Załącznik Nr 5 do Zarz. Nr 33/11/12

(faculty stamp)

COURSE DESCRIPTION

1. Course title: PROGRAMMING LEGO MINDSTORMS NXT ROBOTS	**2. Course code:** NXT
3. Validity of course description: 2016/2017	
4. Level of studies: BA, BSc programme	
5. Mode of studies: intramural studies	
6. Field of study: MACROFACULTY; RAU	
7. Profile of studies: comprehensive practical	
8. Programme: all	
9. Semester: 7	
10. Faculty teaching the course: Faculty of Automatic Control, Electronics and Computer Science	
11. Course instructor: PhD Eng. Piotr Czekalski, PhD Eng. Grzegorz Baron	
12. Course classification: Common Courses	
13. Course status: elective	
14. The language of instruction: English	
15. Pre-requisite qualifications: An elementary understanding of Newton physics, basic skills on C# and Java programming.	
16. Course objectives: The main goal is to present audience a modern robot building platform and a wide range of construction and programming methods of LEGO Mindstorms NXT robots. The course contains a presentation on both constructing and programming universal robotics platform based on LEGO Mindstorms NXT. Programming in NXT-G visual language on LabVIEW-based Mindstorms EDU NXT Software environment will be presented (autonomous systems), programming in C# as well, as running programs on dedicated NXT Virtual Java Machine (NXJ) will be presented. Additionally, the course covers communication ideas on both inter-robotics and robots-to-PC models. As an extra part, this course presents embedded system construction of NXT Intelligent Brick considerations on popular sensors, to let the students design and implement their own interfaces, robot constructions.	

17. Description of learning outcomes:

No	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1	Has knowledge on how to program a mobile robot in different environments and is able to use literature, online resources and tutorials to implement it. Can collaborate within the development group and prepare a report documenting their achievements.	LE	Lecture and laboratory	K1A_W3, K1A_W9, K1A_K3, K1A_K4
2	Knows data and programming structures and is able to choose appropriate of them to solve given problem.	LE	Lecture and laboratory	K1A_W12, K1A_W18, K1A_K3, K1A_K4
3	Has structured knowledge on the algorithmics, methods of the software implementation of the numerical problems in engineering, programming in object-oriented models in C#, Java or Python and graphical languages in the mobile robotics control algorithms.	LE	Laboratory	K1A_W3

18. Teaching modes and hours

W. **Ćw.** **L.** **P.** **Sem.** 15/0/30/0/0

19. Syllabus description:

Lecture:

Why just NXT platform? From a game to the business and industry. Platform precedors.
Overview of NXT Intelligent Brick construction and it's communication interfaces. Platform specification and capabilities.
Overview of available platform sensors and servo motors.
Constructing NXT robots. Theory vs physics.
Open hardware platform Mindstorms NXT – Hardware Development Kit.
The most popular NXT models overview.
Mindstorms NXT application software models. Internal (autonomous) software and remote managed software. Serial and parallel programming. Calibrating sensors and servo motors. A starting point and border conditions. Uploading autonomous programs and communicating over Bluetooth protocol.
Programming in NXT-G Visual Language on LabVIEW environment.
Programming in Microsoft Visual Programming Language (VPL) and C# language on Microsoft Robotics Studio.
Programming with means of Virtual Java Machine for NXT Intelligent Brick.

Laboratory:

The main target is to let the audience practice construction and programming of NXT base robots. All exercised are performed by students during laboratories. The laboratory is equipped with 9 complete Mindstorms NXT platforms (edu edition) each equipped with NXT Intelligent Brick, a set of genuine LEGO sensors and actuators and 3 EV3 platforms plus modern PC workstations. The laboratory also contains a set of third-party sensors, including object tracking cameras, tilt/accelerometer sensors, gyro sensors, compass sensors and colour recognition sensors.
Lab exercises:
1. Programming in NXT-G on LabVIEW environment – simple operations on Tribot, Spike, Roboarm popular models.
2. Programming in Java on dedicated JVM (LeJOS) with particular respect for conceptual movement programming model (including Pilots and Navigators) over a flat, Cartesian surface.
3. Programming in C# with Mindsqualls or programming in C# with native Microsoft libraries for EV3. This also includes a sort of UI devices including Kinect or Leap Motion or MYO band to control the robot (as chosen by students).

20. Examination: none

21. Primary sources:

1. Creating Cool MINDSTORMS NXT Robots, Daniele Benedettelli, Apress, 2008.
2. LEGO Mindstorms NXT-G Programming Guide, Jim Kelly, Apress, 2007.
3. LEGO Mindstorms NXT: The Mayan Adventure, James Floyd Kelly, Apress, 2006.
4. Advanced NXT: The Da Vinci Inventions Book, Matthias Paul Scholz, Apress, 2007.
5. Extreme NXT: Extending the LEGO Mindstorms NXT to the Next Level, Michael Gasperi, Philippe E. Hurbain, and Isabelle L. Hurbain, Apress, 2007.
6. The LEGO MINDSTORMS NXT Zoo! - A Kid-Friendly Guide to Building Animals with the NXT Robotics System, Fay Rhodes, No Starch Press, 2008.
7. Building Robots with LEGO Mindstorms NXT, Mario Ferrari, Guilio Ferrari, and David Astolfo, Syngress, 2007.
8. The Unofficial LEGO MINDSTORMS NXT Inventor's Guide, David J. Perdue, No Starch Press, 2007.
9. Maximum LEGO NXT: Building Robots with Java Brains, Brian Bagnall, Variant Press, 2007.
10. On-line: LeJOS Tutorial, http://lejos.sourceforge.net/nxt/nxj/tutaorial/index.htm, August 2011.
11. On-line: NXJ API, http://lejos.sourceforge.net/nxt/nxj/api/index.html, August 2011.
12. On-line: PC NXJ API: http://lejos.sourceforge.net/nxt/pc/api/index.html, August 2011.
13. On-line: http://msdn.microsoft.com/en-us/robotics/default.aspx, Microsoft, January 2009.
14. On-line: Simply Sim..., http://www.simplysim.net/index.php?scr=scrViewNews&t=2&idnews=18, January 2009.
15. Programming Microsoft Robotics Studio, Sara Morgan, MS Press, 2008.
16. The LEGO Mindstorms NXT Idea Book: Design, Invent, and Build, Martijn Boogaarts, Jonathan A. Daudelin, Brian L. Davis, Jim Kelly, Lou Morris, Fay and Rick Rhodes, Matthias Paul Scholz, Christopher R. Smith, Rob Torok, Chris Anderson, No Starch Press, 2008.
17. Claudia Frischknecht & Thomas Other: LEGO Mindstorms NXT – Next Generation –, Christian Plessl, Andreas Meier, Dr. Lothar Thiele, Institut für Technische Informatik und Kommunikationsnetze, Swiss Federal Institute of Technology, 2006.
18. LEGO Mindstorms NXT Power Programming: Robotics in C, John C. Hansen, Variant Press, 2007.
19. Professional Microsoft Robotics Developer Studio, Kyle Johns, Trevor Taylor, Wrox, 2008.
20. On-line: http://mindstorms.lego.com/Overview/NXTreme.aspx, August 2009.
21. On-line: http://en.wikipedia.org/wiki/Lego_Mindstorms, August 2009.
22. On-line: http://mynxt.matthiaspaulscholz.eu/tools/, August 2009.
23. On-line: http://www.lugnet.com/robotics/nxt/interesting, October 2011.
24. On-line: http://www.ni.com/academic/mindstorms/, October 2011.
25. On-line: http://zone.ni.com/devzone/cda/tut/p/id/9079#toc0, October 2011.

22. Secondary sources:

23. Total workload required to achieve learning outcomes:

No.	Teaching mode	Contact hours / Studet workload hours
1	Lecture	15/0
2	Classes	0/0
3	Laboratory	30/15
4	Project	0/0
5	BA/MA Seminar	0/0
6	Other	0/0
	Total number of hours	0/0

24. Total hours: 60

25. Number of ECTS credits: 2

26. Number of ECTS credits allocated for contact hours: 1,5

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 0,5
26. Comments:

Approved:

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(date, Instructor's signature)

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(date , the Director of the Faculty Unit signature)