d. Sample of course specification

EE3110 Measurement and Instrumentation

1. Course title: Measurement and Instrumentation

2. Course ID: EE3110

3. Credits: 3(3-1-0-6)

- Theory and Assignment: 45hours
- Laboratory experiment: 15hours

4. Intended attendee: 3rd year electrical engineeringstudents

5. Requirement:

- Pre-requisites: Circuit Theory (EE2010)

6. Expected Learning Outcomes

The main objective of the course is to provide students with basic knowledge of measurement techniques (error, range, span, measurement result handling, operating principles of instrument, measurement device components), help students understand how to use measurement devices in manufacturing systems as well as laboratory equipment. The course also enables students to approach the knowledge of the following-up courses such as process control, industrial measurement and control.

Upon successful completion of this course, students will be able to:

- Comprehending basic methods of handling measurement results
- Get the know-how of measurement device calibration
- Understand the basic working principles of electrical parameter instrumentation devices
- Understand the operating principles of several basic physical quantities
- Level of contribution to the educational program's output criteria: <Defined by 3 types: I (introductory only), T (teaching) or U (demand students to do experiment) to meet with the sub criteria in the educational program's output standard

Contribution to program outcomes:

Outcomes	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	2.6	3.1	3.2	3.3	4.1	4.2	4.3	4.4	4.5
Level	T	T	I	T	T	T	T	-	T	-	-	-	I	T	-	-	-

7. Course summary:

Part 1: Theoretical basis of measurement: fundamental parameters in instrumentationengineering i.e: errors, measurement techniques, measurement devices, result handling (calculation of measurement uncertainty, measurement steps to evaluate a measurement device).

Part 2: Methods and measurements of common electrical quantities: current, voltage, electric charge, resistance, inductance, capacitance, frequency, phase difference, power and electrical energy.

Part 3: Methods and devices for measuring non-electrical quantities. Sensors and components for measuring non-electrical quantities commonly found in industry: temperature measurement, force measurement, pressure, weight, flow, engine speed,…

8. Textbooks and references:

- Lecture (PDF): given by lecturer in class
- Textbooks:
- Instrumentation Engineering, *Instrumetation Group*, Science and Technics Publishing House, 2011
- References:
- Measurement methods of electrical and non-electrical quantities, Nguyen TrongQue, Hanoi University of Science and Technology Publishing House, 1996
- Technical basis of measurement, Nguyen TrongQue, Nguyen ThiLan Huong, Pham Thi Ngoc Yen, Science and Techniques Publishing House, 2009
- Measurement of physical quantities, Pham Thuong Han(editor), Science and Techniques Publishing House, 5th edition, 2010

Measurement, Instrumentation, and Sensors Handbook, 2ed Edition, CRC press, 2014

- 9. Learning methods and activities:
- Course attendance: in compliance with general regulation
- Laboratory experiment: complete all assigned experiments
- Exercise/Assignment: complete all assigned homework

10. Grading plan: Progress (0.3) – FinalExam(TL: 0.7)

- Coursework will be weighted as follows:
- Progress evaluation: weighting factor of 0.3
- Final exam:
- Requirement: Complete all assigned laboratory experiments
- Under multiple-choice or written exam
- Weighting factor of 0.7

11. Tentative Schedule

Week	Topic/Activity	Textbook	Note
1-2	INTRODUCTION Chapter 1. The basic definitions		1 Homework

	1.1 The definition of measurement, method of measurement and classification of measurement methods 1.2 Measurement devices and classification 1.3 Specifications of the measurement device 1.4. Measurement result handling, calculation of measurement uncertainty		
3-5	ELECTRICAL MEASUREMENT Chapter 2. Methodsanddevicesformeasuringcurrent, voltageandelectriccircuitparameters 2.1. Analoguemeters: analoguedisplay, ammeters, voltmeters, ohmmeters 2.2. Digital meters: ADC, digital display, structureof digital voltmeter 2.3. High voltageandcurrentmeasurement 2.4. Lump elementmeasurement (R,L,C) 2.5. Large resistancemeasurement		1 Homework Laboratory Session 1 Session 2
6	Chapter 3. Methodsanddevicesformeasuring power andenergy 3.1. Analoguewattmeters 3.2. Analogue power meters 3.3. Digital wattmetersandpower meters: usageof digital multipliers		Laboratory session 4
7	Chapter 4. Methodsanddevicesformeasuringtemporal parameters 3.1. Time counter 3.2. Period, frequency, phasedifferencemeasurement 3.3. Oscilloscopes		Laboratory session 5
8-9	NON-ELECTRICAL QUANTITY MEASUREMENT Chapter 1. Specifications of sensors and non-electrical quantity measurement devices Definition and classification of sensors Structureofnon-electricalquantitymeasurementdevices: signalconditioningcircuit		Homework

10-11	Chapter 2. Methods and devices for measuring temperature 2.1. Thermistors 2.2. Thermocouples 2.3. Optical methods: Thermal radiation		1 Homework
12-13	Chapter 3. Methods and devices for measuring strain, force, pressure, pressure difference, flow 3.1 Types of sensors used: strain gauge, piezoelectric, inductance, mutual inductance, capacitance 3.2 Deformation measurement methods 3.3. Force measurement methods 3.4 Pressure and pressure difference measurement methods 3.5 Flow measurement methods: induction, pressure difference, ultrasonic, turbine, heat		
14	Chapter 4. Methodsanddevicesformeasuringdisplacementandgeometricdimensions Basic definitions Displacementmeasurement Velocitymeasurement Accelerator measurement		
15	Revision		

12. Content of laboratory sessions

Session 1: Measurement device test and evaluation of the device errors (3 hours)

Session 2 & 3: Practice of computer-based virtual instrumentation (LabVIEW software) (6 hours, 2 sessions)

Session 4: Temperature measurement (3 hours)

Session 5: Single phase power meter test (3 periods)

EE4435 Digital Control System

1. Course: Digital Control System

2. Code: EE4435

3. Credits: 3(2-1-1-6)

Theory + Exercise: 30 classes

4. Participation: Junior engineering students from 6th semester (compulsory for Electrical Engineering and Control Engineering& Automation fields)

5. Prerequisites:

Control theory I
Microprocessor

6. Learning Objectives and Outcomes

This course equips the students with fundamentals of digital control system. The course presents mainly on the frequency domain. The time domain is introduced briefly and will be analyzed thoroughly in Master program.

Contribution level: GT (introduction only), GD (tutorial), SD (practice)

Criteria	1.1	1.2	1.3	2.1	2.2	2.3	2.4	2.5	2.6	3.1	3.2	3.3	4.1	4.2	4.3	4.4	4.5
Level	GD	GD															

7. Brief contents

Chapter 1: Introduction to Digital Control System

Chapter 2: Stability of Digital Control System

Chapter 3: Output Feedback Control

Chapter 4: State Feedback Control

Chapter 5: Digital Control System Implementation

8. Required Materials:

Texbook:

1. QuangNg.Ph.:*Digital Control System Lecture Note*. SectionA (Bachelor), version 11/2008

References:

1.Franklin, G.F.; Powell, J.D.; Workman, M.L.: *Digital Control of Dynamic Systems*. Addison Wesley, 2nd Edition, 1994

2. Isermann, R.: *Digitale Regelsysteme*. Bd. I und II, Springer, 2. Auflage, 1987-1988

3. Quang Ng.Ph.: *MALAB & Simulink dành choKỹ sư điều khiển tự động*. NXB KH&KT, 2006

4. Houpis, C.H.; Lamont, G.R.: *Digital Control System*. McGraw-Hill, Inc., 2nd Edition, 1992

9. Learning Methods and Student Obligation:

Class attention: 70% of total classes.

Labs: Attend and pass the laboratory reports.

10. Grading

Midterm: 0.25
Final examination (writing): 0.75

11. Tentative schedule

Week	Contents	Textbook	Assignment
1-3	CHAPTER 1: INTRODUCTION TO DIGITAL CONTROL SYSTEM **1.1 Structure and database of digital control system** **1.2 Signal model in the z domain** **1.3 System model (z-transfer function, discrete-timestate space model)**		
3-5	CHAPTER 2: STABILITY OF DIGITAL CONTROL SYSTEM **2.1 Algebraic Criteria** **2.2 Root Locus Method** **2.3 System Performances Prediction**		
5-9	CHAPTER 3: OUTPUT FEEDBACK CONTROL **3.1 Approximate the Continuous PID Controller** **3.2 Parameters Optimization Methods (Integral criteria, module optimization, pole placement)** **3.3 Structure Optimization Methods (model balanced controller, dead-bead controller)**		

9-13	CHAPTER 4: STATE FEEDBACK CONTROL **4.1 Review** **4.2 Controllability, observability, controller form, observer form** **4.3 Structure of digital control system in the state space domain**		
13-15	CHAPTER 5: DIGITAL CONTROL SYSTEM IMPLEMENTATION **5.1 Signal Re-construction Problems** **5.2 System Design Using Computer** **5.3 Microcontroller Design**		

12.Lab sessions: Students have to registry and receive documents for lab practice in advance. Each group includes 3-5 students. One laboratory lasts in 3 hours, students are asked about preparation in 20-40 minutes. After doing at lab, students write the report and submit after 1 week. The grade for the lab includes of preparation and report.

Lab 1 (After studying chapter 1 and 2): “z-transfer function, discrete-time state space model”

Lab 2 (After studying Section 3.2): “Controller design based on parameters optimization method”

Lab 3 (After studying Section 3.3): “Controller design based on structure optimization method”

Lab 4 (After studying chapter 4): “Controller design in state space domain”