

KOMPLEKSNI MEHATRONSKI SISTEMI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

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| Predmet: | KOMPLEKSNI MEHATRONSKI SISTEMI |
| Course title: | COMPLEX MECHATRONIC SYSTEMS |
| Članica nosilka/UL Member: | UL FS |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri | Izbirnost |
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| Strojništvo, tretja stopnja, doktorski | Proizvodno inženirske znanosti, kibernetika in mehatronika (smer) | | Celoletni | izbirni |

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| Univerzitetna koda predmeta/University course code: | 0033458 |
| Koda učne enote na članici/UL Member course code: | 7303 |

| Predavanja /Lectures | Seminar /Seminar | Vaje /Tutorials | Klinične vaje /Clinical tutorials | Druge oblike študija /Other forms of study | Samostojno delo /Individual student work | ECTS |
|---------------------------------|-----------------------------|----------------------------|--|---|---|-------------|
| 90 | | | | | 160 | 10 |

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| Nosilec predmeta/Lecturer: | Janez Diaci |
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| Izvajalci predavanj: | Janez Diaci |
| Izvajalci seminarjev: | |
| Izvajalci vaj: | |
| Izvajalci kliničnih vaj: | |
| Izvajalci drugih oblik: | |
| Izvajalci praktičnega usposabljanja: | |

Vrsta predmeta/Course type:

Izbirni predmet /Elective course

Jeziki/Languages:

Predavanja/Lectures:

Angleščina, Slovenščina

Vaje/Tutorial:

Angleščina, Slovenščina

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

Veljajo splošni pogoji za doktorski študij.

General prerequisites for the third level studies.

Vsebina:**Content (Syllabus outline):**

Sodobne tehnologije procesiranja podatkov v KMS.

Strojna oprema za vgradne računalnike: procesorji, sestavne komponente, vmesniške komponente, pretvorniki, prikazovalniki, povezave med računalniki in drugimi enotami, omrežja, mikrokrmilniki. Programirljiva logična vezja visoke stopnje integracije kot strojna oprema v KMS.

Programska oprema za vgradne računalnike: jeziki in metode programiranja, operacijski sistemi, delo v realnem času in hkratne dejavnosti.

Metodologije načrtovanja in izvedb vgradnih računalniških sistemov za KMS: strojna in programska oprema.

Izbrana poglavja iz algoritmov obdelave signalov, slik in 3D izmerkov oblike teles. Analiza 3D izmerkov in metode ekstrakcije karakterističnih dimenzij - značilk. Algoritmi združevanja podatkov iz večsenzorskih sistemov.

Izbrana poglavja iz modeliranja in simulacije KMS.

Opto-mehatronske sistemi.

Opto-mehatronske tehnologije. Komponente: optične, opto-elektronske in elektro-optične, mehatronske. Optomehatronska integracija. Osnovne opto-mehatronske funkcionalne enote. Metodologije načrtovanja in izvedbe.

Advanced data-processing technologies for CMS

Embedded system hardware: processors, chip-sets, interfaces, converters, displays, communication interfaces, networks, microcontrollers. Field-programmable gate arrays as platforms for high-performance data processing in CMS.

Embedded system software: programming languages and methods, operation systems, real-time operation, simultaneous tasks.

Design and implementation methodologies for embedded systems in CMS: hardware and software.

Selected topics in algorithms for signal and image processing. Processing of 3D data sets (clouds of points acquired during 3D shape measurements); analysis of 3D data sets and extraction of characteristic dimensions / features. Multi-sensor data fusion algorithms.

Selected topics in modeling and simulation of CMS.

Opto-mechatronic systems.

Opto-mechatronic technologies. Components: optical, opto-electronic in electro-optic, mechatronic. Optomechatronic integration. Basic optomechatronic functional units. Design and implementation

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| Mikro izvedbe: mikro-opto-mehatronski sistemi. Izbrani primeri opto-mehatronskih sistemov. | methodologies. Micro-scale implementations: micro-opto-mechatronic systems. Selected examples of opto-mechatronic systems. |
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Temeljna literatura in viri/Readings:

- [1] T. Scheurer: Foundations of computing: system development with set theory and logic, Addison-Wesley, 1994.
- [2] K. Edwards: Real-time structured methods: systems analysis, Wiley, 1993.
- [3] A. Burns, G. Davies: Concurrent programming, Addison-Wesley, 1993.
- [4] C.A.R. Hoare: Communicating sequential processes, Prentice-Hall, 1985.
- [5] D.R. Martinez, R.A. Bond, and M.M. Vai, High Performance Embedded Computing Handbook: A Systems Perspective, CRC, 2008. – izbrana poglavja
- [6] P. Marwedel, Embedded System Design, Springer, 2003.
- [7] R. Zurawski, Embedded Systems Handbook, CRC, 2005. – izbrana poglavja
- [8] J. Wikander and B. Svensson, Real-Time Systems in Mechatronic Applications, Springer, 1998.
- [9] D.C. Karnopp, D.L. Margolis, and R.C. Rosenberg, System Dynamics: Modeling and Simulation of Mechatronic Systems, Wiley, 2006.
- [10] F. Caccavale and L. Villani, Fault Diagnosis and Fault Tolerance for Mechatronic Systems, Springer, 2002.
- [11] D. Auslander, J. Ridgely, and J. Ringgenberg, Control Software for Mechanical Systems: Object-Oriented Design in a Real-Time World, Prentice Hall PTR, 2002.
- [12] R.H. Bishop, The Mechatronics Handbook, Second ed., CRC, 2007. – izbrana poglavja.
- [13] C.W.D. Silva, Mechatronic Systems: Devices, Design, Control, Operation and Monitoring, CRC, 2007. – izbrana poglavja
- [14] H. Cho: Optomechatronics: Fusion of Optical and Mechatronic Engineering, CRC Press, 2005. – izbrana poglavja
- [15] H. Ukita, Micromechanical Photonics, Springer, 2006.
- [16] H. Mitchell, Multi-Sensor Data Fusion: An Introduction, Springer, 2007.
- [17] J.W. Gardner, V. Varadan, and O.O. Awadelkarim, Microsensors, MEMS and Smart Devices, Wiley, 2001. – izbrana poglavja

Cilji in kompetence:

Cilji:

Študentu podati metodološko osnovo, nabor specialnih znanj in zahtevnih eksperimentalnih tehnik, potrebnih za samostojno raziskovalno delo na področju mehatronskih sistemov višje

Objectives and competences:

Goals:

The principal goal is to give the student the methodology basis, specialist knowledge and advanced experimental techniques required for conducting individual research in the field of complex

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| <p>stopnje kompleksnosti.</p> <p>Kompetence:</p> <ul style="list-style-type: none"> • sposobnost razumevanja in analize zahtevnih znanstvenih publikacij z ožjega področja študentovega doktorskega študija in s širšega področja kompleksnih mehatronskih sistemov (KMS), • sposobnost uporabe rezultatov iz teh publikacij pri reševanju lastnih raziskovalnih nalog v okviru doktorskega študija; • sposobnost prepoznavanja smeri razvoja na tem področju in usmerjanje lastnega raziskovalnega dela na tej osnovi; • sposobnost uporabe sodobnih metodologij za načrtovanje, razvoj in verifikacijo KMS, • sposobnost snovanja, razvoja, izvedbe in integracije programske opreme za krmiljenje KMS, • sposobnost uporabe najnovejših rešitev na področju strojne in programske opreme za snovanje in razvoj novih rešitev na področju KMS, • osvojena znanja in veščine, potrebna za načrtovanje in izvedbo zahtevnih nalog v okviru eksperimentalnega razvoja na področju KMS. | <p>mechatronic systems.</p> <p>Competences:</p> <p>The student acquires the following core competences:</p> <ul style="list-style-type: none"> • the ability to understand and analyze elaborate scientific/research publications from the narrower field of the student's PhD thesis as well as from the wider field of complex mechatronic systems, • the ability to apply the published results to solve research task within the framework of the student's PhD thesis, • the ability to recognize research and development trends in this field and use this as a basis for directing student's own research work, • the ability to employ advanced methodologies for the design, implementation and verification of complex mechatronics systems (CMS), • the ability to conceive, design, implement and integrate software solutions for the control of CMS, • the ability to use existing state-of-the-art hardware and software solutions for conception of novel CMS solutions, • the know-how required for conducting demanding tasks of experimental development in the field of CMS. |
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| <p>Predvideni študijski rezultati:</p> <ul style="list-style-type: none"> • sposobnost razumevanja in analize zahtevnih znanstvenih publikacij z ožjega področja študentovega doktorskega študija in s širšega področja kompleksnih mehatronskih sistemov (KMS), • sposobnost uporabe rezultatov iz teh publikacij pri reševanju lastnih raziskovalnih nalog v okviru doktorskega študija; • sposobnost prepoznavanja smeri razvoja na tem področju in usmerjanje lastnega raziskovalnega | <p>Intended learning outcomes:</p> <p>The student acquires the following core competences:</p> <ul style="list-style-type: none"> • the ability to understand and analyze elaborate scientific/research publications from the narrower field of the student's PhD thesis as well as from the wider field of complex mechatronic systems, • the ability to apply the published results to solve research task within the framework of the student's PhD thesis, |
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| <p>dela na tej osnovi;</p> <ul style="list-style-type: none"> • sposobnost uporabe sodobnih metodologij za načrtovanje, razvoj in verifikacijo KMS, • sposobnost snovanja, razvoja, izvedbe in integracije programske opreme za krmiljenje KMS, • sposobnost uporabe najnovejših rešitev na področju strojne in programske opreme za snovanje in razvoj novih rešitev na področju KMS, • osvojena znanja in veščine, potrebna za načrtovanje in izvedbo zahtevnih nalog v okviru eksperimentalnega razvoja na področju KMS. | <ul style="list-style-type: none"> • the ability to recognize research and development trends in this field and use this as a basis for directing student's own research work, • the ability to employ advanced methodologies for the design, implementation and verification of complex mechatronics systems (CMS), • the ability to conceive, design, implement and integrate software solutions for the control of CMS, • the ability to use existing state-of-the-art hardware and software solutions for conception of novel CMS solutions, • the know-how required for conducting demanding tasks of experimental development in the field of CMS. |
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Metode poučevanja in učenja:

Learning and teaching methods:

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| <p>Predavanja, laboratorijske vaje, seminarsko delo, e-izobraževanje, konzultacije. Seminarsko delo v čim večji meri navezuje se na področje doktorskega raziskovanja. Študij z uporabo priporočene literature.</p> | <p>Lectures, laboratory practice & seminar work, e-education, consulting. The seminar work is related, as much as possible, to the student's doctoral research field. Study on a recommended literature basis.</p> |
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Načini ocenjevanja:

Delež/ Weight

Assessment:

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| <p>Ustni izpit, poročilo o seminarskem delu. Pogoj za opravljanje ustnega izpita je uspešno izdelano in pozitivno ocenjeno seminarsko delo. Način (ustno izpraševanje, projekt): • projekt (seminarska naloga) (60%) • ustno izpraševanje (40%)</p> | | <p>Oral exam, report on seminar work. The condition for admission to oral exam is successful completion of seminar work, rewarded with a passing grade. Method (oral examination, project) • project (seminar assignment) (60%) • oral examination (40%)</p> |
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Reference nosilca/Lecturer's references:

prof. dr. Janez DIACI

PAVLOVČIČ, Urban, DIACI, Janez, MOŽINA, Janez, JEZERŠEK, Matija. Wound perimeter, area, and volume measurement based on laser 3D and color acquisition. BioMedical engineering online, ISSN 1475-925X, Apr. 2015, vol. 14, f. 1-15.

PRIBOŠEK, Jaka, DIACI, Janez. Electromagnetic microforging apparatus for low-cost fabrication of molds for microlens arrays. Journal of micromechanics and microengineering, ISSN 0960-1317. [Print ed.], 2015, vol. 25, nr. 6, str. 1-10

ZUPANČIČ, Matevž, NOVAK, Dušan, DIACI, Janez, GOLOBIČ, Iztok. An evaluation of industrial ultrafiltration systems for surface water using fouling indices as a performance indicator. Desalination, ISSN 0011-9164. [Print ed.], Jul. 2014, vol. 344, str. 321-328

KUŠČER, Lovro, DIACI, Janez. Assessment of the kinematic parameters of distant noncooperative objects. Advances in mechanical engineering, ISSN 1687-8132. [Printed ed.], 2013, str. 1-7

BOSIGER, Georgije, PERHAVEC, Tadej, MARINČEK, Marko, DIACI, Janez. Method for optodynamic source localization during Er:YAG laser ablation. Journal of biomedical optics, ISSN 1083-3668, Oct. 2013, vol. 18, iss. 10, str. 100505-1-100505-3.