# POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

## COURSE DESCRIPTION CARD - SYLLABUS

Course name
Second Physical Laboratory [S1FT2>IIPF]

### Course

Field of study
Technical Physics

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

### Number of hours

Lecture
0

Laboratory classes
45

Other
0

Tutorials
0

Projects/seminars
0

### Number of credit points

3,00

### Coordinators

dr Ewa Chrzumnicka
ewa.chrzumnicka@put.poznan.pl

### Lecturers

### Prerequisites

Knowledge of experimental physics within the curriculum implemented in the Technical Physics program (1st-3rd semester, undergraduate level).

### Course objective

1. To provide students with expanded knowledge on selected topics in experimental physics. 2. To teach students how to perform more complex experiments. 3. To develop students' skills in processing measurement results, especially focusing on correctly formulating conclusions. 4. To cultivate teamwork skills while also encouraging individual development of competencies.

### Course-related learning outcomes

Knowledge:
1. Familiarity with experimental techniques and principles of experimental research planning in physics.
2. Knowledge of higher mathematics techniques necessary for quantitative description, understanding, and modeling of physical problems of medium complexity.
3. Detailed physical description of studied phenomena or laws.

Skills:
1. Ability to use modern measurement apparatus and plan detailed experiment procedures.
2. Ability to analyze experiment results, determine experiment errors, identify sources of errors, and suggest ways to reduce or eliminate them.
3. Learning how to process and present measurement results in the form of posters and scientific articles according to applicable standards.

Social competences:
1. Perceiving possibilities and ways for continuous updating and supplementing knowledge in the field of contemporary science and technology.
2. Ability to collaborate within a team, fulfill duties assigned as part of work division, and show co-responsibility for team's work results.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

1. Evaluation of the student's activity and independence during exercises (30%).
2. Evaluation of the written report from the exercise performed (30%).
3. Oral colloquium to check understanding of the physical description of the studied phenomenon, experiment details, and acquired skills in processing and analyzing results (40%).
4. The final grade is the arithmetic mean of the grades obtained from individual exercises.

## Programme content

1. Study of mechanical and electromagnetic harmonic oscillations.
2. Investigation of thermoelectric phenomena.
3. Verification of Malus's law and study of the linear electro-optic effect - Pockels effect.
4. Study of the direct and reverse piezoelectric effect.
5. Investigation of ferroelectric crystals properties.
6. Production of metal-semiconductor junction using vacuum deposition.
7. Determining the spectral characteristics of a single-mode temperature-tunable semiconductor laser.

## Course topics

1.Simple vibrating motion, damped motion, resonance. Vibration of an RLC circuit.
2.Seebeck, Peltier phenomenon.
3.Polarization of light, modulation of light.
4.Dielectric polarization, division of dielectrics.Piezoelectric crystals and their applications.
5.Pyroelectric and ferroelectric properties of crystals. Ferroelectric phenomenon.
6.Definition of Fermi level for semiconductor metals. Resistive and conductive layer in semiconductor.Technology of metal-semiconductor junction.Operation of diffusion pump.
7.Principle of operation of lasers, semiconductor lasers.Solid state band theory.Absorption and recombination phenomena in semiconductors.

## Teaching methods

Active learning method: students perform a series of 2 laboratory exercises from different physics fields. Under the instructor's guidance, they deepen their knowledge about the phenomenon under study, plan the course and scope of work, prepare the experimental setup, establish a detailed measurement plan, perform the experiment, process the results, and conduct their critical analysis.

## Bibliography

Basic:
1.”II Pracownia Fizyczna” pod red. M.Bertrandt, Wydawnictwo Politechniki Poznańskiej, Poznań 2008
2. D.Halliday, R.Resnick, J.Walker., Podstawy fizyki, t. 1 - 5, PWN, Warszawa 2003
3. J . Massalski, M. Massalska, Fizyka dla inżynierów, t. 1-2, WNT, Warszawa 2006
4. MODERN PHYSICS (Modern Physics 4e) Paul A. Tipler and Ralph A. Llewellyn Physics for scientists and
engineers Paul M. Fishbane. - 2. ed., extended. - Upper Saddle River, NJ : Prentice Hall, c 1996

Additional:
1. R.P.Feynman, R.B.Leighton, M.Sands, Feynmana wykłady z fizyki, PWN, Warszawa, 1970
2. Ch. Kittel, W. D. Light, M. A. Ruderman, Mechanika, PWN, Warszawa 1969
3. E. M. Purcell, Elektryczność i magnetyzm, PWN, Warszawa 1971
4. F. Ratajczak, Optyka ośrodków anizotropowych , Warszawa, Wydawnictwo Naukowe PWN 1994.
5. B. Ziętek, Optoelektronika, Toruń ,Wydawnictwo Uniwersytetu im. M. Kopernik 2005.
6. E.R. Mustiel , E. R. Parygin., Metody modulacji światła, Warszawa, Państwowe Wydawnictwo Naukowe 1974.
7. A. Chełkowski , Fizyka dielektryków, Warszawa, Wydawnictwo Naukow0-Techniczne 1993.
8. H. Abramczyk , Wstęp do spektroskopii laserowej, Warszawa, Państwowe Wydawnictwo Naukowe 2000.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 75 | 3,00 |
| Classes requiring direct contact with the teacher | 45 | 2,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 30 | 1,00 |