COURSE DESCRIPTION CARD - SYLLABUS

Course name
Photonics [S2FT2>Foto]

Course

Field of study
Technical Physics

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

dr hab. Danuta Stefańska prof. PP
danuta.stefanska@put.poznan.pl

Lecturers

Prerequisites

Fundamental knowledge of wave optics, physics of lasers, quantum physics. Ability of solving elementary problems in the aforementioned fields, ability of obtaining information from indicated sources. Understanding of necessity of extending one’s own competences, ability of systematic work.

Course objective

1. Transferring to students the fundamental knowledge in the field of fiber optics and nonlinear optics, within the frame described in program contents, necessary for further independent development. 2. Developing the skills of solving simple problems on the basis of the knowledge acquired, necessary for designing experimental setups with the use of functional modules in fiber optics and nonlinear optics. 3. Developing the abilities of systematic self-education.

Course-related learning outcomes

Knowledge:
1. student can define fundamental concepts in the field of fiber optics and fiber-optic technology, as well as can discuss generally polarization and nonlinear effects essential for light propagation in optical fibers, within the frame of program contents

2. student knows fundamental concepts in the fields of nonlinear optics of bulk materials, as well as nonlinear fiber optics
3. student can discuss the ptoperties of selected photonic materials, including nonlinear optical media
4. student knows the basics of selected nonlinear optical effects and their applications for frequency conversion of optical radiation

Skills:
1. student can perform simple calculation of the parameters of optical fibers with defined specifications, as well as configure the systems with intended purpose on the basis of ready-made components
2. student can design simple nonlinear optical systems, including nonlinear fiber-optic systems
3. student can perform analysis of optical systems, consisting of the elements and function modules
4. student can choose photonic and nonlinear-optical materials for particular applications
5. student can unaided develop and extend his/her competences

Social competences:
1. student is aware of the necessity of self-development and systematic work, as well as the use of expert knowledge
2. student understands non-technical aspects of engineering activity and show responsibility for the decisions made

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

In terms of the methods used to verify the achieved learning outcomes, the following grading thresholds are applied:
50.1-60% - 3.0;
60.1-70% - 3.5;
70.1-80% - 4.0;
80.1-90% - 4.5;
from 90.1% - 5.0.
The grade is based on an individual written assignment and/or the assessment of an oral response.

Programme content

The program of the module covers selected problems in fiber optics and nonlinear optics

Course topics

1. Linear ligth propagation in anisotropic media
2. Fundamentals of propagation of classical light in optical fibers
3. Linear fiber-optic components. Mode coupling in fiber-optic transmission lines
4. Polarization controllers and analyzers in fiber-optic transmission lines. Fiber-optic polarization components
5. Light propagation in periodic media, fiber-optic Bragg gratings, photonic crystal fibers
6. Fundamentals of nonlinear optics. General properties of nonlinear fiber-optic media, in particular those applied in fiber-optic technology
7. Nonlinear second- and third order frequency conversion (second and third harmonic generation, selected processes of three- and four-wave mixing)
8. Nonlinear effects dependent on the light intensity, optical Kerr effect, self-focusing and self trapping, self phase modulation, cross phase modulation
9. Propagation of optical pulses in dispersive media. Solitons in fiber-optic transmission lines. Supercontinuum generation
10. Generation of high harmonics and ultrashort pulses

Teaching methods

Lecture: multimedia presentation illustrated with examples

Bibliography

Basic:
1. B.E.A.Saleh, M.C.Teich, Fundamentals of Photonics, Wiley Series in Pure an Applied Optics, John Wiley & Sons, 2007 (2 ed.), 2019 (3 ed.)
2. M.Karpisz, E.Weinert-Rączka Nieliniowa optyka światłowodowa Wydawnictwo Naukowo-Techniczne, Warszawa, 2009
3. R.W.Boyd, Nonlinear Optics, Elsevier Science, 2008 (3 ed.), 2020 (4 ed.)

Additional:
1. G.P.Agrawal, Nonlinear Fiber Optics (6 ed.), Elsevier Inc., Academic Press, 2019
2. G.P.Agrawal, Applications of Nonlinear Fiber Optics (3 ed.), Elsevier Inc., Academic Press, 2020
3. Selected articles from scientific periodicals

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00