|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Gradniki sistemov vodenja | | | | | | | | | | | | | | |
| **Course title:** | | | Control Systems Instrumentation | | | | | | | | | | | | | | |
|  | | | | |  | | | | | | | |  | |  | | |
| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Univerzitetni študijski program prve stopnje Elektrotehnika | | | | | **Avtomatika** | | | | | | | | 3. | | zimski | | |
| 1st cycle academic study programme Electrical Engineering | | | | | **Control Systems** | | | | | | | | **3.** | | **winter** | | |
|  | | | | | | | | | | | | | | | | | |
| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni- strokovni/compulsory professional | | | | | |
|  | | | | | | | | | | | |  | | | | | |
| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64123 | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **45** |  | | | **45** | | |  | | | |  | | | **85** | |  | **7** |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Sašo Blažič, Aleš Belič | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik. | | | | | | | | |  | Enrolment in the year of the course. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Predmet bo obravnaval merilnike, regulatorje in krmilnike ter izvršne sisteme na področjih: procesne industrije, izdelčne industrije, robotike ter posebne gradnike s področij spremljanja lastnosti snovi, analiznih meritev, biosenzorjev, mikrosenzorjev, biosenzorjev in virtualne senzorike. V okviru predmeta bodo obravnavani naslednji vsebinski sklopi:  Osnovni principi teorije vodenja.  Varnostni standardi na področja sistemov vodenja (stopnje zaščite IP in stopnja mehanske odpornosti IK, gradniki v eksplozijsko nevarnih okoljih).  Standardni signali regulacijske zanke.  Merilni sistemi:  merilniki (pozicija, pot, hitrost, pospešek, sila, navor, nivo, pretok, temperatura, tlak, bližina, oddaljenost, vlažnost, toplotna prevodnost, viskoznost, gostota, analizne meritve, posebni merilniki),  vision-based merilniki,  merilni pretvorniki.  Izvršni sistemi:  aktuatorji in končni izvršni členi (elektromotorni, hidravlični in pnevmatski pogoni, zvezni in diskretni ventili, črpalke)  aktuatorski pretvorniki (frekvenčni pretvornik, rele, elektropnevmatski ventil, elektrohidravlični ventil, pretvornik zrak-tok itd.)  Regulatorji in krmilniki.  Poudarek pa bo na izbiri in parametriranju gradnikov ter njihovo vključevanje v sisteme vodenja in nadzora. | | | | | | | |  | | The course treats measurement systems, controllers, and actuators used in the following problem areas: process industry, manufacturing industry, and robotics. It will also deal with some special cases of measurement systems for substance analysis, analytical measurements, microsensors, biosensors, and virtual sensors. The following chapters will be covered:  Basic principles of control systems.  Safety standards in the area of automation systems (Ingress Protection – IP, IK rating, equipment in hazardous areas)  Standard signals of control systems.  Measurement systems:  sensors (position, path, speed, acceleration, force, torque, level, flow, temperature, pressure, proximity, distance, humidity, thermal conductivity, viscosity, density, analytical measurements, special measurements),  vision-based measurement systems,  transmitters.  Actuator systems:  actuators (electrical, hydraulic and pneumatic motors, control and on/off valves, pumps)  power converters (frequency converter, relay, electro-pneumatic valve, electro-hydraulic valve etc.)  Process Controllers and Programmable Logic Controllers.  Main stress will be given to parameterisation of instrumentation and its implementation in the control and supervisory systems. | | | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. A. Belič: Gradniki in tehnologije v sistemih vodenja. Založba FE in FRI, Ljubljana, 2012. 2. R. Karba: Gradniki sistemov vodenja, Založba FE in FRI, Ljubljana, 1994. 3. J. Kocijan, J. Petrovčič: Praktični vidiki uporabe gradnikov v sistemih vodenja, Založba FE in FRI, Ljubljana, 2002 . 4. C. W. de Silva: Sensors and actuators: control systems instrumentation, CRC Press, Boca Raton, Florida, USA, 2007. 5. J. Stenerson: Fundamentals of Programmable Logic Controllers, Sensors and Communication, Regents/Prentice Hall, Englewood Cliffs, 1994. 6. S. Strmčnik in soavtorji: Celostni pristop k računalniškem vodenju procesov, Založba FE in FRI, Ljubljana, 1998. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Spoznati gradnike sistemov vodenja in njihovo povezovanje s stališča inženirja uporabnika/vzdrževalca/načrtovalca ter njihovo vključevanje v sistem vodenja in nadzora. | |  | | Get to know fundamental instrumentation in control systems practice and their implementation from engineer's (user/maintainer/control system designer) point of view. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Principi delovanja najbolj pogostih merilnikov, krmilnikov in aktuatorjev ter razumevanje njihove medsebojne komunikacije v sistemih vodenja. | | |  | Understanding principles of operation for most commonly used measurement systems, controllers and actuators and their communication. | |
|  | | |  |  | |
| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja, seminar, laboratorijske vaje, v okviru lab. vaj tudi strokovni ogledi avtomatizacije v polindustrijskih in industrijskih obratih | | |  | Lectures, seminar, laboratory exercises, excursions to industiral and semi-industrial plants. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| K izpitu lahko študent pristopi šele po opravljenih laboratorijskih vajah.  laboratorijske vaje  seminar  ustni izpit | 25%  30%  45% | | | | The exam can be taken only after the laboratory exercises are completed.  laboratory exercises  seminar  oral exam |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. LEPETIČ, Marko, KLANČAR, Gregor, BLAŽIČ, Sašo. Analiza izvedljivosti avtomatizacije poravnave žarilnih nitk z uporabo strojnega voda pri izdelovanju avtomobilskih žarnic = Feasibility study of car bulb filament alignment automation using computer vision. *Elektrotehniški vestnik*, ISSN 0013-5852. [Slovenska tiskana izd.], 2004, vol. 71, no. 1-2, str. 7-12.  2. BOŠNAK, Matevž, BLAŽIČ, Sašo. Vodenje modelne naprave helikopterja CE150 z vmesnikom PoKeys56U. V: ZAJC, Baldomir (ur.), TROST, Andrej (ur.). *Zbornik dvajsete mednarodne Elektrotehniške in računalniške konference ERK 2011, 19.-21. september 2011, Portorož, Slovenija*, (Zbornik ... Elektrotehniške in računalniške konference ERK ..., ISSN 1581-4572). Ljubljana: IEEE Region 8, Slovenska sekcija IEEE, 2011, zv. A, str. 227-230  3. BLAŽIČ, Sašo. On periodic control laws for mobile robots. *IEEE transactions on industrial electronics*, ISSN 0278-0046. [Print ed.], Jul. 2014, vol. 61, no. 7, str. 3660-3670  4. PREGLEJ, Aleksander, STEINER, Igor, BLAŽIČ, Sašo. Multivariable predictive functional control of an autoclave. *Strojniški vestnik*, ISSN 0039-2480, 2013, vol. 59, no. 2, str. 89-96  5. KARBA, Rihard, ATANASIJEVIĆ-KUNC, Maja, BELIČ, Aleš, KOCIJAN, Juš, PETROVČIČ, Janko. Vloga senzorjev v sistemih vodenja procesov. Informacije MIDEM, ISSN 0352-9045, 2003, letn. 33, št. 1, str. 41-44. | | | | | |