(*faculty stamp*)

Z1-PU7	WYDANIE N1	Strona 1 z 4

COURSE DESCRIPTION

1. Course title: Internet of Things	**2. Course code:** IoT
3. Validity of course description: 2017/2018	
4. Level of studies: BA, BSc programme ~~/ MA,MSc programme lub 1st cycle / 2nd cycle of higher education~~	
5. Mode of studies: intramural studies ~~/ extramural studies~~	
6. Field of study: CEIE - Interdisciplinary Studies: Automatic Control and Robotics, Electronics and Telecommunications, Computer Science	(FACULTY SYMBOL) RAU2
7. Profile of studies: comprehensive practical	
8. Programme: all	
9. Semester: 6	
10. Faculty teaching the course: Faculty of Automatic Control, Electronics and Computer Science	
11. Course instructor: Ph.D. Eng. Piotr Czekalski, Ph.D. Eng. Krzysztof Tokarz	
12. Course classification: common courses	
13. Course status: ~~compulsory /~~elective	
14. Language of instruction: English	
15. Pre-requisite qualifications: none	
16. Course objectives: A general objective of the module is to introduce students with general IoT approach, devices, structures, programming and common applications. Students are guided through various areas of IoT, starting from device construction and sensor selection for real world sensing and measurements, through interconnecting devices to constitute network and finally towards data processing with means of modern approaches including semantic data and NLP.	
17. Description of learning outcomes:	

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Student is aware of IoT construction techniques, ways of interfacing physical world in IoT, and energy efficient solutions.	CL	Lecture	K1A_U1, K1A_U17, K1A_U18, K1A_U21, K1A_W4,
2.	Student is aware of the importance and role of IoT in everyday living (including society, business, industry and environment)	CL	Lecture	K1A_K2, K1A_K3, K1A_K1,
3.	Student can design architecture and implement IoT platform	LE	Laboratory	K1A_U2, K1A_U17, K1A_U18, K1A_U21,
4.	Student can create complex software solution for IoT data harvesting and processing	LE	Laboratory	K1A_U2, K1A_U17, K1A_U18, K1A_U21,
5.	Student is aware of importance of networking in IoT	CL, LE	Lecture, laboratory	K1A_U1, K1A_U17, K1A_U21, K1A_W4, K1A_W14

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory:

30 / 0 / 0 / 0 / 0 / 30

19. Syllabus description:

1. Introduction to IoT
2. IoT hardware (platform, sensors)
    a. Platforms review (Arduino, Raspberry, others)
    b. Interfacing with physical world
3. Networking in IoT
    a. Hardware for networking
    b. Data link layer
    c. Network layer
    d. Communication protocols
    e. Security and energy efficient networking
4. IoT cloud
    a. Servers
    b. Data storage and processing
    c. Security and safety
5. Programming for IoT
    a. Local programming
    b. Network communication
    c. Data processing
6. Natural language processing
7. Audio, video and image processing in IoT
8. Semantic web
9. Applications

20. Examination: none

21. Primary sources:

- IoT introduction: http://theinstitute.ieee.org/static/special-report-the-internet-of-things
- http://www.ladyada.net/learn/arduino/

Wireless communication:

- http://www.ni.com/tutorial/3541/en/
- http://www.ni.com/white-paper/14916/en/
- https://technet.microsoft.com/en-us/library/cc757419(v=ws.10).aspx
- http://standards.ieee.org/about/get/802/802.11.html
- https://learn.sparkfun.com/tutorials/bluetooth-basics
- https://www.csrsupport.com/download/49793/CS-327738-RP-2-Training%20and%20Tutorials%20-%20Introduction%20to%20Bluetooth%20Smart.pdf
- https://docs.zigbee.org/zigbee-docs/dcn/03-1323.pdf

Hardware and programming:

- http://www.amazon.com/Designing-Internet-Things-Adrian-McEwen/

Cloud solutions for IoT:

- "A Survey of Research on Cloud Robotics and Automation", by B. Kehoe, S. Patil, P. Abbeel and K. Goldberg. IEEE Transactions on Automation Science and Engineering: Special Issue on Cloud Robotics and Automation. Vol. 12, no. 2. Apr. 2015
- "Cloud-Enabled Robots", by J. Kuffner. IEEE-RAS International Conference on Humanoid Robots, 2010.

Machine learining:

- Beinuo Zhang, Zhewei Jiang, Qi Wang, Jae-sun Seo, Mingoo Seok, "A neuromorphic neural spike clustering processor for deep-brain sensing and stimulation systems," *ACM/IEEE International Symposium on Low Power Electronics and Design (ISLPED)*, 2015,http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7273496

NLP, Audio, Images and Video in IoT:

- Jurafsky, Daniel, and James H. Martin. Speech and Language Processing (2nd ed.). 2009.
- Johnson, Keith. Acoustic and Auditory Phonetics (3rd ed). 2011.
- Schuller, Björn; Batliner, Anton
- Computational Paralinguistics: Emotion, Affect and Personality in Speech and Language Processing, Wiley Chichester, 2014
- Bella DePaulo. The Lies We Tell and the Clues We Miss. (collected papers). 2009.
- Praat: http://www.fon.hum.uva.nl/praat/
- OpenSMILE: http://www.audeering.com/research/opensmile
- Linguistic Inquiry and Word Count (LIWC): http://liwc.wpengine.com
- SentiWordnet: http://sentiwordnet.isti.cnr.it
- Whissell's Dictionary of Affect: http://www.amsciepub.com/doi/abs/10.2466/pms.1986.62.3.875
- Kaldi: http://kaldi.sourceforge.net
- Pocket Sphynx: http://cmusphinx.sourceforge.net/2010/03/pocketsphinx-0-6-release/
- HTK Toolkit: http://htk.eng.cam.ac.uk
- Festival: http://www.cstr.ed.ac.uk/projects/festival/
- HTS: http://hts.sp.nitech.ac.jp
- He, Junfeng, Jinyuan Feng, Xianglong Liu, Tao Cheng, Tai-Hsu Lin, Hyunjin Chung, and Shih-Fu Chang. "Mobile product search with bag of hash bits and boundary reranking." In Computer Vision and Pattern Recognition (CVPR), 2012 IEEE Conference on, pp. 3005-3012. IEEE, 2012.
- Thomee, Bart, Benjamin Elizalde, David A. Shamma, Karl Ni, Gerald Friedland, Douglas Poland, Damian Borth, and Li-Jia Li. "YFCC100M: The new data in multimedia research." Communications of the ACM 59, no. 2 (2016): 64-73.
- Kalkowski, Sebastian, Christian Schulze, Andreas Dengel, and Damian Borth. "Real-time analysis and visualization of the YFCC100M dataset." In Proceedings of the 2015 Workshop on Community-Organized Multimodal Mining: Opportunities for Novel Solutions, pp. 25-30. ACM, 2015.

22. Secondary sources:

Networking and security:

- http://rethink-iot.com/2015/03/20/on-lpwans-why-sigfox-and-lora-are-rather-different-and-the-importance-of-the-business-model/
- http://arxiv.org/abs/1510.00620
- http://arxiv.org/abs/1504.03242
- http://thethingsnetwork.org/
- http://www.lora-alliance.org/What-Is-LoRa/Technology
- http://www.rysavy.com/Articles/2014-03-IEEE-Defining-Spectrum-Efficiency.pdf

- https://transition.fcc.gov/bureaus/oet/tac/tacdocs/meeting92314/TAC-Internet-of-Things-Position-Statements.pdf
- https://www.owasp.org/index.php/OWASP_Internet_of_Things_Project
- https://transition.fcc.gov/oet/tac/tacdocs/reports/2015/FCC-TAC-Cyber-IoT-White-Paper-Rel1.1-2015.pdf
- https://www.ftc.gov/system/files/documents/reports/federal-trade-commission-staff-report-november-2013-workshop-entitled-internet-things-privacy/150127iotrpt.pdf
- https://epic.org/privacy/internet/iot/

- http://www.ti.com/lsds/ti/wireless_connectivity/6lowpan/overview.page?paramCriteria=no
- https://datatracker.ietf.org/doc/rfc7252/
- https://github.com/mqtt/mqtt.github.io/wiki

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	15/15
2	Classes	0/0
3	Laboratory	15/15
4	Project	/
5	BA/ MA Seminar	/
6	Other	/
	Total number of hours	30/30

24. Total hours: 60

25. Number of ECTS credits: 2

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

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 1

26. Comments:

Approved:

…….
(date, Instructor's signature)

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(*date , the Director of the Faculty Unit signature)*