Modernization of Mechatronics and Robotics for Bachelor degree in Uzbekistan through Innovative Ideas and Digital Technology

(MechaUz)

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MechaUZ_WP3_Training courses

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ROBOT CONTROL SYSTEMS

Trainer

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Professor

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Prof. dr. Vytautas Bučinskas was born in Šiauliai, Lithuania, in 1962. In 2002 he defended PhD thesis in the field of Theory of Machines and became associated professor in the Department of Machine Engineering, at Vilnius Technical University. In 2013 Department of Mechatronics and Robotics was established, and he took a steering chair in it. His current research interests include the design of mechatronic systems, the dynamical properties of mechatronic systems, and energy harvesting from vibrations.

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Course description: This course is dedicated to introducing the typical configuration of industrial robot control systems, including aspects of available programming methods and the most popular robot programming languages.

Prerequisites: The course is introductive, but it is desirable that the listeners would be familiar with the basics of the mechatronic systems.

Learning Outcomes: New knowledge about industrial robot control systems composition, popular programming languages, and available programming methods.

Literature:

- Taghirad, Hamid D. Parallel robots: mechanics and control. FL : CRC Press, Taylor & Francis Group, 2013. ISBN 9781466555761.
- Mohsen Shahinpoor, Siavash Gheshmi. Robotic surgery: smart materials, robotic structures, and artificial muscles. Singapore: Pan Stanford Publishing, 2015. xiv, 196 p. ISBN 9789814316231.
- Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo. Robotics: modelling, planning and control. London: Springer, 2009. ISBN 9781846286414.

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ROBOT CONTROL SYSTEMS

Trainer

Andrius Dzedzickis

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Dr. Andrius Dzedzickis received a PhD degree in Mechanical Engineering with a topic related to the sensing applications and control of mechanical systems dynamic characteristics from Vilnius Gediminas technical university, Vilnius, Lithuania, in 2019. Now Andrius holds associate professor and senior researcher positions in the Department of Mechatronics, Robotics and Digital Manufacturing at Vilnius Gediminas Technical University. His current research interest includes machine learning, robotics, development and research of various sensors.

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INTERNET OF THINGS

Trainer

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Lecturer

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Short biography: From 2015 lecturer, study courses IoT, Electronics, Electrotechnics, Electro drives etc.
From 2021 director of prof. BSc. study program "Smart technologies and Mechatronics".

Course description: The course provides knowledge and skills in the development of controlled devices, data acquisition and transmission.

In Part 1, participants make sensor connections based on the programmable controller Arduino Uno, programming takes place using the programming language C ++; organizes data transmission via Bluetooth, gains experience in program library applications for connections of various actuators.
In Part 2, participants make sensor connections based on the Raspberry Pi microcomputer, programming takes place using the programming language Python; organizes data transmission to a remote server using Internet technologies; simple digital and analogue and higher complexity sensors (GPS, US, photo/video camera modules, etc.) are used for data acquisition.
Prerequisites: C++ and Phyton programming

Learning Outcomes: Participants will know the basic principles of creating controllable devices; will be able to create sensor connections with several types of programmable controllers, organize data transmission channels, send data to a remote server and receive processed information; knows the application of program libraries for the microcontroller, software structure, development of work functions (subprograms), code debugging.
Literature: 1. B.W. Evans Arduino Notebook, San Francisco, USA; 2. T. Igoe Making Things Talk, San Francisco, USA, 2019; 3. C. Dow Internet of Things Programming Projects 2018 Packt Publishing, Birmingham, UK
Course Schedule: Classes can take place on 16-17.05.2023. Lesson duration 90 min theory + 90 min workshop if equipment will be available (Arduino and Raspberry Pi with sensors).

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IoT and AI: THEORY AND PRACTICE

Trainer

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Researcher

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Bachelor in Electronics, MSc in Informatics and Software Engineering and PG studies in Cybersecurity from EST-IPCA. More than 20 years of experience in the electronics manufacturing industry. Specialist in development and integration of IIoT , software development and data analysis.

Course description: The IoT and AI course provides a comprehensive exploration of the theoretical foundations and practical applications of the Internet of Things (IoT) and artificial Intelligence (AI). Participants will delve into the concepts, technologies and methodologies driving the convergence of IoT and AI, gaining knowledge and skills necessary to design, develop, and deploy intelligent IoT systems.

Prerequisites: Basic understanding of Computer Science.

Learning Outcomes: Upon completion of the course, Participants will gain a comprehensive understanding of IoT and AI fundamental, including system design, AI integration, data analysis, scalability and ethical considerations. They will develop practical skills in designing and deploying IoT systems, integrating AI algorithms, and extracting insights from the sensor data. Through hands-on projects, students will apply their knowledge, enhancing their problem-solving abilities.

Literature: “Building the Internet of Things” by Maciej Kranz; “Artificial Intelligence: A Modern Approach” By Stuart Russell and Peter Norvig; “IoT: Building Arduino-Based Projects” by Peter Waher; “The Fourth Industrial Revolution” by Klaus Schwab.

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MOBILE ROBOTICS

Trainer

Konstantinos Dimopoulos

Associate Professor

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Dr Konstantinos Dimopoulos is an accociate professor in the Department of Computer Science at CITY College. He is the Director of the MSc programs and the pricipal research ethics administrator of the Department. He has worked with the application of Neural Networks as nonlinear identifiers for the purpose of control and linearisation of nonlinear systems. He has also worked with the investigation of nonlinear control strategies and their application on robotic manipulators.

Course description: This course is a basic introduction to robotics with strong emphasis on mobile robots, movement, environment sensing and actuation.

Prerequisites: The course is introductive, no special knowledge is required, but a small background in computer science and programming would be helpfull.

Learning Outcomes: Understand the basic concepts in robotics, sensing, actuation and control of mobile robots.

Literature:

- Taghirad, R. Siegwart and I.R. Nourbakhsh, Introduction to Autonomous Mobile Robots (latest edition), MIT Press.
- R.R. Murphy, Introduction to AI Robotics (latest edition), MIT Press.

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ADDITIVE MANUFACTURING: FROM 3D MODELING TO 3D PRINTING

Trainer

Manolis Tzimtzimis

PhD Candidate

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Mr. Manolis Tzimtzimis is currently a PhD Candidate in Additive Manufacturing and Machine Learning field at the IHU. He is also the Technical Laboratory Associate at the DMMC Lab. He has experience with various advanced manufacturing technologies such as 3D printing, Computer Numerical Control (CNC) and Laser Machining. He is also proficient with parametric 3D Computer Aided Design and 3D Scanning methods. Finally, Manolis has participated in various national and European research projects.

Course description: This course introduces the main principles for the additive manufacturing process. First, the Computer Aided Design process will be briefly explained through specific examples in robotic systems, and the files will be exported to the slicer software, to be prepared for the 3D printing Process. Finally, the most important parameters for the 3D printing process will be analyzed.

Prerequisites: There is no prerequisites for this course.

Learning Outcomes: Understand the main principles of a CAD model, and identify the key features for the 3D printing process, both to software and hardware operations.

Literature:

- Chua C.K., Leong K.F. and Lim C.S. (2010) Rapid Prototyping: Principles and Applications, 3rd Edition
- Gibson I., Rosen D., Stucker B., (2015) 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2nd Edition
- Bertoline G., Wiebe E., Hartman N. and Ross M. (2010) Fundamentals of Graphics Communication

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NUMERICAL METHODS

Trainer

Patriks Morevs

Lecturer

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Expert in International Relations
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Course description: The course anticipates introduction of numerical methods to students as well as principles of numerical methods, computer modelling basics, differential equations and also application of numerical methods in modeling software such as Ansys, Comsol, Fluent, Siemens Start CCM+, etc.

Prerequisites: Linear Algebra course, Calculus course, Programming course, Differential Equations course

Learning Outcomes: Participants know basic numerical methods; students are able to understand the meaning of numerical methods and spheres of application. Students can apply numerical methods for the solution of differential equations. Students can use Ansys software for modelling simple situations. Participants know the perspectives of numerical methods.

Literature: Download Ansys Student | Workbench-based Simulation Tools.

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