UNIVERSITY OF SPLIT

FACULTY OF ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE

# DETAILED PROPOSAL OF THE STUDY PROGRAMME

## UNDERGRADUATE UNIVERSITY STUDY IN ELECTRICAL ENGINEERING AND INFORMATION TECHNOLOGY

SPLIT, February 2022

## 1.1. List of mandatory and elective courses

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study: 1. | | | | | | | | |
| Semester: I. | | | | | | | | |
| STATUS | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| Mandatory | FEMX01 | Mathematics 1 | 45 | 0 | 45 | 0 | 0 | 7 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study: 1. | | | | | | | | |
| Semester: II. | | | | | | | | |
| STATUS | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| Mandatory | FEMX02 | Mathematics 2 | 45 | 0 | 45 | 0 | 0 | 7 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study: 2. | | | | | | | | |
| Semester: III. | | | | | | | | |
| STATUS | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| Mandatory | FEMX03 | Mathematics 3 | 30 | 0 | 30 | 0 | 0 | 5 |
| | FEMA02 | Physics 2 | 45 | 0 | 30 | 15 | 0 | 7 |
| | FETA01 | Economics and Production Organization | 30 | 0 | 0 | 0 | 0 | 3 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study: 2. | | | | | | | | |
| Semester: IV. | | | | | | | | |
| Mandatory | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| | FELA09 | Systems Theory | 45 | 0 | 0 | 15 | 0 | 5 |
| | FELA02 | Electrotechnical Materials and Technology | 30 | 0 | 0 | 15 | 0 | 4 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

**Specialisation: Control and Systems**

| List of courses | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year of study: 3. | | | | | | | | | |
| Semester: V. | | | | | | | | | |
| | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| Mandatory | FELA10 | Electronic Circuits | 30 | 0 | 15 | 15 | 0 | 5 |
| | FELA13 | Object Oriented Programming | 30 | 0 | 0 | 30 | 0 | 5 |
| Elective | FELA40 | Computer and Data Security | 30 | 0 | 0 | 30 | 0 | 5 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study: 3. | | | | | | | | |
| Semester: VI. | | | | | | | | |
| | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| Mandatory | FELA20 | Digital Instrumentation 1 | 30 | 0 | 0 | 15 | 0 | 5 |
| | FELA43 | Wireless Sensor Networks | 30 | 0 | 0 | 30 | 0 | 5 |
| Elective | FELB08 | Databases | 30 | 0 | 0 | 30 | 0 | 6 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

**Specialisation: Electronics and Computer Engineering**

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study: 3. | | | | | | | | |
| Semester: V. | | | | | | | | |
| | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| Mandatory | FELA10 | Electronic Circuits | 30 | 0 | 15 | 15 | 0 | 5 |
| | FELA17 | Computer Architectures | 30 | 0 | 0 | 30 | 0 | 5 |
| | FELA13 | Object Oriented Programming | 30 | 0 | 0 | 30 | 0 | 5 |
| Elective | FELA14 | Internet Programming | 30 | 0 | 0 | 30 | 0 | 5 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study: 3. | | | | | | | | |
| Semester: VI. | | | | | | | | |
| Mandatory | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| | FELA27 | Operating systems | 45 | 0 | 0 | 15 | 0 | 5 |
| | FELA20 | Digital Instrumentation 1 | 30 | 0 | 0 | 15 | 0 | 5 |
| Elective | FENA25 | Diagnostic methods in vehicle | 30 | 0 | 0 | 15 | 0 | 5 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

**Specialisation: Electrical Engineering**

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study: 3. | | | | | | | | |
| Semester: V. | | | | | | | | |
| STATUS | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| | FENA08 | Elements of Electrical Power Switchgears | 45 | 0 | 0 | 15 | 0 | 6 |
| | FENA09 | Power Electronics | 30 | 0 | 0 | 30 | 0 | 6 |
| | FENA10 | Control Engineering | 45 | 0 | 0 | 15 | 0 | 5 |
| | Total | | 210 | 0 | 15 | 90 | 0 | 30 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study: 3. | | | | | | | | |
| Semester: VI. | | | | | | | | |
| STATUS | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| | Total | | 60 | 0 | 15 | 45 | 0 | 22 |
| Elective | FENA15 | Electrical Distribution Networks | 30 | 0 | 0 | 15 | 0 | 4 |
| | FENA20 | Marine Electrical Engineering | 30 | 0 | 0 | 15 | 0 | 4 |
| | FENA25 | Diagnostic methods in vehicles | 30 | 0 | 0 | 30 | 0 | 5 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

**Specialisation: Communication and Information Technology**

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study 3. | | | | | | | | |
| Semester: V. | | | | | | | | |
| STATUS | CODE | PREDMET | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| | FELA13 | Object Oriented Programming | 30 | 0 | 0 | 30 | 0 | 5 |
| | FELA17 | Computer Architectures | 30 | 0 | 0 | 30 | 0 | 5 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

| List of courses | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year of study: 3. | | | | | | | | |
| Semester: VI. | | | | | | | | |
| STATUS | CODE | COURSE | HOURS IN SEMESTER | | | | | ECTS |
| | | | L | S | AE | LE | DE | |
| Mandatory | FELA32 | Electromagnetic Fields | 30 | 0 | 15 | 15 | 0 | 5 |
| | FELA29 | Digital signal processing | 30 | 0 | 0 | 15 | 0 | 5 |
| | L = lectures, S = seminars, AE = auditory excercise, LE = laboratory excercise, DE = design excercise | | | | | | | |

## 1.2. Course description

| **NAME OF THE COURSE** | **MATHEMATICS 1** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FEMX01 | Year of study | 1 | | | | |
| **Course teacher** | Ivan Slapničar, Ph.D., Full Professor, Anita Matković, Ph.D., Associate Professor, Josipa Barić, Ph.D., Assistant Professor. | Credits (ECTS) | 7 | | | | |
| Associate teachers | Ph.D. Nevena Jakovčević Stor, Irena Bego, Anita Carević, Marija Čatipović, Lea Dujić, Ivana Grgić, Lana Periša, Marina Mandić, Dajana Radišić, Mirjana Strukan, Stjepan Vedran Vukasović, Vanja Županović. | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 45 | | 45 | | |
| Status of the course | obligatory | Percentage of application of e-learning | 10 | | | | |
| **COURSE DESCRIPTION** | | | | | | | |
| Course objectives | Training students for:<br>- application of mathematical concepts and tools from the area of linear algebra, vector calculus, analytic geometry, diferential calculus, analysis of real functions of real variable, sequences and series of numbers and functions, to solving engineering problems. | | | | | | |
| Course enrolment requirements and entry competences required for the course | Good knowledge of High School mathematics and passed State Exam in Mathematics. | | | | | | |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>- state definitions and theorems from the enitre course,<br>- reproduce proofs of basic theorems,<br>- illustrate theorems with examples,<br>- solve systems of linear equations,<br>- apply vector calculus to analytical geometry of space,<br>- interpret derivatives mathematically, geometrically and physically,<br>- analyse functions of one variable,<br>- test convergence of sequences and series of numbers and functions. | | | | | | |

| Course content broken down in detail by weekly class schedule (syllabus) | Course content | L or S hours | AE hours |
|---|---|---|---|
| | 1. Introduction. Relations. Functions. Sets of numbers, complex numbers, trigonometric form of complex number, Moivre formulas. | 3 | 3 |
| | 2. Matrices. Basic operations with matrices. Matrix formulation of system of linear equations. Gaussian elimination. Linear independence and rank of a matrix. Kronecker-Capelli theorem. | 3 | 3 |
| | 3. Inverse matrix. Determinants. Submatrices and subdeterminants. Laplace expansion of a determinant. Cramer's rule. | 3 | 3 |
| | 4. Vectors. Basic operations with vectors. Coordinate system. Unit vector and cosines of directions. Linear independence of vectors and basis of a space. Scalar (dot) product, vector product and mixed product. | 3 | 3 |
| | 5. Equations of a line. Equations of a plane. Applications of analytic geometry. | 3 | 3 |
| | 6. Functions of a real variable: defining function, classification of functions. Limits and continuity. Asymptotes. Review of elementary functions. | 3 | 3 |

| | | | |
|---|---|---|---|
| | 7. Derivatives. Tangent and normal. Differential and approximate computation. | 3 | 3 |
| | 8. Higher derivatives and differentials. Derivatve of a parametric function. Theorems of differential calculus (Fermat, Rolle, Cauchy, Lagrange). L'Hospital's rule and limits of undetermined forms. | 3 | 3 |
| | 9. Monotonicity. Necessary and sufficient conditions for extrema. Geometrical extrema. | 3 | 3 |
| | 10. Curvature. Sufficient condition for convexity and concavity. Necessary and sufficient conditions for inflection points. Examining functions and drawing graphs. | 3 | 3 |
| | 11. Sequences of real numbers. Basic inequality of convergence. Accumulation point and sub-sequence. Boundedness, monotonicity and convergence. Properties of limits. Cauchy series. Some important limits. | 3 | 3 |
| | 12. Series of real numbers. Sufficient condition for convergence. Convergence criteria. Absolute convergence. Alternating series. | 3 | 3 |
| | 13. Sequences of functions. Series of functions. Power series and convergence radius. Differentiating series of functions. Taylor series and applications. | 3 | 3 |
| | List of laboratory or design exercises | | LE or DE hours |
| | | | |
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☒ independent assignments<br>☐ multimedia<br>☐ laboratory<br>☐ work with mentor<br>☐ (other) | |
| Student responsibilities | | | |

| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | | | | | | |
|---|---|---|---|---|---|---|
| Class attendance | 3 | Research | | Practical training | |
| Experimental work | | Report | | Self study | 3.6 |
| Essay | | Seminar essay | | (Other) | |
| Tests | 0.2 | Oral exam | | (Other) | |
| Written exam | 0.2 | Project | | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | During semester two mid-term exams are held. The first exam is scheduled after 7 weeks of lectures, and the second in the week following the lectures. At each mid-term exam students can get 40 points, while the remaining 20 points are attained through assignements during lectures and excercises. The condition for passing the course is minimum 20 points on each mid-term exams and a total of at least 50 points. After semester, two final exams and a correction exam are held.<br><br>Students which did not pass one mid-term exam, can take only this part of the exam during final exams.<br><br>Student which did not pass any mid-term exam, take the final exam with comprehensive course content. In that case, masimum numbers of available points is 80. The condition for passing the course is minimum 40 points in the final exam and a total of at least 50 points. The grade is formed after the second final exam according to article 75 of the Statute of FESB:<br>15% of the best students get the mark excellent (5),<br>next 35% students get the mark very good (4),<br>next 35% students get the mark good (3), and<br>the last 15% students get thet mark sufficient (2). |

<table>
<tr><td></td><td colspan="3">Students who did not pass the course after final exams, and have obtained total of at leat 10 points, can attend the correction exam. On the correction exam maximal number of points is 100, and the minimum requirement for a passing grade is 50 points.<br><br>Mid-term exams, final exams and correction exams are held according to the exam schedule.</td></tr>
<tr><td rowspan="4">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>I. Slapničar, Matematika 1, FESB, Split, 2002.</td><td>20</td><td>http://www.fesb.unist.hr/mat1</td></tr>
<tr><td>I. Slapničar, J. Barić, M. Ninčević, Matematika 1 – zbirka zadataka, FESB, Split, 2010.</td><td>20</td><td>http://www.fesb.unist.hr/mat1</td></tr>
<tr><td>Lecture materials on FESB e-learning portal.</td><td></td><td>httpd://elearning.fesb.unist.hr</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">- Petar Javor, Matematička analiza 1, Element, Zagreb, 2001.<br>- Luka Krnić i Zvonimir Šikić, Račun diferencijalni i integralni, I. dio, Školska knjiga, Zagreb, 1993.<br>- S. Pavasović i ostali, Matematika - riješeni zadaci, Građevinski fakultet, Split, 1999.<br>- B. P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1995.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">- homework<br>- short tests<br>- quizzes<br>- mid-term exams<br>- final exam<br>- student questionnaires</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

| **NAME OF THE COURSE** | **MATHEMATICS 2** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FEMX02 | Year of study | 1 | | | | |
| **Course teacher** | Ivan Slapničar, Ph.D., Full Professor,<br>Anita Matković, Ph.D., Associate Professor,<br>Josipa Barić, Ph.D., Assistant Professor. | Credits (ECTS) | 7 | | | | |
| Associate teachers | Ph.D. Nevena Jakovčević Stor, Irena Bego, Anita Carević, Marija Čatipović, Lea Dujić, Ivana Grgić, Lana Periša, Marina Mandić, Dajana Radišić, Mirjana Strukan, Stjepan Vedran Vukasović, Vanja Županović. | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 45 | | 45 | | |
| Status of the course | obligatory | Percentage of application of e-learning | 10 | | | | |

| **COURSE DESCRIPTION** | |
|---|---|
| Course objectives | Training students for:<br>- application of mathematical concepts and tools from the area of integral calculus, ordinary differential equations, functions of several variables and multiple integrals, to analyze and solve engineering problems. |
| Course enrolment requirements and entry competences required for the course | Good knowledge of High School mathematics and passed State Exam in Mathematics. |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>- state definitions and theorems from the enitre course,<br>- reproduce proofs of basic theorems,<br>- illustrate theorems with examples,<br>- identify integrals which are elementary integrable and solve them.<br>- solve ordinary differential equations and systems of differential equations.<br>- apply differential equations to model population growth, heat conduction, the oscillator and the predator-prey system.<br>- identify quadratic surfaces<br>- analyze the extrema of real functions of several variables.<br>- apply a single and multiple definite integrals to computation of area, curve length, volume and center of gravity in the standard coordinate systems. |

| Course content broken down in detail by weekly class schedule (syllabus) | Course content | L or S hours | AE hours |
|---|---|---|---|
| | 1. Indefinite integrals. Definition and basic properties. Table of basic integrals. Basic techniques of integration. | 3 | 3 |
| | 2. Integration of rational functions. Integration of trigonometric functions. Recursive formulae. | 3 | 3 |
| | 3. Integration of some irrational functions. Integrating a series of functions. Application of integrals to free fall with air resistance problem. | 3 | 3 |
| | 4. Definite integrals. Definition and basic properties. Newton-Leibnitz formulae. Techniques of integration. Improper integrals. | 3 | 3 |
| | 5. Application of definite integrals - the length of arc planar curve, volume and surface area of the rotating body. Numerical integration – trapezoid rule, Simpson's rule, Richardson extrapolation. | 3 | 3 |
| | 6. The functions of several variables. Definition and basic properties. Domain of the function. Limits and continuity. Quadratic surfaces. | 3 | 3 |

| | | | |
|---|---|---|---|
| | 7. Partial derivatives. Differentiability. Tangent plane. Extrema of functions of several variables. Conditional extrema. | 3 | 3 |
| | 8. Multiple integrals. Basic concepts and definitions. Double integral. Double integral in polar coordinates. Applications of double integral. | 3 | 3 |
| | 9. Triple integral. Triple integral in cylindrical and spherical coordinates. Change of variables in multiple integrals. | 3 | 3 |
| | 10. Introduction to Differential Equations. Basic concepts and definitions. Examples: modeling population growth, logistic equation, equation of heat conduction, Hooke's law. Equations with separable variables. | 3 | 3 |
| | 11. Homogeneous differential equations. Exact differential equations. Integration factor. Linear differential equations of the first order. | 3 | 3 |
| | 12. Bernoulli differential equation. Euler method as numerical procedure for solving linear differential equations. Differential equations of second order. | 3 | 3 |
| | 13. Linear differential equations of second order with constant coefficients. Example: electronic circuits - harmonic oscillator. Systems of differential equations. Lotka-Volterra equations for predator-prey system. | 3 | 3 |
| | List of laboratory or design exercises | | LE or DE hours |
| | | | |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☒ independent assignments<br>☐ multimedia<br>☐ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 3 | Research | | Practical training | |
| | Experimental work | | Report | | Self study | 3.6 |
| | Essay | | Seminar essay | | (Other) | |
| | Tests | 0.2 | Oral exam | | (Other) | |
| | Written exam | 0.2 | Project | | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | During semester two mid-term exams are held. The first exam is scheduled after 7 weeks of lectures, and the second in the week following the lectures. At each mid-term exam students can get 40 points, while the remaining 20 points are attained through assignements during lectures and excercises. The condition for passing the course is minimum 20 points on each mid-term exams and a total of at least 50 points.<br>After semester, two final exams and a correction exam are held.<br>Students which did not pass one mid-term exam, can take only this part of the exam during final exams.<br><br>Student which did not pass any mid-term exam, take the final exam with comprehensive course content. In that case, maximum numbers of available points is 80. The condition for passing the course is minimum 40 points in the final exam and a total of at least 50 points. The grade is formed after the second final exam according to article 75 of the Statute of FESB:<br>15% of the best students get the mark excellent (5),<br>next 35% students get the mark very good (4),<br>next 35% students get the mark good (3), and<br>the last 15% students get thet mark sufficient (2). |

<table>
<tr><td rowspan="1"></td><td colspan="3">Students who did not pass the course after final exams, and have obtained total of at least 10 points, can attend the correction exam. On the correction exam maximal number of points is 100, and the minimum requirement for a passing grade is 50 points.<br><br>Mid-term exams, final exams and correction exams are held according to the exam schedule.</td></tr>
<tr><td rowspan="3">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>I. Slapničar, Matematika 2, skripta, FESB, Split</td><td></td><td>http://www.fesb.unist.hr/mat2</td></tr>
<tr><td>Lecture materials on FESB e-learning portal.</td><td></td><td>https://elearning.fesb.unist.hr</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">- Petar Javor, Matematička analiza 2, Element, Zagreb, 2000.<br>- Luka Krnić i Zvonimir Šikić, Račun diferencijalni i integralni, I. dio, Školska knjiga, Zagreb, 1993.<br>- B. P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1995.<br>- Dž. Lugić, Matematika II: metodički riješeni zadaci i kratki pregled definicija i teorema, FESB, 1999.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">- homework<br>- short tests<br>- quizzes<br>- mid-term exams<br>- final exam<br>- student questionnaires</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

| **NAME OF THE COURSE** | **MATHEMATICS 3** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FEMX03 | Year of study | 2 | | | | |
| **Course teacher** | Ivan Slapničar, Ph.D., Full Professor,<br>Anita Matković, Ph.D., Associate Professor,<br>Josipa Barić, Ph.D., Assistant Professor | Credits (ECTS) | 5 | | | | |
| Associate teachers | Ph.D. Nevena Jakovčević Stor, mr. sc. Ivančica Mirošević, Irena Bego, Anita Carević, Marija Čatipović, Lea Dujić, Ivana Grgić, Lana Periša, Marina Mandić, Dajana Radišić, Mirjana Strukan, Stjepan Vedran Vukasović, Vanja Županović | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 30 | | 30 | | |
| Status of the course | obligatory | Percentage of application of e-learning | 10 | | | | |

**COURSE DESCRIPTION**

| | |
|---|---|
| Course objectives | Training students for:<br>application of mathematical concepts and tools from the area of Vector analysis, Fourier analysis and Laplace transformation, to analyze and solve engineering and economy problems. |
| Course enrolment requirements and entry competences required for the course | Passed courses Mathematics 1 and Mathematics 2. |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>- state definitions and theorems from the enitre course,<br>- illustrate basic notions and connections between them with examples,<br>- apply Hamilton differencial operator on scalar and vector fields,<br>- calculate line integrals over scalar and vector fields,<br>- calculate surface integrals over scalar and vector fields,<br>- represent functions by Fourier series and integral,<br>- solve differential equations by use of Laplace transformation. |

| Course content broken down in detail by weekly class schedule (syllabus) | Course content | L or S hours | AE hours |
|---|---|---|---|
| | 1. Vector analysis. Vector functions of scalar variable. Limits and continuity. Derivative and integral. | 2 | 2 |
| | 2. Scalar and vector fields. Gradient, divergence and curl. Hamilton and Laplace operator. | 2 | 2 |
| | 3. Conservative and solenoidal fields. Sidelong derivatives. | 2 | 2 |
| | 4. Line integrals. Curve parametrization. Tangent line. Line integral of a scalar field. | 2 | 2 |
| | 5. Line integral of a vector field. Flow, calculation of scalar potential and Green's theorem. | 2 | 2 |
| | 6. Surface integrals. Surface parametrization. Tangent plane. Surface integral of a scalar field. | 2 | 2 |
| | 7. Surface integral of a scalar field. Gauss and Stokes theorems and their applications. | 2 | 2 |
| | 8. Fourir analysis. Periodic functions and periodic extensions. Ortogonal trigonometric systems. | 2 | 2 |
| | 9. Fourier series. Dirichlet's conditions. Convergence of Fourier series. | 2 | 2 |

| | | | |
|---|---|---|---|
| | 10. Fourer series for even and odd functions. Parseval's equality. | 2 | 2 |
| | 11. Fourier integral. Fourier transformation, inverse Fourier transformation theorems and their applications. | 2 | 2 |
| | 12. Laplace transformation. Basic properties of Laplace's transformation. Inverse Laplace transformation. | 2 | 2 |
| | 13. Convolution. Applications to differential equations. | 2 | 2 |
| | List of laboratory or design exercises | | LE or DE hours |
| | | | |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☒ independent assignments<br>☐ multimedia<br>☐ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | Regular attendence to and active participation in lectures and excercises. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 2 | Research | | Practical training | |
| | Experimental work | | Report | | Self study | 2.6 |
| | Essay | | Seminar essay | | (Other) | |
| | Tests | 0.2 | Oral exam | | (Other) | |
| | Written exam | 0.2 | Project | | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | During semester two mid-term exams are held. The first exam is scheduled after 7 weeks of lectures, and the second in the week following the lectures. At each mid-term exam students can get 40 points, while the remaining 20 points are attained through assignements during lectures and excercises. The condition for passing the course is minimum 20 points on each mid-term exams and a total of at least 50 points.<br><br>After semester, two final exams and a correction exam are held.<br>Students which did not pass one mid-term exam, can take only this part of the exam during final exams.<br><br>Student which did not pass any mid-term exam, take the final exam with comprehensive course content. In that case, maximum numbers of available points is 80. The condition for passing the course is minimum 40 points in the final exam and a total of at least 50 points. The grade is formed after the second final exam according to article 75 of the Statute of FESB:<br><br>15% of the best students get the mark excellent (5),<br>next 35% students get the mark very good (4),<br>next 35% students get the mark good (3), and<br>the last 15% students get thet mark sufficient (2).<br><br>Students who did not pass the course after final exams, and have obtained total of at least 10 points, can attend the correction exam. On the correction exam maximal number of points is 100, and the minimum requirement for a passing grade is 50 points.<br><br>Mid-term exams, final exams and correction exams are held according to the exam schedule. |

| | **Title** | **Number of copies in the library** | **Availability via other media** |
|---|---|---|---|
| Required literature (available in the library and via other media) | L. Korkut, M. Krnić, M. Pašić, Vektorska analiza, Element, Zagreb, 2014. | 5 | |
| | N. Elezović, Fourierov red i integral, Laplaceova transformacija, Element, Zagreb, 2014. | 5 | |
| | Ivan Slapničar, Matematika 3, FESB, Split | | http://www.fesb.unist.hr/mat3 |
| | Lecture materials on FESB e-learning portal. | | https://elearning.fesb.unist.hr/ |
| Optional literature (at the time of submission of study programme proposal) | Luka Krnić i Zvonimir Šikić, Račun diferencijalni i integralni, I. dio, Školska knjiga, Zagreb, 1993.<br>- B. P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1995.<br>- Dž. Lugić, Matematika II: metodički riješeni zadaci i kratki pregled definicija i teorema, Sveučilište u Splitu, FESB, 1999. | | |
| Quality assurance methods that ensure the acquisition of exit competences | - homework<br>- short tests<br>- quizzes<br>- mid-term exams<br>- final exam<br>- student questionnaires | | |
| Other (as the proposer wishes to add) | | | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="7">PHYSICS 2</td></tr>
<tr><td>Code</td><td>FEMA02</td><td>Year of study</td><td colspan="5">2</td></tr>
<tr><td>Course teacher</td><td>Ivica Puljak, Ph.D., Full Professor, Nikola Godinović, Ph.D., Associate Professor, Ilja Doršner, Ph.D., Associate Professor, Damir Lelas, Ph.D., Assistant Professor</td><td>Credits (ECTS)</td><td colspan="5">7</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Dunja Polić, Ivica Sorić<br>Toni Šćulac, Darko Zarić, Toni Vrdoljak</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>45</td><td>0</td><td>30</td><td>15</td><td>0</td></tr>
<tr><td>Status of the course</td><td>Obligatory</td><td>Percentage of application of e-learning</td><td colspan="5">0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="7">Training students for:<br>- understanding of basic laws of classical and quantum physics;<br>- ability to apply laws of classical and quantum physics to real-life problems.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="7">None</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="7">Students will be able to:<br>- define fundamental physical variables and equations that are used to describe simple harmonic oscillations, dumped harmonic oscillations and forced harmonic oscillations;<br>- name types of mechanical waves and provide associated examples;<br>- apply superposition principle to evaluate interference between two or more coherent waves;<br>- describe Maxwell's equations;<br>- define fundamental quantities and laws that are used in geometric and physical optics;<br>- explain quantum nature of light using the example of photoelectric effect;<br>- name quantum numbers of atoms;<br>- describe wave nature of matter.</td></tr>
<tr><td rowspan="8">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="4">Course content</td><td colspan="2">L or S hours</td><td>AE hours</td></tr>
<tr><td colspan="4">Matter elasticity. Simple harmonic motion. Mathematical and physical pendulum. Dumped oscillations. Resonant oscillations.</td><td colspan="2">3</td><td>2</td></tr>
<tr><td colspan="4">Interference of harmonic oscillations. Mechanical waves: nomenclature, simple harmonic wave, wave equation, wave equation of transversal wave on a wire, energy of mechanical waves.</td><td colspan="2">3</td><td>2</td></tr>
<tr><td colspan="4">Wave superposition. Reflection and transmition of waves. Standing waves. Wave interference. Wave packets. Phase and group wave speed. Spherical waves, plane waves.</td><td colspan="2">3</td><td>2</td></tr>
<tr><td colspan="4">Sound waves. Sound intensity and loudness. Doppler's effect. Ultrasound.</td><td colspan="2">3</td><td>2</td></tr>
<tr><td colspan="4">Gauss' law for electric and magnetic fields, Amper's law. Biot-Savart's law. Electromagnetic oscillations..</td><td colspan="2">3</td><td>2</td></tr>
<tr><td colspan="4">Maxwell's equations. Electromagnetic waves.</td><td colspan="2">3</td><td>2</td></tr>
<tr><td colspan="4">Geometrical optics. Laws of geometrical optics. Mirrors. Lenses. Magnifying glass. Microscope. Physics of human eye.</td><td colspan="2">3</td><td>2</td></tr>
</table>

| | | | |
|---|---|---|---|
| | Physical optics. Interference. Young's experiment. Optical lattice. | 3 | 2 |
| | Heat radiation. Ultraviolet catastrophe. Planck's law of black body radiation. Quanta of light. Photoelectric effect. Compton's effect. | 3 | 2 |
| | Atomic structure. Line spectra. Rutherford's model of atom. Bohr's model of atom. | 3 | 2 |
| | Quantum numbers. Periodic system of elements. Roentgen's radiation. Lasers. | 3 | 2 |
| | Wave nature of matter. | 3 | 2 |
| | Atomic nucleus. | 3 | 2 |
| | List of laboratory or design exercises | | LE hours |
| | Mathematical pendulum | | 1 |
| | Physical pendulum | | 1 |
| | Addition of harmonic oscillations | | 1 |
| | Knut's tube experiment | | 1 |
| | Quink's tube experiment | | 1 |
| | Standing wave | | 1 |
| | Measurements of the earth magnetic dipole moment | | 1 |
| | Demonstrations of magnetism and Faraday law | | 1 |
| | Lenses and mirrors | | 1 |
| | Optical grid experiments | | 1 |
| | Spectral lines of gasses | | 1 |
| | Measurement of the ratio of electron charge and mass | | 1 |

| | | |
|---|---|---|
| Format of instruction | ☒ **lectures**<br>☐ seminars and workshops<br>☒ **exercises**<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☐ independent assignments<br>☐ multimedia<br>☒ **laboratory**<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | The presence on lectures in the amount of at least 70 % of the times scheduled. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 3,0 | Research | | Practical training | |
| | Experimental work | | Report | | Individual work | 3,6 |
| | Essay | | Seminar essay | | (Other) | |
| | Tests | 0,2 | Oral exam | | (Other) | |
| | Written exam | 0,2 | Project | | (Other) | |

**Grading and evaluating student work in class and at the final exam**

There are two midterm exams, two final exams and one make-up exam. The first midterm exam is after 7 weeks of lectures and the second one is after the next 6 weeks. Each midterm test lasts for 105 minutes and consists of the following 6 questions:

- 2 obligatory questions (basic course questions);
- 4 additional questions that test the theory and problem solving knowledge.

The requirement for passing grade at the midterm exams is to have at least 90% from each obligatory question and at least 50% from each of remaining 4 questions. Students that do not pass one of the midterm exams can retake it during the final exams. Final exams lasts 165 minutes each and consist out of the following 12 questions:

- 4 obligatory questions (basic course questions);
- 8 additional questions that test the theory and problem solving knowledge.

<table>
<tr><td></td><td colspan="3">The requirement for passing grade at the final exam is to have at least 90% from each of obligatory questions and at least 50% from each of remaining 8 questions. Final grade is determined using the relative grading system based on the arithmetic mean of the per cents of each of the additional questions. Obligatory questions do not enter the arithmetic mean. Students that have passed both midterm exams or final exams are grouped in four categories: 15% of the students with the highest arithmetic means are assigned grade A (excellent), 35% of the students with the next best arithmetic means are assigned grade B (very good), 35% of the students with the next to next best arithmetic means are assigned grade C (good), and 15% of the students with the lowest passing arithmetic means are assigned grade D (satisfactory).<br>Students who fail to pass the course through midterms and/or final exams have one make-up exam at the beginning of fall. This exam features the same format as the final exam.<br>Exam schedule is predetermined through the academic calendar.</td></tr>
<tr><td rowspan="4">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>V. Henč-Bartolić, P. Kulišić: Valovi i optika, Školska knjiga Zagreb, 1989.</td><td></td><td></td></tr>
<tr><td>V. Henč-Bartolić i suradnici: Riješeni zadaci iz valova i optike, Školska knjiga, Zagreb 1992.</td><td></td><td></td></tr>
<tr><td>J. Vuletin: Zadaci iz Fizike (Titraji i valovi, Toplina, Atomi), FESB, Split, 1996.</td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">- N. Cindro: Fizika 2, Školska knjiga, Zagreb, 1991; D. Halliday, R. Resnick, J. Walker: Fundamentals of Physics, 7th Edition, John Wiley & Sons, Inc., 2005; E. M. Purcell: Udžbenik fizike Sveučilišta u Berkeleyu, Svezak 2., Elektricitet i magnetizam, Tehnička knjiga, Zagreb, 1988; E. V. Wichmann: Udžbenik fizike Sveučilišta u Berkeleyu, Svezak 4., Kvantna Fizika, Tehnička knjiga, Zagreb, 1988.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">- Student evaluation surveys<br>- Teacher self-evaluation<br>- Institutional and non-institutional evaluations</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **NAME OF THE COURSE** | **ECONOMICS AND PRODUCTION ORGANIZATION** | | | | | | | |
| **Code** | FETA01 | Year of study | 2. | | | | | |
| **Course teacher** | Ivica Veža, Ph.D., Full Professor | Credits (ECTS) | 3 | | | | | |
| Associate teachers | | Type of instruction (number of hours) | L | S | AE | LE | DE | |
| | | | 30 | | | | | |
| Status of the course | Obligatory | Percentage of application of e-learning | 0 | | | | | |

**COURSE DESCRIPTION**

| | |
|---|---|
| Course objectives | Training students for:<br>- understanding basic knowledge of production organization theory, and new organization structures<br>- solving problem of profitability (based on income and cost) and equilibrium point (based on supply and demand) |
| Course enrolment requirements and entry competences required for the course | None |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>- define the difference between classic and neoclassic organization theories<br>- define the modern theories of organization<br>- define outer and inner factors that affect the selection of organization structure<br>- calculate fixed and variable costs<br>- calculate equilibrium point |

Course content broken down in detail by weekly class schedule (syllabus)

| Course content | L or S hours | AE hours |
|---|---|---|
| Introduction. Organization basics. | 2 | |
| Theory of organization (classic, neoclassic, modern). Modelling of organization structures. | 2 | |
| Types of organization structures. | 2 | |
| Modern trends in organization modelling. | 2 | |
| Lean Management (VS,5S, kaizen) | 2 | |
| Toyota Production System. | 2 | |
| Parallel engineering, fractal factory. | 2 | |
| Networked factory (virtual factory), business process reengineering, agile manufacturing. | 2 | |
| Organization of material factors. Organization of human resources. | 2 | |
| Organization of control and management. Organization dynamics. | 2 | |
| Enterprise, entrepreneurship, entrepreneur. Legal entities of enterprise. Types of integration of enterprise. | 2 | |
| Organization of business functions. | 2 | |
| Theory of production and costs. Theory of production. Optimal combination of production factors. Production costs. | 2 | |

| List of laboratory or design exercises | LE or DE hours |
|---|---|
| | |

| Format of instruction | | |
|---|---|---|
| | ☒ lectures<br>☒ seminars and workshops<br>☐ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☐ independent assignments<br>☐ multimedia<br>☐ laboratory<br>☐ work with mentor<br>☐ (other) |

<table>
<tr><td>Student responsibilities</td><td colspan="6"></td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1,0</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Individual work (Other)</td><td>2,0</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td>0</td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. In the final exams students that did not pass the midterm exams take part. Each midterm test consists of 5 theoretical questions and lasts for 45 minutes. The midterm and final exams are carried out as written tests. The requirement for passing grade is 40 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula:<br>Grade(%) = 0,5 (M1 + M2)<br>the activities in percentage:<br>- M1, M2 – test results.<br>Final grade is calculated after the second final exam based on the ECTS relative grade system in accordance to Regulations of studies and studying system of University of Split. Students that passed the exam are divided into the four groups: 15% best ones are given grade excellent, next 35% are given grade very good, next 35% grade good, and last 15% grade sufficient. Students that didn’t pass the exam after second final exam write correction exam on the autumn and maximum grade they can get is sufficient. Correction exam is test of the whole curriculum of the course. It is a written test consisting of 10 theoretical questions and lasts for 45 minutes.</td></tr>
<tr><td rowspan="3">Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Dulčić, Ž.; Pavić, I.; Rovan, M.; Veža, I.: Proizvodni menedžment. Fakultet elektrotehnike, strojarstva i brodogradnje – Ekonomski fakultet, Split, 1996.</td><td>5</td><td></td></tr>
<tr><td colspan="4">Sikavica P.; Novak, M.: Poslovna organizacija, informator, Zagreb, 2011.</td><td>5</td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">- Schroeder, R.G.: Upravljanje proizvodnjom, Mate, Zagreb, 2000</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="6">- Assessment of students presence on lectures<br>- Annual institutional evaluation of students success on exams<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Feedback from faculty alumni students of the importance of the curriculum of courses</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="6"></td></tr>
</table>

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **NAME OF THE COURSE** | **SYSTEMS THEORY** | | | | | | | |
| **Code** | FELA09 | Year of study | 2. | | | | | |
| **Course teacher** | Vladan Papić, Ph.D., Full Professor | Credits (ECTS) | 5 | | | | | |
| Associate teachers | Tea Marasović, Ph.D., Assistant Professor<br>Ivo Stančić, Ph.D., Assistant Professor | Type of instruction (number of hours) | L | S | AE | LE | DE | |
| | | | 45 | 0 | 0 | 15 | 0 | |
| Status of the course | Obligatory | Percentage of application of e-learning | 0 | | | | | |

| | |
|---|---|
| **COURSE DESCRIPTION** | |
| Course objectives | Training students for:<br>- Understanding and application of basic principles used in analysis and synthesis of technical systems,<br>- Describing and analysing of simple linear dynamical systems,<br>- Permanent acquiring and deepening of knowledge in the area of theory of technical systems. |
| Course enrolment requirements and entry competences required for the course | None |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>- Explain fundamental principles of systems theory and basic features of systems,<br>- Use standard software packages for analysis of systems,<br>- Apply methods and techniques for descripton of behaviour of linear dynamical systems in time and frequency domain,<br>- Mathematically formulate simple electrical and mechanical systems,<br>- Analyze stability and steady-state errors of linear dynamical systems,<br>- Interprete system using the state variables. |

Course content broken down in detail by weekly class schedule (syllabus)

| Course content | L hours | AE hours |
|---|---|---|
| Introduction to systems | 3 | |
| Linear, nonlinear, variable and non-variable systems, examples | 2 | |
| Transfer function | 3 | |
| Laplace transform, examples | 4 | |
| Block diagrams and signal-flow graphs. | 3 | |
| First order systems. Examples. | 2 | |
| Second order systems. Examples. | 5 | |
| Syste description in frequency domain. | 3 | |
| Nyquist and Bode dijagrams. Examples. | 4 | |
| Graphoanalytical criterium of stability. | 3 | |
| Analitical criterium of stability. | 2 | |
| Steady-state errors. | 2 | |
| Description of system with state variables. | 3 | |

| List of laboratory exercises | LE hours |
|---|---|
| Introduction to MATLAB, Laplace transform in solving differential equations. | 1 |
| Transfer functions and time response. | 2 |
| Modelling and system simulation with Simulink | 2 |
| Time response of first and second order systems. | 2 |
| Frequency analysis: polar and Nyquist plots. | 2 |
| Frequency analysis: Bode plots | 2 |
| Modelling with state variables. | 2 |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☐ independent assignments<br>☒ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | The presence on lectures in the amount of at least 70 % of the times scheduled.<br>Performed all required laboratory exercises. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 1,5 | Research | | Practical training | |
| | Experimental work | | Report | | Individual work | 2,2 |
| | Essay | | Seminar essay | | Laboratory exercises | 0,5 |
| | Tests | 0,2 | Oral exam | | Preparation for laboratory exercises | 0,5 |
| | Written exam | 0,1 | Project | | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. In the final exams students are answering parts they did not pass in the midterms. The midterm and final exams are carried out as written tests and it lasts for max. 75 minutes.<br>The requirement for passing grade is 50% points on each midterm exam or final exam and positive assessment of laboratory exercises. In final grading (in percentage), each midterm exam contributes with max. 40%, lab. exercises with max. 20% out of total possible points (40%+40%+20%).<br>Final grade is formed in the following way:<br>Percentage Grade<br>50% to 61% sufficient (2)<br>62% to 74% good (3)<br>75% to 87% very good (4)<br>88% to 100% excellent (5) |

| Required literature (available in the library and via other media) | **Title** | **Number of copies in the library** | **Availability via other media** |
|---|---|---|---|
| | Papić, V. Teorija sustava, predavanja. Interna skripta. | | e-learning portal |
| | Zanchi, V. : Automatika, 3rd edition, FESB, Split, 2003./2004. | 5 | |
| | Zanchi, V., Cecić M., Šupuk T. : MATLAB podrška u analizi regulacijskih sustava, FESB, Split, 2006. | 5 | |
| | | | |

| | |
|---|---|
| Optional literature (at the time of submission of study programme proposal) | Hohn Van de Vegte: Feedback Control System, Prentice Hall Inc., 1986.<br>Gugić, P.: Teorija automatskog reguliranja I, FESB-Split, 1981. |
| Quality assurance methods that ensure the acquisition of exit competences | - Evaluation of results in accordance with the above learning outcomes<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Institutional and non-institutional evaluations |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="7">ELECTROTECHNICAL MATERIALS AND TECHNOLOGY</td></tr>
<tr><td>Code</td><td>FELA02</td><td>Year of study</td><td colspan="5">2.</td></tr>
<tr><td>Course teacher</td><td>Maja Stella, Ph.D.,<br>Assistant Professor</td><td>Credits (ECTS)</td><td colspan="5">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Prof. dr. sc. Dinko Begušić, Ph.D., Full Professor<br>Josip Lörincz, Ph.D., Assistant Professor</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>30</td><td>0</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Status of the course</td><td>Obligatory</td><td>Percentage of application of e-learning</td><td colspan="5"></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="7">Training students for:<br>- understanding structure, properties, and application of basic materials and technologies in electrical engineering<br>- knowledge and application of conductive, semiconductive, insulating and magnetic materials in electrical engineering,<br>- basic knowledge in microelectronic and optical technologies<br>- permanent adoption and deepening of the knowledge of materials and technology in electrical engineering.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="7">None</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="7">Students will be able to:<br>- define and apply basic knowledge of basic materials and technologies in electrical engineering<br>- evaluate and apply basic materials and technologies<br>- evaluate and apply a conductive, semiconductive, insulating and magnetic materials in electrical engineering<br>- evaluate and apply the fundamental microelectronic and optical technologies<br>- permanently adopt and deepen the knowledge of materials and technology in electrical engineering.</td></tr>
<tr><td rowspan="10">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Course content</td><td>L or S hours</td><td>AE hours</td></tr>
<tr><td colspan="5">Introduction. Structure and properties of materials. Properties of conductors</td><td>2</td><td>-</td></tr>
<tr><td colspan="5">Materials for conductors: copper and its alloys and aluminum</td><td>2</td><td>-</td></tr>
<tr><td colspan="5">High melting point conductors: tungsten, molybdenum, tantalum and niobium. Materials for specific purposes: gold, silver, iron and platinum.</td><td>2</td><td>-</td></tr>
<tr><td colspan="5">Materials for resistors, thermocouple, thermocouple, fused, conductors through the glass and contacts</td><td>2</td><td>-</td></tr>
<tr><td colspan="5">Superconductivity and superconducting materials. Semiconductor materials. Cleaning semiconductors. Methods for obtaining a single crystal</td><td>2</td><td>-</td></tr>
<tr><td colspan="5">Magnetic materials in general. Soft magnetic materials (iron, alloys: iron-calcium and iron-nickel.</td><td>2</td><td>-</td></tr>
<tr><td colspan="5">The soft magnetic materials for the HF technique (a ferromagnetic powder and ferrite core). Hard magnetic materials (carbon steels, alloy dispersion, ductile hard magnetic materials and materials based on metal oxides).</td><td>2</td><td>-</td></tr>
<tr><td colspan="5">Insulating materials in general. Features overview the most commonly used insulation materials: air, insulating liquids, mica, ceramics.</td><td>2</td><td>-</td></tr>
<tr><td colspan="5">Glass, varnishes, putty insulation, laminates and fibrous materials, caoutchouc and rubber, synthetic resin (thermoplastic and thermosetting). Printed circuit.</td><td>2</td><td>-</td></tr>
</table>

| | | | |
|---|---|---|---|
| | Soldering process. Microelectronics: Introduction and historical development. The division of integrated circuits. Planar technology: general. | 2 | - |
| | Procedures of planar technology: epitaxy, oxidation or passivation Si surface, diffusion and ion implantation. Metallization. | 2 | - |
| | Thin layer technology: generally, preparation of thin film components (resistors, capacitors, conductive paths). Thick film technology: in general, production of thick components (resistors, capacitors, conductive paths). Methods for preparation of application specific integrated circuits (ASIC). | 2 | - |
| | Fiber optic transmission systems: historical development, the light propagation through the light conductor, the optical fiber type, the protection of the optical fiber, types of optical fiber and manufacture of the fiber optical cable | 2 | - |
| | List of laboratory or design exercises | | LE or DE hours |
| | Specific electric resistance measurement | | 2 |
| | Resistance measurement of color-coded resistors | | 2 |
| | Varistors | | 2 |
| | Thermistors | | 2 |
| | Measuring the temperature with thermocouple | | 2 |
| | Testing quality of transformer plates and measurement losses in the iron | | 2 |
| | Rated power dissipation in resistors | | 2 |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☐ independent assignments<br>☐ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 1,0 | Research | - | Practical training | - |
| | Experimental work | - | Report | - | Individual work | 2,2 |
| | Essay | - | Seminar essay | - | Laboratory exercises | 0,5 |
| | Tests | 0,2 | Oral exam | - | | |
| | Written exam | 0,1 | Project | - | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm and final test consists of 5 theoretical questions. The duration of each test is 2 school hour. In the final exams students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises, the seminar exercise and 50 % points on each midterm exam or the final exam. The continuous knowledge assessment grade (in percentage) is formed according to the formula:<br>$\text{Grade}(\%) = 0{,}2\ LV + 0{,}4\ (M1 + M2)$<br>the activities in percentage:<br>• LV – laboratory assessment,<br>• M1, M2 – test results.<br><br>The final grade is based on the grade of the continuous knowledge assessment grade and the oral part of the final exam. The students whose grade may be formed without the need for the oral part of the final exam may not be obliged to attend the oral part of the exam.<br>There are two terms for the final exam and one additional term for the make up exam. |

| | | | |
|---|---|---|---|
| | The requirement for attendance of the final exam or the make up exam is the passing grade for all laboratory exercises. At the final exam the student writes the test from the area of the midterm exam(s) which has/have not been successfully passed before. At the make up exam the student writes the test from the complete course. | | |
| Required literature (available in the library and via other media) | **Title** | **Number of copies in the library** | **Availability via other media** |
| | M. Kapov: Elektrotehnički materijali i tehnologije, skripta, FESB Split, 2005. | | e-learning portal |
| Optional literature (at the time of submission of study programme proposal) | M. Vrdoljak, M. Kapov: Elektrotehnički materijali- lab. vježbe, skripta, FESB Split, 2001<br>V. Bek: Tehnologija elektromaterijala, ETF Zagreb, 1989.<br>P. Biljanović: Mikroelektronika, ETF Zagreb, 1983. | | |
| Quality assurance methods that ensure the acquisition of exit competences | - Evaluation of results in accordance with the above learning outcomes<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Institutional and non-institutional evaluations | | |
| Other (as the proposer wishes to add) | | | |

| **NAME OF THE COURSE** | **ELECTRONIC CIRCUITS** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FELA10 | Year of study | 3. | | | | |
| **Course teacher** | Ivan Marinović, Ph.D., Full Professor | Credits (ECTS) | 5 | | | | |
| Associate teachers | Duje Čoko, Ph.D. | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 30 | | 15 | 15 | |
| Status of the course | Obligatory | Percentage of application of e-learning | | | | | |
| **COURSE DESCRIPTION** | | | | | | | |
| Course objectives | Training students for:<br>- DC and AC analysis of basic electronic circuits<br>- doing measurements applying oscilloscope | | | | | | |
| Course enrolment requirements and entry competences required for the course | Finished course *Electronic components and circuits* | | | | | | |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>- understand principles of basic analogue electronic circuits<br>- do DC analysis of electronic circuits<br>- do AC analysis of electronic circuits<br>- do analysis in frequency domain<br>- make measurements of basic circuit parameters applying oscilloscope | | | | | | |

| Course content broken down in detail by weekly | Course content | L or S hours | AE hours |
|---|---|---|---|
| | Cascade amplifier | 1 | 0.5 |
| | Amplifier frequency characteristic and Bode diagram | 1 | 0.5 |

<table>
<tr><td rowspan="16">class schedule (syllabus)</td><td>Low-frequency and high-frequency analysis of BT and JFET amplifiers</td><td>4</td><td>2</td></tr>
<tr><td>Impulse response of linear amplifier</td><td>1</td><td>0.5</td></tr>
<tr><td>Nose in BT, JFET and MOSFET amplifiers</td><td>1</td><td>0.5</td></tr>
<tr><td>Feedback amplifiers</td><td>6</td><td>3</td></tr>
<tr><td>Power amplifiers, A-class amplifier with transformer, AB-class amplifier</td><td>8</td><td>4</td></tr>
<tr><td>Differential amplifier</td><td>2</td><td>1</td></tr>
<tr><td>Operational amplifier</td><td>6</td><td>3</td></tr>
<tr><td colspan="2">List of laboratory or design exercises</td><td>LE or DE hours</td></tr>
<tr><td colspan="2">Frequency characteristic of BT amplifier</td><td>2</td></tr>
<tr><td colspan="2">Frequency characteristic of JFET amplifier</td><td>2</td></tr>
<tr><td colspan="2">Frequency characteristic of two-stage amplifier</td><td>2</td></tr>
<tr><td colspan="2">Feedback amplifier</td><td>2</td></tr>
<tr><td colspan="2">AB-class amplifier</td><td>2</td></tr>
<tr><td colspan="2">Differential amplifier</td><td>2</td></tr>
<tr><td colspan="2">Operational amplifier</td><td>3</td></tr>
</table>

<table>
<tr><td>Format of instruction</td><td>☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ on line in entirety<br>☐ partial e-learning<br>☐ field work</td><td>☐ independent assignments<br>☐ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="2">The presence on lectures and exercises in the amount of at least 70% of the times scheduled. Performed all required laboratory exercises.</td></tr>
</table>

<table>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Exercises</td><td>1</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>Individual work</td><td>2</td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after next 6 weeks. Each midterm test consists of theoretical questions and numerical problems as well as the final test. In the final exams students that did not pass the midterm exams take part. The midterms are carried out as written tests while the final exams are written and oral. The absolute grading is applied.</td></tr>
</table>

<table>
<tr><td rowspan="3">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>P. Biljanović: Elektronički sklopovi, Školska knjiga, Zagreb</td><td>5</td><td></td></tr>
<tr><td>I. Zulim, P. Biljanović: Elektronički sklopovi - zbirka zadataka, Školska knjiga, Zagreb</td><td>5</td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">-</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">- Evidence of students attendance<br>- Annual analysis of grades achieved<br>- Teachers self-evaluation<br>- Students feedback via questionnaires and surveys</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

| **NAME OF THE COURSE** | **OBJECT ORIENTED PROGRAMMING** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FELA13 | Year of study | 2 | | | | |
| **Course teacher** | Ivo Mateljan, Ph.D., Professor<br>Marjan Sikora, Ph.D., Assistant Professor | Credits (ECTS) | 5 | | | | |
| Associate teachers | | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 30 | | | 30 | |
| Status of the course | Obligatory | Percentage of application of e-learning | 30 | | | | |

**COURSE DESCRIPTION**

| | |
|---|---|
| Course objectives | Training students for:<br>- programming with C++ language,<br>- understanding the principles of object oriented programming |
| Course enrolment requirements and entry competences required for the course | Competences from the first year of study. |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | On completion of the course, students should, regarding C++ language, be able to:<br>- explain the concept of namespace, scope and lifetime<br>- explain difference between object based and object oriented programming<br>- explain the polymorphism<br>- use fundamental STL classes: string, vector, list<br>- use the facilities in the "iostream" to provide user and file i/o in programs<br>- use the exception handling mechanism<br>- use Microsoft Visual Studio, to make programs with GUI, with MFC classes |

Course content broken down in detail by weekly class schedule (syllabus)

| Course content | L or S hours | AE hours |
|---|---|---|
| Introduction to class. Object based and object oriented programming. | 2 | |
| Structural programming, functions and primitive data types. Pointers and references. | 2 | |
| Operators, type conversion, variable scope and lifetime. | 2 | |
| Classes and objects. | 2 | |
| Class abstraction, interface and implementation. | 2 | |
| Recapitulation and preparation for mid-term. | 2 | |
| Operator overloading. | 2 | |
| Streams and file operations. | 2 | |
| Generic programming and templates. Strings. | 2 | |
| Inheritance and STL library. | 2 | |
| Polymorphism. | 2 | |
| Exception handling. Multithreading. | 2 | |
| Recapitulation and preparation for exam | 2 | |

| List of laboratory or design exercises | LE or DE hours |
|---|---|
| Compilation, debugging, functions | 2 |
| Overloaded functions, pointers and references. | 2 |
| Operators, type conversion, scope and lifetime of memory objects. | 2 |
| Classes an objects I | 2 |
| Classes an objects II | 2 |
| Dynamic memory allocation, operator overloading | 2 |
| Streams and file operations | 2 |
| Strings | 2 |
| Templates | 2 |
| Inheritance | 2 |
| Polymorphism | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Format of instruction | ☒ lectures<br>☒ seminars and workshops<br>☒ exercises<br>☐ *on line* in entirety<br>☒ partial e-learning<br>☐ field work | | | ☐ independent assignments<br>☐ multimedia<br>☒ laboratory<br>☒ work with mentor<br>☐ (other) | | |
| Student responsibilities | | | | | | |
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 2 | Research | 1 | Practical training | |
| | Experimental work | | Report | | Team work | |
| | Essay | | Seminar essay | | (Other) | |
| | Tests | 1 | Oral exam | | (Other) | |
| | Written exam | | Project | 1 | (Other) | |
| Grading and evaluating student work in class and at the final exam | Grade (%) = 0,15L + 0,15P + 0,35(M1 + M2)<br><br>Two mid-term exams (M); Laboratory (L); Project (P) | | | | | |
| Required literature (available in the library and via other media) | **Title** | | | | **Number of copies in the library** | **Availability via other media** |
| | Ivo Mateljan: OOP, lecture notes, FESB, 2001. | | | | | |
| | Stroustrup, B., The C++ programming Language, Adison Wesley, 1986. | | | | | |
| Optional literature (at the time of submission of study programme proposal) | Owen L. Astrachan, Computer Science Tapestry, McGrawHill 2000. | | | | | |
| Quality assurance methods that ensure the acquisition of exit competences | - Evaluation of results in accordance with the above learning outcomes<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Institutional and non-institutional evaluations | | | | | |
| Other (as the proposer wishes to add) | | | | | | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="6">COMPUTER AND DATA SECURITY</td></tr>
<tr><td>Code</td><td>FELA40</td><td>Year of study</td><td colspan="5">3.</td></tr>
<tr><td>Course teacher</td><td>Mario Čagalj, Ph.D., Full Professor</td><td>Credits (ECTS)</td><td colspan="5">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>30</td><td>0</td><td>0</td><td>30</td><td></td></tr>
<tr><td>Status of the course</td><td>Elective</td><td>Percentage of application of e-learning</td><td colspan="5">0</td></tr>
</table>

**COURSE DESCRIPTION**

<table>
<tr><td>Course objectives</td><td colspan="3">Introduce students to:<br>- fundamentals of computer and data security,<br>- critical thinking on security issues in computer systems.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="3">None</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="3">Students will be able to:<br>- define the basic concepts of computer security such as authentication, access control, data confidentiality, system and data integrity<br>- analyse vulnerabilities of password-based authentication systems,<br>- suggest basic protection measures.</td></tr>
<tr><td rowspan="21">Course content broken down in detail by weekly class schedule (syllabus)</td><td>Course content</td><td>L hours</td><td>AE hours</td></tr>
<tr><td>Introduction to computer security.</td><td>2</td><td></td></tr>
<tr><td>Basic cryptographic primitives (encryption and authentication)</td><td>4</td><td></td></tr>
<tr><td>User authentication (passwords, security tokens, biometry, attacks)</td><td>2</td><td></td></tr>
<tr><td>User authentication on Windows and Unix-like operating systems</td><td>2</td><td></td></tr>
<tr><td>Attacks on passwords (brute-force, dictionary, rainbow tables)</td><td>2</td><td></td></tr>
<tr><td>Access control (Windows, Unix-like OS)</td><td>4</td><td></td></tr>
<tr><td>First midterm exam</td><td></td><td></td></tr>
<tr><td>Malware (viruses, computer worms, botnets)</td><td>2</td><td></td></tr>
<tr><td>Protection against malware (AV software)</td><td>2</td><td></td></tr>
<tr><td>Denial-of-Service (DoS) and Distributed DoS (DDoS) attacks</td><td>2</td><td></td></tr>
<tr><td>Software security (buffer overflow attacks)</td><td>2</td><td></td></tr>
<tr><td>Risk assessment and management</td><td>2</td><td></td></tr>
<tr><td>Second midterm exam</td><td></td><td></td></tr>
<tr><td colspan="2">List of laboratory exercises</td><td>LE hours</td></tr>
<tr><td colspan="2">Intro to computer security using Cryptool</td><td>4</td></tr>
<tr><td colspan="2">User authentication and access control</td><td>6</td></tr>
<tr><td colspan="2">Malicious software (keyloggers)</td><td>6</td></tr>
<tr><td colspan="2">Malicious software (man-in-the-browser attacks)</td><td>4</td></tr>
<tr><td colspan="2">DoS attacks</td><td>4</td></tr>
<tr><td colspan="2">Software security (buffer overflow attacks)</td><td>2</td></tr>
<tr><td>Format of instruction</td><td>☒ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐ on line in entirety<br>☐ partial e-learning<br>☐ field work</td><td colspan="2">☐ independent assignments<br>☐ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☒ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="3">The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises.</td></tr>
</table>

<table>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0,7</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Individual work</td><td>2</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>Laboratory exercises</td><td>2</td></tr>
<tr><td>Tests</td><td>0,2</td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td>0,1</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Students are also required to submit a written report on their work on laboratory assignments; these are also graded.<br><br>The final grade is formed as follows:<br>Grade = Round[ 0,05 P + 0,15 LV + 0,35 M1 + 0,45 M2 ]<br>where:<br>• P – is a grade based on attendance at lectures,<br>• LV – a grade earned during laboratory exercises,<br>• M1, M2 – test results.<br><br>NOTE: If a student fails a given task (P, LV, M1, M2), the corresponding grade is set to 0 in the above formula.</td></tr>
<tr><td rowspan="2">Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Lecture notes and presentations</td><td></td><td>e-learning portal</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">• Stallings W., Borwn L.: Computer Security, Principles and Practice, Pearson Prentice Hall, 2008.<br>• Gollmann D.: Computer Security, 2nd Edition, Wiley, 2005.<br>• Pfleeger C. P., Pfleeger S. L. : Security in Computing, 4th Edition, Prentice Hall, 2006.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="6">- Evaluation of results in accordance with the above learning outcomes<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Institutional and non-institutional evaluations</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="6"></td></tr>
</table>

| NAME OF THE COURSE | DIGITAL INSTRUMENTATION 1 | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FELA20 | Year of study | 3 | | | | |
| **Course teacher** | Ivan Marasović, Ph.D., Assistant Professor | Credits (ECTS) | 5 | | | | |
| Associate teachers | | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 30 | | 0 | 15 | |
| Status of the course | Obligatory | Percentage of application of e-learning | | | | | |
| **COURSE DESCRIPTION** | | | | | | | |
| Course objectives | Training students for:<br>- Understanding the main properties of digital instrumentation chain using microcontrollers in instrumentation.<br>- Signal acquiring and conditioning, analog to digital conversion, data representation.<br>- Development of digital instrumentation chain based on the AVR ATMEL series microcontroller. | | | | | | |
| Course enrolment requirements and entry competences required for the course | None. | | | | | | |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>- State the basic principles of microcontrollers.<br>- Choose the basic peripheral components necessary for microcontrollers based system.<br>- Programing microcontrollers in assembler and C.<br>- Acquisition, conditioning and processing physical signals by using microcontrollers.<br>- Send processed data to computer using serial communication (RS232) and representation on the alphanumerical 16x2 display. | | | | | | |

| Course content broken down in detail by weekly class schedule (syllabus) | Course content | L hours |
|---|---|---|
| | Introduction. Digital instrumentation chain based on the microcontrollers. | 2 |
| | Microcontroller and microprocessors. Microprocessors architecture. Program counter, instructions and operation code, pipeline and status register. Memory organization and buses. | 2 |
| | ATmega16 microcontroller architecture (internal modules, IO ports, timer/counter, USART, ADC). Registers and memory organization and addressing. | 2 |
| | System clock and clock options. Power management and sleep modes. System control and reset. | 2 |
| | General purpose input-output pins, data direction register, data register and input register. Alternate port functions. Timer/counter modules and modes of operation. Timer/counter interrupt vectors. | 2 |
| | Universal Synchronous and Asynchronous serial Receiver and Transmitter (USART) for serial communication. USART register description. Baud rate setting. | 2 |
| | Memory programing, memory and data memory lock bits. Fuse bits, signature and calibration byes. Parallel, serial and JTAG programing. | 2 |
| | Microcontroller peripheral components, supply, reset and clock source circuits. | 2 |
| | Digital instrumentation chain. Acquiring, conditioning and signal processing. Noise and method for noise cancelling. | 2 |
| | Analog circuits in instrumentation chain, amplifiers, filters, bridges and analog-digital converters. | 2 |
| | Data representation, LED, seven segment display, LCD alphanumerical and graphic display. Development of custom defined symbols. Connecting display to microcontroller, initialization and communication. | 2 |

| | | |
|---|---|---|
| | Standard communication interfaces in digital instrumentation, USART (RS232), SPI, TWI/I2C, CAN, WIFI, Ethernet, IrDA, DALI, 1-wire | 2 |
| | ARM microcontrollers and processors. Architecture and mode of operations. | 2 |
| | List of laboratory or design exercises | LE hours |
| | Introduction to Atmel studio and STK500. I/O pins configuration, LED blinking examples in assembler and C. | 3 |
| | Program, data and EEPROM memory using. | 3 |
| | Timer/counter application. Interrupts generated by timer/counter. Executing program - monitoring module (watchdog timer). | 3 |
| | Using serial standard RS232, connecting microcontroller to computer. Analog comparator module application. | 3 |
| | Using alphanumerical 16x2 display and LM35 temperature sensor. Connecting display and temperature sensor to microcontroller and digital thermometer development. | 3 |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☐ independent assignments<br>☒ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | Students should attend at least 70% of the lectures. Students must complete all laboratory exercises. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 2 | Research | | Practical training | |
| | Experimental work | | Report | | Individual work | 1.25 |
| | Essay | | Seminar essay | | Laboratory exercises | 1 |
| | Tests | 0.15 | Oral exam | | Preparation for laboratory exercises | 0.5 |
| | Written exam | 0.1 | Project | | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | There are two midterm exams and a final exam. The first midterm exam is scheduled after 7 weeks of classes and the second one after the following 6 weeks. Each midterm exam is written and consists of 10 theoretical/numerical/programming problems. Each midterm exam lasts 90 minutes. To pass an exam, the student should score at least 50% in the midterms and also have a positive assessment of the laboratory exercises.<br>The final grade (in percentage) is determined according to the formula:<br>Grade(%) = 0,25(M1+M2)+0,5L,<br>where:<br>• M1, M2 – grade from questions in midterms given in percentage,<br>• L – grade from laboratory exercises given in percentage,<br><br>Students not passing the midterm exams take part in the final exam. It consists of 10 theoretical/numerical/programing problems and lasts 160 minutes. For passing the final exam, students must score at least 50%, as well as have a positive assessment of the laboratory exercise. The grade on final exams is determined by the formula:<br>Grade(%) = 0.5(T)+0.5L,<br>where:<br>• T – grade from theoretical questions given in percentage,<br>• L – grade from laboratory exercises given in percentage. |

| | | | |
|---|---|---|---|
| Required literature (available in the library and via other media) | **Title** | **Number of copies in the library** | **Availability via other media** |
| | I. Marasović – autorizirana predavanja (PowerPoint) | | e-learning portal |

| | | | |
|---|---|---|---|
| | M. Ali Mazidi, Sa. Naimi, Se. Naimi, The AVR microcontrollers and embedded systems, Using assembly and C, Prentice Hall, 2011. | | |
| | Ivo Mateljan: Virtualna instrumentacija – skripta, FESB, 2008. | | |
| | A. Šantić: Elektronička instrumentacija, 3. izdanje, Školska knjiga, Zagreb, 1993. | | |
| | Marasović, I: Digitalna instrumentacija I - Upute za laboratorijske vježbe, Skripta za internu upotrebu, | | e-learning portal |
| Optional literature (at the time of submission of study programme proposal) | P. Horowitz, W. Hill: The Art of Electronics, Cambridge University Press, 2015.<br>M. Balch: Complete digital design: A comprenhensive guide to digital electronics and computer system architecture, McGRAW-HILL, 2003.<br>Timothy S. Margush: SOME ASSEMBLY REQUIRED Language Programming with the AVR Microcontroller, CRC Press, 2012.<br>Günther Gridling, Bettina Weiss: Introduction to Microcontrollers, Courses 182.064 & 182.074, Vienna University of Technology Institute of Computer Engineering Embedded Computing Systems Group, 2007 | | |
| Quality assurance methods that ensure the acquisition of exit competences | - Record of number of students attending the classes<br>- Evaluation of results in accordance with expected learning outcomes<br>- Feedback from students via student surveys<br>- Teachers self-evaluation<br>- Institutional and non-institutional evaluations | | |
| Other (as the proposer wishes to add) | | | |

| NAME OF THE COURSE | WIRELESS SENSOR NETWORKS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FELA43 | Year of study | 3. | | | | |
| **Course teacher** | Mario Čagalj, Ph.D., Full Professor | Credits (ECTS) | 5 | | | | |
| Associate teachers | | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 30 | 0 | 0 | 30 | |
| Status of the course | Elective | Percentage of application of e-learning | 0 | | | | |

**COURSE DESCRIPTION**

| | |
|---|---|
| Course objectives | Introduce students to fundamentals of wireless sensor networks. Provide students with insight into basic aspects of design and implementation of wireless sensor / sensing networkster systems. |
| Course enrolment requirements and entry competences required for the course | None |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | After successfully mastering a course, students will be able to:<br>• state the basic features of wireless sensors<br>• explain the most important energy saving mechanisms in wireless sensors<br>• review the energy efficiency of communication algorithms in wireless sensors<br>• establish a simple wireless sensor network<br>  ○ set up various sensors on the sensor node<br>  ○ establish a radio communication between two sensor nodes<br>  ○ connect the sensor network to the Internet<br>• plan more complex sensor networks |

Course content broken down in detail by weekly class schedule (syllabus)

| Course content | L hours | AE hours |
|---|---|---|
| Introduction to sensor networks | 2 | |
| Wireless sensor node architecture | 2 | |
| Basic Network Architecture | 2 | |
| Physical layer: wireless (radio) communication channel | 4 | |
| Data link layer: MAC protocols for access to a shared / shared channel | 4 | |
| First midterm exam | | |
| Data link layer: channel management, encoding and error control | 4 | |
| Network layer: data routing protocols | 4 | |
| Protocols for controlling network topology control | 2 | |
| Applications: e-health, tracking of objects, remote measurements | 2 | |
| Second midterm exam | | |

| List of laboratory exercises | LE hours |
|---|---|
| Intro to Arduino, Nordic nRF24L01+ platforms | 6 |
| Work on project | 20 |
| Project presentations | 4 |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☐ independent assignments<br>☐ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises. | |

<table>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>0,7</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Individual work</td><td>2</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>Laboratory exercises</td><td>0,1</td></tr>
<tr><td>Tests</td><td>0,2</td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td>0,1</td><td>Project</td><td>1,9</td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Students are also required to submit a written report on their work on a laboratory project.<br><br>The final grade is formed as follows:<br>Grade = Round[ 0,05 P + 0,35 PR + 0,25 M1 + 0,35 M2 ]<br>where:<br>• P – is a grade based on attendance at lectures,<br>• PR – a grade earned during laboratory exercises,<br>• M1, M2 – test results.<br><br>NOTE: If a student fails a given task (P, LV, M1, M2), the corresponding grade is set to 0 in the above formula.</td></tr>
<tr><td rowspan="3">Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Lecture notes and presentations</td><td></td><td>e-learning portal</td></tr>
<tr><td colspan="4">Holger K., Andreas W.: Protocols and Architectures for Wireless Sensor Networks, Willey, 2005.</td><td></td><td>Amazon</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">Buttyan, J.-P. Hubaux, Security and Cooperation in Wireless Networks (Thwarting Malicious and Selfish Behavior in the Age of Ubiquitous Computing), Cambridge University Press, 2007.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="6">- Evaluation of results in accordance with the above learning outcomes<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Institutional and non-institutional evaluations</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="7">DATABASES</td></tr>
<tr><td>Code</td><td>FELB08</td><td>Year of study</td><td colspan="5">2.</td></tr>
<tr><td>Course teacher</td><td>Vladan Papić, Ph.D., Full Professor</td><td>Credits (ECTS)</td><td colspan="5">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Tea Marasović, Ph.D., Assistant Professor</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td></td><td></td></tr>
<tr><td>Status of the course</td><td>Obligatory</td><td>Percentage of application of e-learning</td><td colspan="5">0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="7">Training students for:<br>- Understanding how typical database work,<br>- Modelling, normalization and design of simple databases,<br>- Retreaval, input, deleting and updating of data using simple and complex SQL queries.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="7">None</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="7">Students will be able to:<br>- Explain basic terms used in databases, types and structures, methodology and life cycle,<br>- Use standard DBMS,<br>- Come up with queries for creation and retreaval of dana from tables,<br>- Translate given E-R diagram into relational form,<br>- Analyze relations in a database and conclude about level of normalization,<br>- Model simple databases according to given specification,<br>- Explain basic problems of databases working in multi user environment..</td></tr>
<tr><td rowspan="10">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Course content</td><td>L hours</td><td>AE hours</td></tr>
<tr><td colspan="5">Basic terms. File model. Database and database managament system. Physical and logical independence of data. Database design methodology.</td><td>2</td><td></td></tr>
<tr><td colspan="5">Database models. Database types and structures. Database life cycle.</td><td>2</td><td></td></tr>
<tr><td colspan="5">Data modelling. Steps in designing database. Entities and attributes. Relationship and relationship set. Functionality of relationship. Entity membership in relationships.</td><td>2</td><td></td></tr>
<tr><td colspan="5">Representation of ER-model with diagram. Complex ER diagrams. Conceptual database design using ER-model. How to make data model in easiest way?</td><td>2</td><td></td></tr>
<tr><td colspan="5">Relational database model. Structure of relational database. Transfeer of ER model into relational model. Comparison of relational model with network and hierarhical models.</td><td>2</td><td></td></tr>
<tr><td colspan="5">Normalization and normal forms. First normal form (1NF). Functional dependencies – basic definitions and terminology. Second normal form (2NF). Third normal form (3NF)</td><td>2</td><td></td></tr>
<tr><td colspan="5">Boyce-Codd normal form (BCNF). Multi-valued dependencies and forth normal form (4NF). Joining dependencies and fifth normal form (5NF). Normal form of keys and domains. Reasons for aborting with normalization.</td><td>2</td><td></td></tr>
<tr><td colspan="5">Relational model operations. Relational algebra. Relational calculus.</td><td>2</td><td></td></tr>
<tr><td colspan="5">SQL (Structured Query Language). Processing of SQL instruction. Database definition using SQL (DDL). Modification of existing table. Deleting table. Indexes. Inserting data into tables.</td><td>2</td><td></td></tr>
</table>

| | | | |
|---|---|---|---|
| | Database queries. Simple queries on a relation. Search condition. Reports. | 1 | |
| | Queries on more than one relation. Query for table creation. Queries for insert, modification and deleting of dana. Aliases. | 1 | |
| | Aggregate functions. Group queries. Nested queries – subqueries.. Union. SQL queries optimization. | 1 | |
| | Multiuser environment problems. Views. | 1 | |
| | Protection from unautorizhed use. Ading privileges – single and cascade. Revoking priviledges. User groups. Data integrity and security. Time stamps. | 2 | |
| | Database storing and recovery. Database replication. Transaction log. Criteriums for DBMS evaluation. | 2 | |
| | List of laboratory exercises | | LE hours |
| | Introduction to DBMS. | | 2 |
| | ER-diagrams | | 2 |
| | Transfering ER-diagrams into relational model | | 2 |
| | Data modelling: etities and relationships. | | 2 |
| | Creating writing dana into database. | | 2 |
| | Filtering, sorting and searching for data. | | 2 |
| | Simple queries. | | 2 |
| | Complex queries. | | 2 |
| | Input forms. | | 2 |
| | Views and reports. | | 6 |
| | Macro commands. | | 2 |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☒ independent assignments<br>☒ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 1,5 | Research | | Practical training | |
| | Experimental work | | Report | | Individual work | 2,2 |
| | Essay | | Seminar essay | | Laboratory exercises | 0,5 |
| | Tests | 0,2 | Oral exam | | Preparation for laboratory exercises | 0,5 |
| | Written exam | 0,1 | Project | | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. In the final exams students are answering parts they did not pass in the midterms. The midterm and final exams are carried out as written tests and it lasts for max. 90 minutes.<br>The requirement for passing grade is 40% points on each midterm exam or final exam and positive assessment of laboratory exercises. In final grading (in percentage), each midterm exam contributes with max. 40%, lab. exercises with max. 20% out of total possible points (40%+40%+20%).<br>Final grade is formed in the following way:<br>Percentage Grade<br>50% to 61% sufficient (2)<br>62% to 74% good (3)<br>75% to 87% very good (4)<br>88% to 100% excellent (5) |

| | | | |
|---|---|---|---|
| Required literature (available in the | **Title** | **Number of copies in the library** | **Availability via other media** |

| | | | |
|---|---|---|---|
| library and via other media) | Papić, V. Databases, lectures. Textbook, FESB (in Croatian) | | e-learning portal |
| Optional literature (at the time of submission of study programme proposal) | An Introduction to Database Systems, Eighth Edition by C.J. Date, Addison Wesley 2003.<br>Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer D. Widom: Database Systems: The Complete Book, Prentice-Hall 2002.<br>Clare Churcher, Beginning Database Design From Novice to Professional, Apress, 2007. | | |
| Quality assurance methods that ensure the acquisition of exit competences | - Evaluation of results in accordance with the above learning outcomes<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Institutional and non-institutional evaluations | | |
| Other (as the proposer wishes to add) | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **NAME OF THE COURSE** | **COMPUTER ARCHITECTURES** | | | | | | | |
| **Code** | FELA17 | Year of study | 3 | | | | | |
| **Course teacher** | Sven Gotovac, Ph.D. Full Professor | Credits (ECTS) | 5 | | | | | |
| Associate teachers | Dunja Gotovac, Assistant | Type of instruction (number of hours) | L | S | AE | LE | DE | |
| | | | 30 | | | 30 | | |
| Status of the course | Obligatory | Percentage of application of e-learning | 0 | | | | | |
| **COURSE DESCRIPTION** | | | | | | | | |
| Course objectives | Training students for:<br>1. Understand digital computer architecture.<br>2. Define difference between different computer architecture on assembler level.<br>3. Understand computer architecture on the digital circuits level.<br>4. Understand and apply different computer architecture according to the application problem. | | | | | | | |
| Course enrolment requirements and entry competences required for the course | C programming language<br>Digital electronics and circuits | | | | | | | |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>1. Understand difference between computer architecture from the Instruction Set Point of view (ISA)<br>2. Identify the properties and performance of different architectures at the level of logic circuits<br>3. Select and apply the appropriate computer architecture according to the problem being solved.<br>4. Evaluate the impact of architecture on a software solution (advantages and disadvantages). | | | | | | | |

| | | | |
|---|---|---|---|
| Course content broken down in detail by weekly class schedule (syllabus) | Course content | L or S hours | AE hours |
| | Introduction. Different views on the computer. | 2 | |
| | Data and instructions. Classification of Computers and Their Instructions, Instruction set. Instruction format. Addressing Modes. CISC. RISC. | 2 | |
| | Instruction level processor design (Instruction Set Architecture) | 2 | |
| | Arithmetical and Logical instructions, Instruction for Data Transfer. | 2 | |
| | Flow control instructions, Translation from C to assembler and then to binary code. | 2 | |
| | Processor design on digital circuits level. Single bus microarchitecture. | 2 | |
| | Data Path Implementation, Logic Design for the 1-Bus Microarchitecture. | 2 | |
| | Control Unit design, 2-Bus and 3-Bus Microarchitecture | 2 | |
| | Pipeline architecture. | 2 | |
| | Instruction-Level Parallelism – Problems and Solutions | 2 | |
| | Memory System Design, Memory System Components, Two-Level Memory Hierarchy. | 2 | |
| | Cache, Associative cache, Direct Mapped Cache, 2-way Cache. | 2 | |
| | U/I system design. | 2 | |
| | List of laboratory or design exercises | | LE or DE hours |
| | ARM Architecture - Introduction. | | 2 |
| | ARM Instruction Set Architecture, Registers, Memory, Stack. | | 2 |
| | Atmel Studio IDE. Program Structure | | 2 |
| | Instruction Set, Arithmetical and Logical Instructions, Dana Transfer Instructions, Branch Control Instructions | | 8 |
| | Procedures | | 2 |
| | Program Examples | | 10 |
| | Problems for Exercise and Test | | 4 |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☒ independent assignments<br>☒ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 2 | Research | | Practical training | |
| | Experimental work | | Report | | Laboratory exercises | 2 |
| | Essay | | Seminar essay | | Preparation for laboratory exercises | |
| | Tests | 0,4 | Oral exam | | Self-study | 0,5 |
| | Written exam | 0,1 | Project | | | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm test lasts 60 minutes and consists of 5 to 7 theoretical questions and numerical problems and final tests consist of 6 theoretical questions and numerical problems. In the final exams |

<table>
<tr><td></td><td colspan="3">students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises and 50 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula:<br>Grade(%) = 0,33 LV + 0,33 (M1 + M2)<br>the activities in percentage:<br>• LV – laboratory assessment,<br>• M1, M2 – test results.<br>The final grade will be determined after the first test term by applying a relative ECTS grading system in accordance with the Regulations on the study and study system of the University of Split. The group of students who passed the exam is divided into four groups: 15% of the best gets the grade A (excellent), 35% of the following B (very good), the next 35% rating C (good), and the last 15% rating D, E). A group of students who did not pass the exam gains FX score (additional work is required), or F (significant additional work is required). In accordance with the Rulebook for Exam, only two exam periods are organized in the exam period after the completion of classes.<br>According to Article 65 of the Statute of the Faculty, the student is obliged to participate in all forms of teaching and attend: lectures at least 70% of teaching hours and laboratory exercises 100% of teaching hours. If you do not meet these conditions, the student will not be able to access the exam</td></tr>
<tr><td rowspan="3">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>Heuring, V.P., Joredan, H.F.: Computer Systems Design and Architecture, 2rd edition, AddisonWesley, 2003</td><td>2</td><td>Electronic copy<br>On e-learning</td></tr>
<tr><td>S.Gotovac Authorized lectures from the Digital Computer Architecture</td><td></td><td>On e-learning</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">Hennesy & Patterson, "Computer Architecture: A Quantitative Approach", 5rd edition, Morgan Kaufmann, 2011</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">1. Class attendance records.<br>2. Evaluation of results in accordance with the above learning outcomes<br>3. Feedback from students via surveys<br>4. Self-evaluation of teachers<br>5. Feedback from students who have already graduated.<br>6. Institutional and non-institutional evaluations</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="7">INTERNET PROGRAMMING</td></tr>
<tr><td>Code</td><td>FELA14</td><td>Year of study</td><td colspan="5">3</td></tr>
<tr><td>Course teacher</td><td>Darko Stipaničev, Ph.D., Full Professor<br>Ljiljana Šerić, Ph.D., Assistant Professor</td><td>Credits (ECTS)</td><td colspan="5">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Marin Bugarić, Ph.D., Senior Research Assistant<br>Andrija Sommer, mag.ing</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>30</td><td>0</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>Obligatory</td><td>Percentage of application of e-learning</td><td colspan="5">30</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="7">Training students for:<br>- Understanding the operating principles of the Internet<br>- Preparation and processing of data and information for publication on the Web<br>- Designing, editing and maintenance of the content published on the web<br>- Write simple scripts for dynamic web content on.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="7">Completed courses:<br>Programming 1<br>Programming 2</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="7">Students will be able to:<br>1. Appoint communication protocols used on the Internet<br>2. Describe the steps of the TCP / IP protocol<br>3. Identify elements of HTML code<br>4. Design and write HTML code of Web sites consisting of several web pages<br>5. Write an external CSS document with instructions for the design of the sites<br>6. Write simple JavaScript code that dynamically modifies website<br>7. Explain the difference between client and server scripting technology</td></tr>
<tr><td rowspan="21">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Course content</td><td>L or S hours</td><td>AE hours</td></tr>
<tr><td colspan="5">Introduction. History of the Internet. Internet Communication protocols</td><td>6</td><td></td></tr>
<tr><td colspan="5">HTML language for web page development. HTML5</td><td>4</td><td></td></tr>
<tr><td colspan="5">CSS style language. CSS3</td><td>4</td><td></td></tr>
<tr><td colspan="5">XML, XHTML</td><td>2</td><td></td></tr>
<tr><td colspan="5">JavaScript, DOM</td><td>4</td><td></td></tr>
<tr><td colspan="5">Ajax</td><td>2</td><td></td></tr>
<tr><td colspan="5">jQuerry</td><td>2</td><td></td></tr>
<tr><td colspan="5">PHP</td><td>2</td><td></td></tr>
<tr><td colspan="5">Overview of other tehnologijes for web page programming</td><td>2</td><td></td></tr>
<tr><td colspan="6">List of laboratory or design exercises</td><td>LE or DE hours</td></tr>
<tr><td colspan="6">Introduction. History of the Internet. Internet Communication protocols</td><td>2</td></tr>
<tr><td colspan="6">HTML language for web page development. HTML5</td><td>4</td></tr>
<tr><td colspan="6">CSS style language. CSS3</td><td>4</td></tr>
<tr><td colspan="6">XML, XHTML</td><td>2</td></tr>
<tr><td colspan="6">JavaScript, DOM</td><td>2</td></tr>
<tr><td colspan="6">Ajax</td><td>2</td></tr>
<tr><td colspan="6">jQuerry</td><td>2</td></tr>
<tr><td colspan="6">PHP</td><td>2</td></tr>
<tr><td colspan="6">Overview of other tehnologijes for web page programming</td><td>2</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td>Format of instruction</td><td colspan="2">☒ lectures</td><td colspan="5">☒ independent assignments</td></tr>
</table>

| | | |
|---|---|---|
| | ☐ seminars and workshops<br>☒ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☒ multimedia<br>☐ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | The presence on lectures in the amount of at least 70 % of the times scheduled.<br>Performed all required laboratory exercises. | |

| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | | | | | | |
|---|---|---|---|---|---|---|
| | Class attendance | 2 | Research | | Practical training | |
| | Experimental work | | Report | | Individual work (Other) | 2 |
| | Essay | | Seminar essay | | Laboratory exercises (Other) | 0,5 |
| | Tests | | Oral exam | | Preparation for laboratory exercises (Other) | **0,5** |
| | Written exam | | Project | | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | During the semester there will be two mid-term exams (tests). The first mid-exam will be held after 7 weeks of classes, the second after the next 6 weeks. Mid-term exams are written on a computer and consists of 20 random questions to be answered.<br>At the final exam students can take only parts of material that they did not pass in the mid-term exams<br>At the final exam ar autmn students take the whole subject matter of the course.<br>The requirement for passing grade is positively evaluated seminar paper and at least 60% of points achieved on the mid-term / final exam.<br>The number of points is calculated as the arithmetic average of the two mid-term exams, or the number of points the entire final exam.<br>The final grade is determined as follows:<br>Percentage Rating<br>60% to 69% is sufficient (2)<br>70% to 79% good (3)<br>80% to 89% very good (4)<br>90% 100% Excellent (5) |

| Required literature (available in the library and via other media) | **Title** | **Number of copies in the library** | **Availability via other media** |
|---|---|---|---|
| | Lj.Šerić, Programiranje za Internet, predavanj, FESB | | e-learning portal |
| | M.Bugarić, upute za laboratorijske vježbe, FESB | | e-learning portal |
| | http://www.w3schools.com | | web |

| | |
|---|---|
| Optional literature (at the time of submission of study programme proposal) | D. Sušanj, D. Petric: "Velika knjiga o Worl Wide Webu", Znak, Zagreb 1996. g.<br>L. Abrus ,"Irada weba, abeceda za Webmastere",BUG&SysPrint, Zagreb,2003<br>Comer, D.E.: The Internet Book, Prentice Hall, 2000.<br>Zeid, I.: Mastering the Internet & HTML, Prentice Hall, 2000.<br>Deitel, Deitel & Neto, Internet & WWW – How to Program, Prentice Hall, 2000. |
| Quality assurance methods that ensure the acquisition of exit competences | • Keeping records of the class attendance<br>• Annual review of the performance of exam<br>• Student survey in order to evaluate teachers<br>• Self-evaluation of teachers<br>• Feedback from students who have already graduated from about the relevance of the course content |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="7">OPERATING SYSTEMS</td></tr>
<tr><td>Code</td><td>FELA27</td><td>Year of study</td><td colspan="5">3</td></tr>
<tr><td>Course teacher</td><td>Sven Gotovac, Ph.D., Full Professor</td><td>Credits (ECTS)</td><td colspan="5">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Petra Lončar, Assistant</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>45</td><td></td><td></td><td>15</td><td></td></tr>
<tr><td>Status of the course</td><td>Obligatory</td><td>Percentage of application of e-learning</td><td colspan="5">0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="7">Training students for:<br>1. Understand the architecture, complexity and functionality of the operating system.<br>2. Understand the methodology of implementing operating system functionalities.<br>3. Apply and use the functionality of the operating systems in their solutions.<br>4. Estimate which solutions are appropriate for particular applications.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="7">Computer Architecture<br>Data Structures<br>Algorithms</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="7">Students will be able to:<br>1. Understand and explain the operating system architecture and functionality.<br>2. Distinguish the functionality of the operating system<br>3. Understand and explain how individual functionalities are solved.<br>4. Evaluate the performance of individual solutions<br>5. Choose appropriate solutions for a particular application<br>6. Use appropriate solutions in their own applications</td></tr>
<tr><td rowspan="24">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Course content</td><td>L or S hours</td><td>AE hours</td></tr>
<tr><td colspan="5">Introduction to the course, Brief description of topics to be considered, Operating system tasks.</td><td>3</td><td></td></tr>
<tr><td colspan="5">Process Management, Process Definition, Process Descriptor Block, Process States, Context Switch.</td><td>3</td><td></td></tr>
<tr><td colspan="5">Implementation of Process Management Systems, Process State Management, CPU Scheduling Algorithms.</td><td>3</td><td></td></tr>
<tr><td colspan="5">Cooperating Processes, Process Synchronization. Producer-Consumer Problem.</td><td>3</td><td></td></tr>
<tr><td colspan="5">Test&Set Instruction, Mutex, Semaphores. Producer-Consumer Problem Solution by Semaphores.</td><td>3</td><td></td></tr>
<tr><td colspan="5">Deadlock Problem. Possible Solutions.</td><td>3</td><td></td></tr>
<tr><td colspan="5">Memory management system – Introduction to topic.</td><td>3</td><td></td></tr>
<tr><td colspan="5">Logical vs. Physical Address Space. Logical Address Space Creation.</td><td>3</td><td></td></tr>
<tr><td colspan="5">Paging</td><td>3</td><td></td></tr>
<tr><td colspan="5">Virtual Memory.</td><td>3</td><td></td></tr>
<tr><td colspan="5">I/O Subsystem Architecture</td><td>3</td><td></td></tr>
<tr><td colspan="5">Interrupt Driven I/O. DMA.</td><td>3</td><td></td></tr>
<tr><td colspan="5">File Subsystem.</td><td>3</td><td></td></tr>
<tr><td colspan="5">Disk Block Allocation.</td><td>3</td><td></td></tr>
<tr><td colspan="5">Real Time Operating Systems.</td><td>3</td><td></td></tr>
<tr><td colspan="6">List of laboratory or design exercises</td><td>LE or DE hours</td></tr>
<tr><td colspan="6">Introduction to Linux OS</td><td>2</td></tr>
<tr><td colspan="6">Linux OS Processes</td><td>2</td></tr>
<tr><td colspan="6">Linux Processes - Fork Command</td><td>2</td></tr>
<tr><td colspan="6">Linux processes - communication with pipelines</td><td>2</td></tr>
<tr><td colspan="6">Windows OS Multitasking</td><td>2</td></tr>
<tr><td colspan="6">Write multi-tasking programs for the Windows platform</td><td>2</td></tr>
</table>

| | | |
|---|---|---|
| | Write multi-threading programs for the Windows platform | 2 |
| | Time control of thread execution within the process | 2 |
| | Thread Sync Synchronization (Intro, Event) | 2 |
| | Synchronization of thread execution (mutex, semaphores) | 2 |
| | Java multithreading | 2 |
| | Windows interprocess communication | 2 |
| | OS on a virtual machine | 2 |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☒ independent assignments<br>☒ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 2 | Research | | Practical training | |
| | Experimental work | | Report | | Laboratory exercises | 2 |
| | Essay | | Seminar essay | | Preparation for laboratory exercises | |
| | Tests | 0,4 | Oral exam | | Self-study | 0,5 |
| | Written exam | 0,1 | Project | | (Other) | |

**Grading and evaluating student work in class and at the final exam**

There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm test lasts 60 minutes and consists of 5 to 7 theoretical questions and numerical problems and final tests consist of 6 theoretical questions and numerical problems. In the final exams students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises and 50 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula:

$$\text{Grade}(\%) = 0{,}33\ LV + 0{,}33\ (M1 + M2)$$

the activities in percentage:

- LV – laboratory assessment,
- M1, M2 – test results.

The final grade will be determined after the first test term by applying a relative ECTS grading system in accordance with the Regulations on the study and study system of the University of Split. The group of students who passed the exam is divided into four groups: 15% of the best gets the grade A (excellent), 35% of the following B (very good), the next 35% rating C (good), and the last 15% rating D, E). A group of students who did not pass the exam gains FX score (additional work is required), or F (significant additional work is required). In accordance with the Rulebook for Exam, only two exam periods are organized in the exam period after the completion of classes.

According to Article 65 of the Statute of the Faculty, the student is obliged to participate in all forms of teaching and attend: lectures at least 70% of teaching hours and laboratory exercises 100% of teaching hours. If you do not meet these conditions, the student will not be able to access the exam

| | Title | Number of copies in the library | Availability via other media |
|---|---|---|---|
| Required literature (available in the library and via other media) | Tanenbaum, A.S.: Woodhull, A.S.: Operating Systems: Design and Implementation, (3rd Edition) Prentice Hall, 2006. | 2 | Electronic copy on e-learning |
| | S.Gotovac Autorizirana predavanja iz Operacijskih sustava | | e-learning |
| Optional literature (at the time of | Stalings, W.: Internals and Design Principles (7th Edition), 2011. | | |

| | |
|---|---|
| submission of study programme proposal) | |
| Quality assurance methods that ensure the acquisition of exit competences | 1. Class attendance records.<br>2. Evaluation of results in accordance with the above learning outcomes<br>3. Feedback from students via surveys<br>4. Self-evaluation of teachers<br>5. Feedback from students who have already graduated.<br>6. Institutional and non-institutional evaluations |
| Other (as the proposer wishes to add) | |

| NAME OF THE COURSE | DIAGNOSTIC METHODS FOR VEHICLES | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FENA25 | Year of study | 3 | | | | |
| **Course teacher** | Assoc. Prof. Tonko Garma | Credits (ECTS) | 5 | | | | |
| Associate teachers | Miljenko Baković, M.Sc. | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 30 | | | 30 | |
| Status of the course | Elective | Percentage of application of e-learning | 0 | | | | |
| **COURSE DESCRIPTION** | | | | | | | |
| Course objectives | Training students for:<br>• understanding of the concepts related to communication protocols and diagnostic methods used within modern vehicles<br>• Understanding the tools and instrumentation needed to measure and interpret signals on the vehicle communication bus<br>• Understanding of operation and application in instrumentation and diagnostics of modern embedded systems used in vehicles<br>• independent analysis of communication between vehicle microcomputers and external computer, signal processing<br>• independent communication between the on-board microcomputer and the service computer | | | | | | |
| Course enrolment requirements and entry competences required for the course | Course Electrical Measurements or related course successfully passed | | | | | | |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | After successfully completing the course, students will be able to:<br>1. know the theoretical basics of the processed communication protocols used in modern vehicles (CAN, LIN, FlexRay, OBD, UDS, XCP…)<br>2. know the basic tools for testing communication within the vehicle<br>3. independently measure and analyze the communication signals used within the vehicle<br>4. develop simple communication between the computer and the microcomputer used in the vehicle using the "real-time" operating system | | | | | | |

| | | | |
|---|---|---|---|
| Course content broken down in detail by weekly class schedule (syllabus) | Course content | L or S hours | AE hours |
| | Basic knowledge of device communication within modern vehicles | 2 | |
| | Basic insights into the testing of communication within modern vehicles | 2 | |
| | Overview and getting acquainted with CAN bus operation | 4 | |
| | Detailed elaboration of CAN protocol | 2 | |
| | Detailed elaboration of CAN FD protocol | 2 | |
| | Review of the LIN protocol | 2 | |
| | Review of the FlexRay protocol | 2 | |
| | The basics of measuring parameters in a vehicle | 2 | |
| | Measurement of non-electrical parameters within the vehicle | 2 | |
| | Measurement of electrical parameters within the vehicle | 2 | |
| | Basic insights into diagnostic protocols used within the car | 2 | |
| | Implementation of the OBD diagnostic protocol | 2 | |
| | Implementation of the UDS diagnostic protocol | 2 | |
| | Basic knowledge of calibration protocols used within the car | 2 | |
| | Implementation of XCP calibration protocol | 2 | |
| | List of laboratory or design exercises | | LE or DE hours |
| | Implementation of the communication between microcomputers and computers via CAN bus | | 2 |
| | Software implementation of communication between computers and microcomputers via CAN bus | | 2 |
| | Measurement of electrical quantities in vehicles: contact and contactless measurement of DC and AC current | | 2 |
| | Measurement of electrical quantities in vehicles: contact and contactless measurement of DC and AC voltages | | 2 |
| | Measurement of electric quantities in vehicles: measurement of DC and AC power | | 2 |
| | Measurement of electrical quantities in vehicles: measurement of resistance, inductance and capacity | | 2 |
| | Measurement of electric quantities in vehicles: measurement of waveforms by an oscilloscope | | 2 |
| | Measurement of electrical quantities in vehicles: battery test, capacity test | | 2 |
| | Measurement of non-electrical quantities in vehicles: measurement of wheel speed and effect on the ABS system | | 2 |
| | Measurement of non-electrical quantities in vehicles: measurement of illumination. Contact and contactless temperature measurement | | 2 |
| | Measurement of process quantities in vehicles: pressure measurement | | 2 |
| | Measuring process quantities in vehicles: measuring noise and vibration | | 2 |
| | Measuring process quantities in vehicles: measuring forces affecting the driver while driving (so-called "G-force") | | 2 |
| | Measurement of vehicle emissions | | 2 |

<table>
<tr><td></td><td colspan="7">IRT testing of vehicles</td><td>2</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☒ seminars and workshops<br>☐ exercises<br>☐ on line in entirety<br>☐ partial e-learning<br>☐ field work</td><td colspan="5">☒ independent assignments<br>☒ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="8"></td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1,0</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Impended research</td><td>0,5</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1,5</td><td>Laboratory exercises</td><td>1,5</td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>Preparation for laboratory exercises</td><td>0,5</td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="8">Attendance at lectures of at least 70%. Laboratory exercises attendance 100%. Written, submitted and successfully defended seminar paper.</td></tr>
<tr><td rowspan="4">Required literature (available in the library and via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="4">Miljenko Baković, “Komunikacijski protokoli u vozilima", Rimac Automobili, Split, 2019. (ppt prezentacija)</td><td></td><td>e-learning, Internet</td></tr>
<tr><td colspan="4">Christoph Marscholik, “Road Vehicles – Diagnostic Communication”, Paperback – Prosinac, 2010. https://www.amazon.com/Road-Vehicles-Communication-Christoph-Marscholik/dp/8131807347</td><td></td><td>e-learning, Internet</td></tr>
<tr><td colspan="4">Tonko Garma, Upute za laboratorijske vježbe iz kolegija Dijagnostika motornih vozila, autorizirane upute, FESB, 2020</td><td></td><td>e-learning, Internet</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="8">• Unruh, J.; Mathony, H. J.; Kaiser, K.H: Error Detection, Analysis of Automotive Communication Protocols. SAE International Congress 1990.<br>• Christmann, E.: Data Communication in the Automobile – Part 1: Architecture, Tasks, and Advantages of Serial Bus Systems</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="8">- Keeping records of student attendance.<br>- Annual analysis of course statistics in terms of midterm and finals exams.<br>- Feedback from students via surveys.<br>- Teacher self-evaluation.<br>- Feedback from graduated students (or senior students) on course content relevance.</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="8">/</td></tr>
</table>

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="7">ELEMENTS OF ELECTRICAL POWER SWITCHGEARS</td></tr>
<tr><td>Code</td><td>FENA08</td><td>Year of study</td><td colspan="5">3.</td></tr>
<tr><td>Course teacher</td><td>Tonći Modrić, Ph.D.,<br>Assistant Professor</td><td>Credits (ECTS)</td><td colspan="5">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Type of instruction<br>(number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>45</td><td>0</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Status of the course</td><td>Obligatory</td><td>Percentage of application of e-learning</td><td colspan="5">0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="7">Training students for:<br>- understanding the basic theoretical and practical knowledge in the electrical power switchgears,<br>- understanding the concept of different electrical power switchgear types,<br>- dimensioning and selection of basic high voltage electrical power switchgear elements,<br>- determination of equivalent circuits and impedances of elements in power system,<br>- calculation of basic fault currents in power system.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="7">None</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="7">Students will be able to:<br>- specify the role of electrical power switchgears in power system,<br>- enumerate different electrical power switchgear types,<br>- define the currents relevant for dimensioning the electrical power switchgear elements,<br>- specify the basic high voltage elements in the electrical power switchgears,<br>- describe the basic faults in the electrical power switchgear,<br>- calculate the basic fault currents,<br>- compare the characteristic currents and voltages during basic faults in power system,<br>- select the basic high voltage elements in the electrical power switchgear,<br>- distinguish the importance of different methods of power system neutral point grounding.</td></tr>
<tr><td rowspan="7">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="6">Course content</td><td>L hours</td></tr>
<tr><td colspan="6">Role and functions of electrical power switchgears in power system. Different electrical power switchgear types. Basic high voltage elements and subsystems of electrical power switchgears (classification and graphical symbols).</td><td>2</td></tr>
<tr><td colspan="6">Stresses of electrical power switchgear elements caused by electrical current. Basic faults. Calculation of symmetrical and unsymmetrical fault currents using the method of symmetrical components. Numerical examples.</td><td>5</td></tr>
<tr><td colspan="6">Influence of transformation to the unsymmetrical currents distribution. Calculation of unsymmetrically loaded power transformer currents. Application of arrows that represent currents in the case of basic unsymmetrically loaded power transformers. Numerical examples.</td><td>5</td></tr>
<tr><td colspan="6">Equivalent short-circuit impedances of power system elements. Numerical examples.</td><td>6</td></tr>
<tr><td colspan="6">Analysis of typical short-circuit current-time diagram. Short-circuit current components.</td><td>2</td></tr>
<tr><td colspan="6">Definitions and calculations of currents relevant for dimensioning of electrical power switchgear elements (peak, thermal and breaking short-circuit current).</td><td>2</td></tr>
</table>

| | | |
|---|---|---|
| | Voltage stresses of high voltage electrical power switchgear elements. Standard nominal and highest voltages used in power system. Overvoltages. Standard withstand voltages and testing procedures. Insulation coordination. Grounding of power system neutral point. Numerical examples. | 4 |
| | Basic high voltage electrical power switchgear elements. | 7 |
| | Power transformer on load operation (parallel operation, harmonics, unsymmetrical loads). Examples. | 2 |
| | Selection example of typical high voltage elements in the electrical power switchgear. | 2 |
| | Typical system concepts and circuit configurations. | 1 |
| | Basic elements of secondary systems in the electrical power switchgear. | 1 |
| | List of laboratory exercises | LE hours |
| | Unsymmetrical load of two-winding power transformers. | 3 |
| | Unsymmetrical load of three-winding power transformers. | 3 |
| | Measurement of power transformer impedances. | 3 |
| | Current transformer. | 3 |
| | Calculation of fault currents and voltages on a computer. | 3 |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☒ independent assignments<br>☐ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | The presence on lectures in the amount of at least 70% of the times scheduled. Performed all required laboratory exercises and submitted all written reports with measurement and calculation results. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 1,7 | Research | | Practical training | |
| | Experimental work | | Report | | Individual work | 3,0 |
| | Essay | | Seminar essay | | Laboratory exercises | 0,6 |
| | Tests | 0,2 | Oral exam | | Preparation for laboratory exercises | 0,4 |
| | Written exam | 0,1 | Project | | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm test consists of 3 theoretical questions and 1 numerical problem. Each final test consists of 6 theoretical questions and 2 numerical problems. In the final exams students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises with submitted all written reports and 50 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula:<br>Grade (%) = 0,05 NP + 0,05 LV + 0,45 (M1 + M2)<br>the activities in percentage:<br>• NP – attendance at lectures,<br>• LV – laboratory assessment,<br>• M1, M2 – midterm test results.<br>The final grade is determined as follows:<br>• 50 - 61 % sufficient (2)<br>• 62 - 74 % good (3)<br>• 75 - 87 % very good (4)<br>• 88 - 100 % excellent (5) |

| Required literature (available in the library and via other media) | Title | Number of copies in the library | Availability via other media |
|---|---|---|---|
| | T. Modrić: Autorizirana predavanja, FESB | | e-learning portal |
| | T. Modrić: Autorizirane auditorne vježbe, FESB | | e-learning portal |
| | I. Medić, E. Sutlović: Električna postrojenja, upute za laboratorijske vježbe, Redak, Split, 2014. | | webknjizara.hr |
| Optional literature (at the time of submission of study programme proposal) | • H. Požar: Visokonaponska rasklopna postrojenja, Tehnička knjiga, Zagreb, 1990.<br>• K. Meštrović: Sklopni aparati srednjeg i visokog napona, Graphis, Zagreb, 2007.<br>• R. Milošević: Vakuumski električni sklopni aparati, Graphis, Zagreb, 2011.<br>• A. Dolenc: Transformatori, Sveučilište u Zagrebu, 1968. | | |
| Quality assurance methods that ensure the acquisition of exit competences | - Evaluation of student presence on lectures<br>- Evaluation of results in accordance with the above learning outcomes<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Institutional and non-institutional evaluations | | |
| Other (as the proposer wishes to add) | - | | |

| NAME OF THE COURSE | POWER ELECTRONICS | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FENA09 | Year of study | 3 | | | | |
| **Course teacher** | Dinko Vukadinović, Ph.D., Full Professor | Credits (ECTS) | 6 | | | | |
| Associate teachers | Mateo Bašić, Ph.D. Assistant Professor<br>Ivan Grgić, Assistant | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 30 | 0 | 0 | 30 | 0 |
| Status of the course | Obligatory | Percentage of application of e-learning | 0 | | | | |
| **COURSE DESCRIPTION** | | | | | | | |
| Course objectives | Training students for:<br>- understanding of basic principles of power electronics devices switching,<br>- understanding of power converters operating principles<br>- analysis of rectifiers, inverters and non-isolated DC-DC converters | | | | | | |
| Course enrolment requirements and entry competences required for the course | Theory of Systems and Mathematics 3 | | | | | | |
| Learning outcomes expected at the level of the course (4 to | Students will be able to:<br>1) define ways of power electronics devices switching<br>2) explain the natural commutation in phase-controlled rectifiers<br>3) analyze the operation of rectifiers, inverters and non-isolated DC-DC converters | | | | | | |

| | | | |
|---|---|---|---|
| 10 learning outcomes) | 4) make the simulation model of the natural commutation in the phase-controlled converter<br>5) make the simulation model of the phase-controlled three-phase converter<br>6) make the simulation model of the buck non-isolated DC-DC converter<br>7) calculate the power factor of the load connected to the electric grid via the power converter<br>8) specify ways of power electronics devices protection | | |
| Course content broken down in detail by weekly class schedule (syllabus) | Course content | L hours | AE hours |
| | Introduction and basic principles of power electronics devices | 4 | |
| | Ways of power electronics devices turning-off and natural commutation | 2 | |
| | Diode rectifiers | 2 | |
| | Thyristor-based converters | 2 | |
| | Power flow in electric grids with power electronics converters and effects of current distortion | 2 | |
| | AC converters | 2 | |
| | Inverters | 4 | |
| | Non-isolated DC-DC converters | 4 | |
| | Direct AC-AC converters | 2 | |
| | Heat transfer in power electronics devices and power electronics devices protection | 2 | |
| | List of laboratory exercises | | LE hours |
| | Resistor and inductor with a power electronics device (simulation) | | 3 |
| | Natural commutation (simulation) | | 3 |
| | Single-phase full-controlled bridge converter for the DC motor supply (simulation) | | 6 |
| | Three-phase full-controlled bridge converter (simulation and experiments) | | 6 |
| | Single-phase AC voltage controller (experiment) | | 6 |
| | Buck non-isolated DC-DC converter (simulation and experiments) | | 6 |
| Format of instruction | x lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | x independent assignments<br>☒ multimedia<br>x laboratory<br>☐ work with mentor<br>☐ **(other)** | |
| Student responsibilities | The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises. | | |

| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | | | | | | |
|---|---|---|---|---|---|---|
| Class attendance | 1 | Research | | Practical training | | |
| Experimental work | | Report | | Individual work | 3 | |
| Essay | | Seminar essay | | Laboratory exercises | 1 | |
| Midterm exams | 0.3 | Oral exam | | Auditory exercises | 0.5 | |
| Written exam | 0.2 | Project | | (Other) | | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | During the semester, two midterm exams are held - the first after 7 weeks of lectures and the second after 13 weeks of lectures. Each midterm exam consists of 4 problems, either theoretical or numerical. In the final exams, students take those parts of the course which they did not pass in the midterm exams.<br><br>The requirement for passing grade is that the sum of the laboratory exercises' grade (L) and the midterms' grades (M1 and M2), expressed as a percentage, is 50% or more. The sum is calculated as<br>Grade (%) = 0.25L + 0.375(M1 + M2)<br>where the number of points achieved in each midterm exam has to be at least 50%.<br>The students that do not pass the midterm exams take the final written exam which consists of 4 problems. The requirement for a positive evaluation of the final exam is |

<table>
<tr><td></td><td colspan="3">at least 50% points achieved. In the final exam, the students that did not pass one of the midterm exams are presented with 4 problems from the corresponding part of the course. Subsequently, the grade is determined as follows:<br>Grade (%) = 0.25L + 0.75(I)<br>where I is the number of points achieved in the final written exam (at least 50%).<br>The final grade for the course is determined as follows:<br>50% to 61% - Sufficient (2)<br>62% to 74% - Good (3)<br>75% to 87% - Very good (4)<br>88% 100% - Excellent (5)</td></tr>
<tr><td rowspan="3">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>D. Vukadinović, Lj. Kulišić: Predavanja iz energetske elektronike za šk. god. 2013/14</td><td></td><td>e-learning portal</td></tr>
<tr><td>D. W. Hart: Power Electronics, McGraw-Hill, 2011.</td><td></td><td>e-learning portal</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">N. Mohan, T. N. Undeland, T. N. Robbins, Power Electronics: Converters, Applications, and Design, 3nd Edition, John Wiley & Sons, 2003.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">- Keeping records of student attendance<br>- Annual analysis of the performance at midterm exams and final exams<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Feedback from graduated students</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

| NAME OF THE COURSE | CONTROL ENGINEERING | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FENA10 | Year of study | 3 | | | | |
| **Course teacher** | Dinko Vukadinović, Ph.D., Full Professor | Credits (ECTS) | 5 | | | | |
| Associate teachers | Mateo Bašić, Ph.D. Assistant Professor<br>Ivan Grgić, Assistant | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 45 | 0 | 0 | 15 | 0 |
| Status of the course | Obligatory | Percentage of application of e-learning | 0 | | | | |

**COURSE DESCRIPTION**

| | |
|---|---|
| Course objectives | Training students for:<br>- understanding of basic principles of continuous and digital control systems,<br>- stability analysis of control systems<br>- determination of performance indices of control systems |
| Course enrolment requirements and entry competences required for the course | Theory of Systems and Mathematics 3 |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br><br>1) classify control systems upon different criterions<br>2) design the analogue PI controller<br>3) carry out the system stability of continuous and digital control systems<br>4) apply absolute value optimum and symmetrical optimum to determine contoller's parameters<br>5) determine performance indices of control systems upon the response of a controlled variable<br>6) calculate the transfer function of multi-loop systems |

Course content broken down in detail by weekly class schedule (syllabus)

| Course content | L hours | AE hours |
|---|---|---|
| Basic concepts and terminology | 2 | |
| System analysis in the time domain | 1 | |
| Frequency characteristics of systems | 1 | |
| Frequency characteristics of operational amplifiers | 1 | |
| Frequency domain analysis: Nyquist and Bode methods | 2 | |
| Multi-loop automatic control systems, Masson’s rule | 2 | |
| DC machine as an object of control | 2 | |
| Stability of automatic control systems | 1 | |
| Stability criterions by Hurwitz, Nyquist, Bode and Kharitonov | 2 | |
| Performance indices of automatic control systems | 2 | |
| State-variable feedback systems | 2 | |
| PID controller and engineering tuning methods | 2 | |
| Root locus technique | 2 | |
| Control system optimisation - absolute value optimum | 2 | |
| Control system optimisation - symmetrical optimum | 2 | |
| Synthesis of linear systems of automatic control | 3 | |
| Fundamentals of digital control systems | 1 | |
| Z-transform, sampling process and digital control systems | 2 | |
| Digital PID controller | 1 | |
| Sensitivity of control systems | 2 | |
| Experimental synthesis of a cascade speed-control system of a DC motor | 2 | |
| Nonlinear automatic control systems and methods of linearization | 2 | |

| | | |
|---|---|---|
| | List of laboratory exercises | LE hours |
| | Time response and Bode magnitude and phase plots of PI controller | 4 |
| | PI controller tuning based on Ziegler-Nichols method | 3 |
| | Air-temperature control system | 4 |
| | Speed control system of a separately-excited DC motor | 4 |

| | | |
|---|---|---|
| Format of instruction | x lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | x independent assignments<br>☒ multimedia<br>x laboratory<br>☐ work with mentor<br>☐ **(other)** |
| Student responsibilities | The presence on lectures in the amount of at least 70 % of the times scheduled.<br>Performed all required laboratory exercises. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 1.5 | Research | | Practical training | |
| | Experimental work | | Report | | Individual work | 2 |
| | Essay | | Seminar essay | | Laboratory exercises | 0.5 |
| | Midterm exams | 0.3 | Oral exam | | Auditory exercises | 0.5 |
| | Written exam | 0.2 | Project | | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | During the semester, two midterm exams are held - the first after 7 weeks of lectures and the second after 13 weeks of lectures. Each midterm exam consists of 4 problems, either theoretical or numerical. In the final exams, students take those parts of the course which they did not pass in the midterm exams.<br><br>The requirement for passing grade is that the sum of the laboratory exercises' grade (L) and the midterms' grades (M1 and M2), expressed as a percentage, is 50% or more. The sum is calculated as<br>Grade (%) = 0.25L + 0.375(M1 + M2)<br>where the number of points achieved in each midterm exam has to be at least 50%.<br><br>The students that do not pass the midterm exams take the final written exam which consists of 4 problems. The requirement for a positive evaluation of the final exam is at least 50% points achieved. In the final exam, the students that did not pass one of the midterm exams are presented with 4 problems from the corresponding part of the course. Subsequently, the grade is determined as follows:<br>Grade (%) = 0.25L + 0.75(I)<br>where I is the number of points achieved in the final written exam (at least 50%).<br><br>The final grade for the course is determined as follows:<br><br>50% to 61% - Sufficient (2)<br>62% to 74% - Good (3)<br>75% to 87% - Very good (4)<br>88% 100% - Excellent (5) |

| | | | |
|---|---|---|---|
| Required literature (available in the library and via other media) | **Title** | **Number of copies in the library** | **Availability via other media** |
| | Vukadinović, D., „Predavanja iz Regulacijske tehnike za šk. god. 2013/14“, FESB, Split, 2014. | | e-learning portal |
| Optional literature (at the time of submission of study | Dorf, R.C.; Bishop, R.H.: Modern Control Systems, 12th edition, Prentice Hall, 2011. | | |

| | |
|---|---|
| programme proposal) | |
| Quality assurance methods that ensure the acquisition of exit competences | - Keeping records of student attendance<br>- Annual analysis of the performance at midterm exams and final exams<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Feedback from graduated students |
| Other (as the proposer wishes to add) | |

| **NAME OF THE COURSE** | **ELECTRICAL DISTRIBUTION NETWORKS** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FENA15 | Year of study | 3 | | | | |
| **Course teacher** | Damir Jakus, Ph.D.<br>Assistant Professor | Credits (ECTS) | 4 | | | | |
| Associate teachers | Josip Vasilj, Ph.D. | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 30 | | | 15 | |
| Status of the course | Elective | Percentage of application of e-learning | 30 | | | | |
| **COURSE DESCRIPTION** | | | | | | | |
| Course objectives | Training students for:<br>- Understanding the specifics related to the network structure, grid planning and operation as well as network element construction<br>- Development of models for the distribution network analysis under stationary conditions<br>- Understanding the specifics related to the distribution network neutral earthing<br>- Calculation of short circuit currents in distribution networks<br>- Selection of network elements while respecting the technical requirements and ability to propose measures for the network operation improvements<br>- Understanding the effects of distribution generation connection on network conditions<br>- Deepening the basic knowledge in the field of electricity transmission and distribution | | | | | | |
| Course enrolment requirements and entry competences required for the course | None | | | | | | |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>- Identify the typical structures of the distribution networks and their components with all their specifics<br>- Define the classic single line diagram and disposition of distribution substations<br>- Determine the equivalent circuits of distribution network elements for different type of calculations<br>- Perform the distribution network power flow and voltage conditions analysis using specialized software packages<br>- Simulate the impact of distributed generation connection on distribution network conditions | | | | | | |

| | | | |
|---|---|---|---|
| | - Parametrize the distribution network elements to ensure normal network operation<br>- Select low voltage network protection devices and dimensioned TS 10 / 0.4 kV earthing system<br>- To carry out a techno-economic analysis of the excessive consumption of reactive power and to propose measures for power factor improvement<br>- Simulate the operation of the distribution network and to calculate energy losses | | |
| Course content broken down in detail by weekly class schedule (syllabus) | Course content | L or S hours | AE hours |
| | **1.** DISTIRIBUTION NETWORK POSITION AND ROLE IN ELECTRIC POWER SYSTEMS:<br>- production, transmission and distribution of electrical energy<br>- basic characteristics and differences of transmission and distribution networks | 2 | |
| | **2.** DISTIRBUTION NETWORK TOPOLOGY AND STRUCTURE:<br>- Middle voltage network structure<br>- Low voltage network structure | 2 | |
| | **3.** DISTIRBUTION NETWORK SUBSTATIONS:<br>- Distribution substations<br>- Examples of real distribution substations 110/35 V, 35/10 kV and 10/0.4 kV | 2 | |
| | **4.** BASIC ELECTRIC PARAMETERS AND EQUVIVALNET SCHEMES FOR NETWORK ELEMENTS<br>- Symmetrical components system<br>- Physical interpretation of direct, inverse and zero system<br>- Calculation of element impedances<br>- Equivalent schemes | 2 | |
| | **5.** DISTRIBUTION NETWORK FAULT ANALYSIS (PART 1)<br>- Three phase fault<br>- Two phase fault<br>- Single phase faults<br>- Single phase faults in low voltage grid | 3 | |
| | **6.** DISTRIBUTION NETWORK FAULT ANALYSIS (PART 2)<br>- Transformer earthling options in middle voltage distribution networks<br>- Single phase faults<br>- Single phase faults in networks earthed using low-ohm resistors<br>- ground faults in unearthed networks<br>- Examples of fault analysis calculations | 2 | |
| | **7.** APROXIMATIVE NETWORK ANALYSIS UNDER STATIONARY CONDITIONS<br>- Approximate load flow calculations in radial distribution networks<br>- Approximate voltage drop calculations<br>- Rating power lines and transformers based on load flow and voltage drop calculations<br>- Examples of load flow and voltage profile calculations | 2 | |
| | **8.** LOAD FLOW CALCULATION USING BACKWARD-FORWARD METHOD<br>- Formation of incidence matrix: BIBC, BCBV, DLF<br>- Load flow calculations in radial distribution networks<br>- Load flow calculations in weakly meshed distribution networks | 3 | |
| | **9.** LOW VOLTAGE DISTRIBUTION NETWORKS (PART 1)<br>- Specificities of low voltage distribution networks<br>- Low voltage distribution network types based on earthing type<br>- Load modeling and load flow calculations<br>- Load flow / voltage conditions calculations | 2 | |
| | **10.** LOW VOLTAGE DISTRIBUTION NETWORKS (PART 2)<br>- Planning and design of low voltage networks<br>- Network protection and fuse selection criteria<br>- Grounding system calculation in low voltage distribution networks | 2 | |
| | **11.** ACTIVE POWER/ENERGY LOSS CALCULATION | 2 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | - Power/energy loss classification<br>- Power losses in transformers and power lines<br>- Energy loss calculations using approximate approach and using load duration curve | | | | | |
| | **12.** REACTIVE POWER COMPENSATION<br>- Individual/group/central/mixed compensation<br>- Positive effects of reactive power compensation<br>- Dimensioning of capacitors banks | 2 | | | | |
| | **13.** IMPACT OF DISTRIBUTED GENERATION CONNECTION<br>- Impact on network voltage conditions and control<br>- Impact on network losses<br>- Impact on network protection<br>- Higher harmonics, voltage/current asymmetry, flickers… | 2 | | | | |
| | **14.** DISTIRBUTION NETWORK OPERATION AND CONTROL<br>- Supervision, control, SCADA<br>- Network reliability and energy not served<br>- MTU system | 2 | | | | |
| | List of laboratory or design exercises | LE or DE hours | | | | |
| | **1.** Preparing for the lab. Exercises and demonstration of software tools used in exercises | 2 | | | | |
| | **2.** Load flow / voltage conditions/ power losses analysis and compensation of reactive power in the distribution networks | 3 | | | | |
| | **3.** The preparatory exercise for the load flow calculations in low-voltage distribution networks | 3 | | | | |
| | **4.** Low-voltage distribution network project: load modeling / load flow / voltage calculations; selection and rating of lines and transformers, short circuit analysis, selection and compliance testing of fuses, ground resistance calculation and design of pole mounted substation 10/0.4 kV earthing (Part 1) | 2 | | | | |
| | **5.** Low-voltage distribution network project: load modeling / load flow / voltage calculations; selection and rating of lines and transformers, short circuit analysis, selection and compliance testing of fuses, ground resistance calculation and design of pole mounted substation 10/0.4 kV earthing (Part 2) | 2 | | | | |
| | **6.** Analysis of distributed generation connection on the distribution networks | 3 | | | | |
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☒ independent assignments<br>☒ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) | | | | |
| Student responsibilities | - The presence on lectures in the amount of at least 70 % of the times scheduled.<br>- Completed all required laboratory exercises.<br>- Completed and graded seminar work assignment. | | | | | |
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 1 | Research | | Practical training | |
| | Experimental work | | Report | | (Other) | 1 |
| | Essay | | Seminar essay | 0.5 | (Other) | 0.5 |
| | Tests | 0.5 | Oral exam | | (Other) | |
| | Written exam | 0.5 | Project | | (Other) | |
| Grading and evaluating student work in class and at the final exam | During the semester there will be two midterm exams covering lectures. The first midterm exam will be in the eighth week of summer semester, and the second one in the last week of summer semester. As a part of laboratory exercises students will be given their seminar assignments. Student can pass the class by passing two midterm exams and by completing their seminar assignments. In the two final exams in June and July, students can pass reaming part(s) which they didn’t pass through midterm | | | | | |

exams. Also, if the student passes one part of class materials through first final exam, then he is not obliged to re-take that part of the exam in the second final exam. The class subject is divided into two parts according to separation defined for midterm exams.

Students who have failed to pass the class after two final exams can try to pass the subject by taking the disciplinary exam which is organized in first part of autumn term. The last chance to pass the subject is through commission exam which will be held in the second part of the autumn exam period. During the disciplinary and commission exam students have to re-take whole exam covering both subject parts regarding their previous results in mid-term and final exams. In autumn term the requirement for positive mark is that the student has at least 50% success on the exam as well as positive mark from seminar assignment.
The requirement for positive mark is that the student has at least 50% points from each part of the course subject during midterm and final exams (or 50% points for the entire course subject on disciplinary and commission exam), as well as positively evaluated seminar assignment. The final score (in percentage) is formed on the basis of all activities according to the formula:

Grade (%) = 0,3xG1 + 0,3xG2 + 0,3xS + 0.1xP
Grade (%) = 0,6xG + 0,3xS + 0.1xP (for disciplinary and commission exam)

wherein:
• G1, G2 – points obtained for each subject part during midterms and(or) final exams
• G – points obtained during disciplinary and commission exam
• S – point given for seminar assignment
• P – presence at lectures
The final grade is determined as follows:

| Grade (%) | Mark |
|---|---|
| 50 % do 6 1% | sufficient (2) |
| 62 % do 74 % | good(3) |
| 75 % do 87 % | very good(4) |
| 88 % do 100 % | excellent(5) |

Exam terms:
The first and second final exam: June / July
The disciplinary and commission exam: August / September

Under the Article 65 of the Faculty Statute, the student is required to participate in all forms of teaching and attend: lectures at least 70% of scheduled time and laboratory exercises 100% of scheduled time. If you do not meet these requirements, the student will not be able to take the examination.

| Required literature (available in the library and via other media) | Title | Number of copies in the library | Availability via other media |
|---|---|---|---|
| | Goić R., Jakus D., Penović I.: Distribucija električne energije – interna skripta, FESB, 2014. | | e-learning |
| | Goić, R. – Upute za energetske proračune u niskonaponskoj distributivnoj mreži (2009), Split, FESB | | e-learning |

Optional literature (at the time of submission of study programme proposal)

- E. Lakaervi, E.J. Holmes: Electricity Distribution Network Design, Peter Peregrinus Lt, 1989.
- Abdelhay A. Sallam, Om P. Malik:Electric Distribution Systems, Wiley-IEEE Press, 2011.
- Dale R. Patrick, Stephen W. Fardo: Electrical Distribution Systems, The Fairmont Press, 2009.
- E. Lakaervi, E.J. Holmes: Electricity Distribution Network Design, Peter Peregrinus Lt, 1989.
- William H. Kersting: Distribution System Modeling and Analysis, CRC Press, 2002.
- Programski paket PowerCAD, upute za rad (2009), Split, FRACTAL d.o.o.

| | |
|---|---|
| | - Programski paket WINdis, upute za rad (2009), Split, FRACTAL d.o.o. |
| Quality assurance methods that ensure the acquisition of exit competences | - Keeping records of student class attendance<br>- Annual review of the exam success<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Feedback on the subject relevance from the former students who have already graduated |
| Other (as the proposer wishes to add) | |

| **NAME OF THE COURSE** | **MARINE ELECTRICAL ENGINEERING** | | | | | | |
|---|---|---|---|---|---|---|---|
| **Code** | FENA20 | Year of study | 3. | | | | |
| **Course teacher** | Slavko Vujević, Ph.D., Full Professor | Credits (ECTS) | 4 | | | | |
| Associate teachers | | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 30 | 0 | 0 | 15 | 0 |
| Status of the course | Elective | Percentage of application of e-learning | 0 | | | | |

**COURSE DESCRIPTION**

| | | |
|---|---|---|
| Course objectives | Training students for understanding and application of specialized knowledge of:<br>- marine electrical devices and systems,<br>- marine electrical equipment,<br>- marine electrical installations. | |
| Course enrolment requirements and entry competences required for the course | None | |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>- describe the basic principles of ship's electric power generation,<br>- describe the basic principles of ship's electric power transmission and distribution,<br>- describe the basic principles of ship's electric power consumption,<br>- describe high voltage power system on ships,<br>- define safety rules for working with electrical equipment on ships,<br>- compare the features of marine power systems and terrestrial power systems,<br>- use the normative documents in the field of marine electrical engineering,<br>- apply the requirements of classification societies and the requirements of national maritime administrations. | |
| Course content broken down in detail by weekly class schedule (syllabus) | Course content | L hours |
| | Specific features of the ship's electric power system. Marine electric power generation. | 2 |
| | Marine electric propulsion. | 4 |
| | Marine electric power transmission and distribution. | 6 |
| | Marine electric power consumption. | 4 |
| | Marine instrumentation. | 2 |
| | Ship's high voltage electric power system. | 4 |

| | | |
|---|---|---|
| | The dangers of electricity. Protection and safety measures when working with electrical equipment. Safety and security measures on ships. | 2 |
| | Standardization of marine electrical engineering through IEC and ISO. Requirements of classification societies and requirements of national maritime administrations. | 2 |
| | Two midterm exams | |
| | List of laboratory exercises | LE hours |
| | Marine electric power generation | 3 |
| | Marine electric propulsion | 3 |
| | Marine electric power transmission and distribution | 3 |
| | Marine electric power consumption | 3 |
| | Safety and security measures on ships | 3 |
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☐ independent assignments<br>☒ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | Attendance on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises. | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 1.5 | Research | | Practical training | |
| | Experimental work | | Report | | Individual work | 1.7 |
| | Essay | | Seminar essay | | Laboratory exercises | 0.4 |
| | Tests | 0.2 | Oral exam | | Preparation for laboratory exercises | 0.1 |
| | Written exam | 0.1 | Project | | (Other) | |

| | |
|---|---|
| Grading and evaluating student work in class and at the final exam | There are two midterm exams. After two midterm exams, student can pass the entire exam. In the two final exams students take course parts that they did not pass in the preliminary exams. If in the first final exam student passes one of the two course parts, that course part the student does not have to take in the second final exam. The requirement for a positive evaluation of the course part is that the student has completed at least 50 % points from that course part. The final grade (in percentage) can be calculated using the formula:<br>Grade (%) = 0.1*LV + 0.45*(G1 + G2)<br>where activities in percentage are: LV - laboratory assessment, G1 - points from the first course part, G2 - points from the second course part.<br>Students who did not pass the entire exam after two final exams can pass the exam in the additional exams. In the two additional exams students take the entire course. The requirement for a positive assessment of the additional exams is that the student has completed at least 50 % points from the entire course. The final grade (in percentage) can be calculated using the formula:<br>Grade (%) = 0.1*LV + 0.9*G<br>where activities in percentage are: LV - laboratory assessment, G - points from the entire course.<br>The final grade can be calculated as follows:<br>• 50 % to 61 % - pass (2)<br>• 62 % to 74 % - good (3)<br>• 75 % to 87 % - very good (4)<br>• 88 % to 100 % - excellent (5)<br>Each of the midterm exams consists of ten theoretical questions. Two final exams and two additional exams consist of twenty theoretical questions. |

| Required literature (available in the | **Title** | **Number of copies in the library** | **Availability via other media** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| library and via other media) | Vujević, S., "Predavanja iz predmeta Brodska elektrotehnika (113)", Sveučilište u Splitu, FESB, Split, 2014. (lecture notes – electronic version) | | e-learning portal |
| | Milković, M.,"Brodski električni strojevi i uređaji", Sveučilište u Dubrovniku, Dubrovnik, 2005. | 5 | |
| Optional literature (at the time of submission of study programme proposal) | • Hall, D.T., "Practical Marine Electrical Knowledge - Second Revised Edition", Witherby & Co Ltd, 1999.<br>• McGeorge, H.D., "Marine Electrical Engineering and Practice - Second Edition", Butterworth-Heinemann, 1993.<br>• Skalicki, B. i Grilec, J., "Brodski električni uređaji", Sveučilište u Zagrebu, FSB, Zagreb, 2000. | | |
| Quality assurance methods that ensure the acquisition of exit competences | • Evaluation of results in accordance with the above learning outcomes<br>• Feedback from students via surveys<br>• Self-evaluation of teachers<br>• Institutional and non-institutional evaluations | | |
| Other (as the proposer wishes to add) | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **NAME OF THE COURSE** | **ELECTROMAGNETIC FIELDS** | | | | | | |
| **Code** | FELA32 | Year of study | 3 | | | | |
| **Course teacher** | Dragan Poljak, Ph.D., Full Professor | Credits (ECTS) | 5 | | | | |
| Associate teachers | Anna Šušnjara | Type of instruction (number of hours) | L | S | AE | LE | DE |
| | | | 30 | 0 | 15 | 15 | |
| Status of the course | Obligatory | Percentage of application of e-learning | 0 | | | | |
| **COURSE DESCRIPTION** | | | | | | | |
| Course objectives | Training students for:<br>- Understanding and apply fundamental principles and laws of electromagnetism,<br>- Formulating and solve simple problems in static, quasistatic and dynamic fields,<br>- Permanent adopting and fostering the knowledge in electromagnetics,<br>- Applying anaytic and numerical methods to solve engineering problems involving elektromagnetic waves and elektromagnetic radiation | | | | | | |
| Course enrolment requirements and entry competences required for the course | Mathematics 2 and 3, Physics 2, Fundamental of Electrical Engineering 1 and 2 | | | | | | |
| Learning outcomes expected at the level of the course (4 to 10 learning outcomes) | Students will be able to:<br>- Define fundamental notions, quantities, and laws of electromagnetic fields,<br>- Apply fundamental laws of electromagnetic theory for calculation of basic quantities of electromagnetic fields<br>- Apply methods an dtechniques suitable for handling problems in propagation electromagnetic waves and radiation of electrically short antennas,<br>- Mathematically formulate simple cases of plane wav epropagation and radiation from electrically small antennas,<br>- Analyze simple transmission lines, grounding electrodes, antennas | | | | | | |

| | |
|---|---|
| | - Calculate parametars of simple transmission lines, grounding electrodes, antennas<br>- Develop simple codes and use commercial software packages for propagation and radiation problems |

**Course content broken down in detail by weekly class schedule (syllabus)**

| Course content | L or S hours | AE hours |
|---|---|---|
| Introduction. Laws of classical electrodynamics. | 2 | 1 |
| Electrical properties of materials, isotropy, linearity, homogenity. | 2 | 1 |
| Maxwell's equations in differential form. Maxwell's equations in integral form. | 2 | 1 |
| Maxwell's equations for special cases. Media classification and application of approximations depending on frequency range | 2 | 1 |
| Continuity conditions. | 2 | 1 |
| Poynting vector. Poynting theorem. Complex Poynting vector for time-harmonic fields. | 2 | 1 |
| Electromagnetic potentials. Wave equations and paticar solutions for potentials. | 2 | 1 |
| Electrostatic fields. Green theorems. General solution of Poisson equation. The field of a point charge. | 2 | 1 |
| Magnetostatic field. Stationary and quasistationary currents. Magnetic scalar and vector potentials. Biot-Savart law. Self inductance and mutual inductance. | 2 | 1 |
| Solution methods of electromagnetic phenomena. Analytical methods. | 2 | 1 |
| Image theory method. Typical examples. Separation of variables. Typical examples. | 2 | 1 |
| Numerical methods: Finite Difference Method. Method of Moments. Finite Element Method. Typical examples. | 2 | 1 |
| Plane wave. Plane wave propagation in lossless media and lossy media. Electromagnetic radiation. Hertz dipole. | 2 | 1 |

| List of laboratory or design exercises | LE or DE hours |
|---|---|
| Field and potential inside a capacitor. (plate, cylindrical and spherical capacitor) | 3 |
| Spatial charge distribution – Poisson equation. | 2 |
| Field an dpotential of a point charge. | 2 |
| Magnetic field of infinite conductor and infinite cable. | 2 |
| Propagation of EM wave in a dielectric medium. | 2 |
| Propagation of EM wave in a lossy medium. | 2 |
| Radiation of electromagnetic field of a short dipole. | 2 |

| Format of instruction | | |
|---|---|---|
| | ☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☐ independent assignments<br>☐ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |

| Student responsibilities | |
|---|---|
| | |

**Screening student work** *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*

| | | | | | |
|---|---|---|---|---|---|
| Class attendance | 2 | Research | | Practical training | |
| Experimental work | | Report | | (Other) | 2,2 |
| Essay | | Seminar essay | | (Other) | 0,2 |
| Tests | 0,2 | Oral exam | | (Other) | 0,2 |
| Written exam | 0,2 | Project | | (Other) | |

<table>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="3">There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm test (120 min in duration) consists of 3 questions (each containing theoretical part and short numerical problem) and 2 longer numerical problems. The requirement for passing grade is the positive assessment of laboratory exercises and 50 % points on each midterm. Grade (in percentage) is formed according to the formula:<br><br>Grade(%) = 0,5 (M1 + M2)<br><br>where M1 and M2 are the midterm test results, and is determined through following percentage score:<br><br>Percentage score: Grade:<br><br>From 50% to 62% sufficient (2)<br>From 63% to 75% good (3)<br>From 76% to 88% very good (4)<br>From 89% to 100% excellent (5)<br><br>Students who do not pass midterm exams are obliged to pass final test (150 min in duration) in winter/fall examination period. Final test consists of 4 questions (each containing theoretical part and short numerical problem) and 2 longer numerical problems. The requirement for passing grade is 50 % points. Final grade is formed according to the described procedure.The midterm and final exams are carried out as written tests.</td></tr>
<tr><td rowspan="3">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>D.Poljak, Teorija elektromagnetskih polja s primjenama u inženjerstvu, Šk. knjiga Zagreb, 2014.</td><td></td><td></td></tr>
<tr><td>D.Poljak i dr., Modeliranje žičanih antena primjenom računala, Kigen Zagreb 2009.</td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">1. D. Poljak, Advanced Modeling in Computational Electromagnetic compatibility, Wiley Interscience, New York 2007.<br>2. Z. Haznadar, Ž. Štih: Elektromagnetizam, Školska knjiga, Zagreb 1997.<br>3. S. Ratnajeevan, H. Hoole, P. Ratnamahilan, P. Hoole: A Modern Short Course in Engineering Electromagnetics, Oxford University Press, 1996.<br>4. S.M.Wentworth: Fundamentals of Electromagnetics with Engineering Applications, Wiley, 2005</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">- Evaluation of results in accordance with the above learning outcomes<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Institutional and non-institutional evaluations</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="7">DIGITAL SIGNAL PROCESSING</td></tr>
<tr><td>Code</td><td>FELA29</td><td>Year of study</td><td colspan="5">3.</td></tr>
<tr><td>Course teacher</td><td>Dinko Begušić, Ph.D., Full Professor</td><td>Credits (ECTS)</td><td colspan="5">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Maja Stella, Ph.D., Assistant Professor</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>15</td><td>0</td></tr>
<tr><td>Status of the course</td><td>Obligatory:114 (Elective: 111, 112, 120)</td><td>Percentage of application of e-learning</td><td colspan="5"></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="7">Training students for:<br>- understanding and application of basic concepts and methods of digital signal processing,<br>- application of methods for analysis and synthesis of discrete time signals and systems,<br>- application and design of digital filters,<br>- permanent adoption and deepening of the knowledge in the area of digital signal processing.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="7">None</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="7">Students will be able to:<br>- define the basic concepts and methods for analysis of discrete time signals and systems,<br>- apply the the methods for frequency analysis of signals and systems defined in the discrete time domain,<br>- apply the linear integral transforms for discrete time signals and systems analysis and synthesis,<br>- apply and design digital FIR and IIR filters,<br>- understanding of the basic methods of adaptive signal processing,<br>- peroform analysis and synthesis of disrete signals and systems by using standard software environment (MATLAB).</td></tr>
<tr><td rowspan="18">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Course content</td><td>L or S hours</td><td>AE hours</td></tr>
<tr><td colspan="5">The basic concepts of discrete time signals and systems.</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Analysis of linear time invariant systems.</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">z- transform.</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Application of the z-transform in the analysisi of discrete time signals and systems.</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Frequency analysis of discrete time signals and systems.</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Discrete Fourier transform (DFT).</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Fast Fourier transform (FFT).</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Implementation and application of discrete time systems.</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Analysis and synthesis of discrete time systems.</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Digital filter structures.</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Design of FIR filters.</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Design of IIR filters.</td><td>2</td><td>1</td></tr>
<tr><td colspan="5">Adaptive signal processing methods and applications.</td><td>2</td><td>1</td></tr>
<tr><td colspan="6">List of laboratory or design exercises</td><td>LE or DE hours</td></tr>
<tr><td colspan="6">Generation and presentation of discrete time domain signal.</td><td>2</td></tr>
<tr><td colspan="6">Linear time invariant systems in discrete time domain.</td><td>2</td></tr>
<tr><td colspan="6">Analysis of inear time invariant systems using z-transform.</td><td>2</td></tr>
</table>

| | | |
|---|---|---|
| | Application of DFT in linear filtering. | 2 |
| | Linear filtering of long signal sequences using the overlap-save method. | 2 |
| | Design of FIR filters. | 2 |
| | Design of IIR filters. | 2 |

| | | |
|---|---|---|
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ *on line* in entirety<br>☐ partial e-learning<br>☐ field work | ☐ independent assignments<br>☐ multimedia<br>☒ laboratory<br>☐ work with mentor<br>☐ (other) |
| Student responsibilities | . | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)* | Class attendance | 1,5 | Research | - | Practical training | - |
| | Experimental work | - | Report | - | Individual work | 2,2 |
| | Essay | - | Seminar essay | - | Laboratory exercises | 0,5 |
| | Tests | 0,2 | Oral exam | - | Preparation for laboratory exercises | 0,5 |
| | Written exam | 0,1 | Project | - | (Other) | |

**Grading and evaluating student work in class and at the final exam**

There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm and final test consists of 10 theoretical questions and numerical problems. The duration of each test is 2 school hour. In the final exams students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises, the seminar exercise and 50 % points on each midterm exam or the final exam. The continuous knowledge assessment grade (in percentage) is formed according to the formula:

$$\text{Grade}(\%) = 0{,}05\ NP + 0{,}15\ LV + 0{,}4\ (M1 + M2)$$

the activities in percentage:

- NP - attendance at lectures,
- LV – laboratory assessment,
- M1, M2 – test results.

The final grade is based on the grade of the continuous knowledge assesment grade and the oral part of the final exam. The students whose grade may be formed without the need for the oral part of the final exam may not be obliged to attend tthe oral part of the exam.
There are two terms for the final exam and one additional term for the make up exam. The requirement for attendance of the final exam or the make up exam is the passing grade for all laboratory excercises and submitted seminar excercis work. At the final exam the student writes the test from the area of the miterm exam(s) which has/have not been succesfully passed before. At the make up exam the student writes the test from the complete course.

| Required literature (available in the library and via other media) | **Title** | **Number of copies in the library** | **Availability via other media** |
|---|---|---|---|
| | D.Begušić: Digital signal processing, handouts, FESB, 2016. | | e-learning portal |
| | | | |

**Optional literature (at the time of submission of study programme proposal)**

- Martin Vetterli, Jelena Kovačević, Goyal Vivek K: Foundations of Signal Processing, Cambridge University Press, 2014
- Proakis, J.G., Manolakis, D.G.: Digital Signal Processing: Principles, Algorithms, and Applications, Prentice Hall, 1996
- Haykin,S.: Adaptive Filter Theory, Prentice Hall, 1996

| | |
|---|---|
| Quality assurance methods that ensure the acquisition of exit competences | - Evaluation of results in accordance with the above learning outcomes<br>- Feedback from students via surveys<br>- Self-evaluation of teachers<br>- Institutional and non-institutional evaluations |
| Other (as the proposer wishes to add) | |