

TIETOLIIKENNETEKNIikka

Perusopinnot

■ Tiedonsiirron perusteet

Introduction to Signal and Systems

Koodi: TLTE1050

Laajuus: 5 op

Edellytykset: perustiedot matematiikasta

Osaamistavoitteet: opintojakson suoritettuaan opiskelija osaa ratkaista eri lukujärjestelmien väliset suhteet ja muunnokset sekä teho- ja jännitesuureiden väliset suhteet logaritmisella asteikolla desibeliyksikköinä, opiskelija pystyy määrittelemään digitaalisen tiedonsiirtotekniikan peruskäsitteitä, kuten signaalit, näytteenotto, eri siirtomedit, signaalinsuodatus-, koodaus- ja modulaatiotekniikat, opintojakson jälkeen opiskelija pystyy myös tunnistamaan standardointiorganisaatiot ja niiden toimintatavat tietoliikennetekniikassa, opiskelija on myös perehtynyt käytännön tasolla tietoliikennetekniikan problematiikkaan: laitteisiin, mittauksiin ja käytännön laboratoriosovelluksiin sekä pystyy antamaan suullisen ja kirjallisen raportin suorittamastaan laboratoriotyöstä

Sisältö: siirtotiet ja signaalit, teleyhteyden muodostuminen verkkojen kautta, taso ja osoitinkäsite, aika- ja taajuustaso, kanavointi ja kytkentä, tiedonsiirtomenetelmät, näytteenotto, modulaatiotavat, standardointiorganisaatiot tietoliikennetekniikassa ja EMC-perusteet, opintojaksolla suoritetaan myös laboratoriotyöt itsenäisesti tai ryhmässä (esiselustus, kytkennät, mittaukset ja kirjallinen työselsustus analyysineen)

Oppimateriaali: ilmoitetaan opintojakson alussa

Toteutustavat: luennot 35 h, harjoitukset 21 h, laboratoriotyöt 9 h

Suoritustavat: tentti, laboratoriotyöt

Opetus- ja suorituskiehi: suomi

Arvostelu: asteikolla 1-5 tai hylätty

Vastuuhenkilö: Veli-Matti Eskonen

Opettaja: Veli-Matti Eskonen

Vastuuorganisaatio: Tieto- ja tietoliikennetekniikan yksikkö

Lisätietoja:

■ Tietoliikennetekniikan perusteet

Introduction to Telecommunication

Koodi: TLTE1060

Laajuus: 5 op

Edellytykset: perustiedot matematiikasta

Osaamistavoitteet: opintojakson suoritettuaan opiskelija oppii tuntemaan tärkeimmät verkkostandardit, -komponentit ja -protokollat, sekä osaa määrittellä numeerisen televiestinnän perusteet ja datasiirron kerros- ja kehysrakenteet, lisäksi opiskelija ymmärtää sulautettujen järjestelmien toimintaperiaatteet ja osaa ohjelmoida yksinkertaisen sovelluksen

Sisältö: synkronisen ja asynkronisen tiedonsiirron kehysrakenteet ja tahdistus, tietoliikenneverkkoratkaisut sekä hierarkiset yhteykäytännöt eli protokollat, protokollien tehtävät ja toimintaperiaatteet eri OS I-viitemallin tasoilla, sekä tiedonsiirtoon liittyvät yleiset tietoturva-periaatteet

Oppimateriaali: ilmoitetaan opintojakson alussa

Toteutustavat: luennot 28 h, harjoitukset 24 h

Suoritustavat: tentti

Opetus- ja suorituskielet: suomi

Arvostelu: asteikolla 1-5 tai hylätty

Vastuhenkilö: Timo Mantere

Opettaja: Veli-Matti Eskonen

Vastuuorganisaatio: Tieto- ja tietoliikennetekniikan yksikkö

Lisätietoja:

Aineopinnot

■ C and C++ Programming

Code: TLTE2110

Credits: 5 ECTS (5 op)

Learning Outcomes: this course aims to teach the skills necessary for the development of C/C++ applications. After completing this course the student will be able to develop C and C++ programs containing simple data structures. The student will learn how to implement programs according to given flowcharts or ones developed themselves. 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, functions, arrays and pointers, static and dynamic allocation, structures, time handling, file handling, classes, objects, inheritance, templates, STL Library etc.. The exercises contain the development of C/C++ applications related to the previously mentioned course contents.

Study Materials: lecture slides and course literature

1. Kernighan, B.W. & D.M. Ritchie, The C Programming Language, second edition
2. Stroustrup, Bjarne (2013), The C++ Programming Language, Addison-Wesley Longman

Teaching Methods: lectures, practical exercises and final examination

Modes of Study: lectures, practical exercises, homework and final examination

Languages: English (lectures and exercises)

Grading: scale 1-5 or fail, based on final examination

Responsible Person: Mohammed Elmusrati

Teacher(s): Tobias Glocker

Responsible Unit: Department of Computer Science

Additional Information: website: [http:// teg.uwasa.fi/courses/tlte2110/](http://teg.uwasa.fi/courses/tlte2110/)

■ 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: Mohammed Elmusrati

Teacher(s): Tobias Glocker

Responsible Unit: Department of Computer Science

Additional Information: annual course, website <http://teg.uwasa.fi/courses/TLTE2100/>

■ Kandidaatintutkielma

Bachelor's Thesis

Huom. Tietotekniikan koulutusohjelman tietoliikennetekniikan opintosuunnan opiskelijoille

Koodi: TLTE2970

Laajuus: 10 op

Ajankohta: 3. vuosi kevät

Edellytykset: tietoliikennetekniikan perusopinnot ja aineopintoja (yhteensä vähintään 25 op)

Osaamistavoitteet: tavoitteena on kehittää valmiuksia itsenäiseen tiedonhankintaan tutkimusaiheesta, tutkimusohjelman muotoiluun ja rajaamiseen sekä harjaannuttaa opiskelijaa tieteelliseen kirjoittamiseen

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 tiivistelmä sivuksi, 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 aihepiiriin vastuuhjaajaan, alkuraportti, väliraportti (3 op), seminaariesitys ja opponointi, kansitettu ja Turnitin-plagiaatintunnistusjärjestelmällä tarkastettu loppuraportti (7 op), lisäksi kypsyysnäyte (0 op). Opiskelija voi myös halutessaan edetä suoraan loppuraporttiin ja seminaariesitykseen.

Opetus- ja suorituskielet: suomi/englanti

Arvostelu: asteikolla 1-5 tai hylätty

Vastuuhenkilö: Mohammed Elmusrati

Opettaja: Mohammed Elmusrati, Reino Virrankoski

Vastuuorganisaatio: Tieto- ja tietoliikennetekniikan yksikkö

Lisätietoja: ks. tekniikan alan kandidaatintutkielman laadintaohjeet ja tiedekunnan kirjoitusohjeet, kandidaatintutkielmasta kirjoitetaan kypsyysnäyte ohjaajan määräämästä aiheesta, kypsyysnäytteeseen voi ilmoittautua, kun tutkielma on jätetty tarkastettavaksi lopullisessa muodossaan, website <http://teg.uwasa.fi/>, kandidaatintutkielmat tarkistetaan 1.8.2014 lähtien Turnitin-plagiaatintunnistusjärjestelmällä

HUOM! Tietoliikennetekniikan suunnan opiskelijoille

■ 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 tiivistelmäsiivoksi, 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 aihepiiriin vastuuhjaajaan, alkuraportti, väliraportti (TECH2991, 3 op), seminaariesitys ja opponointi, kansitettu ja Turnitin-plagiaatintunnistusjärjestelmällä tarkastettu loppuraportti (TECH2992, 7 op), lisäksi kypsyysnäyte (KNÄYxxxx, 0 op). Opiskelija voi myös halutessaan edetä suoraan loppuraporttiin ja seminaariesitykseen.

Opetus- ja suorituskielet: 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 Architectures

Learning Outcomes: this course aims to teach the students the principles of mobile communication, mobile sets, and mobile networks, since the mobile networks are very important sector of telecommunication business, these concepts are crucial for the students in telecommunication engineering, after completing this course successfully, the student will be able to demonstrate the mobile network (for both GSM/UMTS) structure, they will be able to define the relations between the mobile network blocks, moreover, they can make simple mobile network planning

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 systems, and HSDPA, other different wireless communication topics will be prepared by the students in form of course report, example of those topics are: Bluetooth, Zigbee, LTE, WiMAX, DECT Phones, VoIP, and WiFi

Study Materials:

1. J. Eberspächer, H. Vögel, and C. Bettstetter: GSM, Switching, Services, and Protocols
2. H. Holma and A. Toskala: WCDMA for UMTS
3. course handouts
4. different references based on students' search

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 Elrgouri

Responsible Unit: Department of Computer Science

Additional Information: annual course, website <http://cs.uwasa.fi/courses>

■ 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, 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

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, website <http://cs.uwasa.fi/courses/tlte2050/>

■ Telecommunication Software

Tietoliikenneohjelmistot

Code: TLTE2040

Credits: 5 ECTS (5 op)

Learning Outcomes: this course aims to teach the skills necessary for the design, implementation and the test of mobile phone applications. The applications are developed with Java Mobile and Android. After completing this course the student will be able to develop Graphical User Interface (GUI) applications with Java Mobile 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 Mobile applications and security. The contents of the exercises are the development of Android and Java Mobile applications.

Study Materials: lecture slides, course book: Mikkonen, Tommi (2007), Programming Mobile Devices, An Introduction for Practitioners, WILEY

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: Mohammed Elmusrati

Teacher(s): Tobias Glocker

Responsible Unit: Department of Computer Science

Additional Information: annual course, website <http://teg.uwasa.fi/courses/tlte2040/>

■ Wireless Networks

Langattomat verkot

Code: TLTE2090

Credits: 5 ECTS (5 op)

Learning Outcomes: Getting skills required for wireless communication. Each student has to give a presentation and must write a report about a topic chosen from the list provided by the lecturer. The students will learn to prepare a presentation for the chosen topic from research papers like IEEE, GLOBECOM etc. and must explain their investigations for the audience on an understandable level.

Content: Each participant must give a presentation of 45 minutes, write a report and must pass an exam (materials of all the presentations + reports) to pass the course. The topic has to be chosen from a list provided by the lecturer. All topics are in the field of wireless networks or they are closely related to wireless networks.

Study Materials: presentations, reports and final examination

Teaching Methods: lectures 24 h

Modes of Study: exam, presentation and report (or exam and homeworks)

Languages: English

Grading: scale 1-5 or fail, presentation + report (50%) and final examination (50%)

Responsible Person: Mohammed Elmusrati

Teacher(s): Tobias Glocker

Responsible Unit: Department of Computer Science

Additional Information: annual course, website <http://teg.uwasa.fi/courses/tlte2090/>

Syventävät opinnot

■ Advanced Course in Signals and Systems

Signaalit ja systeemit

Code: TLTE3150

Credits: 5 ECTS (5 op)

Prerequisites: Digital Signal Processing

Learning Outcomes: improving mathematical skills of the students and introducing new mathematical tools for systems analysis

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, website <http://cs.uwasa.fi/courses/tlte3150/>

■ Broadband Wireless Communication

Laajakaistateknikka

Code: TLTE3030

Credits: 5 ECTS (5 op)

Prerequisites: Digital Communication

Learning Outcomes: this course aims to teach the major theoretical background behind modern wireless high rate networks, there are different broadband wireless network standards such as LTE, WiMAX, IEEE 802.11n, etc., however, the major background to achieve high data rate in a limited bandwidth is common between all standards, after completing this course successfully, the student will be able to explain the main challenges to achieve high data rate in wireless networks, moreover, s/he will be able to demonstrate different techniques to overcome the challenges such as using MIMO, coding, diversity, beamforming, and OFDM, furthermore, they will be able to classify between the different standards

Content: this course covers wireless channels, efficient digital modulation methods, channel coding, MIMO concepts and methods, Diversity, beamforming, broadband systems: UltrawideBand, LTE, WiMAX, and IEEE 802.11n

Study Materials:

1. D. Tse and P. Viswanath, Fundamentals of Wireless Communication, Cambridge Univ. Press, 2005
2. A. Goldsmith, Wireless Communication, Cambridge Univ. Press, 2005
3. lecture notes

Teaching Methods: 24 h lectures + 10 h exercises

Modes of Study: quizzes, presentation and report

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, website <http://cs.uwasa.fi/courses/tlte3030/>

■ 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, 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, website <http://cs.uwasa.fi/courses/tlte3090/>

■ 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: Mohammed Elmusrati

Teacher(s): Reino Virrankoski

Responsible Unit: Department of Computer Science

Additional Information: annual course, website <http://cs.uwasa.fi/courses/tlte3120/>

■ 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 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 source coding, sampling theorem, digital modulation and demodulation, error performance analysis, equalizers, channels and link budget analysis, coding and decoding methods, multiplexing techniques, diversity 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, website <http://cs.uwasa.fi/courses/tlte3010/>

■ Embedded C-Programming

Sulautettu C-ohjelmointi

Code: TLTE3170

Credits: 3 ECTS (3 op)

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 and project work 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: Mohammed Elmusrati

Teacher(s): Tobias Glocker

Responsible Unit: Department of Computer Science

Additional Information: annual course, website <http://teg.uwasa.fi/courses/TLTE3170/>

■ Embedded Network Devices

Tietoliikenteen sulautetut järjestelmät

Code: TLTE3100

Credits: 5 ECTS (5 op)

Prerequisites: Computer Architecture, C/C++ Programming, Wireless Networks and Embedded Systems

Learning Outcomes: This course covers embedded network devices design and protocol implementation to them, architectures and operation principles of typical embedded computer systems

are included, including embedded software and structured system design methodologies. The course includes mandatory laboratory exercises to learn the protocol implementation and debugging in practice.

Content:

Study Materials: lecture notes

Teaching Methods: lectures 18 h, laboratory exercises 28 h

Modes of Study: exam, laboratory exercises and homework project

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, website <http://cs.uwasa.fi/courses/tlte3100/>

■ 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 analyse 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, website <http://cs.uwasa.fi/courses/tlte3060>

■ Master's Thesis

Diplomityö

Code: TLTE3990

Credits: 30 ECTS

Recommended time of completion: Available in the beginning of each term

Learning Outcomes: The Master's Thesis is required to show that the student can do independent scientific work; the goal of the thesis work is to teach students how to make independent research and report writing. 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 try to arrange a starting lecture once a semester, if starting lecture is not available must be agreed with supervisor, 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, website <http://cs.uwasa.fi/courses/tlte3080/>

■ 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 and data rate in multi-user wireless networks, the students will be able also to explain the antennas beamforming and the optimum procedures for admission control

Content: this course covers multiple access fundamentals, mobile channel modeling, CDMA 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, website <http://cs.uwasa.fi/courses/tlte3050/>

■ 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, website <http://cs.uwasa.fi/courses/tlte3070/>

■ 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:

Study Materials:

1. lecture notes
2. W. Stallings: Data and Computer Communications, Prentice Hall, 8th edition, 2007
3. A. S. Tanenbaum: 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, website <http://cs.uwasa.fi/courses/tlte3160/>

■ Teletraffic Theory

Tietoliikenneteoria

Code: TLTE3040

Credits: 5 ECTS (5 op)

Prerequisites: Telecommunication Architectures and basic course in probability

Learning Outcomes: this course covers elementary queueing theory and its application to teletraffic and network modelling, in addition, performance analysis methods and network dimensioning based on grade of service constraints are addressed

Content: this course covers revision for probability theory, time interval modeling, Erlang loss systems,

Dimensioning of telecommunication networks, Markovian process, Queuing networks, and performance measurements and simulation

Study Materials:

1. lecture notes
2. Villy B. Ivarsen, Teletraffic Engineering Handbook, <http://www.dtu.dk/teletraffic/>
3. D. Bertsekas and R. Gallager: Data Networks, Chapters 3&4, 2nd ed., Prentice Hall, 1992

Teaching Methods: lectures 24 h and exercises 12 h

Modes of Study: exam and homeworks

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, website <http://cs.uvasa.fi/courses/tlte3040/>

Työharjoittelu

■ Practical Training

Työharjoittelu

Huom. Telecommunication Engineering -ohjelman ja Communications and Systems Engineering -ohjelman 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 web sites:

www.uva.fi/en/for/student/studies/study/practice/internship/credits/

participation: training/internship, a two week (à 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 opiskelijoille

Koodi: TLTE2950/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 suorituskielet: suomi, englanti

Arvostelu: hyväksytty/hylätty

Vastuuhenkilö: Mohammed Elmusrati

Opettaja: Mohammed Elmusrati, Timo Mantere

Vastuorganisaatio: Tieto- ja tietoliikennetekniikan yksikkö

Lisätietoja: työharjoitteluohjeet ovat yliopiston Opiskelijat-verkkosivulla Opiskelumateriaalit-sivuston Muut Ohjeet ja materiaalit -kohdasta, työharjoittelu kannattaa hyväksyttää opintojen loppuvaiheessa

■ Työharjoittelu

Practical Training

Huom. Energia- ja informaatiotekniikan ohjelman 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 suorituskielet: suomi tai englanti

Arvostelu: suorituserkintä (hyväksytty/hylätty)

Vastuuhenkilö: Professor / University Teacher, Jouni Lampinen, Jarmo Alander, Timo Mantere

Opettaja:

Vastuorganisaatio: 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

HUOM! tämä työharjoittelu-opintojakso koskee ainoastaan Energia- ja informaatiotekniikan ohjelmassa kandidaatin tutkintoa suorittavia opiskelijoita