SYLLABI OF THE BACHELOR STUDY PROGRAM IN ELECTRONICS, AUTOMATION AND ROBOTICS (2024–2027)

First Year - First Semester

Course title: **Linear Algebra with Calculus 1**
Lecturer: **Prof. Asoc. Dr. Shqipe Lohaj, Prof. Asoc. Dr. Qefsere Gjonbalaj, Prof. Asoc. Dr. Valdete Rexhbeqaj-Hamiti**
Course status: **Mandatory (Semester I, 7 ECTS)**

Course content: In this course will be studied: complex numbers, parts from linear algebra 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. solves and formulate various problems in the field of his profession when dealing with complex number operations;
2. describe and solve problems related to systems of linear equations, through matrices and determinants;
3. ascertains the functional connections in research of various electrical phenomena, and then using differential calculations describe and examine those functional connections;
4. understand the concept of the derivative as well as its application in the calculation of different measures in different fields of engineering.

Teaching methodology: Lectures, discussions, exercises, consultations, homework, seminar work, intermediate evaluations, final exam.
Evaluation methods: Attendance and classroom activity (10 %), Seminar work and homework (10%), first intermediate evaluation (25%), second intermediate evaluation (25%), final exam (30%).
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:

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

Course title: **Physics for Engineering 1**
Lecturer: **Dr. sc. Valon Veliu**
Course status: **Mandatory (Semester I, 5 ECTS)**

Course content: The course includes basic knowledge of physics (basic principles of mechanics and thermodynamics) necessary to gain general knowledge that is basic in engineering.
Course objectives: Enabling students to use the laws of physics to solve various problems in engineering.
Learning outcomes: After successfully completing this course, the student will be able to:
- analyze and apply problems from mechanics and solve equations of motion;
- analyze and apply problems from translational motion dynamics, Newton's equations;
- analyze and apply the principles of conservation of energy and momentum;
- analyze and apply the equation of circular motion for rigid bodies;
- analyze and apply problems from gravitation, Newton's law of gravity, Kepler's laws;
- nalyze and apply problems from fluid mechanics, continuity equation, Bernoulli's equation;
- analyze and apply problems from molecular physics, the law of ideal gasses, the pressure of molecules on the walls of the container;
- analyze and apply the laws of thermodynamics and cyclic processes of thermodynamics.

Teaching methodology: Lectures, numerical exercises, laboratory exercises, seminar, homework, consultations.
Evaluation methods: Classroom activity 5%, Laboratory exercises 7,5%, Homework 7,5%, Seminar work 10%, First periodic evaluation 35 %, Second periodical evaluation 35% or Final Exam 70 %.
Concretization tools/IT: Pencil, whiteboard, projector and computer.

Literature:

1. S. Skenderi, R. Maliqi, "Fizika për studentët e fakulteteve teknike", UP, Prishtinë, 2005.
2. David Halliday, Robert Resnick, Jearl Walker, Fundamentals of Physics Extended, 10th edition, Wiley (2013).
3. Raymond Serway and John Jewett, Physics for Scientists and Engineers with modern physics, 10th edition, Cengage Learning, (2018)
4. James S Walker, - Physics, 5th edition, Pearson Addison-Wesley (2016).

Course title: **Fundamentals of electrical engineering 1**
Lecturer: **Prof. Ass. Dr. Vjosa Shatri, Prof. Dr. Enver Hamiti, Prof. Dr. Mimoza Ibrani**
Course status: Mandatory (Semester I, 6 ECTS)

Course content: Basics of electricity. Fundamental laws 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 FastCap2, FasterCap and MATLAB/GNU Octave. 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 circuits. Current source. Kirchoff's laws. Analysis of a Circuit Containing Dependent Sources. Complex DC circuits. DC circuit analysis using SPICE (LTspice, PSpice, or similar).
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 electric field problems.
3. Apply FastCap2, FasterCap and MATLAB/GNU Octave software package for solving basic problems in the electrical 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 (LTspice, PSpice, or similar) 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 work.
Evaluation: First assessment:30%, Second assessment: 25%, Home exercises 10%, Attendance: 5%, Final exam, 30%, Total:100%.
Concretization tools: Computer, video projector, and equipped lab with necessary devices to illustrate 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. C. Alexander, -Electric Circuits, McGraw Hill, New York, 2000

Course title: **Fundamentals of Programming**
Lecturer: **Prof.Ass.Dr. Avni Rexhepi, Prof.Asoc.Dr. Kadri Sylejmani**
Course status: **Mandatory (Semester I, 5 ECTS)**

The goal: The purpose of the course is to introduce the basic principles of programming and algorithms, for solving problems with computers 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, go to, 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 %, Colloquy/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**
Lecturer: **Prof.Dr. Sabrije Osmanaj, Prof.Dr. Blerim Rexha**
Course status: **Mandatory (Semester I, 3 ECTS)**

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. analyze 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 homework.

Grading System: Class activity 10%, three homework assignments 40%, online tests or final exam 50%

Literature:
1. Mike Markel & Stuart A. Selber, Technical Communication, 12th Edition, MacMillan, 2018
2. John W. Davies, Communication Skills. A Guide for Engineering and Applied Science Students, Prentice Hall, 2011.

Course: **Practical in Mathematics**
Lecturer: **Prof. Asoc. Dr. Valdete Rexhbeqaj-Hamiti**
Course status: **Elective (Semester I, 3 ECTS)**

Course content: 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:

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

Course: **Basic Software Tools**
Lecturer: **Core FECE staff**
Course status: **Elective (2+0+1) 3 ECTS**

Course content: This course provides a comprehensive introduction to fundamental software tools used across various professional domains. Covering operating systems, file management, text editors, version control, productivity tools, programming fundamentals, and data management, the course aims to equip students with practical skills for efficient work in diverse environments.

Course objectives: Familiarize students with a range of software tools, provide hands-on experience in file management, coding, collaboration, and develop proficiency in text editors, version control, productivity tools, programming fundamentals, and data management.

Learning outcomes: Understand roles of common software tools, develop practical skills in file management, coding, and collaboration, proficiently use text editors, version control, and productivity tools, gain basic understanding of programming and data management, effectively use collaboration tools for communication and file sharing.

Teaching methodology: 30 hours of lectures + 15 hours of exercises. Approximately 65 hours of personal study and exercise including homework

Evaluation methods: Class activity 10%, three homework assignments 40%, online tests or final exam 50%

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:

1. David Thomas, Andrew Hunt, The Pragmatic Programmer: Your Journey To Mastery, 20th Anniversary Edition (2nd Edition), Addison-Wesley Professional, 2019.
2. George Beekman and Ben Beekman, Digital Planet: Tomorrow's Technology and You, Introductory (10th Edition) (Computers Are Your Future), Prentice Hall, 2011.
3. Michael J. Quinn, Computer Confluence Complete: Tomorrow's Technology And You 7th Edition, Prentice Hall, 2005.

First Year - Second Semester

Course title: Analytic Geometry with Calculus 2
Lecturer: **Prof. Asoc. Dr. Shqipe Lohaj, Prof. Asoc. Dr. Valdete Rexhbeqaj-Hamiti**
Course Status: **Mandatory (Semester II, 7 ECTS)**

Course content: In this subject we work: Analytic geometry in space, 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

Learning outcomes: After completion of the course, student will be able to:

1. understand the concept of indefinite and definite integral;
2. apply the concepts of integrals in the calculation of various measures in Geometry, and in various fields of engineering;
3. generalize concepts related to functions with one variable into multi variable functions and in particular into those with two variables;
4. know the concept of differential equations of the first order and of higher orders and know how to find their solutions;
5. apply differential equations in solving various practical problems.

Methodology of teaching: Lectures, discussions, exercises, consultations, homework, mid term exams, final exams.

Methods of assessment: Attendance and classroom activity (10 %), Homework and seminar (10%), First periodic exams (25%), Second periodic exams (25%), Final exams (30%).

Concretization tools: pencil, whiteboard, projector and computer.

Ration between Theoretical part and exercises: 2:1

References

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

Course title: **Physics for Engineering 2**
Lecturer: **Dr. Sc. Valon Veliu**

Course content: The course includes basic knowledge of physics necessary to gain general knowledge that is basic in engineering.

Course objectives: Using the physics laws of modern physics in modelling and solving specific engineering problems.

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

- analyze and solve problems from the elasticity of solid bodies;
- apply the linearization technique to equations of motion of oscillatory;
- explain the wave equation in different mediums;
- understand the equation of mechanical waves and the whole problem for different environments;
- analyze and solve problems from acoustics;
- analyze and solve problems for geometric and wave optics, reflection and refraction of light Snell's law, interference and diffraction;
- analyze and solve problems for the quantum nature of light, black body radiation, photoelectric effect;
- analyze and solve problems for the structure of the atom and atomic models;
- analyze and solve problems from radioactivity and special relativity.

Teaching methodology: Lectures, numerical exercises, laboratory exercises, seminar, homework, consultations.

Evaluation methods: Classroom activity 5%, Laboratory exercises 7,5%, Homework 7,5%, Seminar work 10%, First periodic evaluation 35 %, Second periodical evaluation 35% or Final Exam 70 %.
Concretization tools/IT: Pencil, whiteboard, projector and computer.

Literature:

1. S. Skenderi, R. Maliqi, "Fizika për studentët e fakulteteve teknike", UP, Prishtinë, 2005..
2. David Halliday, Robert Resnick, Jearl Walker, Fundamentals of Physics Extended, 10th edition, Wiley (2013).
3. Raymond Serway and John Jewett, Physics for Scientists and Engineers with modern physics, 10th edition, Cengage Learning, (2018).
4. James S Walker, - Physics, 5th edition, Pearson Addison-Wesley (2016).

Course title: **Fundamentals of electrical engineering 2**
Lecturer: **Prof. Ass. Dr. Vjosa Shatri, Prof. Dr. Enver Hamiti, Prof. Dr. Mimoza Ibrani**
Course status: **Mandatory(Semester II, 6 ECTS)**

Course content: 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 FastHenry2 and MATLAB/GNU Octave. 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 (LTspice, PScpice, or similar). 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 magnetic field problems.
3. Apply FastHenry 2 and MATLAB/GNU Octave software package for solving basic problems in magnetic fields.
4. Understand and apply methods for AC circuit analysis such as: Kirchhof's laws, 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 SPICE (LTspice, PScpice, or similar) 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 of lectures + 15 hours of tutorials, and 15 hours laboratory works.

Evaluation: First assessment:30%, Second assessment: 25%, Home exercises 10%, Attendance: 5%, Final exam, 30%, Total:100%.
Concretization tools: Computer, video projector, and equipped lab with necessary devices to illustrate all teaching material.

Literature:

1. Nexhat Orana, Bazat e elektroteknikës 2, 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: **Algorithms and Data Structures**
Lecturer: **Prof.Asoc.Dr. Kadri Sylejmani, Prof.Ass.Dr. Avni Rexhepi**
Course status: **Mandatory (Semester II, 6 ECTS)**

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 Learning, 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**
Lecturer: **Prof. Dr. Sabrije Osmanaj, prof. Ass. Dr. Artan Mazrekaj**
Course status: **Mandatory (Semester II, 6 ECTS)**

Course content: 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: Class attendance 10%; Assessment from tests 90%. 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.

Second Year - Third Semester

Course: **Calculus 3 with Probability**
Lecturer: **Prof.Asoc.Dr. Shqipe Lohaj**
Course Status: **Mandatory (Semester III, 5 ECTS)**

Course content: Basic concepts of numerical and Fourie Series. Double, triple, line and surface integrals. Part of vector analysis, gradient, tangent plane, divergence and rotor. And finally probability, random variables and distribution functions.

Course objectives: Students should be trained so that the knowledge gained through this course can be applied as an auxiliary equipment in electrical engineering studies.

Expected results
After completion of the course, student will be able to
- solve and formulate various professional problems related to double, triple, line and surface integrals;
- solve and formulate various professional problems related to vector functions in space, scalar and vector spaces and Furie series;
- with acquired knowledge the student will be able to do mathematical models related to concrete professional problems;
- research different electrical occurrences and transform problems from one field to another field to facilitate their solution and interpretation.

Methodology of teaching: Lectures, discussions, exercises, consultations, homework, mid term exams, final exams.

Methods of assessment: Attendance and classroom activity (10 %), Homework and seminar (10%), First periodic exams (25%), Second periodic exams (25%), Final exams (30%).

Concretization tools: pencil, whiteboard, projector and computer.

Ration between Theoretical part and exercises: 2:1

References

1. Hamiti E. - Matematika III, Prishtinë 2008.
2. Hamiti E. - Matematika IV, Prishtinë 2008.
3. Hamiti E, Lohaj SH.-Përmbledhje detyrash të zgjidhura nga Matematika III, Prishtinë 2008.
4. Hamiti E, Lohaj SH.-Përmbledhje detyrash të zgjidhura nga Matematika IV, Prishtinë 2008.

Course title: **Microprocessors and microcontrollers (2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Lavdim Kurtaj**
Course status: **Mandatory**

Course content: Motivation and introduction to microprocessor systems. Logical circuit and microprocessor system design. Microprocessor systems and details about communication between units, time diagrams. Internal structure of 8051 and ARM, variations among different producers. Introduction to the development system. Instruction set. Input/output ports and communication with peripherals. Programming in assembler and C/C++. Keyboard and display. Program structure. State diagrams. Timer function and programming. Interrupts - generation and processing. Serial communication. A/D and D/A conversion. Programming in higher level languages, Basic, C, C++. Course objectives: Familiarity with parts of computer hardware. Uses of microprocessors and/ or microcontrollers in different applications. Basic microcontrollers concepts. Familiarity with architecture of 8051 and ARM family of microcontrollers. Familiarity with software development systems. Microcontroller programming in assembler, Basic, C, C++. Programming and utilization of peripheral devices.

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

- know structure of microprocessor systems that are faced with;
- design microprocessor and microcontroller based systems for specific application;
- write program for specific application;
- find and repair defects in microprocessor systems.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, laboratory exams, projects.

Assessment: Intermediary evaluations 15%+15%, Project 40%, Final exam 15%+15%.

Concretization tools/IT: Computer, projector, simulator, experimental development systems.

Ratio between the theoretical and practical part: 40:60

Literature:

1. S. MacKenzie, The 8051 microcontroller, 4th Edition, Prentice-Hall, 2007
2. Muhammad Tahir and Kashif Javed, ARM Microprocessor Systems: Cortex-M Architecture, Programming, and Interfacing, CRC Pess, 2017
3. Renesas Synergy Development Kit, User's Manual, Renesas Electronics, 2015
4. D. V. Hall, Microprocessors and digital systems, McGraw-Hill
5. Muhammed Ali Mazidi, The 8051 Microcontroller And Embedded Systems Using Assembly and C, Pearson Education, 2007
6. Vinod G. Shelake, Rajanish K. Kamat, Jivan S. Parab, Gourish M. Naik, Exploring C for Microcontrollers: A Hands-on Approach, Springer, 2007
7. Manufacturers manuals for microprocessors and microcontrollers

Course title: Signals and Systems **(3+1+1) 6 ECTS**
Lecturer: **Prof. Ass. Dr. Vjosa Shatri**
Course status: **Mandatory**

Course description: Introduction to basic theoretical concepts of signal and systems. Impulse response and convolution. Differential and difference equations. Fourier series and signal decomposition in harmonic components. Fourier transformation, spectrum of continuous signal and its properties. Amplitude modulation and sampling. System analysis in the frequency domain. Ideal filters. Demodulation and reconstruction of sampled signals. Fourier analysis of signals and systems in discrete time. Laplace transformation and its applications in the analysis of signals and systems. z-transform, properties, transfer function, stability and analysis in z domain. Application of software tools (MATLAB/Simulink, GNU Octave, FastModelica, LTspice, Python) for solving problems.

Course objectives: The objectives of the course are to introduce students to the basic concepts of signals, system modeling, and system classification; to develop students' understanding of time-domain and frequency domain approaches to the analysis of continuous and discrete systems; to provide students with necessary tools and techniques to analyze systems; and to develop students' ability to apply modern simulation software to system analysis.

Learning outcomes: After finishing the course:

- Students will learn properties of signals and systems and the ways how to represent them in time and frequency domain.
- Students will be familiar with fundamental methods of signal and system analysis, in time and transform domain, through problem solving and performing corresponding simulations.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, numerical exercises, laboratory exercises.

Evaluation methods: Laboratory exercises 10%, Intermediary evaluations 25%+25%, Final exam 40 %

Concretization tools: Computer, projector, simulator, experimental plants.

Ratio between the theoretical and practical part: 50:50

Literature:

1. Orhan Gazi, *Principles of Signals and Systems*, Springer, 2023.
2. Khalid Sayood, *Signals and Systems: A One Semester Modular Course*, Morgan & Claypool, 2021.
3. Hwei P. Hsu, *Schaum's Outline of Theory and Problems of Signals and Systems*, Second Edition, McGraw-Hill, 2010
4. Alan V. Oppenheim, Alan S. Willsky, with S. Hamid. *Signals and Systems*. Second Edition, Prentice Hall, 1996.
5. D. Sundararajan, *Signals and Systems: A Practical Approach*, Second Edition, Springer, 2023.

6. Bonnie S. Heck, Edward W. Kamen, *Fundamentals of signals and systems using the Web and MATLAB*, Third Edition, Pearson Education Limited, 2014
7. B.P. Lathi, *Principles of Linear Systems and Signals*, Second Edition, Oxford University Press, 2009

Course title: Automation (2+1+1) 5 ECTS
Lecturer: Prof. Ass. Dr. Drilon Bunjaku
Course status: Mandatory

Course content: Introduction. History of automatic control. Basic concepts and definitions. System, experiment, model, simulation, identification. Demo of the experimental platform QET. Principles of automatic control. Systems classifications. Feedback. Steps for designing an automatic control system. Mathematical modeling, analogies, elements for modeling. Model/system types. Modeling examples. Linearization. System order. Systems of order 0, 1 and 2. Concept of states. State equations. Physical state variables. Solving differential equations. Standard input signals. Response and specifications in the time domain. Stability. Solving state equations. Discrete state equations. Laplace transform. Frequency domain. Poles and zeros. Solving differential equations and state equations with Laplace. Systems representations. Block diagrams and signal flow graphs. Frequency domain analysis. Frequency characteristics. Polar diagrams. Nyquist's diagram. Stability. Bode diagrams. System features and stability. Characteristics of the control system. Routh-Hurwitz criterion for system stability analysis.

Course objectives: Familiarity with concepts of automatic control. Familiarity with the structure of the automatic control system. Familiarity with mathematical methods for systems modeling. Familiarity with time and frequency domain analysis methods. Familiarity with the basic ways to influence the behavior of the system.

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

- be familiar with the concept of automatic control and standard control structures;
- assess the relevance of the feedback concept and its impact on the process control;
- find mathematical model of the system and corresponding block diagrams;
- perform analysis on the properties of the system in the time domain;
- perform analysis on the properties of the system in the frequency domain;
- make measurements and come with conclusions about the system from experimental recordings;
- use simulation software to facilitate the analysis and design of control systems.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, numerical exercises, and laboratory exercises.

Assessment methods: Assessment from activity in lectures and exercises 10%, Laboratory exercises 20%, Intermediate assessments 20%+15%, Final exam 15%+20%.

Concretization tools/TI: Computer, projector, simulator, experimental plants.

Ratio between the theoretical and practical part: 40:60

Literature:

1. F. Golnaraghi & B. C. Kuo. “Automatic Control Systems” John Willey & Sons, 9th edition, 2009.
2. R. Dorf, R. Bishop. “Modern Control System” Pearson, 13th edition, 2017.
3. Norman S. Nise. ”Control systems engineering” John Wiley & Sons, 2020.
5. C. H. Houpis & S. N. Sheldon. “Linear Control System Analysis and Design with MATLAB” CRC Press, 6th edition, 2014

Course title: Basic Electronics **(3+0+1) 5 ECTS**
Lecturer: **Prof. Dr. Qamil Kabashi**
Course status: **Mandatory**

Course content: Semiconductors, p-n junction diode, Characteristics and Parameters, Diode approximations, DC load line analysis, Half-wave rectifier, Two-diode Full-wave rectifier, Bridge rectifier, Capacitor filter circuit (only qualitative approach), Zener diode and voltage regulators: Regulator circuit with no load, Loaded Regulator. Photovoltaic (PV) Cell Structure and Operation. Numerical examples as applicable. Electronics circuit diode - Matlab simulations. BJT operation, BJT Voltages and Currents, BJT amplification, Small signal Bipolar Transistor (Common Base, Common Emitter and Common Collector) characteristics. BJT circuits analysis using MATLAB/SIMULINK. Field effect transistor, working principles, small signal patterns. MOSFET transistors. Basic amplifier configurations: with common source, with common gate and with common drain. MOSFET circuits analysis using MATLAB/SIMULINK. Introduction to Operational Amplifier (OAMP), Ideal OPAMP, Inverting and Non Inverting OPAMP circuits, OPAMP applications: voltage follower, addition, subtraction, integration, differentiation; Numerical examples as applicable. OPAMP circuits analysis using MATLAB/SIMULINK.

Course objectives: To introduce the basics of semiconductors, electronic devices and circuits. Understand the concepts of employing simple models to represent non-linear and active elements- such as: diode, BJT, MOSFET and OPAMP in circuits. This course is one of the fundamental courses for all study programs of electrical engineering and prepares students for advanced courses. Competently communicates with electronics specialists in specifying the technical requirements for electronic equipment.

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

1. understand the basics of electronics within the field of electrical engineering.
2. understand the diode circuits and their applications;
3. understand PV cell structure and operation.;
4. understand circuits with BJT and MOS transistors and their models;
5. perform a small-signal analysis of an amplifier using small signal models for the circuit elements.
6. analyze and utilize operational amplifiers.
7. continue studies in power electronics, digital electronics and other advanced courses.

Teaching methodology: 45 hours of lectures, problem-solving examples as well as 15 hours of laboratory exercises. Approximately 70 hours of personal study including assignments and seminar papers.

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

Ratio between the theoretical and practical part: 40:60

Concretization tools/TI: For lectures, computers, projectors and tables are used, while the practical part will take place at the Electronics lab.

Ratio between the theoretical and practical part: 40:60

Literature

1. Donald Neamen, Microelectronics: Circuits Analysis and Design, McGraw-Hill Education, 4^{th} Edition, 2010.
2. Adel S. Sedra, Kenneth C. Smith, *Microelectronic Circuits*, 8^{th} edition. Oxford Univ. Press, 2019.
3. Thomas L. Floyd, *Electronic devices*, 10^{th} edition. Pearson, 2018
4. Myzafere Limani, Qamil Kabashi, Elektronika (pjesa e pare), Universiteti i Prishtinës, 2023.

Course title: Electronic Measurements **(2+0+1) 4 ECTS**
Lecturer: **Prof. Dr. Milaim Zabeli**
Course status: **Mandatory**

Course content: Metrology, Basics of measurements. Electrical quantities and units, Measuring instruments and their division, Errors and uncertainty of measurements, Class of accuracy. Measurement methods, errors and accuracy (uncertainty), Etalons. Basic circuits: voltage and current divider, potentiometer, compensation circuits (compensators). Measuring bridges and measuring electrical quantities. Sensors. Analogue electronic instruments and measurement of basic quantities. Digital instruments. Electronic oscilloscopes: Oscilloscope measurement techniques, Special oscilloscopes - Oscilloscope with storage. Digital frequency meter. Signal generators. Analog-to-digital conversion (ADC) and digital-to-analog (DAC). Signal analyzers.

Course objectives: To introduce the basic principles of measurement of most important quantities in engineering, properties of measurement signals. Acquiring knowledge to interpret instrument specifications, estimate measurement uncertainty, express complete measurement results and make decisions based on complete measurement results. Gaining skills to handle PC based measuring systems.

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

- Understanding of measurements as basic discipline for acquisition and evaluation of information,
- Understanding of methods how to measure basic electrical quantities,
- To know how to express the measurement results with measurement uncertainty,
- To know how to collect, interpret and evaluate measurement results,
- To know how do measure with oscilloscope,
- To know how to use signal generators and signals analyzing,
- Select an analog to digital converter and estimate the device error.

Teaching methodology: 30 hours of lectures (including the solutions of practical problems) + 15 hours of laboratory exercises. Approximately 60 hours of personal study and exercise including homework.

Assessment: 1st Exam: 20%; 2nd Exam: 20%, Homework: 20 %, Attendance 10%, Final exam: 30%

Concretization tools/IT: During the lectures, the computer will be used with a video projector (smart board), and the practical part will be realized in the laboratory.

Ratio between the theoretical and practical part: 40:60

Literature:

1. Purkait, B. Biswas, S. Das, Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education, 2013
2. U.A.Bakshi, A.V.Bakshi, Electronics Measurements And Instrumentation, Technical Publication PoneTechnical, 2009
3. David B. Bell, Electronic Instrumentation and Measurements, Oxford University Press; 2013,
4. Milaim Zabeli, authorized lectures, Prishtine, 2022.

Second year – Semester IV

Course title: Internet of Things **(2+0+2) 6 ECTS**
Lecturer: **Prof. Ass Dr. Drilon Bunjaku**
Course status: **Mandatory**
Course content: The rapid growth of the "Internet of Things" is changing our world and the rapid drop in price for typical IoT components is allowing people to innovate new designs and products at home.
Therefore, this subject focuses on: Introduction to the fundamentals of Internet of Things. Sensing, actuation, networking basics, communication protocols, sensor networks, Machine-to-Machine communications, IoT definition, characteristics. IoT functional blocks, physical design of IoT, logical design of IoT, communication models. From M2M to IoT. M2M vs IoT an architectural overview. Domain applications of IoT: home automation, industry applications, surveillance applications, etc. Privacy and security issues in IoT. Introduction to Arduino and Raspberry Pi, hardware characteristics, GPI/O, programming etc. Sensors and Actuators. Implementation of sensors and actuator with Arduino and Raspberry Pi in Home Automation. NodeMCU ESP 8266, hardware configuration, technical specifications and features. Wireless communication between two and more NodeMCUs ESP8266 through ESPNow protocol. Creating a web interface with Blynk to control Arduino and/or Raspberry Pi through NodeMCU. Monitoring light, temperature, door lock, and controlling them remotely. Presentation and defense of the projects.
The goal: The goal of the course is to introduce students with various components of the Internet of things such as sensors, actuators, interconnecting modules, communications, internetworking and web interface. At the end students will experience designing and implementing IoT circuits and solutions.
Learning outcomes: On successful completion of the course, students will be able to:

- understand general concepts of Internet of Things (IoT);
- apply design concept to IoT solutions;
- analyze various M2M and IoT architectures;
- recognize various devices, sensors and applications;
- evaluate design issues in IoT applications;
- create IoT home automation solutions using sensors, actuators and devices;
- save IoT system data into the local database.

Teaching methodology:
30 hours of lectures, 30 hours of laboratory exercises. Approx. 75 independent working hours, including home works (or seminar paper).
Grading system: student attendance and activity in lectures 10%, student attendance and activity in laboratory exercises 10%, practical group project with 3-5 students 40% (Report, defense and realization), final exam 40%.
Necessary tools: During lecture sessions a computer with projector is needed, while the practical session will be realized in the laboratory of Electronics.
The ratio between theoretical and practical work: 40:60

Literature:

1. Adeel Javed, "Building Arduino Projects for the Internet of Things. Experiments with Real-World Applications”. Apress Media LLC, 2016.
2. Marco Schwartz, “Internet of Things with ESP8266”. Packt Publishing Ltd, 2016.
3. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, 1st Edition, VPT, 2014.
4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014
5. Francis da Costa, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.
6. Cuno Pfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011

Course title: Power Systems **(2+1+1) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Vezir Rexhepi, Prof. Ass. Dr. Arben Gjukaj**
Course status: **Mandatory**

Course content: Power System and its component parts. Power plants, transmission and distribution system. Thermal power plants, nuclear power plants, hydro power plants, wind power plants, solar plants. Single-phase and three-phase circuits analysis. Cables and transmission lines. Principles of energy conversion. The operating principle of transformer, equivalent schemes, determination of transformer parameter. The operating principle of the DC Machines. Types of excitation. Control of voltage and speed. Models of AC machines. The operating principle of induction machines. Equivalent schemes, the induced voltage, torque and starting of the induction motor. The operating principle of a synchronous machine.
Course objectives: The purpose of the course is to introduce the basic principles of operation of the power system and electrical machines.

Learning outcomes: On successful completion of the course, students will be able to:
- Have knowledge of the power system, its components (power plants, transmission and distribution networks, substations).
- Have knowledge of transformers, operating principles, equivalent schemes, types of transformers and their application.
- To know the principles of energy conversion and operating principle of the DC Machines.
- To recognize principles of operating of AC machines with special emphasis on induction motors and synchronous generators.

Teaching methodology: Lectures, auditoria exercises, Assignments, Lab Experiments, Lab report and presentation.
Assessment: First midterm exam 25%, Second midterm exam 25 %, Lab experiments (20%), Attendance 10%, Final exam 20%.
Concretization means/IT: Laptop, projector, and practical part will be done in the laboratory.
Ratio between the theoretical and practical part of teaching: 40:60

Literature:

1. George G. Karady & Keith Holbert, Electrical Energy Conversion and Transport, 2nd ed. John Wiley, 2013
2. Guru, B.S and Hiziroglu, H.R. Electric Machinery and Transformers, third edition, Oxford University Press, New York- Oxford 2001.
3. G. Latifi, Shndërrimi i energjisë elektrike, Prishtinë 1997
4. V. Komoni, Gani Latifi, Elektronenergjetika, ligjëratat, Prishtinë 2008

Course: **Electromagnetic Fields and Waves (2+1+1) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Vjosa Shatri**
Course status: **Mandatory**

Course content: Vector Analysis: Gradient, Divergence and Curl, Laplacian operator. Electrostatics: Maxwell's equations, Charge and current distributions, Gauss Law, Electrical scalar potential, Electrical properties of materials, Method of images, Electrostatic potential energy. Magnetostatics: Magnetic forces and torques, Maxwell's magnetostatic equations, Vector magnetic potential, Boundary conditions, Inductance, Magnetic energy. Maxwell's equation for time varying fields: Faraday Law, Displacement current, Retarded potentials. Electromagnetic Waves: Derivation of the wave equation, solution of wave equation for TEM case, plane wave concepts, wavelength, attenuation and phase constants, propagation of waves in lossless and lossy media. Transmission Lines: Derivation of transmission line parameters, attenuation and phase coefficients, characteristic impedance, SWR definition, lossless and lossy lines and matching techniques. Application of software tools (FastCap2, FasterCap, FastHenry2, MATLAB/GNU Octave, LTspice, Python) for solving electromagnetic fields, waves and transmission line problems.
Course objectives: To provide students with the background necessary to understand the interplay between electricity and magnetism, the electromagnetic wave properties and its propagation in different media through various junctions.
Learning outcomes: On successful completion of the course, students will be able to:

- Apply vector calculus to analyze the behavior of static electric fields and magnetic fields in standard configurations;
- Describe the parameters of quasistatic and 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 analyze transmission lines;
- Apply software tools (FastCap2, FasterCap, FastHenry2, MATLAB/GNU Octave, LTspice) for solving electromagnetic and transmission line problems.
- Practice calculation of electromagnetic fields to solve practical problems.

Teaching methodology: Lectures combined with simulation and demonstration, discussions, numerical exercises, laboratory experiments.
Assessment: Laboratory experiments 10%, Intermediary exams 25%+25%, Final exam 40%.
Concretization means/IT: Laptop, projector, simulations, laboratory experiments.
Ratio between the theoretical and practical part of teaching: 40:60
Literature:

1. David H. Staelin. *Electromagnetics and Applications*. Massachusetts Institute of Technology via MIT OpenCourseWare, LibreTexts, 2023 ((https://LibreTexts.org).
2. Robert Alan Strangeway, Steven Sean Holland, James Elwood Richie. *Electromagnetics and Transmission Lines: Essentials for Electrical Engineering*. Wiley, 2023.

3. Fawwaz T. Ulaby, Eric Michielssen and Umberto Ravaioli, *Fundamentals of Applied Electromagnetics*, Eighth Edition, Pearson, 2019.
4. Magdy F. Iiskander, *Electromagnetic Fields and Waves*, Waveland Press, 2012.

Course title: Discrete Signals and Digital Processing **(2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Faton Maliqi**
Course status: **Mandatory**

Course content: Discrete signals and systems, impulse response, convolution, difference equations, correlation. Discrete-Time Fourier transform and sampling. z-Transform. Discrete Fourier Transform. Fast Fourier Transform. Discrete system implementation structures. Design of recursive and non-recursive digital filters. Multi-rate signal processing. Random signals and discrete linear systems, introduction to optimal filtering.

Course objectives: Getting a deeper insight into the discrete signal processing and system analysis. Getting acquired with different system structures, DFT, FFT, multi-rate DSP, IIR and FIR digital filter design methods. To introduce students to basics of discrete random signal processing.

Learning outcomes: Students should be able to do the following upon completion of this course:

- To understand and to use different methods for discrete signals and systems analysis in time-domain and frequency domain;
- To understand circular convolution, its relationship to linear convolution, and how linear convolution can be achieved via the discrete Fourier transform;
- To understand Discrete Fourie Transform (DFT) using FFT algorithms;
- To master digital filter (IIR and FIR) design.
- To understand multi-rate discrete systems and multi-rate signal processing techniques.
- To understand basics of discrete random signal processing;
- Use of Matlab and/or C++ to implement signal processing algorithms

Teaching methodology: Lectures, auditoria exercises, Assignments, Lab Experiments, Lab report and presentation.

Assessment: Lab experiments 15%, Intermediary exams 25%, Final exam 60%.

Concretization means/IT: Laptop, projector, and practical part will be done in the laboratory.

Ratio between the theoretical and practical part of teaching: 40:60

Literature:

1. Vinay K. Ingle, John G. Proakis, “Digital Signal Processing using MATLAB”, 3d edition, 2010, Cengage Learning.
2. Alan V. Oppenheim, et al , “Discrete -Time Signal Processing”, 2nd ed., 1998, Prentice Hall.
3. Monson H. Hayes, “Schaum's Outline of Theory and Problems of Digital Signal Processing”, McGraw-Hill, 2011;
4. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing - Principles, Algorithms and Applications, 3rd ed., 1996, Prentice Hall.

Course title: Computer Architecture **(2+0+2) 5 ECTS**
Instructor: **Prof. Dr. Qamil Kabashi, Prof. Ass. Dr. Dhurate Hyseni**
Course status: **Mandatory**

Course content: Introduction to computer organization and architecture. Designing for Performance. Pentium and PowerPC evolution. Top-level view of computer function and interconnection structures. BUS interconnection. Cache memory and elements of cache design. Internal memory. Input/output devices. Programmed and interrupt driven I/O. Direct memory access. RISC versus CISC architecture. CPU structure and function, Instruction Pipelining, Multi-core processors. Parallel processing and multiple processor organization.

Course objectives: The objective of this course is to provide students with a fundamental understanding of the functional components of a computer system. The focus of the course is on the hardware aspects of a system during the execution of software.

Learning outcomes: On successful completion of this course, students should be able to:

- Explain computer architecture, organization, and structure relating to contemporary design for performance.
- Analyze the program execution process through instruction cycles, and the functioning of hardware components during this process using von Neumann architecture as a model.
- Classify various types of buses, their signals, and the different arbitration techniques.
- Illustrate internal and cache memory mapping including parameters of cache design.
- Differentiate and analyze interrupt-driven I/O, programmed I/O, and direct memory access mechanisms
- Explain the different architectural and organizational design issues that can affect the performance of a computer such as Pipelining, Superscalar architecture, RISC, Multi-core processors, and Multiple Processor Organization.
- Implement a simple assembly program and C/C++ using development plates (ARM, ARM-Coretex, 8051).
- Complete assignments, experiments in the laboratory, and present a technical report.

Teaching methodology: Lectures, auditoria exercises, Assignments, Lab Experiments, Lab report and presentation.

Assessment: First midterm exam 20%, Second midterm exam 20 %, Lab experiments (20%), Attendance 10% and Final Exam 30%.

Concretization means/IT: Laptop, SMARTboard, and practical part will be done in the laboratory

Ratio between the theoretical and practical part of teaching: 40:60

Literature:

1. W. Stallings, Computer Organisation and Architecture, 11th Edition, Pearson, 2021
2. S. Tanenbaum, Structured Computer Organization, 6th Edition, Pearson, 2013

Course title: Project Management **(2+1+0) 4 ECTS**
Lecturer: **Prof.Ass. Dr. Nora Sadiku Dushi**
Course status: **Mandatory**

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:

- Define key project management terms and concepts.
- Recall the phases of the project life cycle and their significance.
- Describe the project initiation process and its role in effective project execution.
- Create a comprehensive project plan, including schedule, resource, and budget planning.
- 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.

<u>Electronics specialisation: Year III - Semester V</u>

Course: Electronic Devices **(3+0+1) 6 ECTS**
Lecturer: **Prof. Dr. Milaim Zabeli**
Course status: **Mandatory**

Course content: Energy Band Model, Bonding Model, Carrier Energy, Carrier Concentrations Distributions, Fermi Level in Equilibrium, Carrier Drift in Electric Fields, Recombination & Carrier Lifetime, Quasi-Fermi Levels, Carrier Diffusion, Drift & Diffusion, p-n Contact, Contact Potential, Forward & Reverse Bias, Diode Equation, Reverse Bias Breakdown, Junction Capacitance, MOSFET Basic Concepts, Ideal MOS Capacitor, Threshold Voltage Capacitance vs. Gate Voltage MOSFET Voltage/Current Relations, BJT Basic Concepts, Current Distribution Diagrams, Current Amplification Factor, Emitter Injection Efficiency, Base Charge Transit Time/Lifetime, Common Emitter Amplification.

Course objectives: The course is designed to teach the physical principles and operational characteristics of advanced semiconductor electronic devices with emphasis on metal-oxide systems, bipolar, high-electron mobility, and field-effect transistors. Topics also include quantum point contact and tunneling devices. The course provides advanced background for microelectronics and optoelectronics.

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

- Understand the basic principles of quantum mechanics,
- application of the Schrödinger equation in semiconductor materials,
- understanding the physical aspects of PN junctions,
- understand the details of operation of the advanced semiconductor electronic devices;
- know the parameters of electronic devices that determines their performance and limitations (BJT, MOSFET),
- to know the role of concentration in semiconductor regions,
- be familiar with tendency in contemporary microelectronics and principles of nano-scale electronic devices.

Methods of teaching: 45 hours of lectures +15 hours of laboratory exercises. Approximately 100 hours of personal study.

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

Concretization tools/IT: For lectures, computers, SMARTboard) and tables are used, while the practical part will take place at the Electronics lab.

Ratio between the theoretical and practical part: 50:50

Literature:

1. Ben Streetman and Sanjay Banerjee: Solid State Electronic Devices, Seventh Edition, Pearson, Prentice Hall, 2016,
2. Donald Neamen, Semiconductor Physics and Devices, McGraw-Hill Education, Fourth Edition, 2012.
3. Myzafere Limani, Komponentet Elektronike – ligjërata të autorizuara, Universiteti i Prishtinës, 2009.

Course: **Digital Electronics (2+0+2) 6 ECTS**
Lecturer: **Prof. Dr. Sabrije Osmanaj**
Course status: **Mandatory**
Course content: Introductory concepts, MSI logic circuits, FF timing considerations, propagation delay, critical path, Sequential circuit analysis with state diagrams, Finite State Machine, Hazards in digital circuits. HDL and CAD tools, circuit design with Verilog HDL. Circuit design with HDL, IC logic family, TTL characteristics, MOS, CMOS; Finite State Machines; Memory devices, DRAM, SRAM, ROM, Memory devices, Programmable logic devices, PLA, FPGA.
Course objectives: This module will provide know-how on designing digital circuits and systems. Students will learn to critically analyze and evaluate combinatorial circuits and synchronous and asynchronous sequential circuits from the designer's point of view. This module will also focus on learning computer-aided digital design techniques and hardware description languages (VHDL), mainly for programmable logic devices, logic synthesis and simulation. At the end of the course, the student will be able to design digital circuits and systems, including computer arithmetic circuits and synchronous and asynchronous sequential logic circuits based on programmable logic.
Learning outcomes: On successful completion of the course, students will be able to:

- Explain the fundamental function of digital combinational and sequential building blocks.
- Analyze and design combinational and sequential logic circuits.
- Describe the behavior of digital components and building blocks with hardware description language.
- Simulate with computer tools the description of a digital system and implement the design in Programmable logic.
- Do prototyping, testing, and troubleshooting of digital systems
- Collect and interpret information from data sheets and other information sources.
- Explain function, operation, and layout of different memory systems.
- Use modern development tools to design complex digital circuits.
- Analyze syntax and behavior of the VHDL language.
- Design combinational and sequential logic circuits using VHDL.
- Simulate and make a synthesis of designs using Field Programmable Gate Array

Teaching methodology: Previously prepared material discourse, Discussions, Laboratory work, Seminar work, Internship visits.
Evaluation methods: Individual assignments completed in class 30%; Individual assignments completed at home 30%; Exam 40%.
Concretization tools/IT: Computer, projector, table, and laboratory equipped
Ratio between theoretical and practical part: 1:1.
Literature:

1. Thomas L. Floyd, Digital Fundamentals, 11th Edition, Pearson, 2015.
2. Stephen Brown and Zvonko Vranesic, Fundamentals of Digital Logic with VHDL Design, McGraw-Hill Higher Education, 2023
3. Volnei A. Pedroni, Digital electronics and design with VHDL, Morgan Kaufmann, 2008

4. Anil K. Maini, Digital Electronics: Principles And Integrated Circuits 1st Edition, Wiley India, 2008
5. Roger L Tokheim, Digital Electronics: Principles and Applications 8th Edition, Mc Graw Hill, 2008.
6. G. K. Kharate, Digital Electronics, Oxford University Press, 2012
7. U.A.Bakshi, A.P.Godse, Analog And Digital Electronics, Technical Publications Pune, 2009

Course: Power Electronics **(2+0+2) 5 ECTS**
Lecturer: **Prof. Dr. Sabrije Osmanaj**
Course status: **Mandatory**
Course content: Power semiconductor devices. Properties, static and switching characteristics of power semiconductor devices: Diode, Thyristor, Triac, GTO, MOSFET, IGBT; Fundamentals of power converters and control principles. Single- and multiphase AC/DC half and fully controlled converters with R, RL and RLE loads, continuous and discontinuous modes of operation, influence of freewheeling diode, active and reactive power, power factor, effect of source impedance commutation; DC/DC converters, principles of step-down and stepup converters, analysis of buck, boost, buck-boost, half- and full-bridge converters, control of DC/DC converters; Single- and multiphase DC/AC converters; Application of power electronics.

Course objectives: To provide knowledge on theoretical and applied power electronic devices and power electronic switches, expansion of knowledge on the theory and applications of power convertors, understand the concepts of application of thyristors, analyze and design various power converter circuits (DC/AC, AC/AC and DC/DC and AC/DC).

Learning outcomes: At the end of the course the student will be able to:
- To give an overview of applications of power electronics, different types of power semiconductor devices, their switching characteristics, power diode characteristics, types, their operation and the effects of power diodes on RL circuits.
- To explain the techniques for design and analysis of single-phase diode rectifier circuits.
- To explain different power transistors, their steady state and switching characteristics and limitations.
- To explain different types of Thyristors, their gate characteristics and gate control requirements.
- To explain the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters, Inverters and Voltage controllers.
- To explain the design, analysis techniques, performance parameters and characteristics of Inverters and Voltage controllers.
- To explain Application of power electronics in automation and the process industry,
- To explain Application of power electronics in renewable energy sources

Methods of teaching: Previously prepared material discourse, Discussions, Laboratory work, Seminar work, Internship visits.
Assessment: Individual assignments completed in class 30%; Individual assignments completed at home 30%; Exam 40%.
Concretization tools: For lectures, computers, projectors and tables are used, while the practical part will take place at the Electronics lab.
Literature:

1. M. Rashid, Power electronics, Prentice Hall, 2024,
2. Power Electronics: Converters, Applications and Design, Ned Mohan et al Wiley 3rd Edition,
3. Principles of Power Electronics, ohn G. Kassakian, David J. Perreault, George C. Verghese, Martin F. Schlecht, Cambridge University Press, 2023
4. Power Electronics Circuit Analysis with PSIM, Farzin Asadi, Kei Eguchi, De Gruyter 2021
5. Power electronics in renewable energy systems and smart grid: technology and applications, Bose, Bimal K, IEEE Press, Year: 2019
6. Arezki Fekik, Malek Ghanes, Hakim Denoun, Power Electronics Converters and their Control for Renewable Energy Applications, Academic Press, 2023
7. Myzafere Limani, Elektronika Energjetike, Universiteti i Prishtinës, libër universitar, 2001.

Course: Optoelectronics **(2+0+2) 5 ECTS**
Lecturer: **Prof. Dr. Milaim Zabeli**
Course status: **Elective**

Course description: The nature of light. Characteristic properties and phenomena of light. Radiometric and photometric main concepts. Thermodynamics of radiation and interactions of radiation with material. Photo-emitters. Photo-detectors. Lasers. Optical resonators. Main types of lasers. Modulation of light. Optical-disk systems. Optoelectronics sensor systems. Optical waveguide systems (fiber-optic systems). Signal degradation in optical fibers. Optical fiber fabrication. Fiber-optic communication systems. Integrated optics. Optical information-processing systems. Holography. Optical computer.

Course objectives: The goal of this course is to introduce the main optoelectronic components, devices, and phenomena of optical radiation to which they are based.

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

- Explain phenomena and laws of optical radiation
- Describe the construction and working principle of main optoelectronic components, such as: LEDs, photodiodes, phototransistors, photo-couplers, different types of lasers (solid, gaseous, liquid, etc.) optical-disks, optical waveguides etc.
- Describe the construction and working principle of main optoelectronic devices, such as: modulators (electro-optical, magneto-optic and acousto-optical), laser printer, barcode reader.
- Describe the working principle of recording and reproducing holograms.
- Describe the construction of optical fibers and optical cables.
- Explain the problems that arise during the course of optical fibers and in their coupling with photo- emitter and photo-detector.
- Show areas of use of lasers, illustrating with a concrete implementation.
- outline, roughly, the operation of a telecommunications system based on fibre optic cable.
- Describe the principles on which the optical computer is based.
- Draft a paper on a particular issue or issues in the field of optoelectronics.

Teaching methodology: 30 hours of lectures +30 hours laboratory exercises. Approximately 75 hours of personal study and exercise including home-work.

Evaluation methods: 1st Exam: 20%; 2nd Exam: 20%; Homework: 20%, Attendance 10%, Final exam: 30%

Concretization tools: During the lectures, the computer will be used with a video projector (smart board), and the practical part will be realized in the laboratory.

Ratio between the theoretical and practical part: 40:60

Literature:

1. Nebi Caka, Optoelektronika, Universiteti i Prishtinës, 1996.
2. John Wilson, John Hawkes, Optoelectronics, 3rd edition, Prentice Hall, 2018, ISBN-13:978-9352866663.

3. Saleh, B.E.A.; Teich, M.C. Fundamentals of photonics. 2nd ed., New York , John Wiley& Sons, 2007. ISBN 9780471358329.

Course title: Sensors and Actuators **(2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Faton Maliqi**
Course status: **Elective**

Course description: Introduction to the course, control systems structure and place of sensors and actuators in them. Measurement and usage of measured values. Performance specification and time and frequency domain analysis, static and dynamic characteristics, nonlinearities. Analog signal processing, amplifiers, analog filters, and modulations. Interconnection with digital systems, sampling and holding, multiplexing, A/D and D/A converters. Digital processing, digital filters. Circuit and program based linearization. Circuit for specific alternation of signals. Display devices. Analog motion sensors. Torque, force, and tactile sensors. Temperature, pressure, and flow sensors. Digital motion sensors. Actuators and power drives, logic (On/Off) and proportional, linear, phase and pulse, with analog and digital command. Step motors and drive methods. DC motors. Induction and synchronous motors, variable frequency drives. Linear electric, hydraulic, and pneumatic actuators. Interconnection with acquisition, monitoring, and control units (microcomputer systems, computers, PLC).

Course objectives: The goal of the course is to introduce students with different types of sensors and actuators that are used for process monitoring, instrumentation, and control, together with their signals and processing for successful cooperation with other parts of the system.

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

- Know sensors and signals at their output;
- Select proper sensors that fulfill task requests;
- Design and implement necessary circuit for adaption of signals between units;
- Make actuator selection according to requested specifications;
- Select adequate drive for actuator and to configure it;
- Develop drive circuits of basic structure and complexity;
- Program basic functionalities for interconnecting sensors and actuators for execute monitoring, acquisition, and control tasks.

Methods of teaching: 30 hours of lectures, 30 hours of laboratory exercises

Evaluation methods: Mid-term exams 30%+30%, Lab. works 10%, Project 20%, Attendance 10%.

Concretization means: Computer, projector, Lab works.

Ratio between the theoretical and practical part of teaching: 40:60

Literature:

1. Clarence W. de Silva, Sensors and Actuators: Engineering System Instrumentation, 2ed, CRC, 2015

2. John Vetelino, Aravind Reghu, Introduction to Sensors, 1st ed, CRC, 2010

3. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, 5th ed. Springer, 2015

Course: Electronic Communications **(2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Vjosa Shatri**
Course status: **Elective**

Course content: General model of communication system. Communication media: types, characteristics, and applications. Concept of modulation, techniques of analoge and digitale modulation. Multiplexing, switching, and techniques for multiple access to media. OSI model and communication networks. Architecture and characteristics of telecommunication networks. Use of software tools, SPICE (LTspice, or similar), GNU Octave, OpenModelica, MATLAB/Simulink, Python to analyze communication systems and circuits. Summary of wireless systems and commercial technologies. Classification of services and usage.

Course objectives: Presenting fundamental concepts and knowledge related to characteristics and architecture of electronic communication systems. Using software tools to simulate and analyze communication systems and circuits. Measurements and experiments with communication circuits.

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

- To explain elements of electronic communication systems and define information transmission parameters on different types of communication systems;
- To identify and know main characteristics of digital and analog modulation;
- To select modulation parameters for a given communication;
- To recognize multiplexing techniques and techniques for accessing to communication channel;
- To analyze possibilities and limitations of different communication systems;
- To use software tools to analyze communication systems (LTspice, GNU Octave, OpenModelica MATLAB/Simulink, Python);
- To perform measurements on communication systems.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, laboratory exercises, projects.

Evaluation methods: Laboratory exams 10%, Intermediary evaluations 15%+15%, Project 30%, Final exam 30%.

Concretization tools: Computer, projector, simulator, development systems and experimental plants.

Ratio between the theoretical and practical part: 40:60

Literature:

1. Louis E. Frenzel Jr., *Principles of Electronic Communication Systems*. Fifth Edition, McGraw-Hill, 2023.
2. Louis E. Frenzel Jr., *Experiments and Activities Manual for Principles of Electronic Communication Systems*. Fifth Edition, McGraw-Hill, 2023.
3. R: E. Ziemer, W. H. Tranter, *Principles of Communications*, Wiley, 2008
4. John G. Proakis, Masoud Salehi, *Fundamentals of Communication Systems*, 2nd Edition, Prentice Hall, 2013

5. John G. Proakis, Masoud Salehi, Gerhard Bauch, *Contemporary Communication Systems Using MATLAB*, Cengage Learning, 2013
6. Kwonhue Choi, Huaping Liu, *Problem-Based Learning in Communication Systems Using MATLAB and Simulink*, Wiley-IEEE Press, 2016
7. Donald O. Pederson, Kartikeya Mayaram, *Analog Integrated Circuits for Communication*, Springer, 2008

Course title: **Artificial intellegence (2+0+2) 5 ECTS**
Instructor: **Prof. Ass. Dr. Faton Maliqi**
Course status: **Elective**

Course content: Introduction to AI basic concepts and applications (what it is and how it works), problem-solving methods and algorithm development using search and reasoning. Introduction to Machine Learning and Natural Language Processing. Techniques for supervised and unsupervised learning, clustering, classification, and prediction. Laboratory exercises using Python programming language.

Course objectives: Introduce students to the basic concepts, techniques, and applications of Artificial Intelligence (AI) and enable them to understand and apply AI tools and techniques to solve real-world problems.

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

1. Understand the basic concepts, goals, and limitations of Artificial Intelligence,
2. Understand the basic principles of problem-solving using search and reasoning,
3. Understand the basic concepts and techniques of Machine Learning,
4. Understand the basic concepts and applications of Natural Language Processing,
5. Apply AI techniques to solve real-world problems.

Methods of teaching: 30 hours of lectures + 30 hours of laboratory exercises. Approximately 65 hours of individual study and exercises that include homework.

Grading System: Activity in lectures and lab exercises 10%, Practical project 40 %, Final Exam 50%.

Literature:

1. Artificial Intelligence: A Modern Approach, 4th Edition, Stuart Russell, Peter Norvig. ISBN-13: 978-0134610999, ISBN-10: 0134610997, Prentice Hall.
2. Python Machine Learning, 3rd Edition, Sebastian Raschka, Vahid Mirjalili. ISBN-13: 978-1801078356, ISBN-10: 1801078352, Packt Publishing.
1. Natural Language Processing with Python, Steven Bird, Ewan Klein, and Edward Loper. ISBN-13: 978-0596516499, ISBN-10: 0596516495, O'Reilly Media.

Course: **Fundamentals of Mechatronics (2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Drilon Bunjaku**
Course status: **Elective**

Course content: Introduction of Mechatronics. Mechanical Components and Motion Systems. Power and Driving Systems. Sensing, Numerical Control, and Programming (Microcomputer control block). Modeling and Simulation. System Integration. Introduction of Robotics. Fundamental of Kinematics and Dynamics of wheeled mobile robots. Robotic Programming and Control. Human and Robot Interaction. Independent study on mechatronic design.
Course objectives: The goal of the course is to introduce students with mechatronic products. Nowadays modern products are mostly mechatronic products, where mechanical components are integrated with electrical, electronic, and control components to fulfill high-level system functionalities. Especially, robots are critical components in modern manufacturing and their roles in our societies are becoming increasingly of importance. The design, manufacture, assembly, and operation of mechatronic products require engineers to understand a wide scope of engineering knowledge and to be able to design and integrate mechanical, electric, electronics and control subsystems.
This course is designed to: 1. understand the concept of mechatronics, 2. learn design principles to integrate multidisciplinary components as a system to meet requirements of products, 3. gain the fundamental knowledge about robots and automation, 4. have hand-on skills in developing basic mechatronic products.
Learning outcomes: On successful completion of the course, students will be able to:

- identify, select, and integrate mechatronic components to meet product requirements,
- use kinematic, dynamic and control models for robots,
- use commercial software tools for modeling and simulation of mechatronic systems,
- design and analyze mechatronic products,
- write technical reports and present engineering design solutions efficiently,
- understand the mechatronic subsystems in the functional system;
- identify the role of various sensors and actuators in a mechatronic subsystem.

Teaching methodology: 30 hours of lectures, 30 hours of laboratory exercises. Approx. 75 independent working hours, including homework (or seminar paper).
Assessment: Class and lab. activity 10%+10%, Mid-term exams 10%+10%, Project 30%, Final exam 30%.
Necessary tools: During lecture sessions a computer with projector is needed, while the practical session will be realized in the numerical class session (laboratory).
The ratio between theoretical and practical work: 40:60
Literature:

1. William Bolton, Mechatronics-Electronic Control Systems in Mechanical and Electrical Engineering, Sixth Edition, Pearson, 2015.
2. Clarence W. de Silva, Mechatronics: A Foundation Course, CRC, 2010.

3. Lavdim Kurtaj, Mechatronical Project, WUS-Austria and University of Prishtina, 2011.
4. Clarence W. de Silva, Sensors and Actuators: Control System Instrumentation, CRC, 2007.
5. Victor Giurgiutiu, Sergey Edward Lyshevski, Micromechatronics: modeling, analysis, and design with MATLAB, CRC, 2009.

Course title: Programmable Logic Controllers **(2+0+2) 5 ECTS**
Instructor: **Prof. Dr. Qamil Kabashi**
Course status: **Elective**

Course content: Introduction to the course. Programmable logic controller (PLC) structure. Types of PLCs. Siemens PLCs: LOGO and S7-200. Basic PLC programming. Programming software. Wiring schematics. Functional Blocks and ladder diagram. Sensors with logical/digital output. Logical/digital input modules. Wiring sensors to input modules. Actuators and their logical/digital control. Logical/digital output modules. Wiring actuators to output modules. PLC operation and working cycle. Timer function blocks and their programming. Counter function blocks and their programming. Time diagrams. Writing programs based on time diagrams. Sequential programs and sequential bits. Writing programs based on algorithms and on state diagrams. Analog sensors and actuators. Analog input and output modules. Open systems. Programming languages according to the IEC61131 standard. Specialized input and output modules. Feedback control. PID controller. Standards for communication with PLCs and networking. Human-machine interface (HMI).

Course objective: Familiarity with programmable logic controllers (PLC). Familiarity with using PLCs in automation. Familiarity with methods for creating programs for PLCs. Implementation of a project based on PLC - procedure from idea to hardware and software implementation. Familiarity with advanced structures: modules, network, and human-machine communication.
Learning outcomes: On successful completion of this course, students should be able to:

- Understand the purpose, functions, and operations of a PLC,
- Identify the basic components of the PLC and how they function,
- Select proper PLC system for solving automation problem,
- Run a PLC processor file using PLC programming software,
- Create/Edit PLC project using PLC software,
- Configure the I/O for a PLC project using PLC software,
- Present knowledge on PLC communication possibilities and on human-machine communication.

Methods of teaching: Lectures, PLC Programming Exercises, Consultations, projects, Industry Visits
Evaluation methods: Mid-term exams 20% + 20%, Lab. work 10%, Project 30%, Final exam 20%.

Concretization means: Computer, SMARTboard, Lab work with PLC programming and hardware connections.
Ratio between the theoretical and practical part of teaching: 40:60

Literature:

1. Frank D. Petruzella, *Programmable logic controllers*, fifth ed, McGraw-Hill Education, 2017
2. W. Bolton, *Programmable Logic Controllers*, 6th Ed, Vital source Technologies, 2015
3. User manuals of LOGO! and S7-200 Siemens.

Course name: **Entrepreneurship and Innovation** **(2+0+0) 3 ECTS**
Lecturer: **Prof.Ass. Dr. Nora Sadiku Nushi**
Course status: **Elective**

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

Course content: Introduction to entrepreneurship and 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,

Course name: Management in Engineering **(2+0+0) 3 ECTS**
Lecturer: **Prof.Ass. Dr. Nora Sadiku Nushi**
Course status: **Elective**

Course goal: The main goal is to empower engineering students with foundational management knowledge and skills, enabling them to effectively navigate and lead within technical environments.

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

- Define the core concepts of management and its relevance in engineering;
- Explain the importance of planning and goal setting in engineering management;
- Understand the dynamics of managing change and fostering innovation in technical projects;
- Develop and implement organizational structures suitable for engineering firms;
- Understanding the role of leading and controlling in management.

Course content: An Introduction to Management, Planning: Decision making, Planning ang goal setting, Managing change and innovation, Managing entrepreneurial firms, Organizing: Organizational Structure and Design, Managing Human Resources and Diversity, Managing Work Groups and Work Teams, Leading: Understanding Individual Behavior, Motivating and Rewarding Employees, Leadership and Trust, Organizational and Interpersonal Communication, Controlling: Managing the Control Process, Managing Operations
Methods of teaching: 30 hours of lectures. Approximately 40 hours of personal study and exercise including seminars.
Grading System: Seminar 10%, Mid-term exams 40 %, Final Exam 50 %
Literature:

1. Stephen P. Robbins, Mary Coulter, David A. Decenzo. Fundamentals of management /. 11e.New York, NY : Pearson, 2020
2. Fundamentals of Management. Ricky Griffin, Cengage Learning 2020.
3. Introduction to Management, Edd, John R. Schermerhorn Jr., Daniel G. Bachrach. Wiley. 2015

Electronics Module - Year III - Semester VI

Course name: Microelectronics **(2+1+1) 5 ECTS**
Lecturer: **Prof. Dr. Milaim Zabeli**
Course status: **Mandatory**
Course content: Introduction to Microelectronics. Planar silicon (Si) technology for fabrication of monolithic integrated circuits. Isolation techniques of components in monolithic integrated circuits. Components of bipolar integrated circuits. Components of unipolar (MOS) integrated circuits. Components of integrated circuits based on GaAs. Designing of monolithic integrated circuits. Hybrid integrated circuits (thin-film and thick film). Basic stages of analog monolithic integrated circuits. Basic stages of digital monolithic integrated circuits. Design for testability (DFT) methods in integrated circuits. Introduction to nanotechnology.
Course objectives: The goal of this course is to introduce the modern technologies of fabrication of monolithic and hybrid integrated circuits, and basic stages of analog and digital monolithic integrated circuits.
Learning outcomes: On successful completion of the course, students will be able to:

- Describe in detail the main stages of fabrication of monolithic integrated circuits.
- Compare with each other different isolation techniques of integrated circuits.
- Describe the main features of bipolar transistors and unipolar transistors and other components of integrated circuits.
- Present the main design rules of monolithic integrated circuits.
- Make the difference between monolithic circuits and hybrid circuits (thin-film and thick-film).
- Explain the functioning of basic stages of analog integrated circuits and digital integrated circuits.
- Solve numerical problems related to the technology of fabrication of integrated circuits.
- Draft a paper on a particular issue or issues in the field of microelectronics.

Teaching methodology: 30 hours of lectures (including the solutions of practical problems), 15 hours numerical exercises + 15 hours of laboratory exercises. Approximately 70 hours of personal study and exercise including home-works.
Evaluation methods: 1st Exam: 20%; 2nd Exam: 20%; Homework: 20%, Attendance 10%, Final exam: 30%.
Concretization tools: During the lectures, the computer will be used with a video projector (smat board), and the practical part will be realized in the laboratory.
Ratio between the theoretical and practical part: 40:60
Literature:

1. Nebi Caka, Milaim Zabeli, Mikroelektronika-Parimet dhe Zbatimet, Prishtinë, 2021.
2. Cui Zheng, Micro-Nanofabrication: Technologies and Applications, Springer, 2005.
3. Sami Franssila, Introduction to Microfabrication, John Wiley & Sons Ltd., 2010.

Course: Analog Electronics **(2+0+2) 5 ECTS**
Lecturer: **Prof. Dr. Qamil Kabashi**
Course status: **Mandatory**

Course content: Frequency characteristics of amplifiers, power amplifiers, feedback and stability, frequency compensation, amplifiers with feedback, negative feedback and effects on linear amplifiers, operational amplifiers real and ideal, basic circuits with operational amplifiers, oscillators, active filters, integrated analog circuits, design and implementation of integrated circuits. Circuits analysis using MATLAB/SIMULINK.

Course objectives: To provide an introduction to basic concepts in the field of analog electronics and expanding the theoretical and applicative analysis of analog electronic circuits with emphasis on the characteristics of amplifiers and their frequency response, power amplifiers, theory and applications of operational amplifiers and integrated circuits, familiarity with the concepts and design feedback, oscillators, and active filters.

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

- adopt linear analysis tools such as Bode techniques, the constant time techniques, concepts of feedback (positive and negative);
- identify basic amplifier topologies;
- analyze basic amplifier topologies;
- design the basic amplifiers;
- apply concepts of feedback analysis for analog amplifiers design,
- analyze and design power amplifiers;
- analyze and design analog electronic circuits with OA, like active filters and oscillators..

Methods of teaching: 30 hours of lectures, 30 hours of laboratory exercises. Approximately 80 hours of personal study.

Grading System: Test 1: 20%, Test 2: 20%, Individual project in laboratory (25%), Attendance to lectures 10%, Final exam 25%. Success in preliminary assessments is a prerequisite for the final exam.

Concretization tools: For lectures, computers, SMARTboard and tables are used, while the practical part will take place at the Electronics lab.

Ratio between the theoretical and practical part: 40:60

Literature:

1. Donald Neamen, Electronic Circuit Analysis and Design, McGraw-Hill Education, 2009
2. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, Oxford University Press, 2007,

Course: Cyber Security (2+0+2) 5 ECTS
Lecturer: **Prof. Dr. Blerim Rexha**
Course status: **Mandatory**

Course content: Introduction to Cyber Security and various challenges in cyber security. Cyber Security Vulnerabilities and attacks. Access Control and Security Policies Securing. Web Application, Services and Servers. Internet of Things (IoT) Security. Intrusion Detection and Prevention. Encryption and Cryptography. Risk Management and Emergency Planning. Cyberspace and the Law. Cyber Forensics and Incident Management.

Course objectives: Understand cybersecurity basics and challenges, such as threats, attacks, and vulnerabilities in the digital world. Identify access control methods, security policies, and best practices to safeguard networks, systems, and cyber data from unauthorized access and breaches. Master skills to detect, prevent, and address cyber threats, including unauthorized access, hacker intrusions, and security breaches. Apply encryption and cryptography techniques to secure digital data and communications, including using security algorithms and digital certificates. Develop skills in risk management and emergency planning to respond to cybersecurity breaches, including identifying, assessing, and managing risks, as well as preparing for emergencies and recovering from damage.

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

1. Evaluate fundamental cyber security concepts, theories, and strategies as they apply to real world case studies.

2. Identify, implement, and describe effective access control techniques, security policies, and best practices to safeguard networks, systems, and data from unauthorized access and security breaches.

3. Explain technical and non-technical security solutions on different types of cyber systems.

4. Assess risks, vulnerabilities, and threats to sample cyber systems.

5. Identify attributes associated with cyber security professionals.

Prerequisites:

- Fundamentals of computer software and hardware.
- Basic concepts of operating system and networking.
- Practical knowledge of internet and use of networks.

Teaching Methods: Lectures and in-class discussions (30 hours) + 30 hours of lab exercises. Case studies and practical projects, Readings and analysis of written materials, Practical demonstrations of cybersecurity tools.

Grading System: Classroom Assessment 10%, Projects 40%, Final assessment 50 %

Concretization tools/TI: For lectures, computers, projectors and tables are used, while the practical part will take place at the lab.

Literature:

1. Charles J. Brooks, Christopher Grow, Philip A. Craig Jr., Donald Short. Cybersecurity Essentials, Sybex, 1st Edition, 2018.

2. Robin Sharp. Introduction to Cybersecurity: A Multidisciplinary Challenge. 1st Edition Springer, 2024.

3. Yuri Diogenes, Erdal Ozkaya. Cybersecurity. Attack and Defense Strategies, 3rd Edition, Packt Publishing, 2022.

Course title: Machine Learning (2+0+2) 5 ECTS
Lecturer: Prof. Ass. Dr. Faton Maliqi
Course status: Elective

Course content: This course introduces students to the field of machine learning, focusing on fundamental concepts, algorithms, and applications. Topics include supervised and unsupervised learning, regression, classification, clustering, neural networks, deep learning, and ethical considerations in machine learning.

Course objectives: This course aims to provide students with a solid foundation in machine learning by introducing key concepts, algorithms, and applications. Students will learn to implement and evaluate machine learning models, including regression, classification, clustering, and neural networks. They will also explore ethical considerations in machine learning. Through assignments and projects, students will develop problem-solving skills and gain practical experience in applying machine learning techniques to real-world datasets. The course will prepare students for advanced studies and research in machine learning while fostering critical thinking, analysis, and effective communication of machine learning concepts and results.

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

- Understand and explain fundamental machine learning concepts and algorithms;
- Implement and apply machine learning algorithms to solve real-world problems;
- Evaluate and interpret machine learning models;
- Recognize ethical considerations in machine learning.
- Discuss issues such as bias, fairness, and privacy in machine learning applications.

Prerequisites:

- Basic understanding of linear algebra;
- Basic knowledge of probability and statistics;
- Programming experience in a high-level language (e.g., Python)

Teaching Methods: Lectures and in-class discussions (30 hours) + 15 hours of lab exercises. Case studies and practical projects, readings and analysis of written materials, practical demonstrations of machine learning tools associated with Matlab or Python.

Grading System: Classroom Assessment 10%, Projects 40%, Midterm Exam 20%, Final exam 30%.

Concretization tools/TI: For lectures, computers, projector and tables are used, while the practical part will take place at the lab.

Literature:

1. Sebastian Raschka, Vahid Mirjalili, “Python Machine Learning”, Packt, 3rd Edition, 2019;

2. Andriy Burkov, “Machine Learning Engineering”, True Positive Inc., 2020;

3. Christoph Molnar, “Intepretable Machine Learning”, Lulu.com, 2019;

Course title: Fundamentals of Robotics **(2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Lavdim Kurtaj**
Course status: **Elective**

Course content: Introduction and historical development of robotics. Direct kinematics problem. Rotation and composite matrix. Image geometry. Inverse kinematics problem and methods, analytic, geometric, and numeric. Robot arm dynamics. Lagrange-Euler formulation. Newton-Euler formulation. Manipulator trajectory planning. Interpolated trajectories at different levels. Planning trajectories in Cartesian space. Planning trajectories under different constraints. Controlling robotic manipulator. Controlling PUMA and CRS Catalyst-5 robot. Computed torque technique. Other control methods. Adaptive control. Sensors in robotics. Visual information processing. Robot programming.

Course objectives: Familiarity with robotic concepts. Describing relative positions and motions in space. Methods for calculating dynamic interactions. How to do joint control and reactions between then. Familiarity with methods for task decomposition at different execution levels. Familiarity with sensors and processing of their information. Robot programming.

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

- identify robot structure and characteristic elements;
- describe motions and to calculate dynamic interactions;
- design robot joint controller;
- make transition from given problem to necessary executive details;
- get engaged into advanced control and information processing from different sensors, as the foundation for making "intelligent" robots.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, laboratory exams, projects.

Evaluation methods: Intermediary evaluations 15%+15%, Project 40%, Final exam 15%+15%.

Concretization tools: Computer, projector, simulator, development systems and experimental plants.

Ratio between the theoretical and practical part: 40:60

Literature

1. K.S. Fu, R.C. Gonzales, C.S.G. Lee, *ROBOTICS, Control, Sensing,Vision, and Intelligence*, McGraw-Hill
2. Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Second Edition, Springer, 2017
3. Paul P., *Robot Manipulators Mathematics, Programming and Control*, MIT Press
4. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, *Robotics: Modelling, Planning and Control*, Springer, 2009
5. Bruno Sicilianoa and Oussama Khatib (eds.), *Springer Handbook of Robotics*, Second Edition, Springer 2016

Course title: Optical Communication Technology **(2+0+2) 5 ECTS**
Lecturer: **Prof. Dr. Milaim Zabeli**
Course: **Elective**

Course content: Introduction to fiber optic systems. Optical fibers, propagation of light along the optic fiber, single mode fibers (SM), multimode fibers (MM), plastic optical fibers (POF), step index fibers (SI), graded index fibers (GI). Losses in optical fibers. Dispersion. Optic cables. Connecting optic fibers and problems: fusion splicing, mechanical splices, connectors, couplers. Optical sources: LEDs, lasers (ILD). Optic detectors: PIN diodes, avalanche diode (APD). Optic system communication: testing system, system design with SI and MM mode fibers. Optical modulators. Optical amplifiers. Examples of optical communication systems.

Course objectives: The course deals with the basic phenomena related to the technology that enables the transmission of the optical signal of information through an optical communication system.

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

- To know how the propagation of light through optical fibers is possible,
- Distinguish between different fiber types.
- Determine parameters of optical sources LEDs and LDs.
- Determine parameters of photo-detectors PIN and APD.
- To practically perform the connection of optic fibers,
- To test optical fibers, or optical transmission systems,
- To determine losses in fibers or optical systems,
- Give examples of optical communication systems.

Teaching methodology: 30 hours of lectures + 30 hours laboratory exercises. Approximately 60 hours of personal study and exercise including home-works.

Evaluation methods: 1st Exam: 20%; 2nd Exam: 20%, Homework (seminar): 20%, Attendance 10%, Final exam: 30%.

Concretization tools: During the lectures, the computer will be used with a video projector (smart board), and the practical part will be realized in the laboratory.

Ratio between the theoretical and practical part: 40:60.

Literature:

1. John Crisp, Barry Elliott, Introduction to Fiber Optics; Newnes, 2005, ISBN: 0 7506 675679
2. G.P. Agrawal, Fiber-Optic Communication Systems, 4th edition, John Wiley, 2018, ISBN: 978- 0-470-50511-3
3. Rozeta Mitrushi, Komunikimet me fibra optike, Tiranë, 2007.

Course title: **Embedded Systems (2+0+2) 5 ECTS**
Lecturer: **From industry**
Course status: **Elective**
Course content: Introduction to embedded systems. Parallel and serial communication. I/O ports and specialized communication units. Communication between "smart" units, Cyber-Physical Systems, and the Internet of Things. Case Study 8051 microcontroller. Case Study MSP 430 microcontroller. Case Study ARM family of microcontrollers. Case Study Arduino development board. Case Study Raspberry Pi development board. Network topologies, ISO layers. BUS communication protocols for networked devices. Interrupt service mechanism. System timers. Device drivers. Cooperative and preemptive multitasking. Inter-process communication and synchronization, "Threads" and "Tasks". Real-time operating system.
Course objectives: To elaborate on the basic concepts of embedded systems, communications, synchronization processes, and operating systems.
Learning outcomes: On successful completion of the course, students will be able to:

- Understand the concepts of embedded systems;
- Understand the interfacing with input / output devices and other peripheral devices;
- Programming driver units and interrupt service mechanisms;
- Understand inter-process communication and process synchronization;
- Learn functional principles of Operating System and Real-time Operating System;
- Be able to use microcontrollers along with other analogue and digital peripherals.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, laboratory exercises, projects.
Evaluation methods: Laboratory exercises 10%, Intermediary evaluations 15%+15%, Project 30%, Final exam 30%.
Concretization tools: Computer, projector, simulator, development systems and experimental plants.
Ratio between the theoretical and practical part: 40:60
Literature:

1. Tianhong Pan, Yi Zhu, Designing Embedded Systems with Arduino - A Fundamental Technology for Makers, Springer, 2018
2. Jonathan Valvano, Embedded Systems: Real-Time Operating Systems for ARM Cortex M Microcontrollers, 2nd Edition, CreateSpace Independent Publishing Platform, 2012
3. Manuel Jiménez, Rogelio Palomera, Isidoro Couvertier, Introduction to Embedded Systems: Using Microcontrollers and the MSP430, Springer, 2014
4. Alexander Barkalov, Larysa Titarenko, Małgorzata Mazurkiewicz, Foundations of Embedded Systems, Springer, 2019
5. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 2nd edition, McGraw Hill, 2010
6. James K. Peckol, Embedded Systems: A Contemporary Design Tool, Wiley, 2019

7. Peter Marwedel, Embedded System Design: Embedded Systems, Foundations of Cyber-Physical Systems, and the Internet of Things, Springer, 2018
8. Alan Holt, Chi-Yu Huang, Embedded Operating Systems: A Practical Approach, Springer, 2018
9. Perry Xiao, Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed, Wiley, 2018
10. Sai Yamanoor, Srihari Yamanoor, Raspberry Pi Mechatronics Projects, Packt Publishing, 2015
11. Derek Molloy, Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux, Wiley, 2016
12. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, 2nd edition, Morgan Kaufmann Publication, 2008
13. Renesas Synergy Development Kit, User's Manual, Renesas Electronics, 2015
14. David Russell, Introduction to Embedded Systems: Using ANSI C and the Arduino Development Environment, Morgan and Claypool Publishers, 2010

Course: Computer Aided Design of Electronic Circuits **(2+0+2) 5 ECTS**
Lecturer: **Prof. Dr. Milaim Zabeli**
Course status: **Elective**

Short course description: The importance of using software tools in the field of electronic circuits. Analysis and design of analog electric-electronic circuits in DC mode. Sensitivity analysis (worst case) in DC mode of electronic designed circuit, Monte Carlo analysis of designed electronic circuits. Analysis of performance, temperature, noise, phase, Furie, smoke of electronic circuits. Analysis of digital circuits using the CAD tools for specific working conditions. Creating hierarchical designs. Technical documentation. Printed circuit board (PCB) fabrication technique and assembly technologies.

Course objectives: This course presents an introduction to the general process of computer-aided design of simple and more complex electronic circuits, for different working conditions.

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

- use the computer programs (CAD) for the analysis, design and simulation of electronic circuits in DC mode,
- analyze the behavior of the designed circuits for different temperature conditions,
- analyze the performance of the designed circuits for specific working conditions, as well as noise analysis,
- analyze the designed circuit in time and frequency domain,
- analyze the behavior of digital circuits in time domain and static conditions of operations,
- create models and hierarchical designs of electronic circuits,
- prepare technical documentation,
- describe how printed circuit boards (PCBs) are fabricated.

Teaching methodology: 30 hours of lectures + 30 hours laboratory exercises. Approximately 60 hours of personal study and exercise including home-works (seminary work).

Evaluation methods: 1st Exam: 25%; 2nd Exam: 25%; Homework: 20%, Attendance 10%, Final exam: 20%.

Concretization tools: During the lectures, the computer will be used with a video projector (smart board), and the practical part will be realized in the laboratory.

Ratio between the theoretical and practical part: 40:60

Literature:

1. Dennis Fitzpatrik, Analog Design and simulation using OrCAD capture and Pspice, Newnes, 2018
2. Peter Wilson, The Circuit Designer's Companion, 4th edition Newnes; 2017;
3. Kraig Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor, Newnes, 2009.

Course: **Internship (2+0+0) 5 ECTS**
Lecturer: **Prof. Dr. Milaim Zabeli**
Course status: **Mandatory**

Course content: The content of this course depends on the company where the student shall finish 120 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 a 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.

Course objectives: The students gain professional experience, depending on the field of study, in one of the local companies.

Learning outcomes: To be qualified for professional work, in the relevant field of study, and to be more prepared for the labor market.

Teaching methodology: 120 working hours in the company, 30 working hours for the preparation of the presentation of a professional internship.

Evaluation methods: Presentation evaluation 40%, Presentation of the paper: 60%. Total:100%

Ratio between the theoretical and practical part: 0:100

Course title: **Bachelor Thesis 5 ECTS**
Course status: **Mandatory**
Course content: The thesis could be proposed by the supervisor or can be chosen by the student and should be in accordance with the qualification profile. The bachelor thesis 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, and provides instructions for use and directions of future development.
Course objectives: The bachelor thesis is a comprehensive and independent task where the student must 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.
Learning outcomes: Upon completion of this course the student will be able to:

- Gain confidence in knowledge gained;
- Have the ability for further studies of mandatory additional literature;
- Consult with mentor with questions well prepared and structured;
- Present their work in written form, with a 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 a presentation prepared in PowerPoint.

Methods of teaching: Compliant with the actual regulation at the faculty level on how to conduct a bachelor thesis.
Literature: Depending on the bachelor thesis, different literature will be offered from a mentor.

Automation and Robotics Sepecialisation - Year III - Semester V

Course title: Fundamentals of Control Systems **(2+1+2) 6 ECTS**
Lecturer: **Prof. Ass. Dr. Drilon Bunjaku**
Course status: **Mandatory**

Course description: Transfer function analysis and the influence of pole/zero position on the system response. Introduction to the concept of controllers and their influence on the quality of system dynamic response. Techniques for designing controllers in the time and frequency domain. Steady-state error. Regulatory devices and influence on system behavior. Controller tuning to achieve time domain specification. Using Bode diagrams to design controllers in the frequency domain to achieve the desired level of phase margin and steady-state error. Controller design using the root locus method. Introduction to digital control and design of controllers in state space.

Course objectives: The purpose of the course is to introduce the students with the important concept of controllers and become capable to use the different techniques to tune the controllers.

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

- fully understand the concept of controller and their influence in the general performance of control systems.
- use different methods of designing controller in the time domain.
- use different methods of designing controller in the frequency domain.
- analyze unstable systems and the improvement of their performance by integrating the controller in the control system structure.
- use the root locus technique for the analysis and design of regulatory systems
- notice the relation between designing controllers in time and frequency domain
- introduction to controller design in state space.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, numerical exams, laboratory exams, seminary work.

Evaluation methods: Seminar 10%, Laboratory exams 10%, Intermediary evaluations 15%+15%, Final exam 50 %

Concretization tools: Computer, projector, simulator, experimental plants.

Ratio between the theoretical and practical part: 40:60

Literature:

1. Farid Golnaraghi and Benjamin C. Kuo, *Automatic Control Systems*, Tenth Edition, McGraw-Hill Education, 2017
2. Constantine H. Houpis, Stuart N. Sheldon, *ALinear Control System Analysis and Design with MATLAB*, Sixth Edition, CRC Press, 2014
3. John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, *Linear Control System Analysis and Design: Fifth Edition, Revised and Expanded*, Marcel Dekker, 2003

Course title: **Fundamentals of Robotics (2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Lavdim Kurtaj**
Course status: **Mandatory**
Course content: Introduction and historical development of robotics. Direct kinematics problem. Rotation and composite matrix. Image geometry. Inverse kinematics problem and methods, analytic, geometric, and numeric. Robot arm dynamics. Lagrange-Euler formulation. Newton-Euler formulation. Manipulator trajectory planning. Interpolated trajectories at different levels. Planning trajectories in Cartesian space. Planning trajectories under different constraints. Controlling robotic manipulator. Controlling PUMA and CRS Catalyst-5 robot. Computed torque technique. Other control methods. Adaptive control. Sensors in robotics. Visual information processing. Robot programming.
Course objectives: Familiarity with robotic concepts. Describing relative positions and motions in space. Methods for calculating dynamic interactions. How to do joint control and reactions between them. Familiarity with methods for task decomposition at different execution levels. Familiarity with sensors and processing of their information. Robot programming.
Learning outcomes: On successful completion of the course, students will be able to:

- identify robot structure and characteristic elements;
- describe motions and to calculate dynamic interactions;
- design robot joint controller;
- make transition from given problem to necessary executive details;
- get engaged into advanced control and information processing from different sensors, as the foundation for making "intelligent" robots.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, laboratory exams, projects.
Evaluation methods: Intermediary evaluations 15%+15%, Project 40%, Final exam 15%+15%.
Concretization tools: Computer, projector, simulator, development systems and experimental plants.
Ratio between the theoretical and practical part: 40:60
Literature

1. K.S. Fu, R.C. Gonzales, C.S.G. Lee, *ROBOTICS, Control, Sensing,Vision, and Intelligence*, McGraw-Hill
2. Peter Corke, Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Second Edition, Springer, 2017
3. Paul P., *Robot Manipulators Mathematics, Programming and Control*, MIT Press
4. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo, *Robotics: Modelling, Planning and Control*, Springer, 2009
5. Bruno Sicilianoa and Oussama Khatib (eds.), *Springer Handbook of Robotics*, Second Edition, Springer 2016
6. Antti J. Koivo, *Fundamentals for Control of Robotic Manipulators*, John Wiley & Sons, 1989

Course title: Programmable Logic Controllers **(2+0+2) 5 ECTS**
Instructor: **Prof. Dr. Qamil Kabashi**
Course status: **Mandatory**

Course content: Introduction to the course. Programmable logic controller (PLC) structure. Types of PLCs. Siemens PLCs: LOGO and S7-200. Basic PLC programming. Programming software. Wiring schematics. Functional Blocks and ladder diagram. Sensors with logical/digital output. Logical/digital input modules. Wiring sensors to input modules. Actuators and their logical/digital control. Logical/digital output modules. Wiring actuators to output modules. PLC operation and working cycle. Timer function blocks and their programming. Counter function blocks and their programming. Time diagrams. Writing programs based on time diagrams. Sequential programs and sequential bits. Writing programs based on algorithms and on state diagrams. Analog sensors and actuators. Analog input and output modules.Feedback control. PID controller. Standards for communication with PLCs and networking. Human-machine interface (HMI).

Course objective: Familiarity with programmable logic controllers (PLC). Familiarity with using PLCs in automation. Familiarity with methods for creating programs for PLCs. Implementation of a project based on PLC - procedure from idea to hardware and software implementation. Familiarity with advanced structures: modules, network, and human-machine communication.

Learning outcomes: On successful completion of this course, students should be able to:

- Understand the purpose, functions, and operations of a PLC,
- Identify the basic components of the PLC and how they function,
- Select proper PLC system for solving automation problem,
- Run a PLC processor file using PLC programming software,
- Create/Edit PLC project using PLC software,
- Configure the I/O for a PLC project using PLC software,
- Present knowledge on PLC communication possibilities and on human-machine communication.

Methods of teaching: Lectures, PLC Programming Exercises&consults, projects, Industry Visits
Evaluation methods: Mid-term exams 20%+20%, Lab.work 10%, Project 30%, Final exam 20%.

Concretization means: Computer, SMARTboard, Lab work with PLC programming and hardware connections.

Ratio between the theoretical and practical part of teaching: 40:60

Literature:

1. Frank D. Petruzella, *Programmable logic controllers*, fifth ed, McGraw-Hill Education, 2017
2. W. Bolton, *Programmable Logic Controllers*, 6th Ed, Vital source Technologies, 2015
3. User manuals of LOGO! and S7-200 Siemens.

Course title: Artificial Intelligence **(2+0+2) 5 ECTS**
Instructor: **Prof. Ass. Dr. Faton Maliqi**
Course status: **Elective**

Course content: Introduction to AI basic concepts and applications (what it is and how it works), problem-solving methods and algorithm development using search and reasoning. Introduction to Machine Learning and Natural Language Processing. Techniques for supervised and unsupervised learning, clustering, classification, and prediction. Laboratory exercises using Python programming language.

Course objectives: Introduce students to the basic concepts, techniques, and applications of Artificial Intelligence (AI) and enable them to understand and apply AI tools and techniques to solve real-world problems.

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

6. Understand the basic concepts, goals, and limitations of Artificial Intelligence,
7. Understand the basic principles of problem-solving using search and reasoning,
8. Understand the basic concepts and techniques of Machine Learning,
9. Understand the basic concepts and applications of Natural Language Processing,
10. Apply AI techniques to solve real-world problems.

Methods of teaching: 30 hours of lectures + 30 hours of laboratory exercises. Approximately 65 hours of individual study and exercises that include homework.

Grading System: Activity in lectures and lab exercises 10%, Practical project 40 %, Final Exam 50%.

Literature:

3. Artificial Intelligence: A Modern Approach, 4th Edition, Stuart Russell, Peter Norvig. ISBN-13: 978-0134610999, ISBN-10: 0134610997, Prentice Hall.
4. Python Machine Learning, 3rd Edition, Sebastian Raschka, Vahid Mirjalili. ISBN-13: 978-1801078356, ISBN-10: 1801078352, Packt Publishing.
2. Natural Language Processing with Python, Steven Bird, Ewan Klein, and Edward Loper. ISBN-13: 978-0596516499, ISBN-10: 0596516495, O'Reilly Media.

Course title: Smart Actuators and Drives **(2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Lavdim Kurtaj**
Course status: **Elective**

Course content: Introduction to the course, structure of modern control systems, distributed control structure. Communication networks and communication with distant sensors and actuators. Smart actuators and structure, drive block, measurement block, digital processing block, communication block. Local block for monitoring, configuring and commanding. Measurement and using measured values for advanced and sensorless drives. Static and dynamic characteristics, nonlinearities. Analog signal processing, amplifiers, analog filters, and modulations. Interconnection with digital systems. Digital processing system (with microprocessor, microcontroller, DSP, programmable digital circuits, CPLD, FPGA), digital processing, digital controllers (circuit and software based). Linear and pulse drives with microprocessor digital control. Specific functional processing, self-diagnosing, learning and adaptation, coding, security, fail-safe. Communicating with human (HMI), local devices for display and for accepting commands. Standard sensor and actuator communication networks, wired (AS-i, Profibus, DeviceNet, Industrial ethernet, ModBus) and wireless (ZigBee, WiFi), protocols. Access to other maintenance functions from distance.

Course objectives: To introduce students with the structure of distributed systems for monitoring, instrumentation, and control, when using smart actuators with integrated drives. Introduction with architecture and functionality of smart actuator construction blocks. Communication networks, standards, and protocols.

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

- know smart actuators and ways of communication with them;
- select proper actuator that fulfill task requests;
- design and implement functional systems with smart actuator;
- make smart actuator selection according to requested specifications;
- configure smart actuators for interplay in network;
- design and implement smart actuator (electronic part for driving and processing, programming part) with basic structure based on microcontroller.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, numerical exams, laboratory exams, projects.

Evaluation methods: Intermediary evaluations 10%+10%, Laboratory exercises 20%, Project 30%, Final exam 15%+15%.

Concretization tools: Computer, projector, simulator, development systems and experimental plants.

Ratio between the theoretical and practical part: 40:60

Literature:

1. Clarence W. de Silva, Sensors and Actuators: Engineering System Instrumentation, Second Edition, CRC Press, 2016
2. Gerard Meijer (Ed.), Smart Sensor Systems, Wiley, 2008

3. Victor Giurgiutiu, Sergey Edward Lyshevski, Micromechatronics: Modeling, Analysis, and Design with MATLAB, CRC Press, 2009
4. Lavdim Kurtaj, Mechatronical Project, WUS-Austria and University of Prishtina, 2011
5. Muhammad Tahir and Kashif Javed, ARM Microprocessor Systems: Cortex-M Architecture, Programming, and Interfacing, CRC Press, 2017
6. Renesas Synergy Development Kit, User's Manual, Renesas Electronics, 2015
7. Nikolay V. Kirianaki, Sergey Y. Yurish, Nestor O. Shpak, Vadim P. Deynega, Data Acquisition and Signal Processing for Smart Sensors, Wiley, 2002
8. Ned Mohan, First Course On Power Electronics And Drives, MNPERE, 2003

Course title: Smart Sensors **(2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Drilon Bunjaku**
Course status: **Elective**

Course content: Introduction to the course, structure of modern control systems, distributed control structure. Communication networks and communication with distant sensors and actuators. Smart sensors and structure, measurement block, digital processing block, communication block. Local block for monitoring and configuring. Measurement and usage of measured values. Performance specification with time and frequency domain analysis. static and dynamic characteristics, nonlinearities. Analog signal processing, amplifiers, analog filters, and modulations. Interconnection with digital systems, sampling and holding, multiplexing, A/D and D/A conversion. Digital processing system (with microprocessor, microcontroller, DSP, programmable digital circuits, CPLD, FPGA), digital processing, digital filters, linearization circuit and program based). Specific functional processing, self-diagnosing, learning and adaptation, coding, security. Communicating with human (HMI), local devices for display and for accepting commands. Standard sensor and actuator communication networks, wired (AS-i, Profibus, DeviceNet, Industrial ethernet, ModBus) and wireless (ZigBee, WiFi), protocols. Access to other maintenance functions from distance.

The goals: The goal of the course is to introduce students with structure of distributed systems for monitoring, instrumentation, and control, and with smart sensors as part of them. Introduction with architecture, functionality construction blocks and communication networks, standards and communication protocols.

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

- distinguish between ordinary sensor and smart sensor;
- know smart sensors and ways of communication with them;
- select proper actuator that fulfill task requests;
- design and implement functional systems with smart sensors;
- make smart sensor selection according to requested specifications;
- configure smart sensors for interplay in network;
- design and implement a smart sensor (electronic part programming part) with basic structure based on microcontroller.

Methods of teaching: 30 hours of lectures, 15 hours of laboratory exercises.
Evaluation methods: Mid-term exams 30%+30%, Lab. works 10%, Project 20%, Attendance 10%.
Concretization means: Computer, projector, Lab works
Ratio between the theoretical and practical part of teaching: 40:60
Literature:

1. Clarence W. de Silva, *Sensors and Actuators: Engineering System Instrumentation,* 2ed, CRC, 2016
2. Gerard Meijer (Ed.), *Smart Sensor Systems*, Wiley, 2008
3. Randy Frank, *Understanding Smart Sensors*, 3rd ed., Artech House, 2013.

Course title: Communications in Automation **(2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Lavdim Kurtaj**
Course status: **Elective**

Course content: Control systems with communication networks: design, telemetry, remote control, controllability and operation in real time. ISO/OSI reference model: overview of layers function, protocols, connection and connectionless services, transparency and virtual links. Physical links between distributed control building blocks: wired transmission media, fiber optics, radio links, topologies, serial/parallel transmission, simplex, half-duplex and full-duplex links, standards of physical layer (RS-232, RS-485), synchronization, channel coding (parity, CRC). Logical links; connection, connectionless and connection less with confirmation, protocols. Fieldbuses: purposes and use, operation in real time, and synchronization, Profibus, ModBus, CAN, TTP. Wireless networks, ZigBee. Local area networks: concept of ISO standards 8802, Ethernet family (standard, fast, giga, industrial, hyperLAN). Local area building blocks.

Course objectives: The objective of this course is to gain general knowledge about data telecommunication networks, knowledge about particular communication systems used in automation and their specifications, to learn systematic approach in design of complex systems.

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

- demonstrate knowledge and understanding of specifics of the industrial communication networks;
- identify type of network to be used depending on nature of the problem;
- evaluate network properties for working in real time;
- to design communication systems for telemetry, remote control, control of equipment with decentralized structure;
- to develop, maintain, and use industrial networks;

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, numerical exams, laboratory exams, projects.

Evaluation methods: Intermediary evaluations 10%+10%, Laboratory exams 20%, Project 30%, Final exam 15%+15%.

Concretization tools: Computer, projector, simulator, development systems and experimental plants.

Ratio between the theoretical and practical part: 40:60

Literature:

1. Michael Duck, Richard Read, Data Communications and Computer Networks: For Computer Scientists and Engineers, Prentice Hall, 2003
2. Bogdan M. Wilamowski and J. David Irwin, Industrial Communication Systems, The Industrial Electronics Handbook, CRC, 2011
3. Steve Mackay, Edwin Wright, Deon Reynders, John Park ASD, Practical Industrial Data Networks: Design, Installation and Troubleshooting, Newnes, 2004
4. Deon Reynders, Steve Mackay, Edwin Wright, Practical Industrial Data Communications: Best Practice Techniques, Newnes, 2004

5. Marco Di Natale, Understanding and Using the Controller Area Network Communication Protocol: Theory and Practice, Springer, 2012
6. Lavdim Kurtaj, Mechatronical Project, WUS-Austria and University of Prishtina, 2011
7. Renesas Synergy Development Kit, User's Manual, Renesas Electronics, 2015

Course title: Finite Element Methods **(2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Vjosa Shatri**
Course status: **Elective**

Course content: Introduction. Theory of numerical methods (FEM). Modeling with FEM. FEM wtih MATLAB. Modeling techniques. Applications of FEM in analyzing different systems. Electrical systems. Magnetic systems. Thermal systems. Mechanical systems. Computation of electromagnetic components: resistors, inductivities, forces, etc. Computation of thermal parameters: thermal flux, temperature distribution, influence of temperature to system characteristics. Computation of mechanical parameters: mechanic stability, mechanical stress, mechanic vibrations, noise. Co-simulation methods. Analyzing systems with co-simulation.

Course objectives: The objective of the course is to introduce students with numerical methods (finite element methods, FEM) and how to use them to analyze and solve different technical problems.

Learning outcomes: By finishing this course a student will:

- Know theory of finite element methods and their application in solving different electrical, magnetic, thermal, and mechanics problems;
- Learn necessary steps for modeling different components by using numerical methods, starting from building real geometry, selecting materials and defining corresponding characteristics, setting boundary conditions, and defining resulting quantities;
- Know techniques for simulating real systems by using co-simulation methods;
- Be able to apply numerical methods to model and analyze some given system and document it.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, laboratory exercises, projects.

Evaluation methods: Laboratory exams 10%, Intermediary evaluations 15%+15%, Project 30%, Final exam 30%.

Concretization tools: Computer, projector, simulator, experimental plants.

Ratio between the theoretical and practical part: 40:60

Literature:

1. Albert E. Ruehli, Giulio Antonini, Lijun Jiang. *Circuit Oriented Electromagnetic Modeling using the PEEC Techniques*. IEEE Press / Wiley, 2017.
2. Dennis Michael Sullivan and Jennifer E. Houle. *Electromagnetic Simulation Using the FDTD Method with Python*. IEEE Press / Wiley, 2020.
3. José Roberto Cardoso, *Electromagnetics through the Finite Element Method: A Simplified Approach Using Maxwell's Equations*, CRC Press, 2016
4. Prof. Dr. Juergen Nitsch, Dr. Frank Gronwald, Prof. Dr. Gunter Wollenberg. *Radiating Nonuniform Transmission-Line Systems and the Partial Element Equivalent Circuit Method*. Wiley, 2009.
5. Daryl L. Logan, *First Course in the Finite Element Method*, Sixth Edition, Cengage Learning, 2006

6. E. Madenci, I. Guven, *The Finite Element Method and Applications in Engineering Using Ansys*, Springer, 2007
7. G. Dajaku, *FEM in der Antriebstechnik*, Lecture script, University of Federal Defence Munich, Germany
8. Ozlem Ozgun and Mustafa Kuzuoglu, *MATLAB-based finite element programming in electromagnetic modeling*, CRC Press, 2019

Course title: Operating Systems **(2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Dhurate Hyseni**
Course status: **Elective**

Short description of the content: Computer systems in general (including basic elements). Multicore and multiprocessor organization of computers. Operating systems in general (operating system objectives, operating system evolution, modern operating systems, virtual machines). Process and control description (process states, process control). Threads (processes and threads, thread types, Windows 10 threads, processes in Linux and thread management). Concurrent systems - mutual exclusion (principles of competitiveness, hardware support, semaphores, monitors, message passing). Memory management. Virtual memory. Disk management. File management.

The goals: The student will be taught principles of modern operating systems.

Learning outcomes: The students who succeeded in this course will be able to;

- Understand the logical structure of OS,
- Learn the principles modern operating systems,
- Processes and their states,
- Understand the thread and multi-threaded applications,
- Understand the relationship between subsystems of a modern operating system,
- Understand kernel and microkernel,
- Understand the principle of concurrent processes and mutual exclusion,
- Evaluate the efficiency aspect of using system resources (processor, cache, memory, virtual memory and disk).

Methods of teaching: Lectures, exercises, tutorials and team work accompanied with assignments.

Evaluation methods: Mid-term exams 25%+25%, Lab. works 10%, Project 30%, Attendance 10%.

Concretization means: Computers, projector, Lab works.

Ratio between the theoretical and practical part of teaching: 50:50

Literature:

1. W. Stallings, *Operating Systems- Internals and Design Principles.*9 th edition, Pearson, 2019.
2. A.S. Tanenbaum, H. Bos, *Modern operating systems*, 8th edition, Prentice Hall, 2008
3. Silberschatz, P.B. Galvin & G Gag*ne,* Operating system concepts*. 10th edition, Addison Wesley, 2018*.

Course name: **Entrepreneurship and Innovation** **(2+0+0) 3 ECTS**
Lecturer: **Prof.Ass. Dr. Nora Sadiku Nushi**
Course status: **Elective**

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:

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

Course content: Introduction to entrepreneurship and 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,

Course name: **Management in Engineering (2+0+0) 3 ECTS**
Lecturer: **Prof.Ass. Dr. Nora Sadiku Nushi**
Course status: **Elective**

Course goal: The main goal is to empower engineering students with foundational management knowledge and skills, enabling them to effectively navigate and lead within technical environments.

Learning outcomes: On successful completion of the course, students will be able to:
- Define the core concepts of management and its relevance in engineering;
- Explain the importance of planning and goal setting in engineering management;
- Understand the dynamics of managing change and fostering innovation in technical projects;
- Develop and implement organizational structures suitable for engineering firms;
- Understanding the role of leading and controlling in management.

Course content: An Introduction to Management, Planning: Decision making, Planning ang goal setting, Managing change and innovation, Managing entrepreneurial firms, Organizing: Organizational Structure and Design, Managing Human Resources and Diversity, Managing Work Groups and Work Teams, Leading: Understanding Individual Behavior, Motivating and Rewarding Employees, Leadership and Trust, Organizational and Interpersonal Communication, Controlling: Managing the Control Process, Managing Operations
Methods of teaching: 30 hours of lectures. Approximately 40 hours of personal study and exercise including seminars.
Grading System: Seminar 10%, Mid-term exams 40 %, Final Exam 50 %
Literature:

1. Stephen P. Robbins, Mary Coulter, David A. Decenzo. Fundamentals of management /. 11e.New York, NY : Pearson, 2020
2. Fundamentals of Management. Ricky Griffin, Cengage Learning 2020.
3. Introduction to Management, Edd, John R. Schermerhorn Jr., Daniel G. Bachrach. Wiley. 2015

Course title: **Modeling and Simulation (2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Drilon Bunjaku**
Course status: **Mandatory**

Course content: Fundamental principles for modeling dynamical systems. Methods for transforming one model type to the other. Model linearization. Simulation of dynamical systems, fundamentals of MATLAB and Simulink. Models of electrical processes, circuits and electromagnetic systems. Models for mechanical processes. Thermal processes. Simulation and design of control systems.

Course objectives: Objectives of this course are to introduce details of several analytical and practical methods of modeling. Students will improve skills in using MATLAB/Simulink for building and simulating models of dynamical systems.

Learning outcomes: On successful completion of this course, students should be able to:

- present the linear system through differential equations, transfer function, amplitude response, impulse response and step response;
- be able to convert the system from one form to another by explaining the advantages and disadvantages of each;
- prepare MATLAB simulation codes for system model;
- implement the appropriate model for the given problem by making proper choices of model type and calculate the model error;
- design and implement simulations, selecting the right tools and methods for different types of systems;
- use simulation models in order to identify and improve system performance;
- to interpret simulation results clearly and accurately for both technical and non-technical audiences.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, numerical exams, laboratory exams, seminary work.

Evaluation methods: Seminar 10%, Laboratory exams 10%, Intermediary evaluations 15%+15%, Final exam 50 %

Concretization tools: Computer, projector, simulator, experimental plants.

Ratio between the theoretical and practical part: 40:60

Literature:

1. "*Simulation of Dynamic Systems with MATLAB and Simulink*", Klee, H., CRC Press, Boca Raton, FL., 2007.
2. "*Modeling and Simulation of Dynamic Systems*", Woods, R. L., and Lawrence, K. L., Prentice-Hall, Upper Saddle River, NJ, 1997.
3. "*System Dynamics*", Palm III, W.J., McGraw-Hill, NY, 2010.

Course title: Digital Control Systems (2+0+2) 5 ECTS
Lecturer: Prof. Ass. Dr. Lavdim Kurtaj
Course status: Mandatory
Course content: Introduction to the subject. Examples of discrete and digital control. Signal conversion and processing. Typical digital sensors. Connection with actuators. Step-motors. Structure of digital control systems. Modeling. z-Transform. Modified z-transform. Signal between sampling instants. Transfer function, block diagram and signal flow graphs. State variable method. Controllability, observability and stability. Time domain and z domain analysis. Frequency domain analysis. Digital simulation and digital redesign. Cascade compensation with a digital controller equivalent to continuous one. Digital controllers. Root locus in the z plane. Implementation of digital control systems. Software implementation of digital controllers. Finite word length. Digital signal processors (DSP).
Course objectives: Familiarity with concepts of digital control. Familiarity with structure of digital control systems. Familiarity with analysis and design methods for digital control systems. Implementation of microprocessor based digital controllers, hardware and software parts. Familiarity with advanced digital control devices.
Learning outcomes: On successful completion of the course, students will be able to:

- understand digital control systems;
- evaluate performances of digital control systems and be able to take necessary measures to improve them;
- design microprocessor based system for implementing digital controller;
- write software support for implementing digital controllers;
- get involved in streams of advanced digital control.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, numerical exams, laboratory exams, seminary work.
Evaluation methods: Intermediary evaluations 15%+15%, Project 40%, Final exam 15%+15%.
Concretization tools: Computer, projector, simulator, development systems, and experimental plants.
Ratio between the theoretical and practical part: 40:60
Literature:

1. B.C. Kuo, Digital Control Systems, Saunders College Publishing, Florida
2. C.H. Houpis, G.B. Lamont, Digital Control Systems: Theory, Hardware, Software, McGraw-Hill, New York.
3. R.C. Dorf and R.H. Bishop, Modern Control Systems, Prentice Hall, 2005
4. G.F. Franklin, J.D. Powell, and M. Workman, Digital Control of Dynamic Systems, Addison Wesley, 3rd Ed., 1998
5. G. C. Goodwin, Stefan F. Graebe and M. E. Sagado, Control System Design, Prentice-Hall, Inc., 2001
6. Lavdim Kurtaj, Mechatronical Project, WUS-Austria and University of Prishtina, 2011
7. Renesas Synergy Development Kit, User's Manual, Renesas Electronics, 2015

Course title: Cyber Security (2+0+2) 5 ECTS
Lecturer: Prof. Dr. Blerim Rexha
Course status: Mandatory

Course content: Introduction to Cyber Security and various challenges in cyber security. Cyber Security Vulnerabilities and attacks. Access Control and Security Policies Securing. Web Application, Services and Servers. Internet of Things (IoT) Security. Intrusion Detection and Prevention. Encryption and Cryptography. Risk Management and Emergency Planning. Cyberspace and the Law. Cyber Forensics and Incident Management.

Course objectives: Understand cybersecurity basics and challenges, such as threats, attacks, and vulnerabilities in the digital world. Identify access control methods, security policies, and best practices to safeguard networks, systems, and cyber data from unauthorized access and breaches. Master skills to detect, prevent, and address cyber threats, including unauthorized access, hacker intrusions, and security breaches. Apply encryption and cryptography techniques to secure digital data and communications, including using security algorithms and digital certificates. Develop skills in risk management and emergency planning to respond to cybersecurity breaches, including identifying, assessing, and managing risks, as well as preparing for emergencies and recovering from damage.

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

1. Evaluate fundamental cyber security concepts, theories, and strategies as they apply to real world case studies.
2. Identify, implement, and describe effective access control techniques, security policies, and best practices to safeguard networks, systems, and data from unauthorized access and security breaches.
3. Explain technical and non-technical security solutions on different types of cyber systems.
4. Assess risks, vulnerabilities, and threats to sample cyber systems.
5. Identify attributes associated with cyber security professionals.

Prerequisites:

- Fundamentals of computer software and hardware.
- Basic concepts of operating system and networking.
- Practical knowledge of internet and use of networks.

Teaching Methods: Lectures and in-class discussions (30 hours) + 30 hours of lab exercises. Case studies and practical projects, Readings and analysis of written materials, Practical demonstrations of cybersecurity tools.

Grading System: Classroom Assessment 10%, Projects 40%, Final assessment 50 %

Concretization tools/TI: For lectures, computers, projectors and tables are used, while the practical part will take place at the lab.

Literature:

1. Charles J. Brooks, Christopher Grow, Philip A. Craig Jr., Donald Short. Cybersecurity Essentials, Sybex, 1st Edition, 2018.

2. Robin Sharp. Introduction to Cybersecurity: A Multidisciplinary Challenge. 1st Edition Springer, 2024.

Yuri Diogenes, Erdal Ozkaya. Cybersecurity. Attack and Defense Strategies, 3rd Edition, Packt Publishing, 2022.

Course: **Nonlinear Control Systems (2+0+2) 5 ECTS**
Lecturer: **Prof. Dr. Sabrije Osmanaj/Mr. Sc. Arben Mashkulli, PhD Candidate**
Course status: **Elective**

Brief overview: Introduction to general concepts of nonlinear dynamic systems. The difference between the mathematical apparatus used in the linear and nonlinear control systems. The influence of nonlinear components and other forms on nonlinearity in the study of control systems. Methods of analyzing nonlinear systems. Pendulum, definition, and equations. Limit cycles and their properties. Types of singular point and their analysis. Nonlinear system analysis in the phase plane and their phase trajectories. Phase trajectories for typical nonlinear components. Nonlinear system analysis using the isoclines method. The Linearization of Nonlinear Components., its role and importance on analysis of nonlinear systems. Types of linearization. Static Linearization. Differential Linearization. Stochastic Linearization. Harmonic Linearization.The describing function: nonlinear system study using the describing function. Deriving describing functions for typical nonlinear elements. Deriving oscillation parameters using different methods. Stability testing of nonlinear dynamic systems based on Lyapunov stability theory. Lyapunov's indirect method for stability. Ljapunov's direct method for stability. The problem of Lurie. Popov's method and its geometric interpretation.

The goal: This course aims to introduce the students to the nonlinear counterpart of control systems. The discussions will focus on the influence of typical nonlinear components and other forms of nonlinearity on the response of control systems. Different forms of analyzing nonlinear systems will be introduced.

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

- Tell the difference between linear systems (modeled in the working point) and systems with nonlinearities in them.
- Observe the distortions that nonlinear components introduce in control systems and the influence of these distortions on the performance of control systems
- Apply the phase plane method and the isoclines method to analyze system features.
- Understand special effects that are only found in nonlinear systems (such as limit cycles)
- Fully understand the concept of describing function and its importance in the study of nonlinear control systems.
- Emphasizing the concept of nonlinear system stability by giving comprehensive analyses with the stability concept of the linear systems.

Teaching methodology: 30 hours of lectures, 15 hours of numerical exercises, and 15 hours of laboratory exercises. Approximately 60 hours of personal study and exercise including seminars.

Grading System:
Seminar 10%, Mid-term exams 30 %, Final Exam 60 %
Necessary tools: During lecture sessions a computer with projector is needed, while the practical session will be realized in the numerical class session (laboratory).
The ratio between theoretical and practical work***:*** 60:40

Literature:

1. A. Mashkulli, *Sistemet Jolineare të Rregullimit*- Authorized Lecture Notes*,* 2018.
2. H. K. Khalil, *Nonlinear Control,* Pearson, 2015.
3. H. K. Khalil, *Nonlinear Systems,* Pearson, *2002*.
4. Jurgen Adamy, *Nonlinear Systems and Controls*, 2022.
5. Z. Vukic, L. Kuljaca, *Nonlinear Control Systems, 2003*

Course: **Machine learning (2+0+1) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Faton Maliqi**
Course status: **Elective**

Course content: This course introduces students to the field of machine learning, focusing on fundamental concepts, algorithms, and applications. Topics include supervised and unsupervised learning, regression, classification, clustering, neural networks, deep learning, and ethical considerations in machine learning.

Course objectives: This course aims to provide students with a solid foundation in machine learning by introducing key concepts, algorithms, and applications. Students will learn to implement and evaluate machine learning models, including regression, classification, clustering, and neural networks. They will also explore ethical considerations in machine learning. Through assignments and projects, students will develop problem-solving skills and gain practical experience in applying machine learning techniques to real-world datasets. The course will prepare students for advanced studies and research in machine learning while fostering critical thinking, analysis, and effective communication of machine learning concepts and results.

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

- Understand and explain fundamental machine learning concepts and algorithms;
- Implement and apply machine learning algorithms to solve real-world problems;
- Evaluate and interpret machine learning models;
- Recognize ethical considerations in machine learning.
- Discuss issues such as bias, fairness, and privacy in machine learning applications.

Prerequisites:

- Basic understanding of linear algebra;
- Basic knowledge of probability and statistics;
- Programming experience in a high-level language (e.g., Python)

Teaching Methods: Lectures and in-class discussions (30 hours) + 15 hours of lab exercises. Case studies and practical projects, readings and analysis of written materials, practical demonstrations of machine learning tools associated with Matlab or Python.

Grading System: Classroom Assessment 10%, Projects 40%, Midterm Exam 20%, Final exam 30%.

Concretization tools/TI: For lectures, computers, projector and tables are used, while the practical part will take place at the lab.

Literature:

1. Sebastian Raschka, Vahid Mirjalili, “Python Machine Learning”, Packt, 3rd Edition, 2019;
2. Andriy Burkov, “Machine Learning Engineering”, True Positive Inc., 2020;
3. Christoph Molnar, “Intepretable Machine Learning”, Lulu.com, 2019;

Course title: Real-time Control Systems (2+0+2) 5 ECTS
Lecturer: Prof. Ass. Dr. Lavdim Kurtaj
Course status: Elective

Course content: Introduction to Real-Time Systems. Definitions of Real-time systems. Embedded systems. Designing and Developing Real-time Systems. Architecture. Interrupts and Exceptions. Timers and Real-time Facilities. Real-Time Devices. Event driven activities, state machines. I/O Devices and Buses: Serial devices and parallel devices, Peripheral serial buses. Multitasking in Real-Time Systems: Scheduling, Synchronization, Inter-task communication. Real-time kernels and operating systems. Data Acquisition and Control Systems: Analog to digital conversion and digital to analog conversion, multi-threaded real-time data acquisition, applications using real-time data acquisition and control. Periodic and event-based control tasks. Integrated Control and Scheduling. Implementation aspects. Control over networks.

Course objectives: The aim of the course is that the student should learn how to design and implement computer-based control systems that meets task real-time requirements.

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

- implement a computer-based control systems using concurrent programming techniques;
- apply basic scheduling analysis for real-time systems;
- use state machines for implementation of event-based control systems;
- design multitask programs where communication and synchronization is realized using semaphores, monitors, and messages;
- design and program a computer-based control system on PID form and state-space form;
- understand how time-delays and jitter affect control performance;
- understand the problems associated with control over networks.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, laboratory exams, projects.

Evaluation methods: Intermediary evaluations 10%+10%, Laboratory exams 20%, Project 30%, Final exam 15%+15%.

Concretization tools: Computer, projector, simulator, development systems and experimental plants.

Ratio between the theoretical and practical part: 40:60

Literature:

1. Jiacun Wang, *Real-Time Embedded Systems*, Wiley, 2018
2. Jane W. S. Liu, *Real-Time Systems*, Prentice-Hall, 2000
3. Amitava Gupta, Anil Kumar Chandra, Peter Luksch, *Real-Time and Distributed Real-Time Systems: Theory and Applications*, CRC Press, 2016
4. Sam Siewert and John Pratt, *Real-time embedded components and systems : with Linux and RTOS*, Mercury Learning and Information, 2016
5. Insup Lee, Joseph Y-T. Leung, Sang H. Son, *Handbook of Real-Time and Embedded Systems*, CRC Press, 2007
6. Tian Seng Ng, *Real Time Control Engineering: Systems And Automation*, Springer, 2016

7. Kim R. Fowler, *What Every Engineer Should Know About Developing Real-Time Embedded Products*, CRC Press, 2008
8. Rob Williams, *Real-Time Systems Development*, Butterworth-Heinemann, 2005
9. Lavdim Kurtaj, *Mechatronical Project*, WUS-Austria and University of Prishtina, 2011
10. Renesas Synergy Development Kit, User's Manual, Renesas Electronics, 2015
11. Asif Mahmood Mughal, *Real Time Modeling, Simulation and Control of Dynamical Systems*, Springer, 2016

Subject: **Computer Data Acquisition and Analysis (2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Drilon Bunjaku**
Course status: **Elective**

Brief overview: Introduction to structure of data acquisition systems. Concentrated local systems. Input units for different types of data sources: discrete and analog, slow and fast, periodical and transitory, with small and large amounts of data. Storing media, volume, access time, and security. Processing software with general dedication (MATLAB and LabVIEW). Development user dedicated applications (C, C++, VB, assembler and specialized software). Distributed systems and communication infrastructure. Clock synchronization (time). Communication over wired networks (RS-232, RS-485, CAN, Ethernet). Communication over power lines and optical fibers. Wireless communication and exploitation of existing communication networks (radio links, ZigBee, WiFi, GPS, GPRS). Communication protocols (IEC, DNP, ModBus) and protocol converters for communication over heterogeneous networks. Remote terminal units. Systems for supervisory control and data acquisition. Units for presenting data and analysis results as well as communicating with humans.

The goal: The goal of the course is to provide an introduction to computer systems for data acquisition from different sources by type, speed, amount and space distribution, storing collected data, analyzing and presenting results of analysis.

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

- estimate type of data and to select adequate acquisition system;
- design and implement local system for data acquisition;
- use different mechanisms for transporting data to distance, with wires ore wireless;
- understand and use systems for storing massive amount of data;
- develop applications for data processing;
- design and program systems for presenting results in as much as possible human friendly form;
- secure data during their collection, processing, and transmission.

Teaching methodology: 30 hours of lectures, 15 hours of numerical exercises and 15 hours of laboratory exercises. Approx. 75 independent working hours, including home works (or seminar paper).

Grading System: Mid-term exams 10%+10%, Lab. work 20%, Project 30%, Final exam 30%.

Necessary tools: During lecture sessions a computer with projector is needed, while the practical session will be realized in the numerical class session (laboratory).

The ratio between theoretical and practical work: 40:60

Literature:

1. John Park, Steve Mackay, *Practical Data Acquisition for Instrumentation and Control Systems*, Newnes, 2003
2. David Bailey, Edwin Wright, *Practical SCADA for Industry*, Newnes, 2003
3. Viktor Boed, *Networking and Integration of Facilities Automation Systems*, CRC Press, 1999

4. Gordon Clarke, Deon Reynders, *Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems*, Newnes, 2004
5. Michele Vadursi (Ed.), *Data Acquisition*, Sciyo, 2010

Course title: **Building Automation (2+0+2) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Lavdim Kurtaj**
Course status: **Elective**
Course content: Common electrical installation. System structure in home and buildings. Topologies, potential and importance of automation. Intelligent buildings. Comfort, security, and energy savings. Historical development and integrated communication infrastructure. Direct digital control. Residential building automation as a distributed control system. Collecting information from sensors. Recording, monitoring, and alarming. Actuators and interconnection with communication infrastructure. Functional interconnection of sensors and actuators over a communication network. Control centers and accessing from distance. Ways of communication: dedicated wires, over power lines, wireless, optical fibers. Open and proprietary communication standards (X10, BACnet, LonTalk, KNX/EIB, ZigBee). Configuring and programming. Programming languages: ladder diagram, functional blocks, instruction list, structured text, and structured functional diagrams. Designing and documenting. Integration with future smart networks.
Course objectives: The goal of the course is to introduce systems for home, building, and other objects where people live and work, as a road toward so-called smart buildings. Introduction to topology, communication infrastructure, and constituent elements. Fulfillment of requests for configuration, programming, and documenting the system.
Learning outcomes: On successful completion of the course, students will be able to:

- know functional details of building automation;
- know topologies of building automation systems and their potential;
- design automation system according to given specifications;
- according to gained knowledge to select proper sensors and actuators;
- understand and implement selected communication structure;
- configure and program systems constituents so they can operate as a whole;
- document and understand documentation of automation systems.

Teaching methodology: Combined lectures with simulations and demonstrations, discussions, laboratory exams, projects.
Evaluation methods: Intermediary evaluations 10%+10%, Laboratory exams 20%, Project 30%, Final exam 15%+15%.
Concretization tools: Computer, projector, simulator, development systems and experimental plants.
Ratio between the theoretical and practical part: 40:60
Literature:

1. Shengwei Wang, *Intelligent Buildings and Building Automation*, Spon Press, 2010
2. Hermann Merz, Thomas Hansemann, Christof Hübner, *Building Automation: Communication systems with EIB/KNX, LON und BACnet*, Springer, 2009
3. Viktor Boed, *Networking and Integration of Facilities Automation Systems*, CRC Press, 1999

4. Robert McDowall, *Fundamentals of HVAC Control Systems*, Butterworth-Heinemann, 2006

Course: **Internship (2+0+0) 5 ECTS**
Lecturer: **Prof. Ass. Dr. Lavdim Kurtaj**
Course status: **Mandatory**
Course content: The content of this course depends on the company where the student shall finish 120 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 a 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.
Course objectives: The students gain professional experience, depending on the field of study, in one of the local companies.
Learning outcomes: To be qualified for professional work, in the relevant field of study, and to be more prepared for the labor market.
Teaching methodology: 120 working hours in the company, 30 working hours for the preparation of the presentation of a professional internship.
Evaluation methods: Presentation evaluation 40%, Presentation of the paper: 60%. Total:100%
Ratio between the theoretical and practical part: 0:100

Course title: **Bachelor Thesis 5 ECTS**
Course status: **Mandatory**
Course content: The thesis could be proposed by the supervisor or can be chosen by the student and should be in accordance with the qualification profile. The bachelor thesis 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, and provides instructions for use and directions of future development.
Course objectives: The bachelor thesis is a comprehensive and independent task where the student must 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.
Learning outcomes: Upon completion of this course the student will be able to:

- Gain confidence in knowledge gained;
- Have the ability for further studies of mandatory additional literature;
- Consult with mentor with questions well prepared and structured;
- Present their work in written form, with a 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 a presentation prepared in PowerPoint.

Methods of teaching: Compliant with the actual regulation at the faculty level on how to conduct a bachelor thesis.
Literature: Depending on the bachelor thesis, different literature will be offered from a mentor.