UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Senzorji za detekcijo fotonov, elektronov in ionov
Course title:	Photon, Electron and Ion Detection Sensors

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Senzorske tehnologije, 3. stopnja	/	1	1
Sensor Technologies, 3rd cycle	/	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: ST3-538

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
15	15			15	105	5

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transfered to individual work.*

Nosilec predmeta / Lecturer: Doc. dr. Klemen Bučar

Jeziki / Languages:	**Predavanja / Lectures:**	Slovenski ali angleški / Slovene or English
	Vaje / Tutorial:	Slovenski ali angleški / Slovene or English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Zaključen študij druge stopnje ustrezne (naravoslovne ali tehniške) smeri ali zaključen študij drugih smeri z dokazanim poznavanjem osnov področja predmeta (pisna dokazila, pogovor).

Prerequisits:

Completed second cycle studies in natural sciences or engineering or completed second cycle studies in other fields with proven knowledge of fundamentals in the field of this course (certificates, interview).

Vsebina:

- Učinek delcev in sevanja na snov
- Sodobni detektorji fotonov in delcev
  - Plinski detektorji
  - Trdni detektorji
  - Polprevodniški detektorji
  - Scintilacijski detektorji
  - Pozicijsko občutljivi detektorji
- Uporaba detektorjev
  - Osnovni poskusi
  - Uporaba v analizah snovi
  - Uporaba v dozimetriji in zaščiti pred sevanjem
  - Detekcija elektronov
  - Detekcija ionov

Content (Syllabus outline):

- Interaction of particles and radiation with matter
- Modern detectors for photon and particles
  - Gas filled detectors
  - Solid state detectors
  - Semiconductor detectors
  - Scintillation detectors
  - Imaging detectors
- Detectors usage
  - Basic experiments
  - Use in analysis of matter
  - Dosimetry and radiation protection
  - Detection of electrons
  - Detection of ions

○ Ionska optika, elektrostatične leče, energijski analizatorji • Izhodni signali iz različnih vrst detektorjev in obdelava podatkov • Praktični primeri: ○ Elektronski analizator ○ Ionski spektrometer na čas preleta ○ Merjenje razpadnega spektra nuklida	○ Ion optics, electrostatic lenses, energy analysers • Signals from different types of detectors and processing of data • Practical examples: ○ Electron analyser ○ Ion time-of-flight spectrometer ○ Measuring nuclide spectrum

Temeljni literatura in viri / Readings:

Osnovna literatura / Basic literature:

- W. R. Leo, Techniques for Nuclear and Particle Physics Experiments: A How-to Approach, 1994.
- G. Gilmore, Practical Gamma-Ray Spectrometry: 2nd (second) Edition, 2009.
- G. F. Knoll, Radiation Detection and Measurement, 2010.

Dodatna literatura / Complementary literature:

- Detector manuals, manufacturer's datasheets.
- Recent articles from the relevant field, such as Review of Scientific Instruments, Nuclear Instruments and Methods in Physics Research Section A and B.

Cilji in kompetence:	**Objectives and competences:**
Razumeti delovanje različnih vrst detektorjev, njihove značilnosti in primernost v različnih pogojih. Naučiti se rokovanja z njimi in pridobiti znanja, potrebna za gradnjo novih eksperimentov in zbiranje ter obdelavo izmerjenih podatkov.	Understand theoretical and practical principles of detector operation, their properties and suitability in different conditions. Acquire practical knowledge on handling the devices, building detector systems, data acquisition and data processing.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študijski rezultati: • na podlagi pridobljenega znanja in razumevanja izbrati primeren senzor za realni problem, • predstavitev študijskih rezultatov v obliki seminarja in diskusije.	After completing the course, the student should have: • knowledge and understanding for choosing the appropriate detector for a real case problem, • presented the results of the studies in the form of research seminar and been able to discuss any questions arising during the seminar.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Interaktivno delo s študentom. Učenje prepoznavanja struktur in vzorcev znanja in reševanje realnih problemov. Laboratorijsko delo.	Interactive work with a student. Recognition of structures and patterns of knowledge and solving real problems. Laboratory work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Izpit	50 %	Examination
Projekt	50 %	Project

Reference nosilca / Lecturer's references:

- BUČAR, Klemen, ŽITNIK, Matjaž, MIHELIČ, Andrej, PENENT, F., LABLANQUIE, P., PALAUDOUX, J., ANDRIC, L., BRAUNE, M., PÜTTNER, R. Quenching of the 2pnd 1Po doubly excited states of helium by a dc electric field. Physical review. A, Atomic, molecular, and optical physics, 2014, 90(1), 013412.
- ROBBA, Ana, VIŽINTIN, Alen, BITENC, Jan, MALI, Gregor, ARČON, Iztok, KAVČIČ, Matjaž, ŽITNIK, Matjaž, BUČAR, Klemen, DOMINKO, Robert, et al. Mechanistic study of magnesium-sulfur batteries. Chemistry of materials, 2017, 29(12), 9555-9564.
- MARCHENKO, Tatiana, ŽITNIK, Matjaž, KAVČIČ, Matjaž, BUČAR, Klemen, BOHINC, Rok, PETRIC, Marko, et al. Electron dynamics in the core-excited CS2 molecule revealed through resonant inelastic X-ray scattering spectroscopy. Physical review. X, 2015, 5(3), 031021.
- ŽITNIK, Matjaž, MIHELIČ, Andrej, BUČAR, Klemen, KAVČIČ, Matjaž, et al. High resolution multiphoton spectroscopy by a tunable free-electron-laser light. Physical review letters, 2014, 113(19), 193201.
- NISKANEN, Johannes, SAHLE, Christoph J., RUOTSALAINEN, Kari O., MÜLLER, Harald, KAVČIČ, Matjaž, ŽITNIK, Matjaž, BUČAR, Klemen, PETRIC, Marko, HAKALA, Mikko, HUOTARI, Simo. Sulphur Kß emission spectra reveal protonation states of aqueous sulfuric acid. Scientific reports, 2016, 6, 21012.