Course description

Department/Unit /	KPF / C765			**Academic Year**	2023/2024
Title	Analytical Methods for the Study of Thin			**Type of completion**	Examination
Long Title	Analytical Methods for the Study of Thin Films				
Accredited/Credits	Yes, 5 Cred.			**Type of completion**	Combined
Number of hours	Lecture 2 [HRS/WEEK] Seminar 1 [HRS/WEEK]				
Occ/max	Status A	Status B	Status C	**Course credit prior to**	NO
Summer semester	7 / -	0 / -	0 / -	**Counted into average**	YES
Winter semester	0 / -	0 / -	0 / -	**Min. (B+C) students**	not determined
Timetable	Yes			**Repeated registration**	NO
Language of instruction	Czech			**Semester taught**	Summer semester
Optional course	Yes			**Internship duration**	0
Evaluation scale	A|B|C|D|E|F				
No. of hours of on-premise	0				
Auto acc. of credit	No				
Periodicity	K				
Substituted course	None				
Preclusive courses	N/A				
Prerequisite courses	N/A				
Informally recommended courses	N/A				
Courses depending on this Course	N/A				

Course objectives:

The student will acquire deeper information about principles, experimental and theoretical possibilities of applications of selected analytical methods suitable for the study of thin films.

Requirements on student

The exam is written and oral. During semester, the knowledge is checked via two tests. Their results are taken into account for the overall evaluation.

Content

UV-VIS spectroscopy. Optical absorption spectra of organic and inorganic compounds. Spectrophotometers - construction and procedures of spectra measurements.
Emission spectroscopy (fluorescence and phosphorescence). Excitation energy transfer. Instruments construction and procedures of measurements.
Optical methods of thin films characterization: optical transmittance and reflectivity, spectroscopic ellipsometry. Profilometry.
Fourier transformation, its basic description and application in infrared spectroscopy. Infrared spectroscopy - principles, spectrophotometers, applications.
Raman spectroscopy. Basic principles. Experimental techniques of Raman spectroscopy.
Theory of nuclear magnetic resonance. Spin behavior in a magnetic field, resonance, nuclear shielding, chemical shift, relaxation. NMR spectrometers and measurements methods. Applications of NMR.
Optothermal experimental methods. Photoacoustics and photoacoustic spectroscopy and microscopy. Applications possibilities to study of thin ink layers.
Electron paramagnetic (spin) resonance. Origin of EPR signal. EPR spectral parameters. EPR spectrometers and applications of EPR for the study of materials properties.
X-ray diffraction. The structure of materials, lattice, crystallographic system and Bravais cells. The origin of X-rays, its monochromatization and detection. Bragg equation.
Mechanical properties. Elastic and plastic deformation. Measurement and evaluation of materials hardness. Strength, yield strength, fatigue strength. Fracture mechanics.
Optical and electron microscopy. Experimental methods and applications. Analysis of chemical composition by EDX. Atomic

force microscopy (AFM) - principles and applications.
Thermoanalytical techniques (DSC, DTA, thermal gravimetry). Principles of the methods, instruments. Determination of chemical composition by elemental analysis.
Mass spectrometry. Principles of the method, basic terms. Mass spectrum. Ionization techniques. Mass analyzers. Applications of mass spectrometry.

Prerequisites - other information about course preconditions

Good knowledge of the physics and macromolecular chemistry at the university level is required. Student should be able to understand the physical principles of experimental analytical methods for the study of properties of thin films to exploit them in his/her research work, for example in the frame of diploma work project.

Competences acquired

The student will get overview of modern experimental analytical methods useful in the study of thin films, including thin films of polymeric materials, and will be able to understand and interpret experimental results acquired by these methods. Acquired knowledge can be utilized for diploma thesis processing.

Fields of study

Guarantors and lecturers

- **Guarantors:** prof. Ing. Petr Němec, Ph.D.
- **Lecturer:** doc. Ing. Marek Bouška, Ph.D. (50%), prof. Ing. Petr Němec, Ph.D. (50%)
- **Seminar lecturer:** doc. Ing. Marek Bouška, Ph.D. (50%), prof. Ing. Petr Němec, Ph.D. (50%)

Literature

- **Basic:** Elektronická verze přednášek předmětu (Němec P., Bouška M.)
- **Basic:** Vondráček P. a kol. *Metody studia a charakterizace struktury polymerů*. Praha, 1991. ISBN 80-7080-087-9.
- **Recommended:** Pavia D.L. *Introduction to Spectroscopy*. 2009.
- **Recommended:** Leng Y. *Materials Characterization: Introduction to Microscopic and Spectroscopic Methods*. 2013. ISBN 978-3-527-33463-6.
- **Recommended:** Campbell D., Pethrick R.A., White J.R. *Polymer Characterization: Physical Techniques*. 2000.

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Kontaktní výuka	39
Příprava na dílčí test	30
Domácí příprava na výuku	13
Příprava na zkoušku	60
Total:	**142**

Teaching methods

Monologic (reading, lecture, briefing)
Skills training

Assessment methods

Oral examination

Written examination

Course is included in study programmes:

Study Programme	Type of	Form of	Branch	Stage	St. plan v.	Year	Block	Status	R.year	R.
Graphic Arts and Printing Technology	Follow-up study	Full-time	Graphic Arts and Printing Technology	1	2022	2023	povinné předměty	A	1	LS
Graphic Arts and Printing Technology	Follow-up study	Full-time	Graphic Arts and Printing Technology	1	2020	2023	povinné předměty	A	1	LS
Graphic Arts and Printing Technology	Follow-up study	Full-time	Graphic Arts and Printing Technology	1	2023	2023	povinné předměty	A	1	LS