(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: MEASUREMENT SYSTEMS	**2. Course code**
3. Validity of course description: 2015/2016	
4. Level of studies: BSc programme	
5. Mode of studies: intramural studies	
6. Field of study: CONTROL ELECTRONIC AND INFORMATION ENGINEERING	(FACULTY SYMBOL) RAU
7. Profile of studies:	
8. Programme:	
9. Semester: 4 (S1)	
10. Faculty teaching the course: Institute of Automatic Control, Faculty Of Automatic Control, Electronics And Computer Science	
11. Course instructor: Roman Wyżgolik, PhD	
12. Course classification: common courses	
13. Course status: compulsory	
14. Language of instruction: English	
15. Pre-requisite qualifications: completed or partially completed courses on Physics, Introduction to electronics, Probability and statistics.	
16. Course objectives: To acquaint students with measurement systems and their role in Automatic Control and Robotics, Electronics and Telecomunication, Computer Science.	

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
W1	Has knowledge about metrology, selected sensors, measuring transducers and measurement systems, about measurement techniques for different physical and electrical quantities. Has basic knowledge about software design for DAQ (Data AcQuisition) systems.	EP/EU	WM, WT	K1A_W11
U1	Can design a simple measurement system and create the application for this system.	CL, PS, OS	L	K1A_U18
U2	Can acquire and analyze signals with the use of DAQ devices.	CL, PS, OS	L	K1A_U20
K1	Can work together in a team in different roles	CL, PS, OS	L	K1A_K3

18. Teaching modes and hours

Lecture: 30, Laboratory: 30

19. Syllabus description:

Semester : 4

Lecture

Introduction to measurement systems in industry, research & development and science. Elements of measurement systems.
Integration of intrinsically safe field instrumentation into industrial communication networks.
Vocabulary of Basic and General Terms in Metrology: sensor, measuring instrument, measuring chain, measuring system, static characteristics - range, span, zero, zero drift, sensitivity, resolution, response, linearity, hysteresis, calibration, accuracy… ; dynamic characteristics.
From sensor to acquisition device. Review of sensors: conventional, thick, thin and semiconductor technologies. Smart transducer, standarized signals and most popular industrial protocols – HART, Profibus PA (and Profibus DP), Foudation Fieldbus. Analog to digital converters for sensors and data acquisition.
Sensors properties: range, sensitivity, characteristic, intrinsic and additional errors.

Selected measurements of physical and electrical quantities: temperature, strain, acceleration, displacement, true RMS , frequency.
The IEEE 1451- a smart transducer interface standard for sensors and actuators.
Devices and interfaces in measurement systems: bench top and modular instruments (multimeters, generators, oscilloscopes..., PXI, universal DAQ boards). Serial and paraler interfaces. CompactRIO and singleboardRIO embedded platforms with RT and FPGA. Vision acquisition systems.
Introduction to Virtual Instrumentation. LabVIEW programming: Project Explorer, VI front panel and block diagram, VI icon and connector pane. Data types. Basic loops and structures. Debuging technics. Clusters and type definition. High level and low level file I/O functions. Design patterns. Data communication between parallel loops.
Examples of Production Line Testers, End-Of-Line testers.

Laboratory

1. Temperature sensors calibration
2. Strain gauges.
3. Digital to analog and analog to digital converters.
4. AC votage measurement.
5. Signal generation and acquisition in DAQ based systems.
6. Dual slope AD converter.
7. LabVIEW 1 – Introduction to LabVIEW programming
8. LabVIEW 2 – State Machine design pattern
9. LabVIEW 3 – Producer Consumer design pattern.
10. Multifunction DAQ device in measurement systems.

20. Examination: yes, semester 4

21. Primary sources:

1. Bentley J. P.: Principles of measurement systems; Longman, London and New York 1985.
2. Fraden J.: AIP Handbook of Modern Sensors; Physics, Design and Applications. American Institute of Physics Press, 3rd ed. p. cm., Springer-Verlag, New York, Berlin, Heidelberg, 2003.
3. Morris A.S.; Langari R.: Measurement and Instrumentation - Theory and Application, Elsevier, 2012
4. Yik Yang: LabVIEW Graphical Programming Coockbook, Packt Publishing, 2014

22. Secondary sources:

1. Travis J., Kring J.: LabVIEW for everyone : graphical programming made easy and fun - 3rd ed, Prentice Hall, 2007.
2. Blume P. A.: The LabVIEW style book, Prentice Hall, 2007
3. International Vocabulary of Basic and General Terms in Metrology. ISO 1993.Guide to the Expression of Uncertainty in Measurement. ISO 1993.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/10
2	Classes	/
3	Laboratory	30/45
4	Project	/
5	BA/ MA Seminar	/
6	Other	10/25
	Total number of hours	70/80

24. Total hours:150

25. Number of ECTS credits: 6

26. Number of ECTS credits allocated for contact hours: 3

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):3

26. Comments:

Approved:

…… *(date, Instructor's signature)*

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