UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Elektromagnetni senzorji
Course title:	Electromagnetic 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: ST-531

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: Prof. dr. Aleksander Zidanšek

Jeziki / Languages:	Predavanja / Lectures:	Slovenski ali angleški / Slovene or English
	Seminar:	Angleški / English

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

Prerequisits:

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

Content (Syllabus outline):

Razvoj in uporaba elektromagnetnih senzorjev: • georadarsko slikanje, • THz slikanje in spektroskopija, • indukcijski senzorji, • magnetometri, • magnetogradiometri. Integracija elektromagnetnih senzorjev. Detekcija skritih predmetov z elektromagnetnimi senzorji. Izdelava slike iz meritev z elektromagnetnimi senzorji. Interpretacija rezultatov.	Development and applications of electromagnetic sensors: • GPR radar imaging, • THz imaging and spectroscopy, • induction sensors, • magnetometers, • magnetogradiometers. Integration of electromagnetic sensors. Detection of hidden objects with electromagnetic sensors. Image extraction from electromagnetic measurements. Interpretation of results.

Temeljni literatura in viri / Readings:

- D. J. Daniels, EM Detection of Concealed Targets, Wiley-IEEE Press, 2009.
- Ciljani izbor in razprava o aktualnih znanstvenih objavah, predvsem v revijah Science, Nature, Physical Review Letters, New Scientist in Scientific World / Targeted selection and discussion of scientific publications, particularly from Science, Nature, Physical Review Letters, New Scientist, and Scientific World.

Cilji in kompetence:

Cilj predmeta je usposobiti študenta za raziskovalno delo z uporabo georadarja in/ali drugih elektromagnetnih senzorjev za izbrane aplikacije.

Cilj se navezuje na kompetence:
• obvladovanje metod in tehnik znanstvenega raziskovanja elektromagnetnih senzorjev,
• sposobnost za samostojno in skupinsko raziskovalno in razvojno delo,
• sposobnost uporabe znanja v praksi in
• delno tudi razvoj integralnega načina mišljenja ter sposobnost za komunikacijo s strokovnjaki drugih disciplin in področij.

Objectives and competences:

The objective of the course is to train a student for research work using a GPR radar and/or other electromagnetic sensors for selected applications.

This objective is related to competences:
• mastering of methods and techniques of scientific research of electromagnetic sensors,
• ability to carry out independent as well as team R&D work,
• ability to use the knowledge in practice,
• and partially also to the development of an integral way of thinking and the ability to communicate with experts from other disciplines and fields.

Predvideni študijski rezultati (izidi):

- Poznati in razumeti teorijo georadarskih, THz, indukcijskih in magnetnih senzorjev,
- načrtovati senzorsko integracijo za izbrane praktične primere,
- uporabiti georadar in/ali druge elektromagnetne senzorje za izbrane aplikacije v raziskovalnem delu,
- izdelati sliko meritve z izbranimi elektromagnetnimi senzorji,
- interpretirati rezultate izbrane meritve,
- vzpostaviti sposobnost komunikacije v angleškem jeziku na področju elektromagnetnih senzorjev.

Intended learning outcomes:

- Know and understand the theory of GPR radar, THz, induction and magnetic sensors
- Plan sensor integration for selected practical cases
- Apply georadar and/or other electromagnetic sensors for selected applications in research
- Extract an image of the measurement with selected electromagnetic sensors
- Interpret the results for a selected measurement
- Establish the ability to communicate in English in the field of electromagnetic sensors

Metode poučevanja in učenja:

Uvodna predstavitev - predavanja.
Seminarsko skupinsko delo.
Vključevanje v projekte za razvoj sposobnosti uporabe opreme.
Uporaba raziskovalne opreme v reševanju izbranega problema, obdelava izmerjenih signalov, analiza rezultatov, priprava seminarske predstavitve.

Learning and teaching methods:

Introductory presentation - lectures.
Seminar team work.
Participation in projects for the development of ability to use research equipment.
Solving selected problem with research equipment, analysis of measured signals, analysis of results, preparation of the seminar presentation.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Seminarska naloga.	50 %	Seminar work.
Zagovor seminarske naloge, pri katerem dokaže osvojitev vseh študijskih izidov z vsaj po enim konkretnim primerom.	50 %	Defense of the seminar work where the student demonstrates the achievement of all learning outcomes with at least one specific case for each outcome.

Reference nosilca / Lecturer's references:

- ABINA, Andreja, PUC, Uroš, JEGLIČ, Anton, ZIDANŠEK, Aleksander. Structural characterization of thermal building insulation materials using terahertz spectroscopy and terahertz pulsed imaging. *NDT & E International*, ISSN 0963-8695. [Print ed.], 2016, vol. 77, str. 11-18, doi: 10.1016/j.ndteint.2015.09.004. [COBISS.SI-ID 28983847]
- PUC, Uroš, ABINA, Andreja, SLUBAN, Melita, ZIDANŠEK, Aleksander, JEGLIČ, Anton, VALUŠIS, Gintaras. Terahertz spectroscopic identification of explosive and drug simulants concealed by various hiding techniques. *Applied optics*, ISSN 1559-128X. Tiskana izd., 2015, vol. 54, no. 14, str. 4495-4502, doi: 10.1364/AO.54.004495. [COBISS.SI-ID 28541735]
- ABINA, Andreja, PUC, Uroš, JEGLIČ, Anton, ZIDANŠEK, Aleksander. Structural analysis of insulating polymer foams with terahertz spectroscopy and imaging. Polym. test.. [Print ed.], 2013, vol. 32, issue 4, str. 739-747, doi: 10.1016/j.polymertesting.2013.03.004. [COBISS.SI-ID 26612263]
- CORDOYIANNIS, George, KRALJ, Samo, KUTNJAK, Zdravko, JESENEK, Dalija, MUŠEVIČ, Igor, ZIDANŠEK, Aleksander. Different modulated structures of topological defects stabilized by adaptive targeting nanoparticles. Soft matter, 2013, vol. 9, no. 15, str. 3956-3964, doi: 10.1039/C3SM27644A. [COBISS.SI-ID 26557223]
- ABINA, Andreja, PUC, Uroš, CEVC, Pavel, JEGLIČ, Anton, ZIDANŠEK, Aleksander. Terrestrial and underwater pollution-source detection using electromagnetic multisensory robotic system. Chemical engineering transactions, 2013, vol. 34, str. 61-66, doi: 10.3303/CET1334011. [COBISS.SI-ID 27010855]