Supplementary Texts: F. Reif, Statistical and Thermal Physics (McGraw-Hill, Singapore, 1985)
Kerson Huang, Statistical Mechanics, Wiley, Edition: 2
Kerson Huang, Kerson Hwang, Introduction to Statistical Physics, Willey
Course title: Nuclear Physics, Elementary Particles, Dosimetry  
Course – No.: C-FF  
Semester: 5 Semester  
Course Type: Lecture + Classes + Laboratory  
Hours/Week/WS/SS: (2L+2C+1Lb)/WS  
Number of credits: 5

Lecturer: Andrzej Adamczak, Associate Professor

Institute/Department: Department of Physics  
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland  
Phone No./fax: (048) (17) 854 14 63, e-mail: andrzej.adamczak@prz.edu.pl

Status of the Course in the study Program: Compulsory course

Course description: Lecture:
Elementary particles, cosmic rays, nuclear forces and nuclear models, nuclear reactions, natural radioactivity, characteristics of radioactive sources, x-rays, accelerators, fusion and fission, interactions of nuclear radiation with matter, biological effects of nuclear radiation, detection of ionizing radiation, detectors, application of nuclear radiation in industry and medicine, nuclear safety and radiation protection.

Laboratory:
Studies of gamma-ray absorption in different materials, determination of the beta-radiation range in various materials.

Objectives of the Course:
Students will:
- acquire a fundamental understanding of the ideas and concepts pertaining low-energy nuclear physics, further develop the ability to recognize the appropriate physics that applies, to any given physical situation, use the Chart of the Nuclides to obtain basic data for a particular isotope,
- understand the mechanisms of radiation interaction with human body, know elements of applied radiation protection, know applications of nuclear radiation in industry and medicine.

Teaching methods: Lectures supported by slides and transparencies, problem classes, laboratory, on-line teaching resources.

Prerequisites:
Mathematics: A basic working knowledge of differential calculus, linear algebra, statistics, and geometry.

Physics background: Should include the understanding of basic physics, quantum mechanics, atomic, and molecular physics.

Teaching aids: Books:
K.S. Krane, “Introductory Nuclear Physics”, John Wiley and Sons,
W.N. Cottingham and D.A. Greenwood, “An Introduction to Nuclear Physics”, Cambridge,
J.S. Lilley, “Nuclear Physics: Principles and Applications”,
S. Webb, “The Physics of Medical Imaging”, IOP Publishing Ltd.,
S.R. Cherry, J. Sorenson, M. Phelps, “Physics in Nuclear Medicine”.

Assessment method: Regular 15-min. tests, attendance and activity at the laboratory, final written examination.

Registration for course: No.
Registration for examination: According to the schedule.

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Course title: Quantum Electronics  
Course – No.: C-FF  
Semester: 5 Semester  
Course Type: Lecture + Classes  
Hours/Week/WS/SS: (2L+2C)/WS  
Number of credits: 6

Lecturer: Tomasz Więcek, Ph.D., Eng.

Institute/Department: Department of Physics  
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland  
Phone No./fax: (048) (17) 854 14 63, e-mail: ftkwiece@prz.edu.pl

Status of the Course in the study Program: Compulsory course

Course description: Lecture:
Review of the quantum mechanics of harmonic oscillators, electromagnetic radiation, classical optical interference, coherence and fluctuations, quantization of the electromagnetic field, interaction of radiation and matter, wave propagation in dispersive media, description of polarization of light, interaction, optical resonators, semiconductor laser.

Objectives of the Course:
Students will:
- use classical optical interference,
- understand electromagnetic theory of light propagation,
- understand interaction of radiation and matter,
- know applications of laser beam.

Teaching methods: Lectures supported by slides and transparencies, problem classes, on-line teaching resources.

Prerequisites:
Physics background:
Should include the understanding of basic physics, quantum mechanics, atomic, and molecular physics.

Recommended Reading: Books:
M. Bertolotti, “Masers and lasers” Bristol, A. Hilger, 1983,
G.Baym, “Lectures on Quantum Mechanics”, Benjamin, Reading, 1974,
H.Haken, “Light, Waves, photons, atoms”, Amsterdam, Elsevier, 1986,

Assessment method: Regular 15-min. tests, attendance and activity at the laboratory, final written examination.

Registration for course: No.
Registration for examination: According to the schedule.
Course title: Lasers and their Application, Nonlinear Optics
Course – No.: C-FF
Semester: 5 Semester
Course Type: Lecture + Classes + Laboratory
Hours/Week/WS/SS: (2L+1C+2Lb)/WS
Number of credits: 5

Lecturer:
Tomasz Więcek, Ph.D., Eng.

Institute/Department:
Department of Physics
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland
Phone No./fax: (048) 17 854 17 44, e-mail: ftkwiece@prz.edu.pl

Status of the Course in the study Program:
Compulsory course in Technical Physics.

Course description:
Lecture:
Useful properties of laser beams, spatial and time coherence, gaussian beams, polarization, wave front radius of curvature, nonlinear optical interactions with matter, fibers, photonic crystal, generation and control pulsed light, modulation of light, semiconductor laser, parameters and characteristic of semiconductor lasers, laser scanning, interferomorphic distance measurement, holographic interferometry, laser instruments, laser technology, lasers in processing information, Abbe-Porter experiment, basic holography, types of holograms, electro-optic and magneto-optic effect, focusing laser beam for processing technology.

Objectives of the Course:
Students will be able:
to understand of properties of laser beams, to use the optical parameters for different systems, to know basic holography, to know applications of laser technology.

Teaching methods:
Lectures supported by slides and transparencies, problem classes, laboratory, on-line teaching resources.

Prerequisites:
Mathematics: A differential calculus, geometry.
Physics background: Introduction to Geometric Optics and Wave Theory Light.

Recommended Reading:
Books:
M. Bertolotti, “Masers and Lasers an historical approach”, Adam Hilger, Bristol 1983

Assessment method: Regular 15-min. tests, attendance and activity at the laboratory.
Registration for course: No.
Registration for examination: No.

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Course title: Some problems of Technical Diagnostic
Course – No.: C-MI
Semester: 5 Semester
Course Type: Lecture + laboratory
Hours/Week/WS/SS: (2L+1Lb)/WS
Number of credits: 3

Lecturer:
Boguslaw Dolega, Ph.D., Eng.

Institute/Department:
Department of Avionics and Control Systems
al. Powstańców Warszawy 8, 35-959 Rzeszów, Poland
Phone No.: (048) (17) 865 12 74, e-mail: dolbog@prz.edu.pl

Status of the Course in the study Program:
Compulsory course

Course description:
Lecture:
The purpose of this course is to provide an introduction to the technical diagnostic. The basic definitions and principles of this knowledge area are presented. Not only the physical aspects and sources of diagnostic information, but also the methodology and techniques of diagnostics are the subject of these lectures. The special attention is paid to diagnostic tasks in information uncertainty.

Laboratory:
The laboratory classes illustrate the lectures. Students can make introduction to diagnostics experiments, optimization of these experiments and try to use the different diagnostics techniques.

Objectives of the Course:
The students should obtain theoretical and practical knowledge and fundamentals for the implementation of diagnostic. They will be prepared to make the diagnostic experiments in science and industry.

Teaching methods: Lectures and laboratory classes.

Prerequisites:
Mathematics: Basic working knowledge of differential equations, geometry, linear algebra, and stochastics.

Teaching aids: Textbooks, datasheets and presentations.

Assessment method: One written test and laboratory activity.
Registration for course: No.
Registration for examination: According to the schedule.
Recommended Reading: Core Texts:
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<td>Automatics</td>
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**Lecturer:**
Michał Chłędowski, Ph.D., Eng.

**Institute/Department:**
Department of Avionics and Control Systems
al. Powstańców Warszawy 8, 35-042 Rzeszów, Poland

**Type of subject:**
Compulsory course

**Level of course:** Basic.

**Teaching methods:** Lectures and laboratory activity.

**Language of instruction:** Polish.

**Prerequisites:**
Basic knowledge of mathematics, electrotechnics and electronics is necessary.

**Objectives of the course:**
Introduction to the problems of industrial automatics, ways of formulating the tasks and methods of solving them, as well as, to projecting the control systems and permitting on their realization devices.

**Course contents:** Winter Semester:

**Introduction to questions of automatics:**

**Basis of control theory**

**The component units of automatics systems – the realization:**

**The control systems – the usage:**

**Investigation of automatics systems:**
The basis the theoretical investigations of automatics systems. Time responses. The frequencies characteristics in different coordinate systems. Frequencies interpretations of stability criterion. The basic apparatus to investigation of automatics systems. Identification of control object. Investigation of measuring and actuators systems. Investigation of regulators. The investigation of open and closed systems.

**Introduction to questions of design automatics systems:**

**Laboratory**

- **I. Elements of control system**
  1. Measuring systems
  2. Actuators systems
  3. Controllers
- **II. Characteristic in automatic**
  1. Static characteristics of automatics elements
  2. Step characteristic of automatics elements
  3. Frequency characteristic of automatics elements
- **III. Analysis and design of control systems**
  1. Basic elements of automatics. Programme Codas or Matlab
  2. Investigation of influence of feedback coupling on proprieties of elements
  3. Investigation of stability of control systems
  4. Controller design

**Assessment methods:**
calculation exercises – a final test at the end of the semester laboratory – constant and project-work evaluation lecture – written examination
Course title: Introduction to Solid State Physics  
Course – No.: C-FF  
Semester: 6  
Number of credit: 5  
Hours/Week/WS/SS: (2L+2C)/SS  
Lecture + Classes  
Course Type:  

Course title: Introduction to Physics of Continuous Media  
Course – No.: C-FF  
Semester: 6  
Number of credit: 6  
Hours/Week/WS/SS: (3L+2C+1Lb)/SS  
Lecture + Classes + Laboratory  
Course Type:  

Lecturer: Vitaly Dugaev, Associate Professor  
Institute/Department:  
Department of Physics  
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Phone No./fax: (048) (17) 865 1858, e-mail: vdugaev@prz.edu.pl  

Status of the Course in the study Program:  
Compulsory course for specialization “Physics in measurements and diagnostics”  

Course description: Lecture:  
The purpose of this course is to provide an introduction to the physical properties of solids, which are of extraordinary importance in the modern world and are often quite astonishing. We will focus upon the fundamental, unifying concepts important in understanding the properties of nuclei and electrons in solids. The subjects are chosen to establish the basic principles, to describe phenomena that are responsible for the importance of solids in science and technology, and in some cases to include topics of current research. The subjects are chosen to establish the basic principles, to describe phenomena that are responsible for the importance of solids in science and technology, and in some cases to include topics of current research.  

Objectives of the Course: To show how the diverse properties (mechanical, electronic, optical and magnetic) of solid materials can be related to interactions at the atomistic level, using theoretical models.  
To show how the study of condensed matter plays a vital part both in other areas of physics and, more generally in science, technology and industry.  
Teaching methods: Lectures and problems classes, on-line teaching resources.  
Prerequisites:  
Mathematics: A basic working knowledge of differential equations, geometry, linear algebra, and Fourier transform.  
Physics background: Basic knowledge of quantum physics and statistical physics.  
Teaching aids: textbooks and computer programs, presentations.  
Assessment method: Problems-class assignments (35%), regular 15 min. tests (35%), one 90-minute written examination (30%).  
Registration for course: No.  
Registration for examination: According to the schedule.  
Recommended Reading: Core Texts:  
Ch. Kittel Introduction to Solid State Physics  
Neil W. Ashcroft and N. David Mermin, Solid State Physics, Holt and Rinehart and Winston  
Principles in the Theory of Solids, by Ziman, a very readable presentation of the concepts used in Solid State Physics, uncluttered by details.  
Teaching aids: textbooks and computer programs, presentations.  
Assessment method: Problems-class assignments (35%), regular 15 min. tests (35%), one 90-minute written examination (30%).  
Registration for course: No.  
Registration for examination: According to the schedule.  
Recommended reading: Core Texts:  
Richard P. Feynman, Robert B. Leighton, Matthew Sands, The Feynman Lectures on Physics, Addison-Wesley  
V.V. Sychev, Thermodynamics of complex systems, (in Russian or Polish)
**Course title:** Computer modelling  
**Course – No.:** C-FF  
**Semester:** 6 Semester

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<tr>
<th>Course Type:</th>
<th>Hours/Week/WS/SS:</th>
<th>Number of credit:</th>
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<tr>
<td>Lecture + Classes + Projects</td>
<td>(1L+1C+3P)/SS</td>
<td>3</td>
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**Lecturer:**  
Czesław Jasiukiewicz, Associate Professor  
**Institute/Department:**  
Department of Physics  
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland  
Phone No./fax: (048) (17) 854 11 14, e-mail: czjas@prz.edu.pl

**Status of the Course in the study Program:**  
Compulsory course

**Course description:**  
Lecture: The purpose of this course is to provide an introduction to the computer modeling of physical processes. We will focus upon the basic knowledge and experience in writing computer programs.  

**Objectives of the Course:**  
To show how to create algorithms for the numerical simulations and write appropriate computer routines and programs. The course includes the basic knowledge of molecular dynamics, the Monte Carlo methods and an elementary information about the simulation of the quantum processes.  

**Teaching methods:**  
Lectures, problems classes and projects.

**Prerequisites:**  
*Informatics:* A basic knowledge of Windows and Linux systems. Programming in C.  
*Mathematics:* A basic working knowledge of calculus, linear algebra, differential equations and Fourier transform.  
*Physics background:* Basic knowledge of statistical physics and quantum physics.

**Teaching aids:**  
Textbooks and computer programs.

**Assessment method:**  
Elaboration and writing reports of two choosen projects.

**Registration for course:**  
No.

**Registration for examination:**  
No.

**Recommended Reading:**  
Core Texts:  
5. C. Kittel, *Introduction to solid state physics*, John Willey and Sons Inc., 1966  

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**Course title:** Principles of the Molecular Cell Biology  
**Course – No.:** A-CB  
**Semester:** 6 Semester

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<th>Course Type:</th>
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<tr>
<td>Lectures</td>
<td>(2L)/SS</td>
<td>2</td>
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**Lecturer:**  
Elżbieta Walajtys-Rode, Professor  
**Institute/Department:**  
Department of Biochemistry and Biotechnology  
al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland  
Phone no: (+ 48) (17) 865 19 27, e-mail: ewalajty@prz.edu.pl

**Status of the Course in the study Program:**  
Compulsory course

**Course type:** Basic, obligatory.  

**Course aims:**  
To give an understanding of the molecular basis of the structure and function of cell as unit of life. To introduce the students to the dependence between structure and function at the level of biomolecules, biopolymers and functional complexes, subcellular structures, cells and tissues. To give insight into key concepts in molecular biology; genome organisation and gene transfer as well as into mechanisms of metabolic and energy transduction processes.

**Course synopsis:**  
Lecture: The course will cover both basic and applied concepts in biochemistry and cell biology. It is designed for students with minimal knowledge of cell biology and biochemistry. Topics include structure of proteins, lipids and carbohydrates, their function and their interactions with particular focus on proteins. Enzymes and their basic kinetics and mechanisms of action and regulation are covered. Metabolic pathways are examined from functional and regulatory perspectives. Extended topics to be covered include examination of energy transduction processes in heterotrophic and phototrophic organisms. Evolution of the cell and cell specialization as well as plasma membrane structure and transport across the cell membranes and cell to cell signaling are explored. The course provides also an overview of the key concepts in molecular biology including nucleic acid structure and function, DNA replication, transcription, translation, chromosome structure and remodeling and regulation of gene expression in procaryotes and eucaryotes.

**Seminars:**  
Seminars provides an overview of posttranslational protein modifications and application of fluorimetric methods in protein and nucleic acid analysis.
Teaching methods: Lectures and seminars.

Prerequisites:
Chemistry: A basic working knowledge of principles of organic and physical chemistry.
Biology: College level of cell biology.

Teaching aids: Textbooks, presentations (power point).

Evaluation: Seminars: one 60 min written test evaluation (35%), lectures: one 90-minute written test evaluation (65%).

Registration for course: No.
Registration for examination: According to the schedule.

Recommended Reading:
2. B.D. Hames, N.M. Hooper, J.D. Houghton; Instant Notes in Biochemistry, BIOS Scientific Publisher Ltd, 2 Edition, 2004

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<th>Semester:</th>
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<td>Physical Methods in Technology and Medicine</td>
<td>C-FF</td>
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<th>Number of credit:</th>
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<td>Lecture + Laboratory + Project</td>
<td>(2L + 2Lb + 1P)/SS</td>
<td>6</td>
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Lecturer:
Elżbieta Szwajczak, Ph.D.

Institute/Department:
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al. Powstańców Warszawy 6, 35-959 Rzeszów, Poland
Phone No./fax: (048) (17) 856 12 76, (048) (17) 854 14 3 e-mail: etsz@prz.edu.pl

Status of the Course in the study Program:
Compulsory course

Course description: Lecture:
Projects:
1. Introduction: Application of physical methods in material engineering and biomedical engineering; devices; apparatus; detectors. 2. Lasers in medicine: surgery; biostimulation, dermatology; oncology 3. Infrared radiation: telecommunication; crime detection (study); military applications; medical thermography 4. Microwaves: radiotelescopy; radiolocation; heating units (devices) 5. Microscopy: optical properties of materials 6. Ultrasound: ultrasonography; study of mechanical properties; examination and measurement of material structures 7. Ionizing radiation and radioisotopic methods: röntgenoscopy and röntgenography; scintigraphy; tomography; radiotherapy; radiation(al) methods in technology.

Laboratory:

Design works - projects and laboratory works

Objectives of the Course:
Student should obtain knowledge of theoretical and practical background of physical phenomena and methods/techniques used in technology and medicine.

Teaching methods:
Lectures and problems classes (projects), on line teaching resources.
Lectures supported by slides and transparencies.
Projects supported by examples of numerical calculation.
Prerequisites:
A basic working knowledge of mathematical methods in physics is required. Physics background - a basic understanding of (experimental and theoretical physics) classical and quantum mechanics, electromagnetism, thermodynamics, atomic and nuclear physics, optics and condensed matter physics.

Teaching aids:
Textbooks and computer programs, presentations.

Assessment method:
Tests during semester (laboratory), submission of design works (projects), written examination.

Registration for course: No.

Registration for examination: According to the schedule.

Recommended Reading:
D. Pozar, Microwave Engineering, Addison Wesley, 1993
C.M. Rumack, S.R. Wilson, Diagnostic Ultrasound (2-Volume Set) Mosby-Year Book Inc, Hardcover, 2005
J.P. Heath, Dictionary of Microscopy, Willey, 2005

Course title: Smart Measurement Systems
Course – No.: C-MI
Semester: 6 Semester

Course Type: Lecture + Laboratory
Hours/Week/WS/SS: (2L+1Lb)/SS
Number of credit: 3

Lecturer: Jacek Pieniążek, Ph.D., Eng.
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Status of the Course in the study Program:
Compulsory course

Course description:
Lecture:
The purpose of this course is the presentation of modern measurement methods. This course provides an introduction to the analog signal conversion and equivalent digital algorithms, analog to digital conversion, measurement microcontrollers, digital signal processors and interconnection links. Some subject from the area of advanced measurement methods, including error compensation, failure detection and redundancy support in device level and in the measurement system level are presented. These algorithms include classical ones and artificial intelligence possibilities.

Objectives of the Course:
Presentation of the modern measurement methods, including analog to digital conversion and various methods of digital signal processing collaborating with analog measurement devices. The theoretical knowledge will be support by the laboratory stands where students can make practical experiments.

Teaching methods:
Lectures and problems classes.

Prerequisites: Basics of electronics, Fourier transform and signals conversion.
Teaching aids: Textbooks and computer programs, laboratory equipment

Assessment method:
Evaluation of the preparation for laboratory exercises and the reports from exercises (70%), one written test of theoretical knowledge (30%).

Registration for course: No.
Registration for examination: No exam.

Recommended Reading:
C. Marven, G. Ewers A simple approach to digital signal processing John Willey & Sons, Inc, 1996
Course title: Digital technique and microprocessors  
Course – No.: C-MI  
Semester: 6 Semester

Course Type: Lecture + classes  
Hours/Week/WS/SS: (2L+2C)/SS  
Number of credit: 3

Lecturer: Józef Grzybowski, Ph.D., Eng.

Institute/Department:  
Department of Avionics and Control Systems  
al. Powstańców Warszawy 8, 35-959 Rzeszów, Poland  
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Status of the Course in the study Program: Obligatory course

Course description:
Lecture: The purpose of lecture is to provide introduction to digital integrated circuits, TTL and CMOS technology which are basis for all computers. We will focus ourselves on architecture and principle of operation microprocessors, memories, input-output circuits and analog to digital converters. Family of microcomputers Intel, Thomson, Siemens, Microchip, Silicon Laboratories, Texas Instruments, Analog Devices. Architecture and operation DSP processors. Tools for programming and debugging microprocessors systems. Measuring systems and data logging microcomputer systems, examples of hardware and software. Application of Fuzzy Logic with FUZZY- Tech tools. Microcomputer control systems, interfaces IEE625, CAN.

Laboratory: Basis course of programming microcomputer MCS51 family, input-output control, interrupts, analog-digital conversion, display control. Application in motion control, cooperation with PC computer. Microcomputer data logging system.

Objectives of the Course: Learning basic level digital technique and digital circuits application. To show architecture of microprocessors and one chip microcomputers. Basic information how to use microprocessor for data acquisition systems end experiments.

Teaching methods: Lectures and problems classes, on-line teaching resources.

Prerequisites:
Mathematics: A basic working knowledge of differential equations, geometry, linear algebra, Laplace and Fourier transform.

Physics background: Basic knowledge of electrostatics, AC and DC current, magnetics, electromagnetic fields.

Electronics background: Basic knowledge of electronic components, semiconductors, analog circuits, pulsed circuits.

Teaching aids: Textbooks and computer programs, presentations, laboratory exercises.

Assessment method: Problems-class assignments (35%), regular 15 min. tests (35%), one 90-minute written examination (30%).

Registration for course: No.

Registration for examination: According to the schedule.

Course title: Cryogenics
Course – No.: C-FF+EP
Semester: 7 Semester

Course Type: Lectures + Laboratory
Hours/Week/WS/SS: (2L+2Lb)/WS
Number of credit: 6

Lecturers:
Krystyna Chłędowska, Ph.D. and Krzysztof Mleczko, Ph.D., Eng.

Institute/Department:
Department of Physics
al. Powstańców Warszawy 6, 35-042 Rzeszów, Poland
Phone No./fax: (048) (17) 865 18 31, e-mail: kch@prz.edu.pl, kmleczko@prz.edu.pl

Status of the Course in the study Program:
Compulsory course.

Course description:
Lecture and laboratory:
1. The way to absolute zero temperature.
2. The methods of obtain a low temperatures: cooling thermodynamic cycle, Joule-Thomson effect, gas condensing, adiabatic and nuclear demagnetization.
3. Low temperature thermometry: gas thermometers, pressure thermometers, resistance thermometers, magnetic thermometers, thermocouple.
4. Properties of cryogenic liquids: properties of $^4$He, $^3$He, N, CO$_2$.
5. The properties of construction materials in low temperature: mechanical properties, thermal properties, electric properties.
7. Superconductivity: Meissner effect, temperature dependence of resistivity, superconductors I and II type, theory of superconductivity, Josephson effect, SQUIDs.
8. Spin systems: negative absolute temperature.
11. Practical exploitation of low temperature technology.

Objectives of the Course: Student should obtain knowledge of theoretical background and practical methods to working with low temperature.

Teaching methods: Lectures supported by slides and transparencies.

Laboratory.
Prerequisites: Basic knowledge of thermodynamics, statistical physics, quantum physics and mathematics
Teaching aids: Materials referring to the actual topics, textbooks.
Assessment method: Written test during semester
Registration for course: No.
Registration for examination: According to the schedule.