2.6.1 Focal Subjects 2

Focal Subjects 2

Module Summary
Module code: EEIB610
Module coordinator: Prof. Dr. Leize
Credits (ECTS): 24 Points
Semester: 6. Semester
Pre-requisites with regard to content: None
Pre-requisites according to the examination regulations: Regarding to the examination regulations no pre-requisites are required
Competencies: In the focal Subjects, the students choose from the available elective subjects. The competencies result from these. It is also possible to choose from the german-language elective subjects of the EITB course.
Assessment: Results from the chosen subjects.
Usability:

2.6.1.1. Focal Subjects 2: Automation Engineering

Automation Engineering

Module overview
EDP designation: EITB610A
Module Responsible(s): Prof. Dr. Philipp Nenninger
Module scope (ECTS): 7 points
Classification (semester): 6th semester
Content Requirements: Knowledge of the modules control engineering, control engineering, measurement engineering
Prerequisites as per SPO: According to SPO, no formal requirements are necessary.
Competencies: Participants will be able to translate technical issues into automation solutions by

a) Apply appropriate modeling techniques and develop systems in this way b) Be able to make architectural and communication decisions to be able to design and commission systems that function in practice.
Examination Credits: The students' theoretical knowledge as well as their knowledge acquired in the laboratory will be assessed in a written exam (duration 120 min). The practical application of the skills is evaluated in the laboratory experiments through colloquia and a written report.
Usability: This module focuses on the modeling of technical processes in graphical and mathematical form as well as their program-technical realization. The mapping to concrete automation computers, on the other hand, is anchored as a focal point in the "Control Engineering" module. Although the concepts of control engineering are used for modeling, controller design, stability criteria, etc. are reserved for the "Control Engineering" module.

Course: Automation Engineering
EDP designation: NN, (EIT611A, German course)
Lecturer(s): Prof. Dr. Philipp Nenninger
Scope (SWS): 4
Cycle: Summer semester
Type, mode: lecture, compulsory subject
Teaching language: English
Contents: • Process and process types • Basics of modeling • Graphical models, mathematical models, state-oriented models (Petri nets) • Process coupling, conversion principles, coding • Scaling, standardization, monitoring of process variables • Fieldbus systems, requirements and implementation structures • Reliability, safety and availability • Process operation and monitoring • Design, organization and operation of automation systems
Recommended reading: • Polke, M.: Prozess-Leittechnik, Oldenbourg-Verlag, 1994 • Früh, K. F.: Handbuch Prozessautomatisierung, Oldenbourg, 2000 • Jakoby, W.: Automation Technology - Algorithms and Programs, Springer 1996 • Olsson; Piani: Control, Regulation, Automation, Hanser, 1993 • Bergmann, J.: Automatisierungs- und Prozeßleittechnik, Fachbuch-verlag Leipzig, 1999 • Lauber, R., Göhner, P.: Prozeßautomatisierung Band 1+2, Springer 1999 • Strohrmann, G.: Automatisierung verfahrenstech. Processes, Oldenbourg, 2002 • Lunze, J. : Automatisierungstechnik, Oldenbourg, 2003 • Schuler, H.: Litigation, Oldenbourg, 1999 • Felleisen, M.: Prozessleittechnik für die Vefahrensindustrie, Oldenbourg, 2001

- Langmann, R.: Taschenbuch der Automatisierung, Fachbuchverlag Leipzig, 2004
- Charwat, H.J.: Lexicon of Man-Machine Communication, Oldenbourg, 1994.
- Schnell, G.: Bussysteme in der Automatisierungs- und Prozesstechnik, Vieweg, 2000
- Reißenweber, B.: Fieldbus systems, Oldenbourg, 1998
- Scherff, B., Haese, E., Wenzek, H.R.: Fieldbus systems in practice, Springer, 1999

Course: Automation Engineering Laboratory
EDP designation: NN, (EITB612A, German course)
Lecturer(s): Prof. Dr. Philipp Nenninger
Scope (SWS): 2
Cycle: Summer semester
Type, mode: laboratory, compulsory subject
Teaching language: English
Contents: Try to: • Modeling of technical processes • Scaling, normalization and filtering of process variables • Design and implementation of process control solutions with integrated control and regulation functions • Use of systems for operation and monitoring of processes (SCADA systems) • Communication via various fieldbus systems • Test strategies and test aids for process coupling
Recommended reading: • Seitz, M.: Programmable logic controllers, Fachbuchverlag Leipzig, 2003 • Wellenreuther; Zastrow: Automatisieren mit SPS, Vieweg 2001, (ISBN 3-528-03910-8) • Berger, H.: Automation with STEP 7 in IL and SCL, Siemens ed. Publicis Corporate Publishing, (ISBN 3-89578-197-5) • Braun, W.: Programmable logic controllers in practice, Vieweg, 1999 • Borucki, L.: Digital Technology, Teubner, (ISBN 3-519-36415-8) • Hertwig, A.; Brück, R.: Entwurf digitaler Systeme, Hanser, (ISBN 3-446-21406-2).

2.6.1.2. Focal Subjects 2: Robotics

Robotics

Module overview
EDP designation: NN, (EITB640A, German course)
Module Responsible(s): Prof. Dr. Daniel Braun
Module scope (ECTS): 5 points

Classification (semester): 6th semester
Content Requirements: Computer engineering
Prerequisites as per SPO: According to SPO, no formal requirements are necessary.
Competencies: The participants learn how to work with robots in which they a) Learn the necessary theoretical basics about robotics b) Use coordinate transformations and kinetic modeling for path planning c) Learn about hardware, software and sensor technology for robots d) Apply programming methods and programming languages to be able to process common operations in automation technology with robots.
Examination Credits: The students' theoretical knowledge and their knowledge acquired in the laboratory are assessed in a written exam (duration 90 min). The practical skills are evaluated in the laboratory experiments by colloquia and by written reports on each laboratory experiment.
Usability: Control of robots in automation technology applications, application of coordinate transformations, path planning.

Course: Robotics
EDP designation: NN (EIT641A, German course)
Lecturer(s): Prof. Dr. Daniel Braun
Scope (SWS): 2
Cycle: Summer semester
Type, mode: lecture compulsory subject
Teaching language: English
Contents: • Areas of application for industrial and service robots • Kinematic types • Coordinate transformations • Kinetic modeling of manipulators • Railroad planning • Sensors • Control architecture in hardware and software • Programming methods and programming languages
Recommended reading: • Dillmann, R.; Huck, M.: Information Processing in Robotics, Springer-Verlag Berlin, Heidelberg, 1991. • Hertzberg, J.: Mobile Robots, Springer Vieweg, 2012

Course: Robotics Lab
EDP designation: EITB642A
Lecturer(s): Prof. Dr. Daniel Braun
Scope (SWS): 2
Cycle: Summer semester
Type, mode: laboratory, compulsory subject
Teaching language: English
Contents: Try to: • Basics of robot programming • Teach-in procedure • Programming of complex motion profiles • Implementation of palletizing tasks • Drawing complex geometries • Realization of joining processes
Recommended reading: • Dillmann, R.; Huck, M.: Information Processing in Robotics, Springer-Verlag Berlin, Heidelberg, 1991. • Hertzberg, J.: Mobile Robots, Springer Vieweg, 2012

2.6.1.3. Focal Subjects 2: Wireless Communication and Information Technology

Wireless Communication and Information Technology

Module overview
EDP designation: NN
Module Responsible(s): Prof. Dr. Manfred Litzenburger
Module scope (ECTS): 5 points
Classification (semester): 6th semester
Content Requirements: Signals and Systems, Instrumentation and Measurement, Computer engineering
Prerequisites as per SPO: According to SPO, no formal requirements are necessary.
Competencies:

This subject covers the fundamental principles associated with the methods of information transmission in communication networks with special emphasis on wireless networks.
Students will be able to understand, develop and build current and future information systems and networks by

- Understanding the interaction of the protocol entities in a communications network
- Knowing the functionalities and mechanisms of the used protocols
- Understanding how information is transmitted by radio signals in wireless networks
- Understanding the propagation effects affecting radio signals
- Knowing the special challenges and requirements of mobile communications
- Being able to assess the performance of transmission schemes
- Being able to simulate and analyze transmission systems and network protocols with appropriate tools
- Being aware of the data security threads in open (wireless) networks concerning secrecy, authenticity, and integrity and being able to apply data security measures appropriately

Examination Credits:
The students' theoretical knowledge and their knowledge acquired in the laboratory are assessed in a written exam (duration 90 min). The practical skills are evaluated in the laboratory experiments by colloquia and by written reports on each laboratory experiment.

Usability: Control of industrial information methods and wireless communication strategies.

Course: Wireless Communication and Information Technology

EDP designation: NN

Lecturer(s): Prof. Dr. Manfred Litzenburger

Scope (SWS): 3

Cycle: Summer semester

Type, mode: lecture compulsory subject

Teaching language: English

Contents:

- Communication basics
- Networks and protocols, the OSI-protocol stack
- Climbing up the protocol stack:
    - Layer 1: Physical layer
        - Baseband representation of RF signals
        - (QAM-, PSK-) Modulation, demodulation / detection
        - Wireless communication: frequencies, duplexing, radio propagation, path loss models, channel models (AWGN, multipath channels)
        - Criteria for assessing communication systems: Bit error rate (BER) and bandwidth efficiency
        - Multicarrier modulation (OFDM) (time permitting)
        - Cellular mobile networks, cell planning
    - Layer 2: Data link control

▪ Medium access, multiple access, examples: LTE, Ethernet, WLAN ▪ Error control, Automatic repeat request (ARQ), sliding window protocols ○ Layer 3: Networking ▪ Addressing, routing, Quality-of-Service (QoS) provision, example: IP ○ Layer 4: Transport ▪ Flow control, congestion control, example: TCP • Architecture of the Internet • Cryptography and data security ○ Cyphering (DES, AES, …), authentication, integrity protection ○ Integration of security mechanisms in mobile radio systems (GSM, LTE, WLAN) ○ Transport Layer Security (TLS) ○ Mobile Communication Network
Recommended reading: • See ILIAS

Course: Wireless Communication and Information Technology Lab
EDP designation: NN
Lecturer(s): Prof. Dr. Manfred Litzenburger
Scope (SWS): 1
Cycle: Summer semester
Type, mode: laboratory, compulsory subject
Teaching language: English
Contents: Three lab experiments: • Modelling and simulation (Matlab/Simulink) of digital communication systems (or, alternatively, “real” lab experiment with vector signal generator and vector signal-/ spectrum analyzer) • Network and protocol simulation with ns2 • Protocolanalysis of Internet connections with Wireshark
Recommended reading: • See ILIAS

2.6.1.4. Focal Subjects 2: Physical Sensors

Physical Sensors

Module overview
EDP designation: NN, (EITB450, German course)

Module Responsible(s): Prof. Dr. Harald Sehr
Module scope (ECTS): 5 points
Classification (semester): 4th semester
Content Requirements: Physics, direct current technology, alternating current technology, fields, electronics, measurement technology
Prerequisites as per SPO: According to SPO, no formal requirements are necessary.
Competencies: The participants • can explain functional principles of different physical sensors • can explain and interpret essential basic terms and parameters of various sensors • can independently select a suitable sensor principle based on given requirements • can design and dimension signal processing circuits for sensor systems by • Determine and evaluate sensor parameters, • describe the operating principles of various sensors verbally with the aid of sensor characteristics and by means of formula relationships, • Analyze applications and areas of use of various sensor systems, • Analyze tasks from sensor technology and assign suitable sensor parameters and properties, • set up various sensor systems and their signal conditioning circuits in the laboratory and determine parameters and sensor characteristics by measurement, in order to be able to select or develop sensors for specific requirements in their later careers.
Examination performance: Written exam, 120 minutes
Usability: This module builds on teaching content from the foundation course and the third semester and provides essential core competencies for the sensor and environmental measurement technology fields of study. In addition, the module provides knowledge necessary for understanding more advanced courses, e.g. bio- and chemosensorics.

Course: Physical sensors
EDP designation: NN, (EITB451S, EITB451U, German course)
Lecturer(s): Prof. Dr. Harald Sehr
Scope (SWS): 4
Cycle: Summer semester
Type, mode: lecture, compulsory subject
Teaching language: English
Contents: • Basic concepts of sensor technology

- Properties and characteristics of sensors
- Resistive sensors
- Capacitive sensors
- Inertial sensors
- Thermocouples
- Piezoelectric sensors
- Magnetic field sensors
- Induction sensors
- Inductance sensors
- Eddy current sensors
- Sensor signal conditioning
- Overview of sensor manufacturing technologies

Recommended reading:

- Niebuhr, Lindner: Physical Measurement Technology with Sensors, Oldenburg
- Hering, Schönfelder: Sensors in Science and Technology, Vieweg + Teubner
- Reif, K.: Sensoren im Kraftfahrzeug, Springer Schrüfer, E.: Elektrische Messtechnik, Hanser
- Schiessle, E.: Sensor Technology and Measurement Recording, Vogel
- Schiessle, E.: Industrial Sensor Technology, Vogel
- Hoffmann, J.: Pocketbook of Measurement Technology, Hanser
- Schanz: Sensors - Sensor technology for practitioners, Hüthig

Course: Laboratory Physical Sensors
EDP designation: EITB452S, EITB452U
Lecturer(s): Prof. Dr. Harald Sehr
Scope (SWS): 2
Cycle: winter semester and summer semester
Type, mode: laboratory, compulsory subject
Teaching language: English

Contents:

- Resistive temperature measurement
- Bending beam force sensors with strain gauges
- Capacitive distance measurement
- Differential transformer with carrier frequency amplifier
- Distance and displacement measurement with eddy current sensors
- Vibration analysis with piezoelectric sensors

Recommended reading:

- Niebuhr, Lindner: Phys. measurement technology with sensors, Oldenburg
- Schrüfer, E.: Elektrische Meßtechnik, Hanser