BACHELOR STUDY PROGRAM SYLLABUSES IN INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) (2024-2027)

YEAR 1
SEMESTER 1

Course title: Linear Algebra with Calculus I (3+3+0) 7 ECTS
Lecturer: Qefsere Doko, Shqipe Lohaj, Valdete Rexhëbeqaj Hamiti
Course status: Mandatory
Short course description: In this course will be studied: complex numbers, parts from linear algebra, analytic geometry and functions with one-variable.
Course objectives: Students should be trained so that the knowledge gained through this course can be applied as an ancillary device in electrical and computer studies.
Learning outcomes:
Upon completion of this course the student will be able to:

1. describe, solve and design various problems in the field of his profession when dealing with complex number operations, through matrices and determinants;
2. describe and solve problems related to systems of linear equations;
3. find the functional connections of the magnitudes of various electrical problems and then with differential calculations, describe and examine those functional connections;
4. understand the concept of the derivative and is able to apply it to many problems in Geometry, Electronics, Telecommunication, Informatics and other areas;
5. demonstrate skills of mathematical modelling and problem solving.

Teaching methodology: Lectures, discussions, exercises, consultations, homework, seminar work, intermediate evaluations, final exam.
Evaluation methods: Seminar work and homework (10%), first intermediate evaluation (25%), second intermediate evaluation (25%), final exam (40%).
Concretization tools/IT: Pencil, whiteboard, projector and computer.
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 2:1.
Literature:

- Hamiti E. - Matematika I, Prishtinë 2008.
- Hamiti E. - Matematika II, Prishtinë 2008.
- Peci H, Doko M. - Përmbledhje detyrash të zgjidhura nga Matematika I, Prishtinë 1997.
- Loshaj Z. – Përmbledhje detyrash të zgjidhura nga Matematika II, Prishtinë 1996.

Course title: Physics for engineering (2+1+1) 6 ECTS
Lecturer: Valon Veliu
Course status: Mandatory
Short course description: The course includes basic knowledge of physics necessary to gain general knowledge that is basic in engineering

Course objectives: Using the physical laws to solve the basic problems of engineering.
Learning outcomes: On successful completion of the course, students will be able to:

- Analyze simple mechanical systems and solve equations of motion.
- Apply principles of conservation of energy and momentum to particle collisions.
- Explain the conditions of statics of rigid bodies and the equation of motion for rotation of the rigid body around fixed axis.
- Understand the first law of thermodynamics and analyze thermodynamic cycles.

Teaching methodology: 45 hours of lectures + 15 hours of auditorial exercises + 15 hours of laboratory exercises. Approximately 75 hours of personal study.
Evaluation methods: Seminar 10%, Mid-term exams 30 %, Final Exam 60 %.
Concretization tools/IT: Pencil, whiteboard, projector and computer.
Literature:

- S. Skenderi, R,Maliqi, "Physic for thechnical faculty", UP, Pristina, 2005.
- J. Serway, Physics for scientists and engineering , Thomson Books, 2004.
- D. Haliday, R.Resnick, J.Walker, Fundametals of Physics, John Wiley &Sons, 2001

Course title: Fundamentals of electrical engineering 1 (3+1+1) 6 ECTS
Lecturer: Enver Hamiti, Mimoza Ibrani
Course status: Mandatory, Semester I, 6 ECTS
Short Course description: Basics of electricity. Fundamental lows of electricity. Electric potential. An electric dipole and flux lines. Electrostatic induction. Electric generator. Polarization in dielectrics. Boundary conditions. Capacitance. Electrostatic networks. Energy and forces in electrostatic fields. Electrostatic field analysis using MATLAB. Concepts, elements and topology of electric circuits. Types of electrical circuits. Elementary DC circuits. Circuit Elements, Electrical resistance- Ohm's law. Construction of circuit model.Voltage and potential in electric circuit. Current source. Kirchoff's laws. Analysis of a Circuit Containing Dependent Sources. Complex DC circuits. DC circuit analysis using SPICE.
Course objectives: The purpose of the course is to introduce the basic principles of electrical field and DC current circuits.
Learning outcomes: On successful completion of the course, students will be able to:
1. Understand fundamental laws of electricity.
2. Apply the fundamental laws of electricity for solving of electric field problems.
3. Apply MATLAB software pavckage for soving basic problems in elctrical field.
4. Understand and apply methods for DC circuit analysis such as: Kirchhof's lows, node voltage method, mesh current method, superposition method, Thevenin's and Norton's theorem.
5. Understand transient response of first order circuits (series RC circuits).
6. Apply PSPICE Software for DC circuit analysis.
7. Apply gained knowledge in other electrical engineering fields.

Teaching Methodology: Presentations, tutorials, discussions, and laboratory works meaning: 60 hours presentations + 15 hours of tutorials, and 15 hours laboratory works.
Evaluation: The pass limit for the course is - 50%.; Participation - 10 %;
Tasks and projects - 30%;
Intermediary tests and final exam - 60%;

Concretization tools: Compjuter, video projector, and equiped lab with neccessary devices to ilustrate all teaching material.

Literature:

1. Nexhat Orana, Bazat e elektroteknikës 1, Prishtinë, 1994
2. M.N. Sadiku, *Elements of electromagnetics*, Oxford University Press, New York, Seventh Edition, 2018.
3. Ch. Alexander, M.N. Sadiku, Electric Circuits, McGraw Hill, New York, 2000.

Course title: Fundamentals of Programming (2+0+3) 6 ECTS

Lecturer: Avni Rexhepi, Kadri Sylejmani

The goal: The purpose of the course is to introduce the basic principles of programming and algorithms, for solution of problems with computer and writing of respective programs (in C++ programming language).

Learning outcomes: On successful completion of the course, students will be able to write programs in C++ programming language, including the use of different functions.

Course content: Introduction to algorithms: sum, product and factorial. Array operations and algorithms: sum/product of the array members, counting members, searching and sorting. Matrix manipulations: creation, sum/product of the members, searching, creating vector from the matrix members. Introduction to C++ programming language: variable types, operators, statements. Input and output: input of numbers, arrays, strings and their output, use of manipulators. Branching: if, goto, switch( ). Loops: while, do-while, for. Loops: breaking, continuing and exiting. Functions: defining and executing, parameters and arguments, mathematical and string functions. Using vectors and matrices with functions. Recursion, pointers, references. User defined types: enumerations, structures, classes.

Methods of teaching: 30 hours of lectures + 30 hours of auditory/lab exercises. Approximately 65 hours of personal study and exercise including home problems/tasks.

Grading System: Attendance lectures 10%, Attendance lab. 10%, Mid-term problems 30 %, Collocui/Final Exam 50 %

Literature:

1. Agni Dika, "Algoritmet, me programe në C++", Universiteti i Prishtinës, Fakulteti Elektroteknik, Prishtinë, 2004, http://www.agnidika.net/algoritmetCpp.pdf
2. Agni Dika Bazat e Programimit në C++, Universiteti i Europës Juglindore, Tetovë, ISBN 9989-866-23-6, http://www.agnidika.net/programimiCpp.pdf
3. H.M. Deitel, P. J. Deitel, How to Program C++, Prentice Hall, Upper Saddle River, New Jersey, ISBN 0-13-111881-1
4. Robert Lafore, Object-Oriented Programming in C++, Sams, Indianopolis, Indiana, ISBN-10:0-672-32308-7

Course title: Communication skills (2+1+0) 5 ECTS

Lecturer: Blerim Rexha, Sabrije Osmanaj

The goal: The goal of this course is to develop written and verbal communication skills and group work.

Learning outcomes: On successful completion of the course, students will be able to:

1. write different official and business letters;

2. write formal and informal emails,
3. Using social media;
4. write a five-paragraph essay;
5. write different reports (visit r., field r., feasibility r., progress r.);
6. write laboratory reports;
7. use the Internet to find specific information;
8. use the computer to write different reports;
9. write minutes of meetings;
10. write a paper on a particular problem or issue;
11. write CVs and applications for work;
12. hold oral presentations;
13. respond to job interviews.

Course content: Introduction to communication skills. Words and sentences. Writing process. Technical information. Internet information and e-mail: World Wide Web (www) and Social media. Essays and exam answers. Laboratory reports. Reports. Proposals, specifications and manuals. Final year projects and reports. Spoken presentations. Group work and meetings. Letters. CVs and job applications. Interviews: Interview for job.
Methods of teaching: 30 hours of lectures + 15 hours of exercises. Approximately 80 hours of personal study and exercise including home-work.
Grading System: Test 1: 25 %, Test 2: 25 %, Test 3: 25%, Homework (seminar paper) 25 %.
Literature:

- Mike Markel & Stuart A. Selber, Technical Communication, 12th Edition, MacMillan, 2018
- John W. Davies, Communication Skills. A Guide for Engineering and Applied Science Students, Prentice Hall, 2011.
- Miller et al, How the World Changed Social Media, UCL Press, 2016
- Majlinda Nishku, Si të shkruajmë: procesi dhe shkrimet funksionale, CDE, Tiranë, 2004.

Course: Practicum in Mathematics (2+1+0) 5 ECTS
Lecturer: Valdete Rexhëbeqaj Hamiti
Course status: Optional
Short course description: In this course will be studied algebraic expressions, polynomials, equations with an unknown, inequations, arithmetic and geometrical strings, trigonometry and analytic geometry.
Course objectives: Students should be trained so that the knowledge gained through this course can be applied in acquiring knowledge from the following subjects.
Learning outcomes:
Upon completion of this course the student will be able:

- to design and solve different problems in the field of equations with an unknown and their implementation;
- to operate with polynomials;
- to apply basic concepts from analytical geometry and trigonometry to various engineering problems.

Teaching methodology: Lectures, discussions, exercises, consultations, homework, seminar work, intermediate evaluations, final exam.
Evaluation methods: Seminar work and homework (20%), first intermediate evaluation (30%), second intermediate evaluation (30%), final exam (20%).
Concretization tools/IT: Pencil, whiteboard, projector and computer.
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 1:1.
Literature:

- Hamiti E., Peci H., Loshaj Z., Gjonbalaj Q., Lohaj Sh. - Përmbledhje detyrash nga matematika, Prishtinë 2001.
- M. Berisha, D. Kamberi, R. Gjergji, R. Zejnullahu, Përmbledhje detyrash nga matematika, Prishtinë 1990.

YEAR 1
SEMESTER 2

Course title: Analytical geometry with Calculus II (3+3+0) 7 ECTS
Lecturer: Valdete Rexhëbeqaj Hamiti
Course Status: Mandatory
Course description
In this subject we work: Integral computation and its implementation, functions with two or more variables and ordinary differential equations.
Course objectives
The student should be able to apply the knowledge gained through this course as an auxiliary device in the studies of electrical engineering and computer engineering subjects
Expected results
After completion of the course, student will be able to

1. Understand the concept of indefinite and definite integral as well as their application in the measurement of various measures in Geometry, Electrotechnics, Telecommunication, Informatics and other fields;
2. Generalize concepts related to functions with one variable into multi variable functions and in particular into those with two variables. Also be able to apply every concept related to the differential calculation for the one variable function in the case of two variable functions;
3. Think logically about various differential equations, solve concrete examples step by step and model different practical problems through differential equations.

Methodology of teaching: Lectures, discussions, exercises, consultations, homework, mid term exams, final exams.
Methods of assessment: Homework and seminar (10%), First periodic exams (25%), Second periodic exams (25%), Final exams (40%).
Concretization tools: pencil, whiteboard, projector and compjuter.
Ration between Theoretical part and exercises: 2:1
References

- Hamiti E. - Matematika I, Prishtinë 2008.
- Hamiti E. - Matematika II, Prishtinë 2008.
- Hamiti E. - Matematika III, Prishtinë 2008.
- Peci H, Doko M. - Përmbledhje detyrash të zgjidhura nga Matematika I, Prishtinë 1997.
- Loshaj Z. - Përmbledhje detyrash të zgjidhura nga Matematika II, Prishtinë 1996.
- Hamiti E, Lohaj SH.- Përmbledhje detyrash të zgjidhura nga Matematika III, Prishtinë 2008.

Course title: Physics for engineering 2 (2+1+1) 5 ECTS
Lecturer: Valon Veliu
Course status: Mandatory
Short course description: The course includes basic knowledge of physics necessary to gain general knowledge that is basic in engineering
Course objectives: Using the physical laws of modern physics in modeling and solving specific engineering problem.
Learning outcomes: On successful completion of the course, students will be able to:

1. Apply the linearization technique to equations of motion of oscillatory.
2. Explain the wave equation in non dispersive medium.
3. Analyze optical systems using the methods of geometrical optics.
4. Explain the phenomena of interference, diffraction and polarization of light.
5. Explain Planck's law of black body radiation.
6. Relate the atomic spectrum to quantization of energy levels..

Teaching methodology: 45 hours of lectures + 15 hours of auditorial exercises + 15 hours of laboratory exercises. Approximately 75 hours of personal study.
Evaluation methods: Seminar 10%, Mid-term exams 30 %, Final Exam 60 %.
Concretization tools/IT: Pencil, whiteboard, projector and computer.
Literature:

- S. Skenderi, R,Maliqi, "Physic for thechnical faculty", UP, Pristina, 2005.
- J. Serway, Physics for scientists and engineering , Thomson Books, 2004.-D. Haliday, R.Resnick, J.Walker, Fundametals of Physics, John Wiley &Sons, 2001

Course title: Fundamentals of electrical engineering 2 (3+1+1) 6 ECTS
Lecturer: Enver Hamiti, Mimoza Ibrani
Course status: Mandatory, Semester II, 7 ECTS
Short Course description: Basics of magnetism. Magnetic flux density. Lorentz force. Biot-Savart's law. Forces due to magnetic field. Magnetic torque and moment. Ampere's law. Magnetic dipole. Magnetization in materials. Generalized Ampere's law. Magnetic boundary conditions. Magnetostatic field analysis using MATLAB. Faraday's law. Inductors and inductances. Magnetic energy. Magnetic circuits. Current and voltage waveforms. Techniques of Circuit Analysis. Sinusoidal Steady-State Analysis. The Sinusoidal Response, The Passive Circuit Elements in the Frequency Domain, Sinusoidal Steady-State Power Calculations, Maximum Power Transfer. AC circuit analysis using SPICE. Magnetically coupled circuits. Response of First-Order *RL* and *RC* Circuits. Transient circuit analysis using SPICE. Balanced Three-Phase Circuits. SPICE analysis of three phase circuits.

Course objectives: The purpose of the course is to introduce the basic principles of magnetic field and AC current circuits analysis.
Learning outcomes: On successful completion of the course, students will be able to:

1. Understand fundamental laws of magnetism.
2. Apply the fundamental laws of magnetism for solving of magnetic field problems.
3. Apply MATLAB software pavckage for solving basic problems in magnetic field.
4. Understand and apply methods for AC circuit analysis such as: Kirchhof's lows, node voltage method, mesh current method, superposition method, Thevenin's and Norton's theorem.
5. Understand transient response of first order circuits (series RL circuits).
6. Apply PSPICE Software for AC circuit analysis.
7. Apply gained knowledge in other electrical engineering fields.

Teaching Methodology: Presentations, tutorials, discussions, and laboratory works meaning**:** 60 hours presentations + 15 hours of tutorials, and 15 hours laboratory works.
Evaluation: The pass limit for the course is 50%. Participation 10%, tasks and projects 30 %, Intermediary tests and final exam 60 %
Concretization tools: Computer, video projector, and equiped lab with neccessary devices to ilustrate all teaching material.
Literature:

1. Nexhat Orana, Bazat e elektroteknikës 2, Prishtinë, 1994
2. M.N. Sadiku, Elements of electromagnetic, Oxford University Press, New York, 2001
3. Ch. Alexander, M.N. Sadiku, Electric Circuits, McGraw Hill, New York, 2000.

Course title: Algorithms and Data Structures (2+0+2) 6 ECTS
Lecturer: Avni Rexhepi, Kadri Sylejmani
The goal: The purpose of the course is to help students in advancing their knowledge for different algorithms, data structures and use of classes and objects in programming.

Learning outcomes: On successful completion of the course, students will be able to compile advanced algorithms, to define structures and classes and to use them in writing advanced programs.

Course content: Definition and use of advanced functions, inline functions, macro functions, function overloading, templates. User defined types. Object oriented programming. Structures: definition of different structures, with different functions as their components, operating structure components. Classes and objects: class definition, classes and member functions. Using public and private members. Declaring objects and operating with their components. Class constructor and destructor. Inheritance, arrays within objects and arrays of objects. Pointers and functions with pointers. References and functions with references. Algorithms, analysis of algorithms, algorithm's growth rate, classification. Data structures. Stack. Queue. Linked lists, adding/deleting nodes. List searching and sorting. Binary tree, tree traversal algorithms, insertion, search and deletion, BST-binary search tree, heap, balanced trees. Graphs, traversal algorithms, minimum spanning tree (Dijkstra-Prim, Kruskal), shortest path algorithm (Dijkstra). Searching and sorting algorithms (Insertion sort, Selection sort, Bubble sort, Shell sort, Merge sort, Quick sort, Heap sort, Bucket sort, Radix sort).

Methods of teaching: 30 hours of lectures + 30 hours of auditorial/lab exercises. Approximately 65 hours of personal study and exercise including home problems/tasks.
Grading System: Attendance lectures 10%, Attendance lab. 10%, Mid-term problems 30 %, Collocui/Final Exam 50 %
Literature:

1. Agni Dika, Programimi i Orientuar në Objekte, me programe në C++, UEJL, Fakulteti i Shkencave Bashkëkohore, Tetovë, ISBN 9989-866-25-2, http://www.agnidika.net/programimiobjekte.pdf
2. D. S. Malik, C++ Programming: Program Design Including, Data Structures, Course Technology, Thomson Leraning, Boston, Massachusetts, ISBN 0-619-03569-2
3. H.M. Deitel, P. J. Deitel, How to Program C++, Prentice Hall, Upper Saddle River, New Jersey, ISBN 0-13-111881-1
4. Robert Lafore, Object-Oriented Programming in C++, Sams, Indianopolis, Indiana, ISBN-10:0-672-32308-7
5. D. S. Malik, Programming: From Problem Analysis To Program Design, Course Technology, Thomson Leraning, Boston, Massachusetts, ISBN 0-619-06213-4

Course title: Digital logic Circuits (2+1+1) 6 ECTS
Lecturer: Sabrije Osmanaj, Artan Mazrekaj
Short course description: Number systems and codes: number systems, codes, encoding, error detection and correction. **Boolean algebra:** propositional logic, Boolean variables, basic operations, derived operations, axioms and theorems, proofs of theorems. **Boolean functions and logic gates:** representations, methods of simplification and conversion, Karnaugh map and truth table, logic gates and circuits, functionally complete sets of operations, timing hazards, logic families and technologies and their characteristics.
Combinational logic circuits: encoders and decoders, multiplexers and demultiplexers, comparators, adders, multipliers, arithmetic and- logic units. **Computer-aided digital design:** minimizers, schematic editors, circuit simulators, hardware description languages, PCB layout designers, IC layout designers. **Sequential logic circuits:** latches and flip-flops, truth table and excitation table, registers, counters, shift registers, ring counters, excitation equations, state table and state diagram, analysis and synthesis of sequential logic circuits. **Three-state buffers and buses:** buffer, Schmitt trigger buffers, three-state buffers, serial buses, parallel buses. **Programmable logic circuits:** storage matrix, ROM, PROM, EPROM, EEPROM, Flash, PLA, PAL, GAL, SRAM, DRAM, CPLD, FPGA. Use of hardware description languages for implementation of combinational and sequential logic in CPLD and
FPGA circuits **Additional topics (in case of spare time, but not required in exams):** microcontrollers, microprocessors, analog-digital and digital-analog converters, clock generators.
Course objectives: To gain the basic theoretical understanding of functioning of digital structures. To acquire the knowledge and basic experience of practical design, implementation and testing of digital structures.
Learning outcomes: After successful completion of the course, students will be able to:

- describe the basic combinational and sequential structures of digital circuits;
- explain the functioning of such structures;
- describe this functioning in one of the hardware description languages;
- detect flaws in such functioning;
- eliminate the basic among such flaws;

- choose the optimal design of a digital structure, taking into account the requirements of size, cost and reliability of functioning;
- design combinational and sequential circuits using the methods of abstract and structural synthesis;
- build a prototype of the designed structure in the form of a printed circuit board;
- test the functioning of such a prototype;
- Formulate the strengths and weaknesses of the chosen design.

Teaching methodology: Lecture classes with examples of problem solving and tutorials to illustrate the theoretical concepts, laboratory work for acquisition of practical skills in design, implementation and testing of digital structures.
Evaluation methods: Final rating represents the sum of: The successful practical work: 25%, First intermediate evaluation: 15%, Second intermediate evaluation: 20%, Regular attendance and involvement in discussions and seminars 10%, Oral test or final exam: 30%, Total: 100%
Concretization tools/IT: Computer, projector, lab, table.
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 1:1.
Literature:

1. Floyd Thomas L., Digital Fundamentals (10th Edition), Prentice Hall, 2008.
2. M. Morris Mano, M. D. Ciletti. Digital Design, 6th ed. Pearson/Prentice Hall, 2017.
3. Fundamentals of Digital Circuits, 3rd Edition, by A. ANAND KUMAR, 2014, Delhi.
4. S.M. Deokar, A. A. Phadke, "Digital Logic Design and VHDL", Wiles, 2009
5. Digital Circuit Analysis and Design with SIMULINK Modeling: And Introduction to CPLDs and FPGAs, Second Edition, Steven T. Karris, Orchard Publications 2007.
6. J. F. Wakerly. Digital Design: Principles and Practices, 5th ed. Pearson/Prentice Hall, 2017.
7. C. Maxfield. Bebop to the Boolean Boogie, 3rd ed. Newnes, 2009.

YEAR 2
SEMESTER 3

Course: Probability and Statistics (3+0+1) 7 ECTS
Lecturer: Valdete Rexhëbeqaj Hamiti
Course status: Mandatory
Short course description: In this course will be studied:
Fundamental concepts and applications of combinatorics. Probability axioms, geometric and conditional probability. Independent events, total probability and Bayes' formula. Discrete and continuous random variables. Numeric parameters of random variables, variance, standard deviation. The discrete and the continuous distributions. The Central limit theorem and the Law of large numbers.
Introduction to statistics. Population and sample. Descriptive statistics. Point estimates of the unknown parameters. Testing of parametric and nonparametric hypotheses. Linear regression.
Course objectives: Students should be trained so that the knowledge gained through this course can be applied as an ancillary device in information and communication technology.
Learning outcomes:

Upon completion of this course the student will be able to:

- calculate the probability of random events;
- use Bayes' theorem;
- know the basic distributions attributes as well as their application to professional problems;
- interpret and apply the central limit theorem;
- understand the basic statistical concepts and tools;
- use techniques for determining point estimates and confidence intervals;
- choose appropriate statistical tests and perform hypotheses testing;
- solve problems from information and communication technology using probabilistic and statistical methods.

Teaching methodology: Lectures, discussions, exercises, consultations, homework, seminar work, intermediate evaluations, final exam.

Evaluation methods: Seminar work and homework (10%), first intermediate evaluation (25%), second intermediate evaluation (25%), final exam (40%).

Concretization tools/IT: Pencil, whiteboard, projector and computer.

Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 2:1.

Literature:

- Douglas C. Montgomery, George C. Runger, "Applied Statistics and Probability for Engineers", Wiley, 2018.
- Murray Spiegel, John Schiller, R. Srinivasan, "Probability and Statistics", McGraw Hill Professional, 2000.
- S. Ross, "A First Course in Probability", 8th edition, Prentice Hall, New Jersey, 2009.
- Murray Spiegel, "Theory and Problems of Probability and Statistics", McGraw-Hill Professional, 1975.
- Miller and Freund's, "Probability and Statistics for Engineers", Pearson, 2018.
- T.T. Soong, "Fundamentals of Probability and Statistics for Engineers", State University of New York at Buffalo, USA, 2004

Course title: Signals and Information (3+1+1) 6 ECTS

Lecturer: Enver Hamiti

Course status: **Mandatory**

Short Course description: Continous signals: periodic, non-periodic and random signals. Signal power and correlation between periodic signals. Signal energy and correlation between aperiodic signals. Fourier analyses of periodic and aperiodic signals, signal spectrum. Signal power and correlation between random signals. Signal filtering and convolution. Clasic analog filters. Sampling and reconstruction of bandlimited signals. Pulse transmittion and intersymbol interference, Nyquist theorem. Basic on information theory: events and information measure. Information sources, entropy and source coding. Communication channel model and channel capacity.

The goal: The goal of the course are to introduce students to the basic concepts of signals and informations. To develop student`s understanding of time-domain and frequency domain approaches to the analysis of continuous and discrete signals; understund to gain knowledge of the fundamental concepts of information theory; and to develop student`s ability to apply modern simulation software to signals and information analysis.

Learning outcomes: Student will learn properties of signals and information and the ways how to represent them in time and frequency domain. After finishing the course student will be able to:

- Understand signals and information.
- Learn the signals and information.
- Characteristic parameters and properties.
- Represent signals in the time and frequency domain through problem-solving and performing corresponding simulations.
- Classify signals and information and their correlations.
- Understand signal transmission and constraints.
- Understand and analyse events and measure information.

Teaching Methodology: 45 hours of lectures + 30 hours of auditorial exercises. Approximately 100 hours of personal study and exercise including seminars.

Evaluation methods and criteria: The pass limit for the course is 50%; Participation 10 %; Tasks and projects 30%; Intermediary tests 60%

Concretization tools: Compjuter, video projector, and equiped lab with software to ilustrate all teaching material.

Literature:

- "Signals, Systems and Inference", Alan V Oppenheim, *George C. Verghese,* Global Edition, Pearson Education, 2018
- "*Schaum's Outline of Theory and Problems of Signals and Systems*", Hwei P. Hsu, 1995, McGraw-Hill.
- "*Signals and Systems*", Alan V. Oppenheim, et al, 2nd ed., 1996, Prentice Hall.

Course: Electronics for ICT (2+0+2) 6 ECTS
Lecturer: Respective department
Course status: Mandatory
Course content: Semiconductors. Diodes, rectifiers, and wave shaping circuits. and Bipolar and Field effect transistors. The Transistor as switch (analysis in DC mode). Small signal AC analysis of single-stage amplifiers with BJT/MOSFET. Memory circuits (bistable circuits). Semiconductor Memories-Types and Architectures- SRAM and DRAM cells, the Flash memory, programmable ROMs. Operational amplifiers and applications. A/D converters and D/A converters.
Course objectives: goal: The aim of the Electronics course is to furnish students with a thorough
comprehension of fundamental electronic components and circuits, specifically tailored to their application in ICT. Encompassing semiconductors, diodes, rectifiers, wave shaping

circuits,bipolar and field-effect transistors, semiconductor memories, operational amplifiers, A/D and D/A converters. The course is designed to empower students with essential knowledge for the analysis and design of electronic circuits within the context ICT fields.

Learning outcomes: On successful completion of the course, students will be able to:

- Comprehend the function of diodes, rectifiers, and wave shaping circuits, and identify their practical applications in computer engineering, particularly in signal processing technology.
- Develop knowledge of the application and function of field-effect transistors (MOSFET) and bipolar transistors in the context of computer systems.
- Understand the role and utilization of transistors as switches in computer engineering applications, including a thorough analysis within the scope of the course.
- Apply small signal AC analysis to single-stage amplifiers using BJT and MOSFET.
- Understand the structure and function of memory circuits (such as bistable circuits), within the context of computer architecture.
- Understand various types and architectures of semiconductor memories, with a focus on SRAM cells, DRAM cells (MOS memories) and Flash memory.
- Understand the function and applications of operational amplifiers, including practical analysis scenarios relevant to the ICT field.
- Understand the function and applications ADC
- Understand the function and applications of DAC.

Teaching methodology: Lectures for theoretical aspects, laboratory exercises and team-work for real-case scenarios and problem solving.

Evaluation method: Test 1: 20%, Test 2: 20%, Laboratory 30%, Final exam 20%, Attendance to lectures 10%. Success in preliminary assessments is a prerequisite for the final exam.

Literature:

1. Donald Neamen, Microelectronics: Circuits Analysis and Design, McGraw-Hill Education, 4th Edition, 2010.
2. Myzafere Limani, Qamil Kabashi, Elektronika (pjesa e pare), Universiteti i Prishtinës, 2023.
3. Thomas L. Floyd, *Electronic devices*, 10th edition. Pearson, 2018

Course: Internet Technologies (2+0+2) 6 ECTS

Lecturer: Mimoza Ibrani

Course status: Mandatory

Short course description: Introduction to Internet communication technologies. Fundamentals of information and communication systems and networks. Information society, digital and green transformation. Internetworking. Evolution of technologies in Internet, hardware, and software. Communication channel model, packet switching vs. circuit switching and data transmission. Signalization and intelligence in networks and systems. Purpose of layered models and communication protocols, protocol data units. OSI and TCP/IP reference models. Architectures of Internet: access and core networks. Examples and operation of selected systems and technologies in communication services provisioning: Ethernet, wireless and mobile networks, Internet based systems with TCP/IP, satellite networks. Comparative analysis of transmission medias. Broadband concept, mobility, and multimedia. Fundamentals of Web and Web technologies. Basic Internet protocols for each layer. Physical and logical addressing in Internet. Internet Protocol (IP). Multiplexing of protocols on the Internet. Network operation (TCP/IP, client-server communication). Routing and switching. Internet services and QoS parameters. Web technology (HTTP, HTML).

Maintenance and troubleshooting. Internet of things – concept and application examples. Convergent interactive Internet applications. Fundamentals of communication security. Internet standards world. Trends and emerging technologies, next generation Internet.

Course objectives: The main objective of the course is to introduce fundamental knowledge about operation and application of information and communication systems and Internet. Students will learn basic principles of the Internet functioning and architecture. The course combines theoretical background with practical applications and real-world examples. The course will introduce students to the principles of the layered TCP/IP architecture, and its basic protocols. It will also relate Internet applications to the IP network infrastructure. The topics build an integral whole, which is of interest and necessary for professional courses in the continuation of the study.

Learning outcomes: After successful completion of the course, students should be able to:

- List the key technologies in Internet, including wired, wireless and mobile network technologies
- Sketch the architecture and explain the operation of access and core networks, Internet and other IP based communication systems
- Differentiate among purposes of communication protocols at various layers of TCP/IP
- Explain the concept and possible use cases of the Internet technologies
- Configure and test a simple network, information and or/communication system

Teaching methodology: Lectures for theoretical aspects, laboratory exercises and team-work for real-case scenarios and problem solving. Case studies and industry invited lecturers.

Evaluation methods and criteria: Evaluation of practical/laboratory exercises 30%, Homework and attendance 10 %, Mid-term evaluation 30%, Final evaluation 30%, Total: 100 %

Literature:

- Curose James, Ros Keith (2020). Computer Networking Top-down approach. Pearson.8th edition.
- William Stallings (2013). *Data and Computer Communications*, (10th ed.). Pearson.
- Janevski, T. (2015). *Internet Technologies for Fixed and Mobile Networks*. Artech House.
- Tanenbaum, A.S., Wetherall, D.J. (2011). *Computer Networks*, 5th, 2011. Pearson Education, Inc

Course: Software tools for Engineering (Matlab, Python, etc.) (2+0+2) 5 ECTS

Lecturer: Bujar Krasniqi

Course status: Mandatory

Short course description: Introduction to MATLAB and Python, Program design and algorithm development, Vectors and Matrixes in MATLAB and Phyton, Functions and data import-export
in MATLAB and Python, Function m-files in MATLAB, Loops in MATLAB and Python, 2D graphics in MATLAB, 3D graphics in MATLAB Simulink in MATLAB, Apply MATLAB Toolboxes, Python scientific computation (NumPy, SciPy, Matplotlib), Apply simulation of communication systems in MATLAB and Python, Simulation of communication systems using Simulink, Data visualization in MATLAB and Python.

Course objectives: The main objective of the course is to equip students with fundamental knowledge about operation and application of MATLAB and Python in solving problems in

ICT. Students will learn from basic principles of programming to the application of both programming languages in solving various problems in ICT.

Learning outcomes: After successful completion of the course, students should be able to:

- distinguish the use of vectors and matrix in MATLAB and Python
- formulate function and loops in MATLAB and Python
- demonstrate appropriate knowledge for data visualization by graphical representation.
- implement examples from communication systems using Simulink, Toolboxes and Python libraries.
- solve ICT problems using MATLAB and python.

Teaching methodology: Lectures, Discussion, Laboratory work.

Evaluation methods and criteria: The successful practical work: 70%, First intermediate evaluation; 10%, Second intermediate evaluation:10%, Regular attendance and involvement in discussions 10%, Total: 100 % .

Literature:

- S. Chapra (2019): Essential MATLAB for Engineers and Scientists, 7th Edition, Publishing House "Elsevier", USA.
- O. Ibe (2017): Applied Numerical Methods with MATLAB for Engineers and Scientists, 4th Edition, Publishing House Mc Graw Hill, USA
- E. Smith (2022) "Introduction to the Tools of Scientific Computing" Springer Second edition
- S. I. Gordon, B. Guilfoos (2017)"Introduction to Modeling and Simulation with MATLAB and Python" CRC Press Taylor & Francis Group

YEAR 2
SEMESTER 4

Course title: Digital Communications (3+1+1) 6 ECTS

Lecturer: Enver Hamiti

Course status: Mandatory

Short Course description: Communication systems model. Information and its measure. Spectral analysis of signals. Random noise. Linear and nonlinear systems. Analog modulations. FDM/FDMA. Sampling process. Pulse modulations. A/D conversion. Pulse code modulation (PCM), differential PCM, delta modulation. TDM/TDMA. Overview of basic analog communication systems. Model of digital telecommunication system. Source encoding. Performance criteria and limits of communication systems. Baseband digital transmission. Line codes. Intersymbol interference. Nyquist criteria. Channel equalization techniques. Digital modulation techniques. Overview of modern digital communication systems.

The goal: The purpose of the course is to introduce the basic principles of digital communications.

Learning outcomes: On successful completion of the course, students will be able to:

- Explain the basic concepts in telecommunications including signals & spectra, sampling, analog modulation processes, noise and its effects, basic A / D conversion techniques and basic multiplex / multiple access techniques

- Identify and recognize main characteristic of analog and digital modulation methods
- Explain basic concepts in digital telecommunications including digital telecommunication systems performance criteria
- Know baseband and passband digital transmission techniques
- Draft a paper on a particular issue or issues in the field of telecommunications.

Teaching Methodology: 45 hours of lectures + 15 hours of auditorial exercises + 15 hours of laboratory exercises. Approximately 100 hours of personal study and exercise including seminars.

Evaluation methods and criteria: Seminar 10%, Mid-term exams 30 %, Final Exam 60 %

Concretization tools: Compjuter, video projector, and equiped lab with neccessary devices to ilustrate all teaching material.

Literature:

- R. E. Ziemer and W. H. Tranter, "Principles of communications", 5th Ed., John Wiley & Sons Inc., 7th Edition, 2014
- Roger Freeman, "Fundamentals of Telecommunications", A John Wiley & Sons, inc. publication, 2013
- HWEI HSU, PH.D. "Analog and Digital Communications" , second edition, Shaum~s outline s series, 2003

Course: Electromagnetic waves (2+1+1) 6 ECTS

Lecturer: Mimoza Ibrani

Course status: Mandatory

Short course description: The course starts with brief explanations of waves and phasors, the nature of electromagnetism, travelling waves and presentation of electromagnetic spectrum. The general concepts of transmission lines are explored, including: the role of wavelength and propagation modes, transmission line equations, concepts of wave propagation on transmission lines, ending with special cases of transmission lines such as: short-circuited line, open-circuited line, quarter-wave transformer and impedance matching. The basic concept of Vector calculus, gradient, divergence, curl and Laplace operator are covered. Maxwell's equations for Electrostatics, Magnetostatics and Time-Varying fields are analyzed and compared, followed with practical application in engineering. The main topic of the course is Propagation of plane waves. Complex permittivity, plane wave propagation in lossless mediums, different types of wave polarizations and their applications will be elaborated. The comparative analysis between: Plane wave propagation in low loss dielectric and good conductor will be presented. Electromagnetic power density for plane wave propagation in lossless and loss mediums will be calculated. Wave reflection and transmission at normal incidence, at oblique incidence, Snell' law and Brewster angle will be covered. The transmission and reflection coefficient will be derived for different practical wave propagation examples. Few of radio frequency propagation models and path loss for different environments will be studied. Research topics in RF propagation issues. The course includes the experimental measurement of RF fields during propagation scenarios.

Course objectives: To provide students with the background necessary to understand the concepts of time varying electromagnetic fields, the electromagnetic wave properties and its propagation in different media through various junctions

Learning outcomes: After successful completion of the course, students should be able to:

- Apply vector calculus to analyse the behavior of static electric fields and magnetic fields in standard configurations;
- Describe the parameters of time varying fields, guided and free space wave propagation and the underpinning role of Maxwell's equations.
- Explain examples of the interaction between waves and media and to be able to relate these to engineering design considerations and function;
- Illustrate and analyse transmission lines and wave propagation for different practical scenarios;
- Analyse the application of radio frequency propagation models and path loss for different environments

Teaching methodology: Lectures for theoretical aspects, laboratory exercises, numerical exercises and tutorials for practical part and engineering problem solving.
Evaluation methods and criteria: Homework and practical exercises 20 %, Mid-term evaluation 40%, Final evaluation 40%, Total: 100 %
Concretization tools/ IT: Computer, projector and different applets and software demonstration for lectures. Applied electromagnetics lab for laboratory exercises.
Ratio between theoretical and practical part: Ratio between practical and theoretical part 40%/60%
Literature:

- Ulaby, F. T., Michielssen, E., & Ravaioli, U. (2010). *Fundamentals of applied electromagnetics* 6e. Boston, Massachussetts: Prentice Hall.
- Magdy F. IIskander (2012) "*Electromagnetic Fields and Waves* ", Illinois Waveland: Press,
- Measurement instrumentation data sheets

Course: Data Transmission (2+0+2) 5 ECTS
Lecturer: Bujar Krasniqi
Course status: Mandatory
Short course description: This course describes the basics of data transmission, beginning with analog and digital communication, continuing with efficiency of transmission media as result of multiplexing and switching. In the second part the students learn the communication network with wired (optical and hybrid optical) and wireless (2G/3G, 4G and 5G), as well as multiple access techniques that are used for data transmission. At the end of the course the multimedia services and their quality for data transmission is covered.
Course objectives: The purpose of this course is that the student during lectures and laboratory exercises expand and deepen their knowledge for data transmission, networks used for data transmission and needed quality of service for data transmission.
Learning outcomes: Upon completion of this course the student will be able to:

- explain analog and digital data transmission
- describe transmission media and techniques used for multiplexing and switching.
- demonstrate necessary knowledge for wired networks (optical and hybrid optical) and wireless networks (2G/3G, 4G and 5G) for data transmission.
- interpret quality of service parameters for multimedia services transmission

Teaching methodology: Lectures, Discussion, Laboratory work.

Evaluation methods: The successful practical work: 40%, First intermediate evaluation; 25%, Second intermediate evaluation:25%, Regular attendance and involvement in discussions 10%, Total: 100 % .
Concretization tools/IT: Computer, projector, laboratory equipped for ICT
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 60:40
Literature:

- B. Forouzan (2013): Data Communication and Networking, 5th Edition, Publishing House"Mc Graw Hill", USA.
- O. Ibe (2018): Fundamentals of Data Communication Networks, Publishing House Wiley, USA
- M. Sauter (2017): From GSM to LTE-Advanced and 5G, An introduction to mobile networking and mobile broadband, 3rd Edition, Publishing House Wiley, USA

Course: Communication Networks (2+0+2) 5 ECTS
Lecturer: Mimoza Ibrani
Course status: Mandatory
Short course description: Computer networks fundamentals: Services, protocols, delays, loss, packet switching, circuit switching, services and reference models. Application layer: Principles of network applications, network application architectures. Web and HTTP, cookies, web cashing. File transfer applications. DNS, DHCP, NAT, Mobile IP. Peer to peer applications and socket programing. Transport layer services. Multiplexing and demultiplexing. Principles of reliable data transfer (ARQ). Connection oriented transport (TCP). Connectionless transport (UDP). Principles of congestion control. Switching and routing in communication networks. Virtual circuits and datagram networks. Router and routing. The IP (Internet protocol). IPv4 and IPv6. Routing algorithms (Link state and Distance vector). Inter and intra autonomous system routing. Broadcast and multicast routing. Addressing and Subnets, Private and Public IP addresses. Subnetting Variable Length Subnet Masks (VLSM), Static, Default and Dynamic Routing. Open Shortest Path Protocol (OSPF) and Routing Information Protocol (RIP), Routing Table algorithms, Multi-Area OSPF, RIPv2, Inter-Domain Routing, Autonomous Systems, Hierarchical routing architecture used in the Internet, Border Gateway Protocol (BGP), Label Distribution Protocol (LDP), Virtual Private Network (VPN), Multi-Protocol Label Switching (MPLS) and Link Virtualization. Network layer data plane and control plane. The link layer: links, access networks and LANs. The services provided by link layer. Error detection and correction techniques. Multiple access links and protocols. Virtual LANs. Comparative analysis of WLAN's. Energy efficiency in communication networks. Green techniques for communication networks.

Course objectives: Understand the principles and concepts on computer networks. Gain familiarity with communication protocols, description and operation of services at the application, transport, network, data link and physical layers

Learning outcomes: After successful completion of the course, students should be able to:

- Demonstrate concept of packet-switching, and identify and analyze the different types of packet delay in packet-switched networks

- Use IP addressing and apply routing algorithms to find shortest paths for network-layer packet delivery
- Explain principles of reliable data transfer and congestion control
- Describe and compare data link layer services and multiple access techniques
- Use networking tools to observe and analyze behaviors of networking protocols
- Configure routing and switching and conduct test and troubleshoot in operating 6networks

Teaching methodology: Lectures for theoretical aspects, laboratory exercises and teamwork for real-case scenarios and problem solving through project work.

Evaluation methods and criteria: Evaluation of practical/laboratory exercises 30%, Homework and attendance 10 %, Mid-term evaluation 30%, Final evaluation 30%, Total: 100 %

Concretization tools/ IT: Computer, projector and different apps for lectures. Computer communication lab for laboratory exercises. Software tools: Packet Tracer, GNS 3.

Literature:

- *Curose James, Ros Keith (2020). Computer Networking Top-down approach. Pearson.8th edition.*
- *William Stallings (2013). Data and Computer Communications, (10th ed.). Pearson.*
- *Computer networks tutorials and case-studies*
- *CCNA Routing and Switching.*

Course: Internship (1+0+0) 3 ECTS

Lecturer: *From the department*

Course status: *Mandatory*

Course description: *The content of this course depends on the company where the student shall finish 75 working hours. As a result, the content is drafted jointly from the coordinator of professional internships, appointed from the company, and the student who is going to work in such company. The coordinator of professional internships, who is appointed from the company, guides the student throughout the duration of his/her work in the company. The two supervisors guide the student throughout the duration of his/her work in the company, and participate as members of the commission in the presentation of the activity report.*

Course goal*: The students gain professional experience, depending on the field of study, in one of the local companies, also the student has to demostrate the ability to analyze the given problem from theoretical and practical aspects, devise a solution using the knowledge acquired in multiple courses and literature.*

Learning outcomes: *Upon completion of this course the student will be able to:*

- *Be qualified for professional work, in the relevant field of study, and to be more prepared for the labour market.*
- *Gain confidence in gained knowledge*
- *Have the ability to further studies o mandatory or additional literature*
- *Consult with mentor with questions well prepared and structured;*
- *Present their work in written form, with standard language and guidelines for this type of work, with a volume of at least 30 sheets of A4 format*
- *Present the work in time of ten minutes with presentation prepared in PowerPoint*

***Teaching methodology**: 75 working hours in the company, 120 hours for preparation of the activity report and for preparation of the final presentation.*
***Evaluation methods:** Writing presentation 40%, Oral presentation: 60%.*
***Ratio between theoretical and practical part:** Ratio between the theoretical and practical part is 50:50*
Literature :

1. *It is depended from the final project, will be provided from the mentor.*

Course title: Project Management (2+1+0) 5 ECTS
***Lecturer:** Prof. Asst. Dr. Nora Sadiku*
***Course goal:** The main goal of this course is to empower students with the knowledge and skills needed to proficiently manage projects throughout their life cycle, addressing the specific challenges within their field.*
***Learning outcomes:** On successful completion of the course, students will be able to:*

1. *Define key project management terms and concepts.*
2. *Recall the phases of the project life cycle and their significance.*
3. *Describe the project initiation process and its role in effective project execution.*
4. *Create a comprehensive project plan, including schedule, resource, and budget planning.*
5. *Assess the effectiveness of project closing and control mechanisms.*

***Course content:** Introduction to project management, The Project Life Cycle (Phases), Project Initiation Process, Project planning, Planning and Defining the Project Scope, Project Schedule Planning, Resource Planning, Budget Planning, Procurement Management, Quality Planning, Risk Management Planning, Project execution, Project control, Project closing, Project presentations,*

***Methods of teaching:** 30 hours of lectures + 15 hours of laboratory exercises. Approximately 55 hours of personal study and exercise including seminars.*

***Grading System:** Seminar 10%, Mid-term exams 40 %, Final Exam 50 %*

Literature:

1. *Davies A. Igberaese . Introduction to Project Management A Source Book for Traditional PM Basics . Routledge 2023*
2. *A Guide to Project Management Body of Knowledge (PMBOK Guide) – and the Standard for Project Management [7 ed.2021]*
3. *Adriene Watt Project Management. Victoria, B.C.: BCcampus. 2014.*

Course title: Professional Communications in English (2+1+0) 5 ECTS
***Lecturer:** From University*
***Course status:** Elective*

Short course description: *This course focuses on specific skills in English. The main focus of this course is based on:*
Oral activities to practice work-related communicative situations
Vocabulary and rhetoric in negotiations and discussions
Oral presentation techniques
CVs and cover letters, formal letters, e-mail and other business-related written communication
Overview of communication strategies for the culturally heterogeneous workplace
Discussions using authentic material to increase the understanding of current topics within technology and natural sciences (for example research ethics, sustainable development, and technological breakthroughs)
Course objectives: *The main objective of this course is to strengthen the students' skills in English in writing and speaking.*
Learning outcomes: *Upon completion of this course the student will be able to:*

- *participate actively in discussions, meetings and negotiations in multicultural workplaces*
- *explain and defend his/her opinions in work-related discussions*
- *identify differences in linguistic style between everyday and work-related communication, and adapt his/her oral and written production according to the audience*
- *write business letters and documents*

Teaching methodology: *Lectures, Discussion, Project work.*
Evaluation methods: *The successful project work: 40%, Home work; 30%, Regular attendance and involvement in discussions 30%, Total: 100 % .*
Concretization tools/IT: *Computer, projector*
Literature:

- *Selected papers and resources*

Course: Digitalization and innovation for sustainable development (2+1+0) 5 ECTS
Lecturer*: Bujar Krasniqi*
Course status: *Elective*
Short course description: *The course comprises lectures, seminars, group project work, and a home exam. During the lectures and seminars, students will participate in discussions and presentations on the challenges and objectives of sustainable development across various sectors of society. Topics will include how digitalization can offer solutions while also posing new challenges, and basic innovation theory with a focus on sustainable innovation.*
The project work will involve collaboration with a company or research project, where students will apply their digitalization knowledge and skills to tackle sustainable development issues. The results of the project work will be presented in a written report and oral presentation during a final seminar.
The home exam will allow students to specialize in a specific area of digitalization for sustainable development of their own choosing.

Course objectives: *The aim of this course is to enable students to gain an understanding of the benefits and drawbacks of digitalization from a systems perspective, in relation to ecological and social sustainable development. This understanding will help them make informed decisions and seek additional knowledge when developing new solutions.*

Learning outcomes: *Upon completion of this course the student will be able to:*

- *Recognize the concept sustainable development*
- *Classify central concepts and methods that are used to describe and assess sustainability aspects of technical solutions with a system perspective*
- *Describe societal challenges with connection to ecological and social sustainable development*
- *Discuss the national and international goals for sustainable development*
- *Apply knowledge of sustainable development to independently suggest, describe and evaluate new solutions within digitalisation for sustainable development in a system's perspective*

Teaching methodology: *Lectures, Discussion, Project work.*

Evaluation methods: *The successful project work: 60%, Home work; 30%, Regular attendance and involvement in discussions 10%, Total: 100 % .*

Concretization tools/IT: *Computer, projector*

Literature:

- *Europe's Digital Decade: digital targets for 2030*
- *Kosovo Digital agenda 2030*
- *Digital agenda for Kosovo 2013 ÷ 2020*
- *C. Machado j. P. Davim "Innovation and sustainable manufacturing" research and development 2023 Elsevier*
- *Anand Nayyar, Akshi Kumar "A Roadmap to Industry 4.0: Smart Production, Sharp Business and Sustainable Development" 2020 Springer*

YEAR 3
SEMESTER 5

Course: Project in networking and communications (2+0+1) 6 ECTS

Lecturer: *Mimoza Ibrani*

Course status: Mandatory

Short course description: *The course is delivered in project-based and problem based-teaching and learning mode. Students work in groups of 3 to 4 students, under the guidance of a supervisor. Project requires finding the necessary literature, analysis of similar problems and solutions, identification of project requirements, definition of technical objectives, planning and time management, creation of alternative solutions, decision making, solution implementation, writing technical documentation, and presentation. The topics will be presented on a semester basis from the field of networking and communications, in close cooperation with industry.*

Topics will be related with Planning, designing, simulating, testing, implementing, and troubleshooting the network, protocol or communication technology in real operating scenario.
Course objectives: *Developing critical thinking in networking -and communication. Promoting cooperation between professional peers in a team environment while creating practical solutions to specific problems. The course will enable experimental and explorative learning and teach the methodology of project work, while trying to offer bachelor level academic solutions for practical industry problems.*
Learning outcomes: *After successful completion of the course, students should be able to:*

- *Build a project team and identify tasks in the field of networking and communication*
- *Demonstrate and present the solution and results of assignments to peers*
- *Analyze progress and finishes project tasks and identify bottlenecks in proposed solution*
- *Plan, design, implement, test and troubleshoot solutions in real operating network and communication scenarios and environments*
- *Draft and present technical report*

Teaching methodology: *Project based and problem-solving oriented methodology. Experiential learning.*
Evaluation methods and criteria: *Evaluation of proposed work/solution/configuration 50 %, presentation of the assignment 20 %, technical report drafting 30%*
Literature:

- *Recent published international textbooks in networking and communication*
- *White papers and technical reports*
- *Software tools and measurement devices datasheet*

Course: Internet of Things (3+0+2) 5 ECTS
Teacher: *Bujar Krasniqi*
Course status: *Mandatory*
Short course description: *Internet of Things (IoT) provides advanced data collection, connectivity, and analysis of data information, which thing has lead Machine-to-Machine communication concepts further than ever before. This course includes explanations of the architecture, standards and platforms for Internet of Things based on Arduino, Raspberry Pi and Low power wide area networks (Lora, Sigfox) an NB-IoT. Building and programming IoT prototypes is a continuous work that students are required to carry out during the semester.*
Course objectives: *This course describes the basic concepts, including the components, tools and analysis behind IoT. The student will understand the software and hardware solutions needed to create Internet of Things products. They also will understand the features of wireless components, communications networks, protocols, costs, and performance of Internet of Things platforms.*
Learning Outcomes:

- *Explain the architecture and characteristics of IoT.*
- *Describe the limitations, opportunities, and differences between technologies that support IoT.*

- *Implement IoT communication networks such as Lora, Sigfox, NB-IoT.*
- *Discuss the architecture, operations, and business benefits of IoT solutions.*
- *Implement IoT prototypes based on Arduino and Raspberry pi.*
- *demonstrate acquired knowledge to connect IoT devices in Low power wide area (Lora, Sigfox) and NB-IoT networks.*
- *Use acquired knowledge to implement IoT solutions for different application areas.*

Teaching Methodology: *Lectures, exercises during class using different materials to continuously work in projects in group of 3 students (independent work), individual homework.*

Evaluation methods and criteria:

- *Student Attendance 10%*
- *Individual assignments completed at home 30%*
- *IoT group projects 60%.*
- *Total: 100 %.*

Tools / IT: *Computer, projector, table, lab equipped with IoT equipments according to projects and tasks.*

Literature:

- *Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri (2018) Picone, Luca Veltri "Internet of Things: Architectures, Protocols and Standards" Wiley*
- *David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry (2017.), IoT Fundamentals, Cisco Press*
- *Arshdeep Bahga, Vijay Madisetti (2014.), Internet of Things: A Hands-On Approach, VPT*
- *Gary Smart (2020), Practical Python Programming for IoT, Packt Publishing*

Course: Network Programming (2+0+2) 6 ECTS

Lecturer: *Zana Limani Fazliu*

Course status: Mandatory

Short course description: *Introduction. Network and Web basics. Python crash course. Adressing, Naming and DNS. Socket programming. TCP, UDP programming. Simple client-server programming. Programming with HTTP for the Internet and WWW. Email, Telnet and FTP. Processing XML and JSON data. Popular Python libraries for network programming. Security and network programming. Security with SSL and TLS; Working with custom certificates and OpenSSL. Network monitoring and security. Network automation and automation tools (Ansible, Salt, StackStorm).*

Course objectives: *The course provides the knowledge and skills necessary to use Python for networking applications, TCP and UDP socket programming and also introduce student to concepts of network automation and programmability.*

Learning outcomes: *After successful completion of the course, students should be able to:*

- *Understand and apply Python code for network programming purposes*
- *Operate in the Linux environment and apply basic Linux commands.*

- *Understand socket programming using TCP, UDP*
- *Build simple client-server programs*
- *Understand basic concepts of network monitoring and security*
- *Understand main concepts of network automation*
- *List and identify main automation tools*

Teaching methodology: *Lectures, class discussions, and problem solving sessions. Laboratory sessions involving programming assignments to apply concepts taught in class.*

Evaluation methods and criteria*: Attendance and participation in class discussions 10%, Coding exercises 40%, Mid-term exam 25%, Final Exam: 25%. Total: 100%.*

Concretization tools/ IT: *Computer, projector and different apps for lectures. Multimedia Laboratory for web design and development.*

Ratio between theoretical and practical part: *Ratio between practical and theoretical part 70%/30%*

Literature:

- *Eric Chou, Mastering Python Networking, 4th Edition, <packt>, 2023.*
- *Brandon Rhodes, John Goerzen, Foundations of Python Network Programming, 3rd Edition, Apress, 2014.*
- *Jason Edelman, Scott S. Lowe & Matt Oswalt, Network Programmability and Automation, O'Reilly, 2018.*

Course: Signal processing and systems (2+0+2) 5 ECTS

Lecturer: Hena Maloku

Course status: Mandatory

Short course description: *Fundamentals of time-discrete signals (signals, signal classification, time and frequency space). Sampling (sampling theorem, effects of sampling in time and frequency domain). Discrete-time systems (linear time- invariant discrete systems, causality, differential equations and discrete linear systems, impulse response , the discrete - time systems structure, implementation) . Frequency analysis of discrete - time signals. Discrete Fourier transform (Fast Fourier transform algorithms, fast discrete filtering using FFT). Z-transform (Z transform and inverse Z transform , application in digital signal processing , rational Z transform, time behavior and roots of rational Z transform) . Analysis and synthesis of discrete time systems in frequency domain (transfer function of the system, analysis of systems with rational Z transfer function, stability, frequency response). Digital filter design (finite response filters, the infinite response filters). Random signal generators (uniform distribution, Gaussian white noise). Signal quantization (analog-to- digital conversion, quantizers, quantization errors).*

Course objectives: *Knowing the basic tools for digital signal processing. Understanding the processes and consequences of capture, analysis and signal processing in discrete - digital form and their reconstruction back to the analog domain. Competence for the selection of a suitable method of digital signal acquisition, understanding the implications of digitalization and understanding the basic signal analysis in time and frequency domain. The ability to use basic*

systems for digital filtering and signal enhancement. Understanding digital signal processing as a building block of complex digital communication devices.

Learning outcomes: *After successful completion of the course, students should be able to:*

- · *Classify signals and systems by type*
- · *Explain the importance of signal processing in communications*
- · *State and explain the Nyquist-Shannon sampling theorem*
- · *Analyze signals using their spectrum*
- · *Analyze systems using theirs transfer function and frequency response*
- · *Explain the equivalence between time continuous and time discrete systems*
- · *Explain signal filtration*
- · *Design a basic digital filter using a computer*
- · *Explain what the fast Fourier transform is and list its applications*

Teaching methodology: *Lectures, class discussions, and practically oriented lab assignments encouraging teamwork.*

Evaluation methods and criteria*: Attendance and participation in class discussions 10%, Laboratory exercises 30%, Mid-term exam (or Seminar/Project) 30%, Final Exam: 30%. Total: 100%.*

Concretization tools/ IT: *Computer, projector and different apps for lectures. Computer Laboratory for practical exercises.*

Ratio between theoretical and practical part: *Ratio between practical and theoretical part 60%/40%*

Literature:

1. *John G. Proakis, Dimitris K. Manolakis, Digital Signal Processing (4th Edition) Prentice Hall; 4 edition, 2006*
2. *Paolo Prandoni, Martin Vetterli (2008.), Signal Processing for Communications, EPFL Press*
3. *Sanjit Kumar Mitra (2010.), Digital Signal Processing: A Computer Based Approach, McGraw-Hill.*

Course: Internship (1+0+0) 3 ECTS

Lecturer: *From the department*

Course status: *Mandatory*

Course description: *The content of this course depends on the company where the student shall finish 75 working hours. As a result, the content is drafted jointly from the coordinator of professional internships, appointed from the company, and the student who is going to work in such company. The coordinator of professional internships, who is appointed from the company, guides the student throughout the duration of his/her work in the company. The two supervisors guide the student throughout the duration of his/her work in the company, and participate as members of the commission in the presentation of the activity report.*

***Course goal**: The students gain professional experience, depending on the field of study, in one of the local companies, also the student has to demostrate the ability to analyze the given problem from theoretical and practical aspects, devise a solution using the knowledge acquired in multiple courses and literature.*
***Learning outcomes:** Upon completion of this course the student will be able to:*

- *Be qualified for professional work, in the relevant field of study, and to be more prepared for the labour market.*
- *Gain confidence in gained knowledge*
- *Have the ability to further studies o mandatory or additional literature*
- *Consult with mentor with questions well prepared and structured;*
- *Present their work in written form, with standard language and guidelines for this type of work, with a volume of at least 30 sheets of A4 format*
- *Present the work in time of ten minutes with presentation prepared in PowerPoint*

***Teaching methodology**: 75 working hours in the company, 120 hours for preparation of the activity report and for preparation of the final presentation.*
***Evaluation methods:** Writing presentation 40%, Oral presentation: 60%.*
***Ratio between theoretical and practical part:** Ratio between the theoretical and practical part is 50:50*
Literature :

- *It is depended from the final project, will be provided from the mentor.*

Course: Web Application Development (2+0+2) 5 ECTS
***Lecturer:** Zana Limani Fazliu*
Course status: Elective
***Short course description:** Internet and Web Protocols, Client-Server Architecture, Web Software, Web Application Components. HTML. CSS. JavaScript programming. DOM. Events. Single Page Applications. Responsive Web Design. Browser/Server Communication. Web Servers. Cookies and Session. Introduction to PHP essentials. Introduction to MySQL databases. Intro to web application development frameworks.*

***Course objectives:** The course provides the knowledge and skills necessary to create dynamic web applications, and prepares students for relevant advanced courses in computer technologies.*
***Learning outcomes:** After successful completion of the course, students should be able to:*

- *Understand main aspects of HTML, CSS, modern JavaScript*
- *Use JavaScript at an advanced level for creating web applications at the front-end layer.*
- *Basic knowledge of a framework for creating web applications using HTML/JavaScript in the front end and PHP/MySQL in the back-end*
- *Ability to create complete web applications, also in the "single page application" modality, by using a simple back-end API server.*

- *Knowledge of the main issues regarding robustness, security, interoperability, and performance of the studied applications, and their applicable best practices.*

Teaching methodology: *Lectures, class discussions, and review of real-world cases based on specific theoretical concepts. Laboratory sessions, involving training and practice in developing web applications.*

Evaluation methods and criteria*: Attendance and participation in class discussions 10%, Programming exercises + Final Project 40%, Mid-term exam 25%, Final Exam: 25%. Total: 100%.*

Concretization tools/ IT: *Computer, projector and different apps for lectures. Multimedia Laboratory for web design and development.*

Ratio between theoretical and practical part: *Ratio between practical and theoretical part 70%/30%*

Literature:

- *Robin Nixon, Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites, 3rd Edition, 2014.*
- *Marijn Haverbeke, Eloquent JavaScript: A Modern Introduction to Programming, 3nd Edition.*
- *Mozilla Developer Network (https://developer.mozilla.org/en-US/)*
- *W3Schools (https://www.w3schools.com/)*

Course: Multimedia technologies and systems (2+0+1) 5 ECTS

Lecturer: Hena Maloku

Course status: Elective

Short course description: *History of multimedia systems. Definition of multimedia and properties of multimedia elements (text , image, animation , sound, video) . Properties of analogue and digital forms of multimedia elements, and the reasons for digitalization. Compression and most relevant multimedia formats. Architecture and features of multimedia systems. Basic multimedia services. Characteristics of terminal equipment used in multimedia. Procedures for the production and processing of multimedia content. Platforms for development of multimedia services (software tools, programming interfaces). Quality measurement in multimedia systems.*

Course objectives: *To provide basic knowledge on the definition of multimedia concepts, basic multimedia elements and their properties. Explanation of the architecture(s) of modern broadcasting and multimedia systems, which serve as the basis for the implementation of multimedia services. Compression of multimedia elements. Understanding of the specifics of analogue and digital broadcasting. Understanding of production, preparation and processing procedures of multimedia materials. Understand the difference between different multimedia systems. Knowledge of hardware equipment characteristics. Understanding of development and management approaches in multimedia platforms, systems and services. Assessment of Quality of service in multimedia systems*

Learning outcomes: *After successful completion of the course, students should be able to:*

- · *Understand multimedia features and multimedia elements.*

- · *Understanding the technological basis of different multimedia systems architecture and consequent advantages and disadvantages.*
- · *Understanding and knowledge of the characteristics of multimedia services.*
- · *Understand the principles behind effective multimedia presentations,*
- · *Design and develop multimedia presentations through software packages*

Teaching methodology: *Lectures, class discussions, presentations and lab assignments encouraging teamwork.*

Evaluation methods and criteria*: Attendance and participation in class discussions 10%, Laboratory exercises and presentations 50%, Mid-term exam 20%, Final Exam: 20%. Total: 100%.*

Concretization tools/ IT: *Computer, projector and different apps for lectures. Computers for Laboratory exercises.*

Ratio between theoretical and practical part: *Ratio between practical and theoretical part 60%/40%*

Literature:

1. *1. Steinmetz R., Nahrstedt K., Multimedia Systems, Springer, (2014 edition)*
2. *2. Ze-Nian Li, Mark S. Drew, Fundamentals of Multimedia, Pearson Prentice Hall, 2004.*

Course: Cloud Networking and Big Data (2+0+1) 5 ECTS

Lecturer: *From Industry*

Course status: *Elective*

Short course description: *This course is an introduction to cloud networking and big data processing. Students will learn about cloud deployment models, virtualization technologies, network architecture, and security in the cloud. They will also explore big data processing with Hadoop, Spark, and Flink, as well as cloud-based data warehousing and analytics, machine learning, and business intelligence. The course emphasizes cloud networking, best practices, and security, and students will have the opportunity to work on a final project that applies the concepts and techniques covered in class.*

Course objectives: *The purpose of this course is to provide students with a solid understanding of cloud networking and big data processing, and to prepare them for careers in cloud computing, data analysis, and related fields. By the end of the course, students will be able to design and implement cloud-based big data solutions, and will have gained practical experience with a range of cloud-based tools and technologies. Additionally, the course emphasizes best practices in cloud networking and security, preparing students to manage and secure complex cloud-based infrastructures. Overall, the course aims to equip students with the skills and knowledge necessary to be successful in the rapidly evolving field of cloud networking and big data processing.*

Learning outcomes: *By studying this course, students can expect to achieve the following outcomes:*

- *A solid understanding of cloud computing and virtualization, and the ability to deploy and manage cloud-based solutions.*
- *A deep understanding of cloud networking architecture, protocols, and best practices, and the ability to design and secure cloud-based infrastructures.*
- *An understanding of big data processing technologies such as Hadoop, Spark, and Flink, and the ability to analyze and visualize large data sets in the cloud.*
- *Practical experience with cloud-based data warehousing, analytics, machine learning, and business intelligence tools and services.*
- *A practical understanding of network automation and orchestration, and the ability to manage complex cloud-based infrastructures.*
- *A solid foundation in cloud-based security, and the ability to identify and mitigate security threats in the cloud.*
- *The ability to work on a team and collaborate with others on complex cloud-based projects.*
- *The ability to think critically and problem-solve in the rapidly evolving field of cloud networking and big data processing.*

Teaching methodology: *Lecture and Lab excercises.*

Evaluation methods and criteria: *Successful lab deliverables: 40%, First Midterm; 10%, Second Midterm:10%, Attendance in lectures and labs 20%, Final test and oral examinations via: 20%, Total: 100 % .*

Tools for lectures and lab/ IT: *A cloud computing platform such as Amazon Web Services (AWS), Microsoft Azure, or Google Cloud Platform (GCP). Virtualization software such as VirtualBox or VMware. Hadoop and Spark for big data processing. Data warehousing and analytics tools such as Amazon Redshift, Google BigQuery, or Microsoft Azure Synapse Analytics. Business intelligence tools such as Tableau, Power BI, or Looker. Programming languages such as Python or Java for cloud networking automation and orchestration.*

Theoretical vs Practical rapport of course study: *1:2*

Literature:

- *Erl, T., Puttini, R., & Mahmood, Z. (2013): Cloud Computing: Concepts, Technology & Architecture, United States*
- *Marz, N., & Warren, J. (2015): Big Data: Principles and best practices of scalable realtime data systems, United States*
- *White, T. (2015): Hadoop: The Definitive Guide, United States*
- *Chambers, B., & Zaharia, M. (2018): Spark: The Definitive Guide, United States*
- *Tigani, J., & Naidu, S. (2019): Building Data Warehouses with Google BigQuery, United States*
- *Lakshmanan, V. (2021): Data Science on the Google Cloud Platform: Implementing End-to-End Real-Time Data Pipelines: From Ingest to Machine Learning, United States*
- *Lee, G., & Hamilton, J. (2014): Cloud Networking: Understanding Cloud-Based Data Center Networks, United States*
- *Mather, T., Kumaraswamy, S., & Latif, S. (2009): Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, United States*

Course title: Entrepreneurship and Innovation *(Elective, Sem. 5, 5 ECTS)*
Lecturer: *Prof. Asst. Dr. Nora Sadiku*
Course goal: *The goal of the course is to equip students with a foundational understanding of entrepreneurship, developing skills for identifying, evaluating, and pursuing entrepreneurial opportunities.*
Learning outcomes: *Upon successful completion of this module, student will be able to:*

1. *Define fundamental entrepreneurship concepts and principles.*
2. *Explain the role of creativity, innovation, and risks in entrepreneurship*
3. *Differentiate various entry options, such as franchise and family business, in entrepreneurial endeavors.*
4. *Develop a comprehensive business plan for a hypothetical entrepreneurial venture*
5. *Propose different options for entering the entrepreneurial space*

Course content: *Introduction to entrepreneurship an innovation course, Concept of entrepreneurship, Nature of small business, Creativity and innovation, Risks and entrepreneurship, Business plan and entrepreneurship, Options for entering entrepreneurship, Franchise as entrepreneurial option, Family Business and succession, Entrepreneurial financing, Entrepreneurial marketing, Digital entrepreneurship, Corporate entrepreneurship, Social entrepreneurship and green entrepreneurship*

Methods of teaching: *30 hours of lectures + 15 hours of laboratory exercises. Approximately 55 hours of personal study and exercise including seminars.*
Grading System: *Seminar 10%, Mid-term exams 40 %, Final Exam 50 %*
Literature:

1. *Veland Ramadani, Robert D. Hisrich, Nora Sadiku-Dushi & Shqipe Gërguri-Rashiti. Ndërmarrësia dhe menaxhimi i biznesit të vogël. Tetovë, 2022*
2. *John Bessant, "Entrepreneurship and innovation", John Wiley & Scons Inc. 2019*
3. *Charles Hampden-Turner, "Teaching Innovation and Entrepreneurship", Cambridge University Press 2009,*

YEAR 3
SEMESTER 6

Course title: Microwave and RF Engineering (2+0+1) 6 ECTS
Lecturer*:* Enver Hamiti
Course status: Mandatory
Short course description: Basic features of radio communication systems. Transmission lines. Smith charts and scattering parameters. CAD tools - Microwave Office, Ansoft, Python. Microwave elements and circuits using microstrip lines. Waveguides and microwave

elements. Basic characteristics and parameters of antennas: far- field, radiation intensity, radiation patterns, directivity, gain, polarization. Microwave antennas. Antenna array.

The goal: Present principles of operation and analysis methods for microwave, passive microwave elements, microwave circuits and antennas that are used for modern communication and wireless systems at frequencies 0.3-300 GHz.

Learning outcomes*:* On successful completion of the course, students will be able to:

- Be familiar with the basic topics in high frequency, microwave engineering and antennas.
- Use HF analysis and design tools for matching purposes, such as Smith chart
- Understand the operation of microwave circuits using S-parameters
- Understand the general parameters and operation of antennas
- Draft a paper on a particular issue or issues in the field of microwave and antennas.

Teaching methodology: 30 hours of lectures + 30 hours of auditorial exercises. Approximately 90 hours of personal study and exercise, including seminars.

Evaluation methods and criteria: Seminar 10%, Projects (homework) 30 %, Final Exam 60 % (Course to minor changes).

Concretization tools: Compjuter, video projector, and equiped lab with neccessary devices to ilustrate all teaching material.

Literature:

- David M. Pozar "**Microwave Engineering** ", Copyright, 2012, John Wiley & Sons Inc.
- D. M. Pozar, **Microwave and RF Design of Wireless Systems,** John Wiley & Sons, 2001
- Kai Chang, **Radio Frequency Circuit Design**, John Wiley & Sons, 2001
- E. Hamiti, **Qarqet komunikuese analoge**, ligjërata të autorizuara, Prishtinë 2009

Course: Mobile Communications (2+0+1) 6 ECTS

Lecturer: Hena Maloku

Course status: Mandatory

Short course description: Introduction to Mobile communications systems, Overview of Wireless Network Topologies (Infrastructure/Infrastructure-less, Stationary/Mobile), their layered architectures, current and emerging technologies, Fundamentals of mobile and wireless network communications in the presence of a noisy channel, multiple access techniques, Wireless radio resource management (RRM), rate adaptation, handover, power allocation and control, Mobility models for Wireless Networks and their effects on end-to-end communication, Fundamentals of modern Cellular Networks and their architectures, Routing protocols for Wireless Networks and solutions to obstacles induced by mobility, Performance analysis of remotely hosted communications, metric interpretation, QoS metrics and techniques based on requirements of delay sensitive wireless Internet applications, Efficient management of network resources through Power and Energy adaptation, Capacity Analysis and Evaluation, comparison of analytical models with simulations, Performance evaluation schemes for network monitoring and efficient resource management. Green mobile communications.

Course objectives: The course aims to provide students with fundamental knowledge into core concepts of the latest and next generation mobile and wireless networks. Throughout the course, students will be exposed to theoretical and practical aspects regarding the architecture and applications of Cellular systems with focus on 4G/5G systems.

Learning outcomes: After successful completion of the course, students should be able to:

- Have a clear understanding of mobile communication techniques and protocols used in Cellular networks with focus on 4G/5G mobile systems
- Understand the mobile propagation fundamentals and models.
- Understand different access techniques and modulation schemes in mobile networks
- Determine and demonstrate various design issues in mobile and wireless systems for seamless and reliable communication considering fundamental concepts such as Radio Coverage, Capacity, Bit and Frame-Error Rate.
- Analyze and demonstrate fundamental network performance measures and have a clear and defined realization of end-to-end mobile network evaluation concepts.
- Successfully evaluate communication protocols under different realistic performance and environmental scenarios, including hands-on experience with simulation tools

Teaching methodology: Lectures, class discussions, presentations and lab assignments encouraging teamwork.

Evaluation methods and criteria: Attendance and participation in class discussions 10%, Laboratory exercises 20%,Project 20%, Mid-term exam 20%, Final Exam: 30%. Total: 100%.

Concretization tools/ IT: Computer, projector and different apps for lectures. Computers for Laboratory exercises.

Ratio between theoretical and practical part: Ratio between practical and theoretical part 60%/40%

Literature:

1. Theodore S Rappaport , Wireless Communications: Principles and Practice,Dorling Kindersley 2002 ISBN-10: 0130422320
2. William Stallings, Wireless Communications & Networks, Pearson , 2005, ISBN13: 9780131918351
3. Jochen Schiller, Mobile Communications, 2 nd Edition ,Pearson, 2004, ISBN-13: 9780321123817
4. Andreas. F. Molisch, "Wireless Communications", Second Edition, John Wiley & Sons Ltd., 2011

Course: Artificial Intelligence and Applied Methods (3+0+1) 6 ECTS

Lecturer: Zana Limani Fazliu

Course status: Mandatory

Short course description: Introduction to artificial intelligence and machine learning. Linear regression. Probabilistic models for learning. Bayesian learning. Supervised learning. Support Vector Machines (SVM). Introduction to neural networks. Unsupervised learning. K-means clustering. Feature extraction. Probabilistic graphical models. Bayesian networks. Markov random fields. Inference and learning. Examples of AI applications in communication systems and wireless networks (modulation, detection and coding of signals, channel modeling, estimation and prediction, for spectrum sensing, localization and positioning, etc.). AI/ML techniques for energy efficiency in communication networks.

Course objectives: The student will acquire fundamental knowledge of the methods and techniques of supervised, unsupervised machine learning and their applications in current and future communication systems from physical to application layer.

Learning outcomes: After successful completion of the course, students should be able to:

- give an account of artificial intelligence and its application areas
- know and account for artificial intelligence methods and technologies
- understand main machine learning concepts
- differentiate between supervised and unsupervised learning methods
- understand the potential of applying artificial intelligence methods in solving problems in communication systems
- formulate and carry out a well defined assignment that requires the application of artificial intelligence techniques

Teaching methodology: Lectures, class discussions, and problem solving sessions. Laboratory sessions involving programming assignments to apply concepts taught in class.

Evaluation methods and criteria: Attendance and participation in class discussions 10%, Coding exercises 20%, Class project/seminar 35%, Final Exam: 35%. Total: 100%.

Concretization tools/ IT: Computer, projector and different apps for lectures. Computer laboratory for coding exercises.

Ratio between theoretical and practical part: Ratio between practical and theoretical part 50%/50%

Literature:

- Osvaldo Simeone, A brief introduction to machine learning for engineers, 2018. Available online: https://nms.kcl.ac.uk/osvaldo.simeone/notesMLSimeone.pdf
- Jeremy Watt, Reza Bohrani, Aggelos Katsaggelos, Machine Learning Refined: Foundations, Algorithms and Applications, Cambridge University Press, 2020
- Ruisi He, Zhiguo Ding, Applications of machine learning in wireless communications, IET, 2019.

Course: Final project (Internship + presentation), 8 ECTS

Lecturer: From the department

Course status: Mandatory

Course description: The content of this course depends on the company where the student shall finish 150 working hours. As a result, the content is drafted jointly from the coordinator of professional internships, appointed from the company, and the student who is going to work in such company. The coordinator of professional internships, who is appointed from the company, guides the student throughout the duration of his/her work in the company, and participates as a member of the commission in the presentation of the professional paper. The final project is a comprehensive and independent task where the student has to demonstrate the ability to analyze the given problem from theoretical and practical aspects, devise a solution using the knowledge acquired in multiple courses and literature.

Course goal: The students gain professional experience, depending on the field of study, in one of the local companies, also the student has to demostrate the ability to analyze the given problem from theoretical and practical aspects, devise a solution using the knowledge acquired in multiple courses and literature.

Learning outcomes: Upon completion of this course the student will be able to:

- Be qualified for professional work, in the relevant field of study, and to be more prepared for the labor market.
- Gain confidence in gained knowledge
- Have theability tofurther studies o fmandatory oradditional literature
- Consult with mentor with questions well prepared and structured;

- Present their work in written form, withastandard languageand guidelines for this typeof work, witha volume ofat least 30 sheetsof A4 format
- Presentthe work in time of ten minutes with presentation prepared in PowerPoint

Teaching methodology: 120 working hours in the company, 50 hours for preparation of the final project and for preparation of the final presantationt.
Evaluation methods: Writing presantation 40%, Oral presantation: 60%.
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 50:50
Literature :

- It is depended from the final project, will be provided from the mentor.

Course: Secure Communications (2+0+1) 4 ECTS
Lecturer: Zana Limani Fazliu
Course status: Elective
Short course description: Basic concepts for providing reliable communications. Basic notions of cryptography and cryptoanalysis. Types of security attacks. Introduction to number theory. Classical symmetric encryption. Block encryption. DES. Modes of operation of block codes. AES. Security of symmetric algorithms. Asymmetric encryption. Public key algorithms. Diffie-Hellman, RSA. Elliptic curve cryptography. Information integrity and authentication. One-way (hash) functions. Digital signature. Digital certificate. PGP. Quantum cryptography. QKD. Application of quantum computers in cryptoanalysis. Basic concepts of network security. Basic security services. Security management. Assessment of security risks. Security mechanisms at OSI layers. IPsec. SSL, TLS. Virtual Private Networks (VPN) based on security mechanisms. Security mechanisms in: WiFi, WiMAX, mobile networks (GSM, UMTS, LTE and 5G), personal networks (Bluetooth, ZigBee). Security of cloud services. Intrusion Detection and Prevention Systems (IDS, IPS).
Course objectives: By passing the course, students will be theoretically and practically familiar with cryptographic techniques, algorithms and protocols (symmetric and asymmetric encryption algorithms, key exchange protocols, hash functions, digital signature algorithms, etc.) and will be able to apply them in various applications. Students will learn the concepts of network security and secure communications across different types of communication networks and systems and will be able to analyze and design them.
Learning outcomes: After successful completion of the course, students should be able to:

- Understand general concepts of information security and privacy.
- Understand the main mechanisms of authentication and key management.
- Discuss the types of security threats and attacks that must be dealt with and give examples of the types of threats and attacks that apply to different categories of computer and network assets
- Explain the fundamental security design principles
- Identify the main security protocols used on the Internet.
- Discuss the principal elements of a network access control system.
- Discuss the principal network access enforcement methods.
- Present an overview of cloud computing concepts.
- Understand the unique security issues related to cloud computing.

Teaching methodology: Lectures, class discussions, and problem solving sessions. Laboratory sessions involving programming assignments to apply concepts taught in class.
Evaluation methods and criteria: Attendance and participation in class discussions 10%, Programming exercises 30%, Mid-term exam (or Seminar/Project) 30%, Final Exam: 35%. Total: 100%.
Concretization tools/ IT: Computer, projector and different apps for lectures. Computer Laboratory for programming exercises.
Ratio between theoretical and practical part: Ratio between practical and theoretical part 60%/40%
Literature:

- W. Stallings, Cryptography and Network Security, Principles and Practices,7th Edition, Prentice Hall, 2017
- Matthieu Bloch, Joao Barros, Physical-Layer Security From Information Theory to Security Engineering, Cambridge University Press, 2011.

Course: Optical Communications (2+0+1) 4 ECTS
Lecturer: Dep. Industry
Course status: Elective
Short course description: This course describes the basics of optical spectrum and light characteristics as electromagnetic wave. The focus of the course is in the optical communication network for different configurations, for local optical networks and wide networks. Also, in this course student practice optical measurements for definition of wavelength and losses in optical fibers (multi-mode, single-mode, polarization and chromatic dispersion).
Course objectives: The course is designed to offer basic knowledge for optical network and its components. The purpose of this course is that the student during lectures and laboratory exercises expand and deepen their knowledge for optical signal transmission over optical fibers. Moreover, student distinguish sources of light, receivers and other basic elements for an optical communication link.
Learning outcomes: Upon completion of this course the student will be able to:

- understand basic principles of optical commmuication systems as transmission characteristics, modulation, multiplexing and switching
- sketch optical communication links for diverse capacities as GPON, EPON, HFC and FTTH
- organize measurment campains in existing optical networks and identify faults in the network
- demonstrate necessary knowledge for optical communication systems as a precondition for beeing incorporated in optical network industry

Teaching methodology: Lectures, Discussion, Laboratory work.
Evaluation methods: The successful practical work: 40%, First intermediate evaluation; 25%, Second intermediate evaluation:25%, Regular attendance and involvement in discussions 10%, Total: 100 % .
Concretization tools/IT: Computer, projector, laboratory equipped for ICT
Ratio between theoretical and practical part: Ratio between the theoretical and practical part is 50:50
Literature:

- John M. Senior. (2009): Optical Fiber Communications: Principles and Practice. Third Edition, Publishing House: Prentice Hall, London.
- R.Ramaswami, K.Sivarajan, G. Sasaki: (2010) Optical Networks: Apractical Perspective 3rd Edition, Publishing House: Elsevier, USA
- Keigo Iizuka. (2002): Elements of Photonics, Publishing House:Wiley, USA
- Bostjan Batagelj. (2017): OPTIČNE KOMUNIKACIJE Laboratorijske vaje, Ljubljana.

Course: Emerging topics in communication (2+0+1) 4 ECTS
Lecturer: Mimoza Ibrani
Course status: Elective
Short course description: The course starts with a series of lectures on emerging topics and development trends in wireless communication and networking. Critical survey on new technologies and their deployment will be presented. Key performance indicators of emerging technologies, their assessment and interrelation, trade off and coexistence mechanisms will be explored. The course includes seminar components and research methodology elements. Students are expected to pick a topic, read research papers, compile state of the art, conduct comparative analysis for different new technologies and propose research informed solutions. The topics and syllabus will be updated continuously to include the emerging topics and technologies. Few of topics include short-range high-speed technologies, electromagnetic exposure aware communications, technologies that enable green and digital transformation, human centered communications, multiparametric network planning and optimization, coexistence and interference in heterogenous networks etc. The topics will be either the ones that emerged as hot topics in the industrial communications community, or which could be worthwhile applied research topics in the next years. The course should be selected from students with potential to continue Master of Science or pursue career in R&D sector.
Course objectives: The objective of the course is two folded: to introduce emerging topics and development trends in wireless communication and networking and to provide students with the concepts, tools and methodologies for proposing research informed solutions.
Learning outcomes : After successful completion of the course, students should be able to:
- Refine their skills of quickly familiarizing themselves with emerging topics and new technologies
- Survey the state of the art in relevant field and identify potential gaps
- Present research informed results
- Compare and contrast technologies and identify their possible applications
- Conduct multiparametric network planning and analyze trade off between network/technology KPIs

Teaching methodology: Lectures and research informed seminars. Invited lectures from EU academics.
Evaluation methods and criteria: 70% project/seminar work , 30 % presentation.
Literature:
There is no text book for the course. The material would be covered from research papers from leading conferences and journals.
Some of the publication venues we plan to explore are from:
- ISI Web of Science
- IEEE Communications Society
- Tutorials and surveys

Course: Animation and Virtual Reality (VR) (2+0+1) 4 ECTS
Lecturers: Hena Maloku
Course status: Elective
Course description: This course focuses on Maxon's Cinema 4D, an intuitive 3D package that is becoming the standard for 3D Motion Graphics work. The class will include demonstrations on the fundamentals of Cinema 4D Lite and CINEWARE, a powerful bridge between After Effects and C4D. Tutorial topics will include: User Interface, Navigation, Modeling, Materials, Textures, Lighting, Camera Tracking, Rendering and Compositing.
The aim of the course is to teach students the principles and multidisciplinary features of virtual reality; to teach students technology for interactivity and multimodal perception of users in VR, in particular visual and audio interface and behavior; to teach VR technology for VR large-scale real-time environmental management; to provide students with an introduction to VR system and development tools.
Course goal: Students will acquire a 3D foundation skill set in Cinema 4D including basic knowledge of modeling, materials, textures, lighting, compositing, camera tracking and rendering.
This course primarily helps develop the skills to apply knowledge of computing and mathematics to solve complex computer science disciplines and the ability to use current techniques, skills and tools necessary for computerization practice with a sense of limitations.
Learning outcomes After successful completion of the course, students should be able to:

- Understand the animation process as: User Interface, Navigation, Modeling, Materials, Lighting, Visualization and Composition
- Understand real time VR technology
- Manage VR system development tools
- Create Motion Graphics animations, and illustrative 3D imagery inside of Cinema 4D Lite and After Effects

Teaching methodology: Lectures, discussion, practical work and presentations
Evaluation methods and criteria: Practical seminar: 40%, First mid-term exam; 20%, second mid-term exam: 20%, attendance: 10%, final exam: 30%,
Concretization tools/ IT: Computer, projector, laboratory and different software tools for lectures.
Ratio between theoretical and practical part: Ratio between practical and theoretical part 50/50%.
Literature:

- Lightning Fast Animation in Element 3D: Master the intricacies of Element 3D, the fast-rendering Adobe After Effects plugin. Ty Audronis, Packt Publishing, 2014. ISBN: 978-1-78355-938-1.
- Cinema 4D Apprentice: Real-World Skills for the Aspiring Motion Graphics Artist. K. McQuilkin, Routledge 2015, ISBN-10: 9781138018624. ISBN-13: 978-1138018624.
- Stop Motion: Craft Skills for Model Animation. S. Shaw, Routledge 2017, ISBN-10: 1138779318. ISBN-13: 978-1138779310.

- Augmented Reality and Virtual Reality: Empowering Human, Place and Business", T. Jung, M. Claudia tom Dieck, Springer 2018, ISBN: 978-3-319-64026-6, 978-3-319-64027-3

Future Presence: How Virtual Reality Is Changing Human Connection, Intimacy, and the Limits of Ordinary Life", Peter Rubin, Harper One 2018. ISBN: 9780062566720