TIETOLIIKENNETEKNIIKKA

Huom. katso myös ICAT-opintojaksokuvaukset (ICAT=information, communication and automation technology). ICAT-kuvaukset sisältävät opintojaksoja, jotka liittyvät sekä automaatio-, tietoliikenne- ja tietotekniikkaan.

Aineopinnot

■Computer Architectures

Tietokoneen arkkitehtuurit

Code: TLTE2100
Credits: 5 ECTS (5 op)
Learning Outcomes: this course aims to teach the skills necessary for understanding the architecture of computers and microcontrollers. After completing this course the student will be able to understand the design principles of modern processors and bus systems. In addition, the student will also learn how to implement programs with assembly programming language. The skills learned in the lectures must be applied in the exercises.
Content: In the lectures the theoretical parts required for the exercises are presented. To the course contents belong the design principles of modern processors, execution of instructions, RISC vs. CISC, memory, address mode, interrupts, assembly language and peripherals.
Study Materials: lecture slides and course book (see course website)
Teaching Methods: lectures 24h and exercises 24h
Modes of Study: lectures, practical exercises and final examination
Languages: English
Grading: scale 1-5 or fail, final examination
Responsible Person: Prof. Mohammed Elmusrati
Teacher(s): Tobias Glocker
Responsible Unit: Department of Computer Science
Additional Information: annual course, website http://teg.uwasa.fi/courses/tlte2100/

■C Programming

Code: ICAT1010
Credits: 3 ECTS (3 op)
Prerequisites: TITE1070 Programming or ICATC1050 Introduction to Programming or respective course which covers the principles of programming, this course is targeted to students without prior knowledge of C.
Learning Outcomes: this course aims to teach the skills necessary for the development of Capplications. After completing this course the student will be able to develop C programs containing simple data structures. The student will learn how to implement programs according to given or own developed flowcharts . Also the use of debuggers will be introduced and applied. The skills learned in the lectures must be applied in the exercises.
Content: In the lectures the theoretical parts required for the exercises are presented. To the course contents belong data types, conditions, loops, arrays and pointers, macros, static and dynamic allocation, structures, time handling and file handling. The exercises contain the development of C/C++ applications related to the previously mentioned course contents.
Study Materials: lecture slides and course book

1. Kerninghan, B.W. & D.M. Ritchie, The C Programming Language, second edition

Teaching Methods: lectures 16 h and exercises 16 h
Modes of Study: lectures, practical exercises, and final examination
Languages: English (lectures and exercises)
Grading: scale 1-5 or fail, based on final examination
Responsible Person: Prof., Mohammed Elmusrati
Teacher(s): Tobias Glocker

Responsible Unit: Department of Computer Science
Additional Information: -

■Kandidaatintutkielma

Bachelor's Thesis
Huom. Energia- ja informaatiotekniikan tutkinto-ohjelman opiskelijoille

Koodi: TECH2990
Laajuus: 10 op
Ajankohta: kandidaatin tutkinnon 3. vuosi
Edellytykset: kandidaatin tutkinnon perusopinnot ja informaatiotekniikan suunnan opinnot aihepiirin alalta
Osaamistavoitteet:
Sisältö: Alkuraportti (n. 1 sivu): sisältää tutkielman alustavan otsikon, lyhyen kuvauksen työstä ja aiheesta, aiheen keskeisemmät kirjallisuuslähteet sekä aikataulusuunnitelman.
Väliraportti (10–15) sivua: Vastaa työmäärältään noin 1/3 koko kandidaatin tutkielmasta. Väliraportissa edellytetään olevan: luonnos tiivistelmäsivuksi, tutkielman sisällysluettelo, johdanto, jossa tavoite ja rajoitus, kirjallisuustyössä kirjoitettuna keskeisiä tekstikohtia/empiirisessä työssä yksityiskohtainen toteutussuunnitelma, hahmotelma johtopäätöksistä. Hyväksytystä väliraportista kirjataan 3 opintopistettä.
Loppuraportti viimeistellään kirjoitusohjeiden mukaisesti. Kandidaatin tutkielma kansitetaan ja tarkastetaan Turnitin-plagiaatintunnistusjärjestelmällä. Tutkielmasta pidetään pienryhmässä seminaariesitys.
Oppimateriaali ja kirjallisuus: tutkielman aiheeseen liittyvät tieteelliset tekstit
Toteutustavat: aloitusluennot syys- ja kevätlukukausien alussa 2 h, ohjaus ja pienryhmätyöskentely 15 h
Suoritustavat: aloitusluennot tai yhteydenotto omaan aihepiirin vastuuohjaajaan, alkuraportti, väliraportti (TECH2991, 3 op), seminaariesitys ja opponointi, kansitettu ja Turnitin-plagiaatintunnistusjärjestälmällä tarkastettu loppuraportti (TECH2992, 7 op), lisäksi kypsyysnäyte (KNÄYxxxx, 0 op). Opiskelija voi myös halutessaan edetä suoraan loppuraporttiin ja seminaariesitykseen.
Opetus- ja suorituskieli: suomi, tutkielmaraportointi voi olla myös englanninkielinen
Arvostelu: arvosana määräytyy tutkielman arvosanan mukaisesti asteikolla 1–5
Vastuuhenkilöt: TkK-koulutusohjelmavastaava, Jouni Lampinen, Timo Mantere, Jarmo Alander
Opettaja: opintosuuntien opettajat
Vastuuorganisaatio: Tieto- ja tietoliikennetekniikan yksikkö, Sähkö- ja energiatekniikan yksikkö
Lisätietoja: Energia- ja informaatiotekniikan ohjelman informaatiotekniikan suunnan opiskelijoille kandidaatintutkielmat tarkistetaan 1.8.2014 lähtien Turnitin-plagiaatintunnistusjärjestelmällä

■Mobile Communication Services and Systems

Matkapuhelinjärjestelmät

Code: TLTE2010
Credits: 5 ECTS (5 op)
Prerequisites: Telecommunication Electronics
Learning Outcomes: After completing the course successfully, the students will be familiar with cellular networks in different aspects and levels. They will understand the concepts of mobile communication over different standards such as GSM, UMTS, HSPA, and LTE. They will be aware in certain depth with the signaling plan as well as the user plan of cellular networks. Moreover, they will be able to perform simple mobile network planning for the GSM and 3G. The students will be familiar with most of the cellular networks blocks and functionalities.
Content: the course consists of different topics on mobile communications such as introduction to mobile communication systems, GSM network architecture, handover principles in GSM, GPRS, EGSM, system capacity and network planning, UMTS network architectures, services offered by UMTS, the integration of UMTS and GSM. Broadband cellular networks such as HSPA+ and LTE as well as LTE-Advanced will be covered. Finally different wireless communication topics will be prepared by the students in the form of course reports, example of such topics are: Bluetooth, Zigbee, LTE, WiMAX, VoIP, WiFi, 5G, and the applications of cellular networks in Energy systems.
Study Materials:

1. J. Eberspächer, H. Vögel, and C. Bettstetter: GSM, Switching, Services, and Protocols
2. H. Holma and A. Toskala: LTE for UMTS: Evolution to LTE-Advanced, 2nd Ed., Wiley 2011
3. Course Handouts
4. Different material based on students' report topic

Teaching Methods: lectures 24 h, project work (each student prepares and presents one oral presentation on a related topic given by the teacher), quizzes, and final examination
Modes of Study: lectures 24 h, project work (each student prepares and presents one oral presentation on a related topic given by the teacher), quizzes and final examination
Languages: English
Grading: scale 1-5 or fail
Responsible Person: Mohammed Elmusrati
Teacher(s): Ahmed Elgargouri
Responsible Unit: Department of Computer Science
Additional Information: annual course

■ Telecommunication Electronics
Tietoliikennetekniikan elektroniikka

Code: TLTE2050
Credits: 5 ECTS (5 op)
Prerequisites: basic studies in electronics and telecommunication
Learning Outcomes: after completing this course successfully, the student will be able to explain what is the meanings of signals in time and frequency domains, what is modulation and demodulations, what is amplitude and frequency modulations and the difference between them, what is analog and digital modulations and the benefits of each of them, basic of RF propagations, impact of noise and communication performance measures, all topics will be covered with strong analytical analysis, the students will be able also to design simple filters and to demonstrate the concepts of electronic circuits required to build analog and digital communication systems. This course is very important for students from other backgrounds than telecommunications and wants to join ComSys program.
Content: this course covers the main concepts of signals in time and frequency domains, sensors, filter analysis and design, oscillators, Analog/Digital Phase Locked Loops (PLL) with some applications, AM, PM and FM modulation and demodulation circuits, automatic gain control circuits, digital communication circuits, analog to Digital Converters (ADC), and some communication systems
Study Materials:
1. Course Handout
2. W. Tomasi: Electronic Communications Systems, 5th edition, Prentice Hall 2004
3. M. Roden: Analog and Digital Communication Systems, 5th edition, Discovery press 2003

Teaching Methods: 24 h lectures
Modes of Study: lectures 24 h, quizzes and final examination
Languages: English
Grading: scale 1-5 or fail
Responsible Person: Mohammed Elmusrati
Teacher(s): -
Responsible Unit: Department of Computer Science
Additional Information: annual course

■ Telecommunication Software
Tietoliikenneohjelmistot

Code: TLTE2040
Credits: 5 ECTS (5 op)
Learning Outcomes: this course aims to teach the skills necessary for the design and implementation of Java and phone applications. The applications are developed with Java and Android. After completing this course the student will be able to develop Graphical User Interface (GUI) applications with Java and Android. The student will learn the skills required for a complete Software Development Process by doing a certain project work. To get high points from the project work the student must be creative by adding additional program features. The student will be able to choose the best development platform for a certain project.
Content: In the lectures the theoretical parts required for the exercises and project work are presented. To the course contents belong the memory management, development rules for applications, dynamically linked libraries, concurrency, managing resources, Android example applications, Java applications and security. The contents of the exercises are the development of Android and Java applications.
Study Materials: Lecture slides. Course book (see course website).
Teaching Methods: 12 h lectures and 12 h exercises

Modes of Study: lectures, practical exercises, project work and final examination
Language: English (lectures and exercises)
Grading: scale 1-5 or fail, final examination (60%) and project work (40%)
Responsible Person: Prof., Mohammed Elmusrati
Teacher(s): Tobias Glocker
Responsible Unit: Department of Computer Science
Additional Information: annual course

Syventävät opinnot

■ Advanced Course in Signals and Systems

Signaalit ja systeemit

Code: TLTE3150
Credits: 5 ECTS (5 op)
Prerequisites: Digital Signal Processing
Learning Outcomes: After completing this course successfully, students will be familiar with analog and discrete signals in time and frequency domain, linear system modelling in time domain and frequency domain, convolution integral, state-space representation, discrete time modeling, Z-transform, DFT, controllability and observability of linear systems, introduction to nonlinear systems. Furthermore, the students will improve their skills in programming, all simulation tasks will be given by Matlab or Scilab (or equivalent package). Several examples in the course will be related to energy systems such as power plants and power distribution. This will enhance the knowledge and the outlook for students.
Content: time invariant systems, Laplace and Fourier transform and their applications in linear systems, analog filters, state space representation, system modeling using state space representation, difference equations, z-transform, DFT/FFT, digital filter design, introduction to Matlab applications in linear system analysis and simulations
Study Materials:

1. S. Karris: Signals and Systems with MATLAB Computing and Simulink Modeling, Orchard Publications; 3rd edition, 2006 or later
2. B. Girod, R Rabenstein, and A. Stenger: Signals and Systems, John Wiley, 2001
3. lecture notes

Teaching Methods: lectures and exercises 28 h
Modes of Study: exam and homeworks
Languages: English
Grading: scale 1-5 or fail
Responsible Person: Mohammed Elmusrati
Teacher(s): Reino Virrankoski
Responsible Unit: Department of Computer Science
Additional Information: annual course

■ Broadband Wireless Communication

Laajakaistatekniikka

Code: TLTE3030
Credits: 5 ECTS (5 op)
Prerequisites: Digital Communication
Learning Outcomes: After completing this course, the students will understand the theoretical background behind all modern broadband communication systems such as IEEE 802.11n/ac, LTE, LTE-Advanced, and 5G. The students will be aware about information theory, MIMO systems, mobile channels, MIMO spatial diversity, MIMO spatial multiplexing, and MIMO-OFDM systems. Students will be able to demonstrate the wireless broadband performance measures, limitations, and challenges. This course will enhance their scientific research skills.
Content: this course covers the following topics: Wireless Channels, Information Theory, MIMO configuration, Spatial Diversity, MIMO Spatial Multiplexing, and MIMO-OFDM
Study Materials:

1. J. Hampton, Introduction to MIMO Communications, Cambridge Press 2014

2. A. Paulraj, R. Nabar, and D. Gore, Introduction to Space-Time Wireless Communication, Cambridge Press 2003
3. Lecture notes

Teaching Methods: 28 h lectures + 10 h exercises
Modes of Study: quizzes and final exam
Languages: English
Grading: scale 1-5 or fail
Responsible Person: Mohammed Elmusrati
Teacher(s): Mohammed Elmusrati
Responsible Unit: Department of Computer Science
Additional Information: every second year

■Communications and Systems Engineering Seminar

Tietoliikennetekniikan seminaari

Code: TLTE3090
Credits: 3-10 ECTS (3-10 op)
Prerequisites: related subject studies on telecommunication engineering
Learning Outcomes: the aim of this course is to introduce research oriented topics in telecommunications and systems with the applications in energy systems. After completing this course successfully, the student will be able to seek scientific information and to prepare and give seminar presentations, moreover, they will be able to demonstrate the principles of the seminar topic
Content: this course has varying contents, the current content is always indicated by the course subtitle presented in the course website
Study Materials: depend on the topic
Teaching Methods: depend on the topic
Modes of Study: attending seminar sessions, quizzes, preparing scientific report and giving at least one presentation
Languages: English
Grading: scale 1-5 or fail or passed/fail (depends on the topic)
Responsible Person: Mohammed Elmusrati and Reino Virrankoski
Teacher(s): Mohammed Elmusrati, Reino Virrankoski
Responsible Unit: Department of Computer Science
Additional Information: annual course

■Computer Simulation in Communication and Systems

Tietoliikennejärjestelmien simulointi

Code: TLTE3120
Credits: 5 ECTS (5 op)
Prerequisites: the basics courses of mathematics
Learning Outcomes: the students will learn how to design and perform simulations by using MATLAB and SIMULINK by following system engineering practices, other simulation softwares may be visited briefly
Content:
Study Materials:

1. lecture notes
2. MATLAB documentation, http://www.mathworks.com
3. SIMULINK documentation

Teaching Methods: lectures 24 h, exercises 24 h, mandatory homework
Modes of Study: passing the exam, exercises and mandatory homework
Languages: English
Grading: scale 1-5 or fail
Responsible Person: Timo Mantere
Teacher(s):
Responsible Unit: Department of Computer Science
Additional Information: annual course

■Digital Communication
Digitaalinen tiedonsiirto

Code: TLTE3010
Credits: 5 ECTS (5 op)
Prerequisites: Telecommunication Electronics is recommended
Learning Outcomes: This course aims to teach different theoretical topics span the digital communication technology. Digital communication is the backbone of today's telecommunication technologies, therefore this course provided the main topics and information to understand the modern communication systems. After completing this course successfully, the students will be aware about the time-frequency relation in communication, challenges of digital communication like losses, noise, fading, ISI, and interference as well as how to mitigate them. The student will be able to explain the main concepts of digital communication transmitters and receivers, moreover, the students will be able to demonstrate the main blocks of digital communication receivers/transmitters. Furthermore, they will be able to evaluate the performance of digital communication system and also to compute the link budget.
Content: This course covers review for probability and stochastic processes, source coding, sampling theorem, digital modulation and demodulation, error performance analysis, ISI problems and equalizers, channels and link budget analysis, channel coding and decoding methods (block and convolutional codes), diversity techniques to overcome fading problems, multiple access techniques, and information theory.
Study Materials:
1. B. Sklar: Digital Communication, 2nd Edition, Prentice Hall, 2001
2. J. Proakis and M. Salehi, Digital Communication, McGraw-Hill, 2008
3. lecture notes

Teaching Methods: lectures 28 h and exercises 10 h
Modes of Study: quizzes, homework, and report
Languages: English
Grading: scale 1-5 or fail
Responsible Person: Mohammed Elmusrati
Teacher(s): Mohammed Elmusrati
Responsible Unit: Department of Computer Science
Additional Information: annual course

■Embedded C-Programming
Sulautettu C-ohjelmointi

Code: TLTE3170
Credits: 3 ECTS (3 op)
Prerequisite: Computer architectures
Learning Outcomes: This course aims to teach the skills necessary to design and program applications for microcontrollers. After completing this course the student will be able to develop C applications for microcontrollers. Besides the programming part, the student will learn the architecture of microcontrollers and the basics of electronic circuits. The student must apply the learned skills in the exercises. To deepen the knowledge each student has to write an exercises report that contains the explanations of the solved exercise tasks.
Content: In the lectures the theoretical parts required for the exercises are presented. To the course contents belong I/O ports, delays, interrupts, timer, Pulse Width Modulation, Analog to Digital Converter, Universal Asynchronous Receiver/Transmitter and Serial Peripheral Interface. The exercises contain the development of Embedded C applications related to the previous mentioned course contents.
Study Materials: lecture slides, datasheets of ATMEL ATmega16
Teaching Methods: 12 h lectures and 12 h exercises
Modes of Study: lectures, practical exercises and final examination
Languages: English (lectures and exercises)
Grading: scale 1-5 or fail, final examination
Responsible Person: Timo Mantere
Teacher(s): Tobias Glocker
Responsible Unit: Department of Computer Science
Additional Information: annual course

■ Introduction to Radio Technology
Radiotekniikka

Code: TLTE3060
Credits: 5 ECTS (5 op)
Prerequisites: Physics and Telecommunication Electronics
Learning Outcomes: this course aims to cover the concepts of RF electronic components, transmission lines, and circuits at high frequencies, after completing this course successfully, the student will be able to model several electronic components at very high frequencies, moreover, they will be able to explain the theoretical concepts of electromagnetic propagation, antennas, microwave equipment, and RF amplifiers, the student will be able to analyze transmission lines at high frequencies using Smith Charts as well as matching techniques
Content: this course covers introduction to electromagnetic and Maxwell's equations, antennas and propagation, passive RF component modeling, transmission line analysis, Smith chart, matching techniques, single and multi-port network analysis, waveguides, active RF components, RF amplifiers and microwave equipment
Study Materials:

1. lecture notes
2. C. Coleman: Radio Frequency Engineering, Cambridge 2004
3. J. Edminister: Electromagnetics, 2nd edition, McGraw-Hill, 1993
4. R. Ludwig and P. Bretchko: RF Circuit Design, Theory and Applications, Prentice Hall, 2000

Teaching Methods: lectures 24 h, quizzes and exam
Modes of Study: lectures 24 h, quizzes and exam
Languages: English
Grading: scale 1-5 or fail
Responsible Person: Mohammed Elmusrati
Teacher(s):
Responsible Unit: Department of Computer Science
Additional Information: every second year

■ Master's Thesis
Diplomityö

Code: TLTE3990
Credits: 30 ECTS
Recommended time of completion: Available in the beginning of each term
Learning Outcomes: After completing the Master's thesis, you will enhance your ability to perform independent scientific work as well as writing technical reports to handle certain problems or for demonstration purposes. Moreover, you will learn how to contribute to the area of research. The contribution could be hardware design, theoretical development, technical improvements, performance analysis (theoretical or by simulations), or comparison between different techniques. However, just collection of information from different references without giving the student perspective is not generally considered as an acceptable contribution in the master thesis. Master thesis can be also done for industry to handle certain challenges. In that case, you will be more interactive with real and practical problems. Master's Thesis must be written according to the Master's Thesis instructions and writing instructions provided by the faculty.
Content: At the beginning of the thesis work, a student must prepare and present a plan about his/her thesis content and it must be agreed jointly with the supervisor.
Study Materials:
1. books/reports/papers related to the thesis topic
2. See also chapter "Graduation and thesis" in the Communications and Systems Engineering handbook for further details related to Master's Thesis and Maturity exam
Teaching Methods: ComSys will arrange a starting lecture once a semester for students planning to start their master thesis. Students are encouraged to participate in other student's Master's Thesis presentations before and during their own Master's thesis work, after the presentations students have the opportunity to discuss their thesis work with other students and staff.
Modes of Study: during the work, the progress must be reported in the reports prepared to present in the thesis seminar
Languages: both English and Finnish are available
Grading: scale 1-5 or fail

Responsible Person: Mohammed Elmusrati
Teacher(s): Professor / University Teacher, Mohammed Elmusrati, Timo Mantere, Reino Virrankoski, Tobias Glocker
Responsible Unit: Department of Computer Science
Additional Information: Contact Communications and Systems Engineering faculty staff during the office hours or during the Master's Thesis presentations, starting from 1.8.2014, all master's theses will be checked with the Turnitin plagiarism detection software

■Project Work in Communications and Systems Engineering
Tietoliikennetekniikan projektityö

Code: TLTE3080
Credits: 3-15 ECTS (3-15 op)
Prerequisites: related subject studies on telecommunications
Learning Outcomes: communication and systems engineering and its applications consists of too many and vast different topics. The aim of this course is to give the students the chance to study and perform small projects related to some interesting topics in communications, automation and energy. The student learns to study/handle real life scientific problems. The topic of the project work must be decided with the agreement with the supervisor. In general, suitable topics can be suggested from network design, dimensioning, performance analysis, electronics, service concepts and hardware/software design, automation, energy delivery systems. Discussions solving a small research problem as well as literature surveys are also possible project work topics.
Content: this course has changing content; the current content is always indicated by the course subtitle presented in the course website
Study materials: depend on the topic
Teaching Methods: depend on the topic
Modes of Study: varying and depend on the topic
Languages: English
Grading: scale 1-5 or fail, or pass/fail (depends on the topic)
Responsible Person: Mohammed Elmusrati
Teacher(s): Mohammed Elmusrati
Responsible Unit: Department of Computer Science
Additional Information: annual course

■Radio Resource Management
Radioresurssien hallinta

Code: TLTE3050
Credits: 5 ECTS (5 op)
Prerequisites: Digital Communication
Learning Outcomes: this course aims to cover the main concepts of radio resource scheduling and management as well as its applications to current and future wireless communication networks, after completing this course successfully, the student will be able to explain what are the radio resources and the relations between them, moreover, the student will be able to compute the optimum transmission power, data rate, and OFDM subbands allocations in multi-user wireless networks, the students will be able also to explain the antennas beamforming and the optimum procedures for load and admission control in cellular networks.
Content: this course covers, multiple access fundamentals and protocols, mobile channel modeling, CDMA systems, OFDM systems, performance measure, handover and mobility, power and rate control, dynamic channel allocation, and high-speed packet scheduling techniques
Study Materials:
1. H. Koivo and M. Elmusrati, Systems Engineering in Wireless Communication, Wiley 2009
2. J. Zander and S. Kim: Radio Resource Management for Wireless Networks, Artech House 2001
3. lecture notes

Teaching Methods: 24 h lectures + 10 h exercises
Modes of Study: quizzes, and exam
Languages: English
Grading: scale 1-5 or fail
Responsible Person: Mohammed Elmusrati
Teacher(s):

Responsible Unit: Department of Computer Science
Additional Information: annual course

■Special Topics in Communications and Systems Engineering

Tietoliikennetekniikan erityiskysymyksiä

Code: TLTE3070
Credits: 1-8 ECTS
Prerequisites: depend on particular topic
Learning Outcomes: communication and systems engineering and their applications is one of the fastest growing fields in the applied science, hence, the aim of this course is to introduce new topics and subjects to track new fields, the main goal is to introduce new topics and quickly react to the needs of evolving modern telecommunications, automation and energy technology, participants should learn a topical subject or deepen their insight in a theoretical question
Content: this course has changing content; the current content is always indicated by the course subtitle presented in the course website
Study Materials: depend on the topic
Teaching Methods: depend on the topic; it can be organized as normal lectures or reading books/papers or both
Modes of Study: varying and depend on the topic
Languages: English
Grading: scale 1-5 or fail, or pass/fail (depending on the topic)
Responsible Person: Mohammed Elmusrati
Teacher(s): Mohammed Elmusrati
Responsible Unit: Department of Computer Science
Additional Information: annual course

■Telecommunication Architectures

Tietoliikennearkkitehtuurit

Code: TLTE3160
Credits: 5 ECTS (5 op)
Prerequisites: Basic course in Probability, Introduction to Signals and Systems, and Introduction to Telecommunication
Learning Outcomes: the course familiarizes the student with the structure and architecture of telecommunications networks, functional entities of the networks, communication protocols and algorithms, and protocol analysis methods, in addition, the course covers most common network standards and solutions
Content: Network types and topology, ISO/OSI reference model, protocol verification, PSTN and data networks, physical layer transmission medium, modulation and demodulation, link logical control, medium access control protocols, network layer, transport layer, session layer, presentation layer, and application layer.
Study Materials:

1. lecture notes
2. W. Stallings: Data and Computer Communications, Prentice Hall, 8th edition, 2007
3. A. S. Tanebaum: Computer Networks, 4th ed., Prentice Hall, 2004

Teaching Methods: lectures 24 h and exercises 12 h
Modes of Study: exam and homework
Languages: English
Grading: scale 1-5 or fail
Responsible Person: Mohammed Elmusrati
Teacher(s): Reino Virrankoski
Responsible Unit: Department of Computer Science
Additional Information: annual available course

Työharjoittelu

■ Practical Training

Työharjoittelu
Huom. Telecommunication Engineering -ohjelman ja Communications and Systems Engineering -ohjelman DI-opiskelijoille

Code: TLTE3950
Credits: 1-10 ECTS
Prerequisites: telecommunication basic studies
Learning Outcomes: in practical training the student familiarizes with working environment and work in telecommunication field by working in a company or an organization and learns to apply studied theory in practice
Content: training/internship in a company or organization, the aim is to gather practical work experience in the field of telecommunication
Literature: -
Study Materials: -
Teaching Methods: practical work experience
Modes of Study: practical training and written report
Languages: Finnish, English
Grading: approved/fail
Responsible Person: Mohammed Elmusrati
Teacher(s): Mohammed Elmusrati, Reino Virrankoski
Responsible Unit: Department of Computer Science and Telecommunication
Additional Information: can be done as a part of the master's degree, for more detailed instructions on internships and the internship see the websites: http://www.uva.fi/en/for/student/studies/practice/internship/ participation: training/internship, a two week (á 40 hours) training period is equivalent to 1 ECTS credit, the Department approves the course credits on the basis of the student's written internship report and the attached work certificate, training should be discussed and agreed beforehand with the supervisor

■ Työharjoittelu

Practical Training
Huom. Tietotekniikan koulutusohjelman tietoliikennetekniikan opintosuunnan ja Telecommunication Engineering -ohjelman DI-opiskelijoille

Koodi: TLTE3950
Laajuus: 1-10 op
Ajankohta: -
Edellytykset: tietoliikennetekniikan perusopinnot
Osaamistavoitteet: työharjoittelussa tutustutaan tietoliikennetekniikan alan työympäristöön ja työhön työskentelemällä yrityksessä tai julkisessa organisaatiossa
Sisältö:
Oppimateriaali ja kirjallisuus: -
Toteutustavat: työharjoittelu
Suoritustavat: kirjallinen raportti, jonka liitteinä työtodistusten kopiot
Opetus- ja suorituskieli: suomi, englanti
Arvostelu: hyväksytty/hylätty
Vastuuhenkilö: Mohammed Elmusrati
Opettaja: Mohammed Elmusrati, Timo Mantere
Vastuuorganisaatio: Tieto- ja tietoliikennetekniikan yksikkö
Lisätietoja: työharjoitteluohjeet ovat verkkosivulla

■ Työharjoittelu

Practical Training

Huom. Energia- ja informaatiotekniikan ohjelman kandidaatin tutkinnon opiskelijoille

Koodi: TECH2950
Laajuus: 1-10 op
Edellytykset:
Osaamistavoitteet: opintojakson suoritettuaan opiskelija osaa hahmottaa tyypillisiä työtehtäviä, kuvata ammattialansa fyysisen ja sosiaalisen toimintaympäristön sekä osaa tunnistaa ammattialansa perinteitä, kieltä, ongelmia ja niiden ratkaisuja
Sisältö: työharjoittelussa tarkoituksena on perehtyä työympäristöön ja työhön opintosuunnan alalla työskentelemällä yrityksessä tai julkisessa organisaatiossa, harjoittelun päätyttyä laaditaan kirjallinen raportti, jonka liitteinä ovat työtodistusten kopiot
Oppimateriaali ja kirjallisuus: -
Toteutustavat: työharjoittelu yrityksessä tai organisaatiossa
Suoritustavat: työharjoittelu ja kirjallinen raportti, jonka liitteinä työtodistusten kopiot (ohjeet raporttiin työharjoitteluohjeissa)
Opetus- ja suorituskieli: suomi tai englanti
Arvostelu: suoritusmerkintä (hyväksytty/hylätty)
Vastuuhenkilö: Professor / University Teacher, Jouni Lampinen, Jarmo Alander, Timo Mantere
Opettaja:
Vastuuorganisaatio: Tieto- ja tietoliikennetekniikan yksikkö, Sähkö- ja energiatekniikan yksikkö
Lisätietoja: työharjoitteluohjeet ovat yliopiston Opiskelijat-verkkosivulla Opiskelumateriaalit-sivuston Muut Ohjeet ja materiaalit -kohdasta, tarkista työharjoittelun määrän rajoitteet oman tutkintosi työharjoitteluohjeista