Course Title

Virtual Enterprise

Course Scope

Credit Points: 2 CP

Workload: 72 Hours

Course Code

B1.V.14

Course Descriptor

This course is aimed at acquirement basic knowledge and competences of simulating electrical and electronic circuits and systems with Multisim, implementing specifications into a design of an entire system with Labview, running key business operations with Bonita ERP.

Study Program

Master's Degree in in Radiophysics

Learning Outcomes

The student who successfully completes this course:

1. Understands how to create a circuit model with Multisim, how to use Multisim simulation, how to use a graphical system design with Labview, how to be responsible for key business processes with Bonita ERP.
2. Understands and uses the methods and techniques in constructing circuit models, in implementing Circuit Analysis for high frequency signals, in creating virtual instrumentation models, in using various SAP ERP transactions.
3. Describes the various approaches for implementing Transient Analysis with Multisim, AC Sweep Analysis with Multisim, Single Frequency AC Analysis with Multisim, Fourier Analysis with Multisim, Pole Zero Analysis with Multisim, Sensitivity Analysis with Multisim, Labview graphical system designing, Labview methods of modular programming (repeti-

tion and loops, arrays, clusters), Labview methods of plotting data, Labview methods of working with structures, strings and file i/o, Labview instrument control methods and Labview motion control methods, Materials Management with Bonita ERP, interaction between departments with Bonita ERP, .

4. Explains the main tasks involved in designing a device, in effectively performing ERP business functions.
5. Demonstrates knowledge of Multisim, Labview and Bonita ERP terms and techniques such as:
   possibility of scheme constructing (customizable graphic interface, free placement and connection of parts of the scheme, the formation of the Reports the Netlists; securing communications while moving parts of the scheme, the possibility of simultaneous replacement of several components, components editing, hierarchical design, possibility of streamlining multi-page projects, notations for circuits and comments to the schemes, SPICE 3X5 / XSPICE standards, expanded model support, importing and exporting NI files with measurement data, LabVIEW VI as inputs and sources, microcontroller emulation, MCU Function, interactive component modeling, parallel LabVIEW simulation, master of operational amplifiers, filter control, amplifiers with common emitter emulation, API for automation, loading simulation code from a DLL, the XSpice command line interface); additional methods of analysis; connecting external equipment using the most common interfaces and protocols; remote control of the experiment; generating and process digital signals; implementing a variety of mathematical data processing methods; visualization of data and the results of their processing (including 3D-models); modeling complex systems; storing information in databases and generating reports
6. Applies the virtual enterprise concept by working on a team project or individually.
7. Uses Multisim, Labview or other online/offline collaborative software to make models of electronic circuits and creating virtual devices.
8. Demonstrates good oral presentation skills.
9. Learns to use virtual collaboration tools like Course site and Google sites.
10. Appreciates the importance of this course competences for understanding the basic business processes and effectively performing their functions in the context of subsequent work in enterprises, for focusing on customer needs, for possession of the basic principles of business and economics, including organizational aspect, market knowledge and business communication.
11. Appreciates the knowledge of the National Instruments software (LabVIEW, Multisim) which makes it possible to create virtual devices and allows to maximize the effectiveness of training, without the need to invest significant financial resources into the material component of the educa-

tional process, to implement the testing of products using the same National Instruments software (and in the case of original solutions, made in the form of real devices) and skills developed in this class or in other settings.

Nominal Duration

Duration: 1 Semester Cycle: Yearly
Starting Term: 1st Semester Workload: 72 Hours
Presence (Direct): 24 Hours Credit Points: 2 CP

Assessment Criteria

EVALUATION:
1. Laboratory assignments and in-class activities – 40%
2. Individual presentation – 10%
3. Homework assignments – 20%
4. Final exam – 30%

Assessment criteria for in-class participation:

a. «Excellent» (5). A critical analysis which demonstrates original thinking and shows strong evidence of preparatory research and broad background knowledge.
b. «Good» (4). Shows strong evidence of preparatory research and broad background knowledge. Excellent oral expression.
c. «Satisfactory» (3). Satisfactory overall, showing a fair knowledge of the topic, a reasonable standard of expression. Some hesitation in answering follow-up questions and/or gives incomplete or partly irrelevant answers.
d. «Fail» (0-2). Limited evidence of relevant knowledge and an attempt to address the topic. Unable to offer relevant information or opinion in answer to follow-up questions.

Assessment criteria for written exam and laboratory assignments:

a. «Excellent» (5). Has a clear argument, which addresses the topic and responds effectively to all aspects of the task. Fully satisfies all the requirements of the task; rare minor errors occur.
b. «Good» (4). Responds to most aspects of the topic with a clear, explicit argument. Covers the requirements of the task; may produce occasional errors.
c. «Satisfactory» (3). Generally addresses the task; the format may be inappropriate in places; display little evidence of (depending on the assignment): independent thought and critical judgment include a partial super-

ficial coverage of the key issues, lack critical analysis, may make frequent errors.

d. «Fail» (0-2). Fails to demonstrate any appropriate knowledge.

Module Contents

DRAFT MODULE SCHEDULE

- Module 1: Circuit modeling with Multisim.
  - Topics: Multisim graphic interface, connection of parts of the scheme, hierarchical design, components editing, rules for constructing schemes, database components, analog simulation, expanded model support, irrational, interactive, animated parts of the scheme, measuring probes, interactive component modeling, parallel LabVIEW simulation, filter control, loading simulation code from a DLL, Transient Analysis, AC Sweep Analysis, Single Frequency AC Analysis, Fourier Analysis, Pole Zero Analysis, Sensitivity Analysis,
  - Lectures: 6 Hours.
  - Practical works: 6 Hours.
  - Self-directed study: 28 Hours.

- Module 2: Creating virtual devices with Labview.
  - Topics: Modular programming in Labview. Repetition and loops. Arrays. Clusters. Structures. Strings and File I/O. Plotting data. Data acquisition. IMAQ Vision. Instrument Control. Motion Control.
  - Lectures: 4 Hours.
  - Practical works: 4 Hours.
  - Self-directed study: 10 Hours.

- Module 3: Virtual enterprise key business processes with SAP ERP.
  - Topics: Materials Management with Bonita ERP, interaction between departments with Bonita ERP.
  - Lectures: 2 Hours.
  - Practical works: 2 Hours.
  - Self-directed study: 10 Hours.

Prerequisite and Conditions

Below you will find prerequisites for Virtual Enterprise course:

a. Physics courses (Electricity and Magnetism).
b. Basics of electrical engineering.
c. Electronics and circuits.
d. Economics.

Methodology

Lectures, homework assignments, in-class exercises, group discussions, presentations, laboratory assignments, and final exam will be used to aid in understanding and application of modern technologies for virtual enterprise.

Assessment Methods

Students' progress will be measured by final exam. The final grade includes 70% of the modular grades (3 modules) and 30% of final exam. The modular grade consists of laboratory assignments, homework assignments, individual presentation and in-class participation (40% of the modular grade). The final exam includes written assignment.

Laboratory Assignments (Exercise sessions):
Laboratory assignments contain the background material and preparation necessary for understanding the virtual enterprise concept. Objective one will be to design and build a measurement device (assigned by the instructor) using Multisim, Labview and fulfill all the business processes which are relevant to this main activity via Bonita ERP. Device design documents will be created to guide this objective. An overview of current industry standards of workmanship and safety shall be included. Students' projects may be undertaken individually or as teams. They may be internal or collaborative with industry. The project may involve developing a specific circuit or a more general exposure in an appropriate industrial environment.

Homework Assignments:
Students will volunteer or be asked to discuss homework due that class period. Late homework will not be accepted. We will use Course Site to upload HW and do some online activities. Please name the files (one file per homework, please) with your last name and then HW1, HW2, etc. If you have a special circumstance, let me know in advance.

Participation:

Students are expected to participate actively in class and online by asking questions, working on in-class and exercises, giving presentations as individuals, and sharing personal experiences and opinions related to the topics discussed. Students who do not participate up to expectations or miss more than x in-class hours without a pre-approved or written excuse will have their final grades reduced by one grade . Be sure to contact me before you miss a class, if possible. Let me know about last minute emergencies via email or phone as soon as you can. Also, please do not use cell phones, laptops, or other devices in class unless you are asked to do so. Be present in class.

Honesty:

You will receive a 0 on any item if you are dishonest. Be sure to cite references properly and do your own work. Also make sure you are honest in everything you do relating to your team projects and online activities.

Presentations:

Each student will give one individual presentation in class and post it in class online platform. The individual presentation should be a 10-15 minute presentation and include visual aids like PowerPoint slides, access to online resources, or use of other software. Include a reference page/slide at the end of the presentation or on the handout. References must have an author, title, and date. Also note references, such as quotes, statistics, etc. on specific slides/pages. Provide a hard copy to me and make it available electronically via email (or upload course web platform) beforehand. Presentations will be evaluated based on content, delivery, and response. I will determine presentation grades right after you present, and one of your classmates will also provide written feedback. If you change your scheduled presentation date without an approved excuse, your presentation grade will be reduced by 10%. Most individual presentations will be based on the results of your laboratory and homework assignments, such designing and manufacturing your measurement device, supporting all relevant business processes with Bonita ERP.

Teaching language

English

Lecturer

TBA

Lab assistant

TBA

Timetable

TBA

Course Plan

We'll add individual presentations to the schedule as soon as possible, and I'll post updated schedules in Course Site. We'll try to spread presentations out and have them fit in with lecture topics, as possible. Submit all assignments through Course Site, plus send me via email and work on your team projects and post results to your Google site. **Check due dates and times in Course Site.**

DRAFT CLASS SCHEDULE

- Lecture 1: Creating a circuit model with Multisim.
    - Topics: Multisim graphic interface, connection of parts of the scheme, hierarchical design, components editing, rules for constructing schemes, database components.
- Lecture 2: Multisim simulation possibilities.
    - Topics: mixed analog-digital simulation, expanded model support, irrational, interactive, animated parts of the scheme, measuring probes, microcontroller emulation, interactive component modeling, parallel LabVIEW simulation, filter control, pulsed power sources simulation, loading simulation code from a DLL.
- Lecture 3: Additional analyses methods.
    - Topics: Transient Analysis, AC Sweep Analysis, Single Frequency AC Analysis, Fourier Analysis, Pole Zero Analysis, Sensitivity Analysis, Temperature Sweep Analysis, Worst Case Analysis.
- Lecture 4: Basic Labview programming concepts and tools.
    - Topics: Modular programming in Labview. Repetition and loops. Arrays. Clusters. Structures. Strings and File I/O.
- Lecture 5: Bonita ERP Basics for virtual enterprise.
    - Topics: Materials Management with Bonita ERP, Production Planning and Execution with Bonita ERP, Sales and Distribution with Bonita ERP.
- Final Exam

- Exercise session 1: Analog devices scheme modeling with Multisim.
- Exercise session 2: Labview simulation for digital elements of a measurement information system.
- Exercise session 3: Labview simulation for the control unit of a measurement information system.
- Exercise session 4: Realizing steps of Materials Management process in Bonita ERP.
- Exercise session 5: Realizing steps department interactions in SAP ERP.

Bibliography and teaching resources

Basic References:

1. William D. Stanley, John R. Hackworth, *Computer-Aided Circuit Analysis with Multisim* (published in 2018).
2. Jovitha Jerome, *Virtual Instrumentation Using Labview* (published in 2010).

Supplementary References:

1. James W. Nilsson, Susan Riedel, *Introduction to Multisim for Electric Circuits* (published in 2018).
2. John Essick, *Hands-On Introduction to LabVIEW for Scientists and Engineers* (published in 2018).

Scheduled Work Plan

TBA

Internet resources

a. https://www.academia.edu/28766509/Multisim_Basics_Schematic_Capture_and_Simulation_Day_1_of_2_Hands-On_Training
b. https://documentation.bonitasoft.com/bonita/7.9/
c. Other websites and online resources will be recommended.

Software

Mandatory use of the following software:

a. Multisim (National Instruments)
b. Labview (National Instruments)
c. Bonita ERP.

Necessary Materials in class

Course WEB SITE: Most course info is in Course Site.
Lecture slides and other information will be available in the course site for this class. You are welcome to read other books as long as you follow course topics. I encourage you to share name of books, sites that might be helpful to your learning.

Scheduling of activities

TBA