A separate important issue of hands-on or virtual labs is the installation of additional special software for operation. It complicates use of personal computers (PC) in places with public PCs or at work if installation of new software is limited.

Problem solution. To meet these needs, both the online course and laboratory for the ACS study were developed within the frameworks of Tempus project 530 278 - TEMPUS-12012-1-DE-TEMPUS-JPHES "iCo-op: Industrial Cooperation and Creative Engineering Education based on Remote Engineering and Virtual Instrumentation".

The purpose of this course is to acquire basic knowledge of modeling, analysis, simulation and design of the ACS of real objects. Prerequisites for the course are knowledge of fundamental high school mathematics and electrical engineering. The course includes 11 lectures, 3 remote laboratory projects via the Internet with video broadcast for operation control of the lab in real time and 1 practical work "Calculation of the proportional-integral-derivative controller for control object with specified dynamic parameters." The volume of the course is 20 study hours and its duration is 2 months.

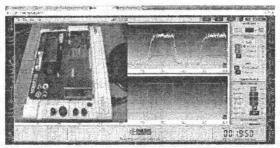


Figure 1 - Web - interface of the online laboratory for ACS research in real

1. A. Cardoso, T. Restivo, P. Cioga, M. Delgado, J. Monsanto, J. Bicker, E. Nunes, and P. Gil, "flock.uc.pt - A Web Platform for Online Educational Modules with Online Experiments", International Journal of Online Engineering, vol. 9, Special Issue 1, 2013. 2. ICo-op. [Online]. Available: www.ico-op.eu.

UDC 371.3

THE ONLINE COURSE AND HANDS-ON LABORATORY FOR MEASUREMENT METHODS STUDY

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Introduction. Measurement is an integral part of industry and daily life. Definitely, there are many measurements in robotics, medicine, oil and gas,

chemical, aircraft, spacecraft and other industries. For instance, measurements of temperature, level, pressure, humidity and flow of gas and fluid are widely performing in petroleum or chemical companies. In any spheres, it should be selected optimal method in depending on required measuring conditions, cost and accuracy. So as any measured result is valuable, if you can assess its accuracy.

This is a subject of the study course on the foundations of Measurement. The course is a basic one in Mechatronics, Automation, Automotive, Robotics, Electrical Engineering, Industrial and Medical Diagnostics and so on. Such course can be implemented as usual study course in college or university and also elearning via the Internet.

Problem formulation. Such online course can be easy developed on Moodle platform. Additional plugins of Moodle platform such a Advanced Forum, created by Chris Follin provide excellent possibilities for communication between teachers and students. In the same time modern web conferencing systems such an open source technology BigBlueButton [2] allow to improve e-learning environment, including communication and feedback environment, based on online real time video lectures, presentations and online meetings between students and teachers.

Nevertheless, development of hands – on labs for measurement methods study to provide students with sufficient practical skills is enough challenging. Obviously, measuring methods can be demonstrated in virtual labs and students can be provided for artificially generated or previous measured data samples. Although, students prefer to use real measuring instruments and study actual measured data. It allows users rather acquire learning course comparing with studies using virtual instruments.

Problem solution. In order to meet these needs there were developed both the online course and hands-on laboratory for measurement methods study within the frameworks of Tempus project 530 278 - TEMPUS-12012-1-DE-TEMPUS-JPHES "iCo-op: Industrial Cooperation and Creative Engineering Education based on Remote Engineering and Virtual Instrumentation"[3].

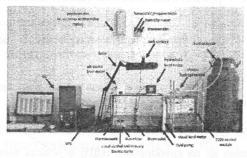


Figure 1 - The appearance of the hands-on lab for measurement methods study

The objectives of the course are to learn how to select optimal measuring method and sensors, measure, analyze and statistically process measuring results.

Requirements for the course study are knowledge of fundamentals of mathematics and physics.

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The online course consists of lectures, remote laboratory works with video guides, practical work and examination after every topic. The volume of the course is 20 study hours and its duration is 2 months.

1. BigBlueButton. [Online]. Available: http://bigbluebutton.org/. 2. ICo-op. [Online]. Available: www.ico-op.eu.

УДК 621.01

ДОСЛІДЖЕННЯ МАТЕМАТИЧНОЇ МОДЕЛІ ПРОЦЕСУ ПЕРЕМІЩЕННЯ ВНУТРІШНЬОТРУБНОГО ДІАГНОСТУЮЧОГО ПРИЛАДУ (ВДП)

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У багатьох галузях промисловості України виникає необхідність здійснення неруйнівного контролю трубопроводів з обмеженим доступом в зону вимірювань. Тому актуальною ϵ задача створення саморухомих пристроїв, які забезпечують доставку засобів інформації в зону можливих дефектів конструкцій [1]. Головною складовою (ВДП) ϵ математична модель переміщення приладу. Збільшення в об'ємі оболонки задньої пневмокамери описується таким рівнянням:

$$m\frac{d^2Z}{dt^2} = pS_k - F, Z(0) = R_c, Z'(0) = 0,$$
 (1)

де $m\frac{d^2Z}{dt^2} = pS_k - F$ — рухома маса оболонки задньої пневматичної камери; S_k

- площа бічної поверхні оболонки задньої пневматичної камери; p — робочий тиск; Z — радіус оболонки задньої пневматичної камери; t — час; F — сила опору. m, S_k , F є конструктивними параметрами і тільки p можна змінювати під час руху ВДП.

Просування вперед на довжину кроку S носової частини відносно фіксованої хвостової описується таким рівнянням:

$$m*\frac{d^2S}{dt^2} = P_b - q$$
, $S(t1) = 0$, $S'(t1) = 0$, (2)

де P_b – корисна сила дії на трубопровід ВДП; q – сила опору трубопроводу $(P_b$ '>>q '); m^* – рухома маса носової частини; S – переміщення носової частини вперед відносно фіксованої хвостової. m^* є конструктивним параметром, P_b можна змінювати під час руху ВДП, а q змінюється самостійно під час руху.