UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Senzorji v robotiki in biokibernetiki
Course title:	Sensors in Robotics and Biocybernetics

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: ST3-547

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. Jan Babič

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:

- Senzorika kot tehnološka izvedba in nadgradnja človekovih čutil; vida, vonja, okusa, dotika in sluha.
- Uporaba senzorske tehnologije v sodobni robotiki, avtomatizaciji proizvodnje in biokibernetiki.
- Integracija senzorjev in aktuatorjev v procese vodenja robotskih sistemov.
- Praktična izvedba kinematičnih in fizioloških meritev pri človeku.
- Pretvorniki senzorskih signalov v analogno in digitalno obliko, primerno za nadaljnjo obdelavo.

Content (Syllabus outline):

- Sensorics as a technological realization and upgrade of the human senses; sight, smell, taste, touch and hearing.
- Utilization of sensor technology in modern robotics, automation of manufacturing and biocybernetics.
- Integration of sensors and actuators into processes of robotic control.
- Practical implementation of kinematical and physiological human measurements.
- Transducers that convert signals from the sensors to the analogue and digital form, that can be used for further processing.

Temeljni literatura in viri / Readings:

Knjige / Books:

- P.P.L. Regtien: Sensors for Mechatronics, Elsevier, 2012. ISBN 9780123914972.
- A.M. Pawlak: Sensors and Actuators in Mechatronics: Design and Applications, CRC Press, 2006. ISBN 0849390133
- B. Siciliano, L. Sciavicco, L. Villani, G. Oriolo: Robotics: Modelling, Planning and Control, Springer, 2010. ISBN 9781846286414

Revije / Periodicals:

- IEEE Transactions on Robotics, ISSN 1552-3098
- IEEE Transactions on Biomedical Engineering, ISSN 0018-9294

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je zajeti pregled in uporabo senzorske tehnologije v sodobni robotiki, avtomatizaciji proizvodnje in biokibernetiki. Pridobljena znanja bodo omogočila študentom razumevanje principov delovanja senzorjev in njihovo praktično uporabo v inženirskem in raziskovalnem okolju.	The objective of the course is to present an overview of the sensor technology in modern robotics, automation of manufacturing and biocybernetics. The acquired knowledge will enable the students to understand the principles of sensor operation and practical application of sensors in engineering and research.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • poznavanje tipov senzorjev ter njihovih prednosti in omejitev, • opredelitev najboljših možnih principov senzoričnega zaznavanja za izbrani robotski sistem, • združevanje senzorjev in aktuatorjev v sisteme vodenja, • sposobnost izvajanja kinematičnih in fizioloških meritev pri ljudeh, • predvidevanje razvoja robotskih in biokibernetskih senzorjev glede na sodobne raziskave.	Knowledge and understanding: • of sensor types with their advantages and limitations, • how to define the best sensing principles for a specific robotic system, • how to join sensors and actuators into control systems, • how to carry-out kinematical and physiological measurements in humans, • predictions of improvements of robotic and biocybernetic sensors based on current research.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Interaktivno delo s študentom v okviru predavanj in seminarske naloge z vključevanjem metod komparativne analize, sinteze in prepoznavanja vzorcev znanja ter usmerjanega reševanja realnih problemov.	Interactive work with a student in the frame of lectures and seminar work, including methods of comparative analysis, synthesis and recognition of knowledge patterns, and supervised solving of real problems.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ustni izpit. Seminarska naloga s predstavitvijo in ustnim zagovorom reševanja izbranega raziskovalnega problema.	50 % 50 %	Oral exam. Seminar work with presentation and oral defense of solving the chosen research problem.

Reference nosilca / Lecturer's references:

- POTOČANAC, Zrinka, GOLJAT, Rok, BABIČ, Jan. A robotic system for delivering novel real-time, movement dependent perturbations. Gait & posture, ISSN 0966-6362. 2017, vol. 58, str. 386-389, doi: 10.1016/j.gaitpost.2017.08.038.
- GRŽINIČ FRELIH, Nina, PODLESEK, Anja, BABIČ, Jan, GERŠAK, Gregor. Evaluation of psychological effects on human postural stability. Measurement : journal of the International Measurement Confederation, ISSN 0263-2241. 2017, vol. 98, str. 98, doi: 10.1016/j.measurement.2016.11.039.
- PETERNEL, Luka, NODA, Tomoyuki, PETRIČ, Tadej, UDE, Aleš, MORIMOTO, Jun, BABIČ, Jan. Adaptive control of exoskeleton robots for periodic assistive behaviours based on EMG feedback minimisation. PloS one, ISSN 1932-6203, 2016, vol. 11, no. 2, str. 0148942-1-0148942-26. doi: 10.1371/journal.pone.0148942.
- RUECKERT, Elmar, ČAMERNIK, Jernej, PETERS, Jan, BABIČ, Jan. Probabilistic movement models show that postural control precedes and predicts volitional motor control. Scientific reports, ISSN 2045-2322, 2016, vol. 6, str. 28455-1- 28455-12, doi: 10.1038/srep28455.
- NEMEC, Bojan, PETRIČ, Tadej, BABIČ, Jan, SUPEJ, Matej. Estimation of alpine skier posture using machine learning techniques. Sensors, ISSN 1424-8220, 2014, vol. 14, no. 10, str. 18898-18914, doi: 10.3390/s141018898.