Basic Information:

Course Title: INFRARED SPECTROSCOPY

Lecturer: Prof. Dr. Rositsa Titorenkova
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Total Teaching Hours: 20

Annotation (up to 150 words)
The course introduces the fundamentals of infrared spectroscopy and its application as a modern analytical technique for the investigation of matter. It covers both basic spectroscopic principles and advanced methods with applications in geology, mineralogy, materials science, and chemical sciences. The course is designed for PhD students in the relevant scientific fields.

Course content (brief description by topics or modules)

Topic / Module 1: **Introduction to basic principles of spectroscopy** – types of spectroscopic methods, energy levels and transitions, units in absorption spectroscopy, molecular energy, probability of absorption transitions, and population of energy levels.

Topic / Module 2: **Fundamentals of vibrational spectroscopy** – Basic principles of vibrational spectroscopy in diatomic and polyatomic molecules, types of molecular vibrations, and characteristic vibrational frequencies.

Topic / Module 3: **Characteristic frequencies and the factors influencing them** – Factors, affecting the position and intensity of spectral peaks, including phase state, hydrogen bonding, solvent effects, isotopic effects, and vibrational coupling.

Topic / Module 4: **Equipment and instruments** – Main components of spectroscopic instrumentation, including radiation sources, monochromators, detectors, and modern accessories, as well as their analytical capabilities.

Topic / Module 5: **Sample preparation for analysis** – Methods for preparing different types of samples for infrared spectroscopic analysis, including gases, liquids, solutions, solids, pastes, and thin films.

Topic / Module 6: **Application of infrared spectroscopy –** Application in the characterization and identification of inorganic and organic substances, including minerals, oxides, salts, and organic compounds**.**

Teaching and assessment methods
In-person lectures, practical exercises, and discussion.

Competencies acquired as a result of training (3–5 points)

- Apply the fundamental principles of infrared spectroscopy in the analysis of materials and substances.
- Interpret vibrational spectra and extract structural information.
- Use spectroscopic techniques for research purposes.
- Analyze and process experimental spectroscopic data.

Literature:

1. Beran, A., Libowitzky, E. (eds.) (2004). *Spectroscopic Methods in Mineralogy*, Volume 6, EMU Notes in Mineralogy, 661 pp.
2. Wartewig, S. (2003). *IR and Raman Spectroscopy: Fundamental Processing*. Wiley-VCH, Weinheim. ISBN 3-527-30245-X.

Additional information (optional) (e.g., special requirements, laboratory equipment, prior knowledge)