

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Mehatronske aktuatorji
Course title:	MECHATRONIC ACTUATORS
Članica nosilka/UL Member:	UL FS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Mehatronika (smer)	2. letnik	2. semester

Univerzitetna koda predmeta/University course code: 0563952

Koda učne enote na članici/UL Member course code: 3071-V

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30		30			40	4

Nosilec predmeta/Lecturer: Primož Podržaj

Vrsta predmeta/Course type: Izbirni strokovni predmet/ Elective specialised course

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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

Izpolnjevanje pogojev za vpis v Visokošolski strokovni študijski program I. stopnje Strojništvo - Projektno aplikativni program.

Meeting the enrollment conditions for the MECHANICAL ENGINEERING - Project Oriented Applied Programme.

Vsebina:

Content (Syllabus outline):

1. Predavanje: Uvod
 ☐ Splošna shema krmilnega sistema
 ☐ Krmilni sistemi z in brez povratne zveze
 ☐ Aktuator kot element v shemi
 ☐ Tipi aktuatorjev
 2. Predavanje: Primerjava aktuatorjev
 ☐ Pnevmatiki in hidravlični
 ☐ Elektromagnetni
 ☐ Prednosti in slabosti
 ☐ Primeri uporabe

1. Lecture: Introduction
 ☐ General scheme of a control system
 ☐ Open and closed loop control systems
 ☐ Actuator as a control system element
 ☐ Types of actuators
 2. Lecture: Actuator comparison
 ☐ Pneumatic and hydraulic
 ☐ Electromagnetic
 ☐ Advantages and drawbacks
 ☐ Applications

<p>3. Predavanje: Elektromotor kot aktuator</p> <ul style="list-style-type: none"> ☐ Pretvorba energije ☐ Povezava med velikostjo, vrtilno frekvenco in močjo ☐ Primeri <p>4. Predavanje: Tipi elektromotorjev in signali potrebni za njihovo delovanje</p> <ul style="list-style-type: none"> ☐ Enosmerni ☐ Sinhronski in asinhronski ☐ Koračni <p>5. Predavanje: Servomotorji</p> <ul style="list-style-type: none"> ☐ Princip delovanja ☐ Tipi servomotorjev ☐ Principi izbire, prednosti in slabosti <p>6. Predavanje: Linearni aktuatorji</p> <ul style="list-style-type: none"> ☐ Linearni elektromotorji ☐ Elektromagneti ☐ Ultrazvočni motorji <p>7. Predavanje: Mehatronske aktuator kot del krmilnega sistema</p> <ul style="list-style-type: none"> ☐ Sklenjena/razklenjena zanka ☐ Resolver, enkoder, potenciometer ☐ Tahogenerator ☐ Absolutni enkoder ☐ Relativni/absolutni pomik <p>8. Predavanje: Omejevalniki gibanja</p> <ul style="list-style-type: none"> ☐ Mehanska in elektromagnetna zavora ☐ Mehanska in električna stikala ☐ Samozapornost <p>9. Predavanje: Linearna vodila</p> <ul style="list-style-type: none"> ☐ Izvedbe ☐ Primerjava ☐ Tipične obremenitve in njihov vpliv <p>10. Predavanje: Hitrostni profili</p> <ul style="list-style-type: none"> ☐ Pomik, hitrost, pospešek, trzaj ☐ Trikotni in trapezni profili ☐ Parametri, ki se jih določa na osnovi hitrostnih profilov <p>11. Predavanje: Ujemanje motorja in bremena</p> <ul style="list-style-type: none"> ☐ Problem vztrajnostnih momentov ☐ Ozadje tega problema in njegovo reševanje <p>12. Predavanje: Praktični primer preračuna</p> <ul style="list-style-type: none"> ☐ Rotacijski primer ☐ Linearni primer <p>13. Predavanje: Uporaba namenskih programov za izbiro komponent in preračun</p> <ul style="list-style-type: none"> ☐ Določitev vhodnih parametrov za program ☐ Praktični primer preračuna s programom za rotacijsko in linearno izvedbo <p>14. Predavanje: Nekonvencionalni aktuatorji</p> <ul style="list-style-type: none"> ☐ Piezoelektrični aktuatorji 	<p>3. Lecture: Electric motor as an actuator</p> <ul style="list-style-type: none"> ☐ Energy conversion ☐ Relation between size, rotating frequency and power ☐ Examples <p>4. Lecture: Types of electric motors and signals needed for their operation</p> <ul style="list-style-type: none"> ☐ DC ☐ Synchronous and asynchronous ☐ Stepper motor <p>5. Lecture: Servomotors</p> <ul style="list-style-type: none"> ☐ Principle of operation ☐ Types of servomotors ☐ Selection, advantages and drawbacks <p>6. Lecture: Linear actuators</p> <ul style="list-style-type: none"> ☐ Linear electric motors ☐ Electromagnets ☐ Ultrasound motors <p>7. Lecture: Mechatronic actuator as a part of control system</p> <ul style="list-style-type: none"> ☐ Open/closed loop ☐ Resolver, encoder, potentiometer ☐ Tachogenerator ☐ Absolute encoder ☐ Relative/absolute translation <p>8. Lecture: Motion limiting devices</p> <ul style="list-style-type: none"> ☐ Mechanical and electromagnetic brake ☐ Mechanical and electromagnetic switches ☐ Self-locking <p>9. Lecture: Linear guides</p> <ul style="list-style-type: none"> ☐ Types ☐ Comparison ☐ Typical loads and their influence <p>10. Lecture: Motion profiles</p> <ul style="list-style-type: none"> ☐ Displacement, speed, acceleration, jerk ☐ Triangular and trapezoidal motion profiles ☐ Parameters determined on the basis of motion profiles <p>11. Lecture: Motor – load matching</p> <ul style="list-style-type: none"> ☐ Problem of moments of inertia ☐ Background of this problem and its solution <p>12. Lecture: An example of a real design</p> <ul style="list-style-type: none"> ☐ Rotational example ☐ Linear example <p>13. Lecture: Application of specialized software for component selection and calculation</p> <ul style="list-style-type: none"> ☐ Input parameters ☐ Practical example for linear and rotational type <p>14. Lecture: Nonconventional actuators</p> <ul style="list-style-type: none"> ☐ Piezoelectric actuators
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<p>🔗 Aktuatorji na osnovi oblikovnega spomina</p> <p>15. Predavanje: Mikroaktuatorji</p> <p>🔗 Mikropogoni</p> <p>🔗 Primeri uporabe</p>	<p>🔗 Actuators based on shape memory</p> <p>15. Lecture: Microactuators</p> <p>🔗 Microdrives</p> <p>🔗 Applications</p>
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Temeljna literatura in viri/Readings:

1. Robert H. Bishop: The Mechatronic Handbook, CRC Press, 2002
2. Sabri Cetinkut: Mechatronics (2nd Ed.), Wiley, 2015
3. Clarence W. de Silva: Sensors and Actuators (2nd Ed.), CRC Press, 2016

Cilji in kompetence:

Cilji:

1. Spoznati temeljne principe delovanja mehatronskih aktuatorjev.
2. Spoznati osnovne kriterije za izbiro ustreznega aktuatorja.
3. Spoznati programsko opremo namenjeno uporabi mehatronskih aktuatorjev.

Kompetence:

1. S2-PAP: Sposobnost samostojnega dela v okviru znanj pridobljenih pri predmetu
2. S12-PAP, P7-PAP: Sposobnost uporabe namenske programske opreme potrebne za delovanje mehatronskih aktuatorjev
3. P3-PAP: Obvlada temeljna strokovna znanja s področja mehatronskih aktuatorjev
4. P4-PAP: Pozna osnovne gradnike mehatronskih aktuatorjev
5. P9-PAP: Diplomant je sposoben samostojno opravljati razvojno aplikativna, inženirska in strokovna dela ter reševati posamezne dobro definirane naloge na področju mehatronskih aktuatorjev.

Objectives and competences:

Objectives:

1. Knowledge of basic functioning of mechatronic actuators.
2. Knowledge of the basic criteria for actuator selection.
3. Knowledge of the software used for the application of mechatronic actuators.

Competences:

1. S2-PAP: The ability to work autonomously in the framework of knowledge obtained.
2. S12-PAP, P7-PAP: The ability to use software used for operation of mechatronic actuators.
3. P3-PAP: Mastering the fundamental specialised knowledge in the field of mechatronic actuators.
4. P4-PAP: Knowing the basic elements of mechatronic actuators.
5. P9-PAP: The graduates are able to independently perform applied developmental, engineering and professional work, and solve well-defined individual tasks in the field of mechatronic actuators

Predvideni študijski rezultati:

Znanja:

Z1: Poznavanje principov delovanja mehatronskih aktuatorjev, njihova prava izbira, in poznavanje programske opreme, ki je potrebna za njihovo delovanje.

Spretnosti:

S1.2: Obvladovanje izbire in uporabe mehatronskih aktuatorjev pri različnih delovnih procesih.

S1.3: Diagnosticiranje in reševanje problemov v različnih procesih, kjer nastopajo mehatronski aktuatorji.

Intended learning outcomes:

Knowledge:

Z1: Knowledge of operation principles of mechatronic actuators, their correct selection, and knowledge of the software needed for their operation.

Skills:

S1.2: Mastering the selection and application of mechatronic actuators for various processes.

S1.3: Problem diagnostics and solving for various processes which include mechatronic actuators.

Metode poučevanja in učenja:

Learning and teaching methods:

<p>P1 Avditorna predavanja z reševanjem izbranih - za področje značilnih - teoretičnih in praktično uporabnih primerov.</p> <p>P2 Obravnava snovi po urejeni in vnaprej razloženi sistematiki.</p> <p>P4 Laboratorijske vaje z realnimi objekti, kot so frekvenčni pretvornik Omron in koordinatne osi Festo.</p> <p>P8 Izdelava in predstavitev aplikativnih seminarских nalog</p>	<p>P1 Auditorial lectures with solving selected field-specific theoretical and applied use cases.</p> <p>P2 Presenting the content according to the explained system.</p> <p>P4 Laboratory exercises with real objects such as Omron frequency inverter and Festo linear axis.</p> <p>P8 Making and presenting applied seminar exercises.</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
Pisni izpit	50,00 %	Written examination
Ustno izpraševanje	30,00 %	Oral examination
Projekt	20,00 %	Project

Reference nosilca/Lecturer's references:

Primož Podržaj:

1. **PODRŽAJ, Primož**, JERMAN, Boris, SIMONČIČ, Samo. Poor fit-up condition in resistance spot welding. Journal of materials processing technology, Apr. 2016, vol. 230, str. 21-25
2. HWANG, Gilgueng, **PODRŽAJ, Primož**, HASHIMOTO, Hideki. Note : resistance spot welding using a microgripper. Review of scientific instruments, 2013, vol. 84, no. 10, str. 1-3
3. ČEBULAR, Andrej, STEPANOVA, A., ŠORLI, Iztok, **PODRŽAJ, Primož**. Weld quality evaluation in radiofrequency PVC welding process. Informacije MIDEM : časopis za mikroelektroniko, elektronske sestavne dele in materiale, dec. 2011, vol. 41, no. 4, str. 290-296
4. **PODRŽAJ, Primož**, HASHIMOTO, Hideki. Intelligent space as a framework for fire detection and evacuation. Fire technology, 2008, letn. 44, št. 1, str. 65-76

PODRŽAJ, Primož, POLAJNAR, Ivan, DIACI, Janez, KARIŽ, Zoran. Influence of welding current shape on expulsion and weld strength of resistance spot welds. Science and technology of welding and joining, 2006, letn. 11, št. 3, str. 250-254