UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Senzorska omrežja
Course title:	Sensor Networks

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: ST3-548

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. Tomaž Javornik

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:

Prerequisits:

Zaključen študij druge stopnje ustrezne (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:

- Uporaba senzorskih omrežji za spremljanje stanja okolja, precizno kmetijstvo, pametne zgradbe, zdravstveno varstvo, varnost in nadzor, pametna omrežja in nadzor energije, njihova uporaba v industriji.
- Arhitektura senzorskega vozlišča in primerjava lastnosti osnovnih gradnikov vozlišča vključno z mikro krmilniki, vrsto spomina, viri energije, senzorji in telekomunikacijskimi vmesniki.
- Pregled, primerjava in izbira komunikacijske tehnologije/standarda/protokola za ožičena senzorska omrežja.
- Pregled, primerjava in izbira komunikacijske tehnologije/standarda/protokola v brezžičnih senzorskih omrežjih s poudarkom na omejitvah

Content (Syllabus outline):

- Applications of sensor networks in environment monitoring, precision agriculture, smart buildings, health care, security and surveillance, smart grids and energy control, industrial applications.
- Architecture of the sensor node and comparison of its building components including micro controllers, type of memory, energy sources, sensors and communication interfaces.
- Overview, comparison and selection of technology/standard/protocol in wired sensor networks.
- Overview, comparison and selection of technology/standard/protocol in wireless sensor networks including study of challenges and

in izzivih fizičnega sloja, sloja MAC, omrežnega sloja, časovne sinhronizacije, lokalizacije. • Podrobna individualna obravnava realnega primera iz študentovega raziskovalnega dela.	constrains of physical layer, MAC layer, network layer, time synchronization and localization. • Detailed individual study of a real case from student's research work.

Temeljni literatura in viri / Readings:

Knjige / Books:
- Verdone, R., Dardari, D., Mazzini, G., Conti, A. Wireless Sensor and Actuator Networks: Technologies, Analysis and Design, Roberto Verdone, Elsevier Science, 2010. ISBN-10: 0123725399
- Zhao, F. and Guibas L., Wireless Sensor Networks: An Information Processing Approach, Morgan Kaufmann Series in Networking, 2004. ISBN-10: 1558609148

Revije / Periodicals:
- Sensors – Open Access Journal, (http://www.mdpi.com/journal/sensors). ISSN 1424-8220
- International Journal of Distributed Sensor Networks, Hindawi. ISSN 1550-1329
- IET Wireless Sensor Systems. ISSN: 2043-6386

Članki / articles:
- Djenouri, D. and Bagaa, M.
  Synchronization Protocols and Implementation Issues in Wireless Sensor Networks: A Review
  IEEE Systems Journal, 2016, Vol. 10(2), pp. 617-627
- Ahmed, E., Yaqoob, I., Gani, A., Imran, M. and Guizani, M.
  Internet-of-things-based smart environments: state of the art, taxonomy, and open research challenges
  IEEE Wireless Communications, 2016, Vol. 23(5), pp. 10-16
- Molloy, D.
  Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux
  Wiley, 2016
- Khan, I., Belqasmi, F., Glitho, R., Crespi, N., Morrow, M. and Polakos, P.
  Wireless Sensor Network Virtualization: A Survey
  Communications Surveys Tutorials, IEEE, 2015, Vol. PP(99), pp. 1-1
- Gupta, S. K. and Sinha, P.
  Overview of Wireless Sensor Network: A Survey
  Telos, 2014, Vol. 3(1), pp. 5201-5207

Cilji in kompetence:

Cilji:
- poznavanje arhitekture senzorskega vozlišča,
- razumevanje principov in poznavanje standardov brezžičnih in ožičenih povezav senzorskih omrežji,
- poznavanje ustreznih korakov za načrtovanje senzorskih omrežji,
- primerjava in problemu ustrezna izbira senzorskega omrežja in komponent senzorskega vozlišča.

Kompetence:
- sposobnost primerjalne analize za izbiro ustreznih elementov senzorskega vozlišča, že

Objectives and competences:

Objectives:
- knowing the architecture of the sensor node,
- understanding the principles and knowing the standards of wireless and wired links in sensor networks,
- knowing the steps required for design of sensor networks,
- comparing and choosing the problem adequate sensor networks and building components of sensor node.

Competences:
- ability for comparative analysis for selecting appropriate elements of sensor node, prebuilt

izdelanih senzorskih vozlišč in komunikacijske tehnologije za povezovanje senzorskih vozlišč, • sposobnost zasnove problemu ustrezne arhitekture senzorskega omrežja, • sposobnost realizacije senzorskega omrežja iz obstoječih gradnikov, • sposobnost upoštevanja omejitev zmogljivosti senzorskih vozlišč in tehnologij za povezovanje senzorskih vozlišč.	sensor nodes and communication technology for sensor nodes interconnection, • ability of the problem adequate design of the sensor network architecture, • construction of an operational sensor network using available building blocks, • consideration of restricted capabilities of sensor nodes and technologies for interconnection of sensor nodes.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • poznavanje najnovejših tehnologij brezžičnih in ožičenih senzorskih omrežij, • osnovno razumevanje prednosti in slabosti posameznih tehnologij senzorskih omrežji ter sposobnost izbire problemu ustrezne tehnologije, • osnovno načrtovanje brezžičnih in ožičenih senzorskih omrežji, • vključevanje pridobljenih znanj v raziskovalno delo.	Knowledge and understanding: • familiarity with contemporary technologies of wireless and wired sensor networks, • basic understanding of advantages and disadvantages of particular sensor networks technologies and ability for selecting appropriate technology according to the specific problem, • basic skills in design wireless and wire sensor networks, • application of acquired knowledge in research work.

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:**
Seminarska naloga s predstavitvijo in zagovorom rešitve izbranega primera iz študentovega raziskovalnega dela.	60 %	Seminar work with presentation and defence of the solution for the selected problem from student's research work.
Ustni izpit.	40 %	Oral exam.

Reference nosilca / Lecturer's references:

- Andrej Hrovat, Gorazd Kandus, Tomaž Javornik, "A survey of radio propagation modeling for tunnels", IEEE Communications surveys and tutorials, vol. 16, no. 2, str. 658-669, 2014.
- Alexey Volkov, Jerneja Žganec Gros, Mario Žganec, Tomaž Javornik, Aleš Švigelj, "Modulated acquisition of spatial distortion maps", Sensors, vol. 13, no. 8, str. 11069-11084, 2013.
- Farukh Nadeem, Erich Leitgeb, Gorazd Kandus, Tomaž Javornik, "Comparing the cloud effects on hybrid network using optical wireless and GHz links", IET communications, vol. 6, no. 5, str. 492-498, 2012.
- Tine Celcer, Gorazd Kandus, Tomaž Javornik, "Adaptive utility-based scheduling algorithm for multiuser MIMO uplink", EURASIP J. wirel. commun. netw. (online), vol. 2011, no. 22, str. 1-12, 2011. http://jwcn.eurasipjournals.com/content/2011/1/22
- Andrej Hrovat, Gorazd Kandus, Tomaž Javornik, "Four-slope channel model for path loss prediction in tunnels at 400 MHz", IET microwaves, antennas & propagation, vol. 4, no. 5, str. 571-582, 2010.