UNIVERSITY OF SPLIT

FACULTY OF MARITIME STUDIES

# ELABORATE PROPOSAL OF THE STUDY PROGRAMME

## University graduate study programme in

## MARINE ELECTRICAL ENGINEERING AND INFORMATION TECHNOLOGIES

SPLIT, 2025

# GENERAL INFORMATION ON HIGHER EDUCATION INSTITUTION

| | |
|---|---|
| Name | University of Split, Faculty of Maritime Studies |
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# GENERAL INFORMATION ON THE STUDY PROGRAMME

| | | | |
|---|---|---|---|
| Name of the study programme | Marine electrical engineering and information technologies | | |
| Provider of the study programme | University of Split, Faculty of Maritime Studies | | |
| Other participants | No | | |
| Type of study programme | Vocational study programme ☐ | University study programme x | |
| Level of study programme | Undergraduate ☐ | Graduate ☒ | Integrated ☐ |
| | Postgraduate university ☐ | Postgraduate specialist ☐ | Graduate specialist ☐ |
| Academic/vocational title earned at completion of study | Master of Science in Marine Electrical Engineering and Information Technologies (univ. mag. ing. el.) | | |

# 1. INTRODUCTION

## 1.1. Reasons for performing the study programme

Requirements to increase the safety and security of the ship's crew, passengers and cargo, prevent possible pollution of the marine environment, increase the level of safety of shipping organizations and information flows on the one hand, and increasingly competitive market on the other, impose the introduction and application of new technologies in maritime affairs. These trends require the high expertise of the crew members who maintain the ship's electrical systems. Due to the increasingly complex and demanding systems of electronics and automation on ships, in addition to boaters and shipbuilders, a new maritime profession - a marine electrical engineer officer - had to be introduced, which enabled the students of the undergraduate study of marine electrical and information technology to easily find a job in the labor market.

However, the undergraduate degree is mainly oriented towards ship systems. However, these personnel cannot respond to land-based new integrated maritime-related technologies such as, for example, complex robotic disembarkation and embarkation systems, wireless information and communication systems for monitoring the traffic of ships and the like. We are witnessing the rapid introduction of electronics, automation, communications and informatics in, for example, automated lighthouse monitoring and control systems and the like. Increasingly, companies and organizations onshore that are involved in the management and security of maritime transport, as well as ports with automated port systems for transhipment of cargo, are looking for experts who are knowledgeable about new technologies in electrical engineering, computer science, automation and information technology.

Therefore, after graduation, it is necessary to continue further education at the graduate level and to obtain a Master's degree in marine electrical and information technologies, which will not only have integrated knowledge in the automation of communications and informatics, but will be able to follow the development of newer technologies in later life.
Completion of this Bachelor's Degree enables students to work on state-of-the-art technology-equipped vessels of the world fleet, in companies applying modern technologies for traffic control, coast guard, ports, as well as companies engaged in the development, design, installation of electronic and IT equipment in shipbuilding. Master's degree engineers will be able to design, install and maintain computer, communications information systems, navigation systems, automatic control systems and other electronic systems used in traffic.

## 1.2. Relationship with the local community (economy, entrepreneurship, civil society, etc.)

From the point of view of assessing the expediency of this study and considering the needs of the labor market in the public and private sectors, this study enables the education of personnel who are able to work on the most complex electrical and information systems, as well as the automatic control systems of state-of-the-art transport systems. Upon completion of their studies, students are able to work on the maintenance of the most complex shore-based traffic control systems, such as Vessel Traffic Services (VTSs), and the like.

The study finds application in all branches of the economy related to maritime and various fields of science, and at the same time forms the basis for successful interaction between entrepreneurship and competent social and state structures. Upon completion of their studies, students gain employment opportunities in maritime, transport, and commercial companies.

## 1.3. Compatibility with requirements of professional organizations

Such a graduate study of Maritime Electrical and Information Technology represents a logical and meaningful continuation of the undergraduate study at the Faculty of Maritime Studies in Split.
When designing the program, special attention was paid to the harmonization of teaching contents and subjects with other international recommendations of the leading world institutions, in particular: International Maritime Organization (IMO), International Telecommunication Union (ITU), Association of Computer Machinery (ACM), Institute of Electrical and Electronic engineers (IEEE), the International Federation for Information Processing (IFIP), UNESCO and the European Computer Driving License Foundation (ECDLF).

Graduate study programs are fully aligned with the spirit and intentions of the STCW Convention, IMO and ISO standards, and their specificity is to educate seafarers from the aspect of increasing their knowledge in the application of electrical and information technology, and raising the level of maritime safety in the broadest sense.

## 1.4. Partners external to the higher education system

In addition to companies and institutions from the narrow maritime industry (related to offshore work), there are also companies from the maritime industry related to the mainland (shipyards, overhaul offices, electronic centers, design institutions) and maritime crewing and training agencies for seafarers.

During their studies, students are encouraged and have the opportunity to familiarize themselves with the work and participate in the work of partner research centers, partner companies, and participate in scientific research and transfer of technology. Some of the domestic partner research and industrial centers are:

- Croatian Hydrographic Institute (HHI) - a state scientific research institute that actively conducts hydrographic research, hydrographic and geodetic research of the Adriatic Sea, creates navigation charts, conducts underwater research and publishes scientific publications in the field of hydrography.

- Maritime Electronic Centre Ltd. (PCE) - a state-owned naval electronics development and naval support company that has a significant development and research component.

- Končar Electrical Engineering Institute - research and development institute that deals with research and development of electrical power equipment and equipment for the use of renewable energy sources.

## 1.5. Financing

The study programme is primarily financed from the budget of MZOM (Ministry of Science, Education, and Youth), and partly from the Faculty's income intended for specific purposes.

## 1.6. Comparability of the study programme with other accredited study programmes in the higher education institutions in the Republic of Croatia and EU countries

When designing the programs, special attention was paid to the harmonization of curricula and courses with other reputable foreign universities in order to make the programs comparable.
It should be emphasized that the system of education of maritime professionals in the world is very diverse and there are no two countries with equal education systems.
This applies to almost all components of education: conditions of enrollment, purpose and purpose of education, type and organization of studies, duration of studies, names of higher education institutions, etc.
An analysis of related institutions worldwide, especially in the European Union, dealing with the education of seafarers, has established a high degree of comparability of study programs.

This especially refers to:

1. Faculty of Marine Electrical Engineering, Gdynia Maritime Academy, Gdynia, Poljska.

2. World Maritime University, Malmö, Sweden.

### 1.7. Openness of the study programme to student mobility (horizontal, vertical, in the Republic of Croatia and international)

The graduate program is similar to the corresponding studies at the Faculty of Maritime Studies in Rijeka, the Faculty of Transport Sciences in Zagreb, as well as at other higher education institutions in the world, with which the Faculty of Maritime Studies at the University of Split has established several forms of cooperation. This guarantees that it is with these institutions that the objectives of the Bologna Declaration can be achieved: the compatibility of study programs and the mobility of teachers and students.

### 1.8. Compatibility with the University of Split and the Faculty missions and strategies, as well as with the strategy statement of the network of higher education institutions

The study program of Maritime Electrical and Information Technology is fully aligned with the mission and strategy of the Faculty of Maritime Studies, University of Split, and with the draft mission and strategy of the University of Split.

### 1.9. Current experiences in equivalent or similar study programmes

The Faculty of Maritime Studies in Split has many years of experience (formerly as the College of Maritime Studies) in conducting very similar undergraduate programs, i.e., studies under the name of *Marine Power Engineering and Electronics* with 2-year duration, and *Marine Electrical Engineering and Information Technology* with 3-year duration, as well as the graduate program of *Marine Electrical Engineering Technologies* with 2-year duration.

Considering Croatia's maritime orientation and its aspiration to remain at the world's maritime peak, we believe that the high-end education of seafarers, electrical engineers and computer specialists with new technologies in maritime transport is a fundamental prerequisite for achieving this goal. There is no other undergraduate degree program at the University of Split that integrates knowledge in automation, electrical engineering, computer science and communications to apply them to maritime systems.

# 2. DESCRIPTION OF THE STUDY PROGRAMME

## 2.1. General information

| | |
|---|---|
| Scientific/artistic area of the study programme | Technical sciences, field of traffic technology and transport |
| Duration of the study programme | 2 years |
| The minimum number of ECTS required for completion of study | 120 |
| Enrolment requirements and admission procedure | Completed undergraduate university study. |

## 2.2. Learning outcomes of the study programme (name 15-30 learning outcomes)

1. To solve problems in the field of marine information and automation systems using scientific methodology, and independently evaluate the obtained results.
2. To critically evaluate the hierarchy, organization, and management of information and communication integrated ship systems and propose appropriate solutions on board and on shore.
3. To compare the applicability and quality of continuous and discrete automatic control systems.
4. To design systems for managing the use of SCADA systems and PLCs, and apply them to marine and shore-based systems.
5. To justify the use of methods and techniques for the development of software systems in modern development environments using measurable parameters.
6. To evaluate and apply concepts of object-oriented programming in the development of software applications.
7. To select a method for analyzing measured signals, to evaluate and classify parameters that affect the management of ship systems.
8. To critically evaluate the development of expert systems for optimal ship management, diagnostics and preventive maintenance.
9. To develop a model of maritime traffic system and synthesize a surveillance system to avoid critical traffic conditions.
10. To critically evaluate the use of renewable energy sources in maritime affairs in terms of the amount of energy generated and the degree of impact on the environment.
11. To assess the use of mechatronic systems in the maritime and marine industries.
12. To critically evaluate the use of electrotechnical materials in maritime industry with particular reference to the writing off of vessels.
13. To plan and conduct applied research based on collected data on electromechanical, electronic and control components of the ship's system using fundamental scientific methods.

14. To determine the impact of professional activity on social, economic and cultural development and benefit.
15. To recommend the implementation of a spectrum of sensors and actuators specific to surface and underwater robots; evaluate their functioning and limitations in the marine environment.
16. To model the influence of external forces on robotic systems and use simulation tools to predict the behavior of robotic systems in the marine environment.
17. To envisage the technological application of marine robotic systems in the coastal area and in the open sea, for the purpose of navigation, surveillance, monitoring of the marine environment and renewable energy sources.

## 2.3. Employment possibilities

Students completing their studies can be employed in companies in the maritime industry (shipyards, repair yards, marine electronic center, related services), domestic and foreign shipping companies, maritime embarkation and training agencies, Croatian Army, Croatian Navy, Coast Guard.

## 2.4. Possibilities of continuing studies at a higher level

Yes, it is possible to continue the study at the doctoral level.

## 2.5. Lower-level study/-ies of the proposer or other institutions that qualify for admission to the proposed study

Graduate study may be enrolled by a person with a completed undergraduate degree in marine electrical and information technology (a study covering STCW II/2 content) or a person who has a related university undergraduate degree from a maritime, traffic or technical faculty.

## 2.6. Structure of the study and its requirements

The graduate study program of Maritime Electrical and Information Technology is organized over a period of 2 years, through 4 semesters, in which students earn at least 120 ECTS credits.

The enrollment requirements for the next semester, or next year, are defined in accordance with the Regulations on Studies and System of Study at the University of Split, and the Regulations on Study at the Faculty of Maritime Studies in Split and the decisions of the Faculty Council.

A student who has interrupted his studies may be allowed to continue his studies in accordance with the Rules of Study at the Faculty of Maritime Studies in Split and the decisions of the Faculty Council.

A student who has lost his / her right to study at another higher education institution or other component of the University may be allowed to continue and complete his / her studies under the conditions and within the time limits in accordance with the

Rules of Study at the Faculty of Maritime Studies in Split and the decisions of the Faculty Council.

The number of students in the study groups for the lecture depends on the number of students who have enrolled in each course. For subjects with more students, the size of the group generally does not exceed 15 students. Exercise groups are also adapted to the number of students enrolled in the courses, with the number of students not exceeding 15. Exercises in the two computer classrooms are limited to 16 and 20 students.

The size of the groups in all types of exercise enables effectiveness and interactive teaching for students.

## 2.7. Guidance through the study system, and counselling

At the Faculty of Maritime Studies in Split, there is no formal student counseling system, but the head of study is in constant communication with students, advises and assists any student in need. The dean and the vice-dean for teaching also have office times for talk with students.
Each of the teachers also has a schedule of consultations with students.

## 2.8. List of courses that the student can take from other study programmes

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## 2.9. List of courses offered in a foreign language

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## 2.10. Criteria and conditions for the transfer of the ECTS credits

ECTS credits can be transferred between different studies. The criteria and conditions for the transfer of ECTS credits are prescribed by the Ordinance on Study at the University of Split, and the Ordinance on Study at the Faculty of Maritime Studies.

## 2.11. Completion of study

| | | |
|---|---|---|
| Requirement for completion of study | Bachelor thesis ☐<br>Master thesis ☒ | Bachelor exam ☐<br>Master exam ☐ |
| Requirements for Bachelor's/Master's thesis or | Requirement for applying for Master thesis is having passed all the exams included in study curriculum. | |

| | |
|---|---|
| Bachelor's/Master's exam | |
| Procedure of evaluation of Bachelor's/Master's exam and evaluation and defence of Bachelor's/Master's thesis | In compliance with the Faculty Ordinance on Graded Assignments, and the Study Curriculum |

## 2.12. List of compulsory and elective courses

| LIST OF COURSES | | | | | | | |
|---|---|---|---|---|---|---|---|
| Year of study: 1 | | | | | | | |
| Semester: 2 | | | | | | | |
| STATUS | CODE | COURSE | HOURS IN SEMESTER | | | | ECTS |
| | | | L | S | E | F | |
| Compulsory | | Object-oriented programming | 30 | | 30 | | 6 |
| | | Modelling and simulation | 15 | | 45 | | 5 |
| | | Applied mathematics | 30 | | 45 | | 6 |
| | | Advanced control and diagnostics | 30 | | 15 | | 4 |
| | | Ship control systems | 15 | | 45 | | 5 |
| | | Scientific research methodology | 30 | | 0 | | 4 |
| | Total compulsory: | | 150 | | 180 | | 30 |

| LIST OF COURSES | | | | | | | |
|---|---|---|---|---|---|---|---|
| Year of study: 1 | | | | | | | |
| Semester: 2 | | | | | | | |
| STATUS | CODE | COURSE | HOURS IN SEMESTER | | | | ECTS |
| | | | L | S | E | F | |
| Compulsory | | Advanced electrotechnical materials | 30 | | 15 | | 4 |
| | | Mechatronics | 30 | | 30 | | 6 |
| | | Selected chapters in ship electric power systems | 30 | | 30 | | 6 |
| | | Integrated communication and information technologies | 30 | | 30 | | 6 |
| | Total compulsory: | | 120 | | 105 | | 22 |
| Elective | | Application programming | 15 | | 30 | | 4 |
| | | Green technologies in maritime affairs | 30 | | 15 | | 5 |
| | | Maintenance and reliability of marine engine systems | 30 | | 15 | | 4 |
| | | Navigational sub-system ergonomics | 30 | | 0 | | 3 |
| | | Remote sensing in a function of sustainable development of the maritime sector | 15 | | 30 | | 4 |
| | Student shall select two elective courses. | | | | | | |

| LIST OF COURSES | | | | | | | |
|---|---|---|---|---|---|---|---|
| Year of study: 2 | | | | | | | |
| Semester: 3 | | | | | | | |
| STATUS | CODE | COURSE | HOURS IN SEMESTER | | | | ECTS |
| | | | L | S | E | F | |
| Compulsory | | Renewable energy sources | 30 | | 15 | | 4 |
| | | Ship's SCADA systems and control | 30 | | 30 | | 6 |
| | | Discrete control systems | 30 | | 30 | | 6 |
| | | Cyber security of ship's systems | 30 | | 15 | | 4 |
| | | Synthesis of traffic and manufacturing supervising systems | 30 | | 15 | | 4 |
| | Total compulsory: | | 150 | | 105 | | 24 |
| | | Visualisation in autonomous shipping | 15 | | 15 | | 3 |
| | | Quality management in shipping | 30 | | 15 | | 5 |
| | | Hydrographic engineering | 30 | | 15 | | 4 |
| | | Integrated navigation system | 30 | | 30 | | 5 |
| | | Internship | 0 | | 150 | | 5 |
| | Student shall select two elective courses. | | | | | | |

| LIST OF COURSES | | | | | | | |
|---|---|---|---|---|---|---|---|
| Year of study: 2 | | | | | | | |
| Semester: 4 | | | | | | | |
| STATUS | CODE | COURSE | HOURS IN SEMESTER | | | | ECTS |
| | | | L | S | E | F | |
| Compulsory | | Design of ship's digital systems | 15 | | 45 | | 5 |
| | | Advanced chapters in signal processing | 30 | | 15 | | 4 |
| | | Maritime robotic systems | 30 | | 30 | | 6 |
| | | Master thesis | 0 | | 150 | | 15 |
| | Total compulsory: | | 75 | | 240 | | 30 |

## 2.13. Course description

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">OBJECT-ORIENTED PROGRAMMING</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="4">1</td></tr>
<tr><td>Course teacher</td><td>Anita Gudelj, Ph.D., Full Professor</td><td>Credits (ECTS)</td><td colspan="4">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="4">20%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">The aim of the course is to instruct students in the basic ideas and concepts of object-oriented programming. Having successfully completed the course, the students should be able to approach team and independent application development using an object-oriented paradigm.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">• Develop object-oriented software applications that include: multiple classes, working with basic static and dynamic data structures, files.<br>• Present basic and anticipate the possibility of using object-oriented programming concepts, primarily encapsulation, data hiding, inheritance, polymorphism.<br>• Present and implement abstract data types using classes<br>• Design a modular software solution using basic object-oriented programming concepts, in C ++ programming language.<br>• Develop your own classes.<br>• Recommend and evaluate an engineering approach to problem solving, based on the acquired knowledge of the classes and inheritance.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures:<br><br>1. Introduction. Overview of programming techniques (unstructured, procedural, modular and object-oriented programming).<br>2. C ++. Standard types. Program flow: loops and decisions; control statements,<br>3. Functions<br>4. Pointers and references<br>5. Classes: data nesting, methods; objects<br>6. Arrays and classes<br>7. Pointers and classes<br>8. Operator overload<br>9. Class strings<br>10. Inheritance<br>11. Abstract classes, polymorphism, virtual classes<br>12. Flows and files<br>13. Generic programming</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">14. Templates<br>15. Presentation of seminar papers.<br><br>Exercises:<br><br>1. Introduction to the development environment and introduction to C ++. Input-output streams.<br>2. Program flow control commands.<br>3. Creating your own functions. Passing arguments by reference and recursion<br>4. Concept of global and local variables, call by reference<br>5. Class, object, access specifiers, indicator this<br>6. Arrays and classes<br>7. Exercise for the in-term test<br>8. In-term test 1<br>9. Operator overload<br>10. Inheritance<br>11. Polymorphism<br>12. Files. File-related input and output streams<br>13. Templates<br>14. Working with complex code examples<br>15. In-term test 2</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☒ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Responsibilities of full-time students:<br><br>Attendance is mandatory for full-time students. In order to get the right to take the exam, students must attend at least 80% of the lectures and 100% of the exercises.<br><br>Responsibilities of part-time students:<br><br>The requirement for obtaining the right to take the exam is attendance at a minimum of 50% of lectures and exercises.</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>1.5</td><td>Research</td><td></td><td>Practical work</td><td>1.5</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Classroom activity</td><td>0.5</td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>0.5</td><td>(Other)</td><td></td></tr>
<tr><td>In-term / written exams</td><td>1.5</td><td>Oral exam</td><td>0.5</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>
</table>

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

**Assessment and evaluation of the work of full-time students:**

In the semester, two in-term tests are written related to the exercises, and short tests related to the theoretical part of the course. The tests from the exercises include practical work on the computer and are taken in the 8th and 15th week of teaching.

**Continuous assessment of students' work:**

| Evaluation components | Success (min. %) | Percentage in grade (%) |
|---|---|---|
| Class attendance | Depending on the activity | 10 |
| Short knowledge tests | 50 | 10 |
| Activity in exercises | 50 | 20 |
| Laboratory exercises test:<br>1. in-term test<br>2. in-term test | 50 | <br>20<br>30 |
| Seminar | 50, depending on topic complexity | 10 |
| Total | | **100** |

Students who do not pass the in-term exams are required to take the written and / or oral part of the exam within the exam terms.

## Final evaluation

| Evaluation components | Success (min. %) | Percentage in grade (%) |
|---|---|---|
| Practical exam (written) | 50 | 50 |
| Theory exam (oral) | 50 | 40 |
| Previous activities (including attendance of lectures and exercises) | 50 | 10 |
| Total | | 100 |

## Grading

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Does not satisfy minimum criteria | insufficient (1) |
| 50-61.9 | Satisfies minimum criteria | sufficient (2) |
| 62-74.9 | Average success with clear shortcomings | good (3) |
| 75-87.9 | Above average success with a few errors | very good (4) |
| 88-100 | Extraordinary success | excellent (5) |

<table>
<tr><td></td><td colspan="3">Grading and evaluating the work of part-time students<br>The evaluation and grading criteria are the same as those for full-time students.</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>1. Mateljan, I. (2003) OOP, course material for students, FESB</td><td>10</td><td>YES</td></tr>
<tr><td>2. Radošević, D.: Programiranje 2, TIVA Tiskara Varaždin i Fakultet organizacije i informatike</td><td></td><td>YES</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">1. Motik, B., Šribar, J.(1997) Demistificirani C++, Element, Zagreb<br>2. Lippman, S. B. (1996) Inside the C++ Object Model. Addison-Wesley, Reading</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process.</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="5">MODELLING AND SIMULATION</td></tr>
<tr><td>Code</td><td>PFE307</td><td>Year of study</td><td colspan="3">1</td></tr>
<tr><td>Course teacher</td><td>Petar Matić; Ph.D., Assist.Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>15</td><td>0</td><td>45</td><td>0</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="3">0</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Students are introduced to how to design mathematical and simulation models using the Matlab / Simulink software package. They model, simulate and process the simulation results on the example of different technical systems with an emphasis on electrical systems, but they also model and simulate mechanical, fluid and thermal systems. Students independently process, analyze and interpret simulation results and perform post-processing of data either in Matlab or export the data to another program for additional processing.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Apply Matlab / Simulink computer software in problem solving through system modeling and simulation.<br>2. Create mathematical and simulation models that are close to real cases and consider all consequences of particular neglect.<br>3. Valorize the simulation results obtained in the Matlab / Simulink software package and apply the conclusions to real systems.<br>4. Anticipate undesirable occurrences in the system and improve the actual system operation by simulation<br>5. Use the simulation models developed in the Matlab / Simulink software package when designing the automatic control system and adjusting the controller.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">LECTURES:<br>1. Introductory lecture and introduction to the rights and obligations of students in the subject. Introduction to working with the Matlab / Simulink software package.<br>2. Formation of mathematical and simulation models of the system using Matlab / Simulink software package.<br>3. Define system parameters using scripts and connect to the system model.<br>4. Modeling and simulation of systems described by equations and systems described by transfer function.<br>5. Plotting of simulation results and subsequent processing of results.<br>6. Interaction of Matlab and other software packages, transfer of data from one program to another.<br>7. Analysis of system response time and interpretation of simulation results.<br>8. Analysis of the system in the frequency range<br>9. Modeling and simulating complex electrical systems using the Matlab / Simulink software package.<br>10. Modeling and simulation of complex electromechanical systems using Matlab /</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">Simulink software package.<br>11. Modeling and simulating other complex technical systems using the Matlab / Simulink software package.<br>12. Design of automatic control system using Matlab / Simulink software package.<br>13. Modeling problem for nonlinear complex systems, time series statistical models<br>14. Modeling problem for nonlinear complex systems, system identification based on measured values, using the Curve Fitting tool in Matlab.<br>15. Data-driven modeling, using Matlab's artificial intelligence tool, the "Neural Network Toolbox".<br><br>EXERCISES:<br>1. Introduction to MATLAB / Simulink. Solving general examples of system modeling based on differential equations and transfer function, and developing a simulation model for simulation in Matlab / Simulink.<br>2. Modeling and simulation of simple electrical systems based on mathematical system model in the form of differential equations and transfer function.<br>3. Modeling and simulation of simple mechanical systems based on the mathematical model of the system in the form of differential equations and transfer function.<br>4. Modeling and simulation of complex system given by block diagram, transfer function and differential equation.<br>5. Modeling and simulation of an electromechanical system (DC motor).<br>6. Design of an automatic control system using a simulation model in Simulink, using the example of a DC motor controlled by excitation current and reinforcement. Comparison of both management modes.<br>7. Setting up the PID controller using the simulation model in Simulink (for example, DC motor).<br>8. Modeling of a complex electromagnetic / power system in Simulink, an energy transformer in different operating modes (operating states) and at different loads on the secondary.<br>9. Modeling and simulation of an induction motor.<br>10. Modeling and simulating fluid processes.<br>11. Design and adjustment of self-regulating fluid process using the model in Simulink.<br>12. Modeling and simulation of thermal processes, heating rooms heated by an electric heater with loss modeling.<br>13. Modeling and simulating the heating of an electrical machine and analyzing the effect of load changes on machine heating.<br>14. Modeling nonlinearity in Matlab using the Curve Fitting tool and the parametric identification method using permeability modeling.<br>15. Modeling nonlinearity in Matlab using neural networks.</td></tr>
<tr><td>Format of instruction</td><td>☒ lectures<br>☒ seminars and workshops<br>☒ exercises<br>☐ on line only<br>☐ mixed e-learning<br>☐ field work</td><td>☒ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="2">Obligations of full-time students:<br><br>Attending classes is mandatory for full-time students. The requirement for obtaining the right to take the exam is attendance at minimum 80% of lectures. In the case of</td></tr>
</table>

an insufficient number of attendances, students do not have the right to take the exam and must enroll in the same course again the following year.

Obligations of part-time students:

Attendance at at least 50% of classes is a requirement for obtaining the right to take the exam. In the case of an insufficient number of attendances, students do not have the right to take the exam and must enroll in the same course again the following year.

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 | | Homeworks | | |
| Essay | | Seminar essay | (2 – alternative to problem task solution) | Computer exercises – report | | 1 |
| Tests | | Oral exam | | Problem solving (task) | | 2 |
| Written exam | | Project | | Other | | |

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

**1. Assessment and grading of full-time students:**

Students take the course by solving problems in the Matlab / Simulink programming environment, and there are two ways to do this.

THE FIRST OPTION
Exercises consist of demonstrating solved examples and solving problems independently. The student correctly evaluates and explains the solution during the semester, for each assignment, and the mean of all grades gives the final grade.

THE SECOND OPTION
The student completely covers one topic, independently forms a system model, analyzes and interprets the simulation results, and writes a seminar paper, which he presents at the end of the semester.

| Assessment components | Success (min. %) | Percentage in grade (%) |
|---|---|---|
| Teaching attendance | 80 | 20 |
| Mean value in problem solving in class | 40 | 80 |
| Seminar | 40 | 80 |

## Grading

| Points (%) | Criterion | Grade |
|---|---|---|
| 0-40 | Does not satisfy minimum criteria | insufficient (1) |
| 40-59 | Satisfies minimum criteria | sufficient (2) |

| | | | |
|---|---|---|---|
| | 60-75 | Average success with clear shortcomings | good (3) |
| | 76-89 | Above average success with a few errors | very good (4) |
| | 90-100 | Extraordinary success | excellent (5) |
| | **2. Evaluation and grading of part-time students**<br>Evaluation and grading criteria are the same as those of full-time students. | | |

| | **Title** | **Number of copies in the library** | **Availability via other media** |
|---|---|---|---|
| Required literature (available in the library and via other media) | Vujović, I., (2014), Modeliranje i simuliranje u elektrotehnici Matlab/Simulink. Split: Pomorski fakultet u Splitu. | | YES |
| | Matlab Tutorial and Help Desk, dostupno na: www.mathworks.com | | YES |
| | Presentations and notes from the classes, model files | | YES |
| Optional literature (at the time of submission of study programme proposal) | 1. Priemer, R., (2013), Matlab for Electrical and Computer Engineering Students and Professionals with Simulink. Edison, NJ : Scitech Publishing.<br>2. Ban, Ž., Matuško, J. i Petrović, I., (2010), Uvod u programski sustav Matlab. Zagreb: FER.<br>3. Corinthios, M., (2009), Signals, Systems, Transforms, and Digital Signal Processing with MATLAB. New York: CRC Press.<br>4. Hahn, B. D. i Valentine, D. T., (2007), Essential MATLAB for Engineers and Scientists. Amsterdam: Elsevier Ltd.<br>5. Karris, S.T., (2006), Introduction to Simulink with Engineering Applications. Orchard Publications.<br>6. Petković, T., (2005), Kratke upute za korištenje MATLAB-a. Zagreb: FER.<br>7. Uvod u Simulink, on-line: http://www.tel.fer.hr/_download/repository/matlab_pred_2_simulink%5b1%5d.pdf<br>8. Kuzmanić, I. i Vujović, I., (2004), Automatizacija broda I – računalne vježbe, elektroničko izdanje na web-u, Split: Pomorski fakultet u Splitu.<br>9. Karris, S.T., (2003), Signals and Systems with MATLAB® Applications. Orchard Publications.<br>10. MATLAB, The Language of Technical Computing, (2002), The MathWorks, Inc. | | |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. | | |
| Other (as the proposer wishes to add) | | | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">APPLIED MATHEMATICS</td></tr>
<tr><td>Code</td><td>PFP 114</td><td>Year of study</td><td colspan="3">1.</td></tr>
<tr><td>Course teacher</td><td>Tatjana Stanivuk, Ph.D., Assoc.Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Goran Kovačević, M.Sc. Math.</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>-</td><td>45</td><td>-</td></tr>
<tr><td>Status of the course</td><td>Compulsory</td><td>Percentage of e-learning</td><td colspan="3">10</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">To enable the student to apply mathematical methods necessary for access to new forms of business and modern technology in maritime affairs, as well as to engage in scientific work in the aforementioned field.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. To select the appropriate method of solution of double integrals;<br>2. Recommend a suitable solution of curve and plane integrals;<br>3. Apply Laplace transforms in solving differential equations;<br>4. Formulate mathematical problems in practice and choose a suitable numerical procedure for solving mathematical problems;<br>5. Determine the magnitude of the solution approximation error and choose the appropriate methodology for solving mathematical problems;<br>6. Analyze and evaluate the impact of individual variables on the studied phenomenon;<br>7. Valorize graphic and numerical methods;<br>8. Apply probability concepts in solving engineering problems;<br>9. Argumentate the procedure for hypothesis setting and testing, and evaluate the outcome of hypothesis adoption / rejection;</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures:<br>1. Introduction to the course. Dual integrals and application;<br>2. Curve integral of the first and second kind;<br>3. Application of curve integral and Green's formula;<br>4. Surface integral of the first and second types; applications;<br>5. Laplace transforms.<br>6. Selected chapters in numerical mathematics; Errors in numerical computing;<br>7. Interpolation;<br>8. Numerical solution of equations;<br>9. Numerical integration.<br>10. Introduction to probability and statistics: Combinatorics;<br>11. Concept and basic features of probability;<br>12. Random variables;<br>13. Numerical characteristics of random variables;<br>14. Descriptive and inferential statistics;<br>15. Course contents overview and discussion on its applications.<br><br>Exercises:</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">1. Double integrals and application;<br>2. Curve integral of the first and second kind;<br>3. Application and Green's formula;<br>4. Plot integral of the first and second types<br>5. Laplace transforms.<br>6. 1st in-term test. Errors in numerical computing;<br>7. Interpolation;<br>8. Numerical solution of equations;<br>9. Numerical integration.<br>10. 2nd in-term test. Combinatorics;<br>11. Examples of probability and conditional probability;<br>12. Random variables;<br>13. Numerical characteristics of random variables;<br>14. Methods of descriptive statistics and methods of statistical inference (1/2);<br>15. Methods of statistical inference (2/2);. 3rd in-term test.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ individual tasks<br>☒ multimedia<br>☐ laboratory<br>☐ mentoring<br>☒ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Responsibilities of full-time students:<br>Attendance at lectures and tutorials in the amount of at least 80% of the estimated hourly rate. Active participation in classes and regular attendance of midterm examinations (three partial exams) taken during class. Passed all three exams release the student of the final written exam, which is organized in the term of the exam term of the lecturer, and with the application to Studomat. After passing the written part of the exam, the student enters the oral part of the exam.<br><br>In case of insufficient number of students, students are not entitled to sign and are obliged to re-enroll in the course next year.<br><br>Responsibilities of part-time students<br>They differ from the obligations of full-time students only in the following items:<br>1. Attendance at lectures and classes at least 50% of the estimated hourly rate.<br>2. Possibility to take a midterm examination in agreement with the subject teacher if the student, for justified reasons, could not start the midterm examination in the time stipulated for this purpose.</td></tr>
<tr><td rowspan="6">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 and in-class activity</td><td>1.875</td><td>Research</td><td>0.5</td><td>Practical work</td><td>0.5</td></tr>
<tr><td>Experimental work</td><td>-</td><td>Report</td><td>-</td><td>Other</td><td>-</td></tr>
<tr><td>Essay</td><td>-</td><td>Seminar</td><td>-</td><td>Other</td><td>-</td></tr>
<tr><td>In-term tests</td><td>2</td><td>Oral exam</td><td>1.125</td><td>Other</td><td>-</td></tr>
<tr><td>Final written test</td><td>2 (alternatively, in-term tests</td><td>Project</td><td>-</td><td>Other</td><td>-</td></tr>
<tr><td></td><td colspan="5"></td></tr>
<tr><td>Grading and evaluating student</td><td colspan="6">1. Evaluation and grading of full-time and part-time students' work:<br>Each student approaches the written and oral examination.</td></tr>
</table>

work in class and at the final exam

The written part of the exam consists of three partial exams (midterm examinations), which are taken during class (6th, 10th and 15th week of classes) or the final written exam, which is organized within the term of exam periods. After passing the written part of the exam, the student enters the oral part of the exam. The latter may be released from the oral part of the exam if he / she is strongly committed during the class and is satisfied with the grade achieved on the written part of the exam.
In order for the student to take a midterm exam, they must score at least 50% of the maximum number of points. Passed all three exams release the student of the final written exam. If a student has passed one or two midterm examinations (out of a possible three), the same part of the course material is excluded from the final written examination and writes only that part of the material which he/she did not satisfy. The grade of the written part of the exam is formed as the mean of the grades obtained by the midterm exam or the points obtained at the final written exam (if the student did not pass the midterm tests).
During the course, the attendance and activity of each student in connection with the course material is monitored and added to the overall grade of the course.

**Continuous student assessment:**

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Lecture attendance | 80 | 31.4 |
| Practical training | 100 | 8.3 |
| Research | 100 | 8.3 |
| 1. in-term test | 50 | 11.1 |
| 2. in-term test | 50 | 11.1 |
| 3. in-term test | 50 | 11.1 |
| Oral exam | 50 | 18.7 |

**Grading:**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0 - 49 | Does not satisfy minimum criteria | insufficient (1) |
| 50 - 64 | Satisfies minimum criteria | sufficient (2) |
| 65 - 79 | Average success with clear shortcomings | good (3) |
| 80 - 89 | Above average success with a few errors | very good (4) |
| 90 - 100 | Extraordinary success | excellent (5) |

**2. Assessment and grading of the work of part-time students**

The assessment and grading criteria are the same as for full-time students.

Required literature (available in the library and via other media)

| Title | Number of copies in the library | Availability via other media |
|---|---|---|
| 1. Merlin; https://moodle.srce.hr/2021-2022/ | - | YES |
| 2. Demidovič B. P. i dr., Zadaci i riješeni primjeri iz matematičke analize za tehničke fakultete, Tehnička knjiga, Zagreb, 1995. | 15 | YES |
| 3. Draščić Ban, B., Poganj T., Primijenjena matematika, Faculty of Maritime Studies in Rijeka, 2009. | | YES |
| 4. Elezović, N., Fourierov red i integral / Laplaceova transformacija, Element, Zagreb, 2010. | 4 | |

| | | | |
|---|---|---|---|
| | 5. Kovač Striko E., Kapetanović N., Ivanković B., Vjerojatnost i statistika, material for students, 2005. | | YES |
| | 6. Tomašević M., Ristov P., Stanivuk T., Statističke metode u istraživanju, Split, 2007. | 15 | |
| Optional literature (at the time of submission of study programme proposal) | 1. B. Apsen (1994) Repetitorij više matematike, Part III, Tehnička knjiga d.d. Zagreb, 1994.<br>2. N. Elezović (2007) Vjerojatnost i statistika. Slučajne varijable, Element, Zagreb,<br>3. I. Ivanšić (1987) Funkcije kompleksne varijable. Laplaceova transformacija, SN Liber<br>4. Ž. Pauše (1990) Riješeni primjeri i zadaci iz teorije vjerojatnosti i statistike, skripta, Zagreb<br>5. R. Scitovski (2004) Numerička matematika, Sveučilište u Osijeku, Osijek<br>6. I. Šošić (2004) Primijenjena statistika, Školska knjiga, Zagreb<br>7. P. Vranjković (1992) Zbirka zadataka iz vjerojatnosti i statistike s uputama i rješenjima, Školska knjiga, Zagreb | | |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. | | |
| Other (as the proposer wishes to add) | | | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">ADVANCED CONTROL AND DIAGNOSTICS</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="4">1</td></tr>
<tr><td>Course teacher</td><td>Ivana Golub Medvešek, Ph.D., Assist. Prof.</td><td>Number of credits (ECTS)</td><td colspan="4">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Nediljko Bugarin</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td></td><td>15</td><td></td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="4"></td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Acquaintance with new technologies and techniques in fault diagnostics and system control, especially the shipboard ones.<br><br>Knowledge of methods of implementation and application methodologies of new technologies and diagnostic and management techniques. Calculation of time to failure and service intervals for maintenance.<br><br>Acquaintance with new technologies in the field of control systems such as the Internet of Things (IoT), cloud computing, infrared diagnostics, diagnostics from signal vibrations, fuzzy logic, expert systems, artificial neural networks, smart electrical networks, fusion of data obtained from more sensors, and the integrated functioning of ship systems.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Critically consider the way system redundancy was introduced.<br>2. To quantify the reliability of the (ship) system.<br>3. To determine the justification of the introduction of sensor fusion in a particular application.<br>4. Assess whether it is possible to undertake the next trip from the thermographic report and data on the mean time to failure.<br>5. Judge the expertise of the expert system at your workplace.<br>6. Argue the existence of a spare system at some point in the system.<br>7. Anticipate the dangers of using ANN, IoT, cloud, fuzzy logic or expert system at some point in the system.<br>8. Plan and conduct applied research based on collected data on electromechanical, electronic and control components of the ship's system using fundamental scientific methods.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">LECTURES<br>1. Introduction. Terms in fault diagnostics and control. Determination of system reliability and availability.<br>2. Integration of marine systems. The role of information and communication technologies in integrated ship functioning. The concept of integrated ship</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">functioning. Diagnostics and management of marine propulsion systems.<br>3. Possibilities for improvement of existing control and diagnostics systems for marine (eg diesel) engines. FDI scheme based on symptom-failure relationships and trend analysis.<br>4. Sensor and actuator fault diagnosis. Sensor networking. Fault tolerance management schemes. Software structures of fault tolerant SU.<br>5. The Internet of Things - concepts, dangers, benefits.<br>6. Vibration analysis of the ship's machine by frequency and time-frequency procedures with the purpose of fault detection.<br>7. Frequency response of characteristic machine failures.<br>8. Infrared cameras, principle of operation and characteristics.<br>9. Thermographic diagnostics of failures. Examples of marine systems thermographic analysis reports.<br>10. Artificial neural networks example of sensor processing of marine diesel engine signals.<br>11. Smart networks - term, examples, modern diagnostics technologies in the smart grid transmission system.<br>12. Expert systems - concepts, types and examples in maritime affairs.<br>13. Fuzzy logic.<br>14. Multisensor Fusion - Advantages, Applications in Civil and Military Systems,.<br>15. Cloud Technology - Concepts, Features, Benefits and Disadvantages.<br><br>EXERCISES<br>1. Testing bearing vibration signals.<br>2. Analysis of availability data.<br>3. Reliability and availability of a computer system (Simulink).<br>4. Reliability and availability of a computer system (Simulink).<br>5. Introduction to ANN with command window and GUI.<br>6. Introduction to ANN with command window and GUI.<br>7. CNN example in industry.<br>8. CNN example in industry.<br>9. CNN example in shipping.<br>10. CNN example in shipping.<br>11. CNN example in shipping.<br>12. Fuzzy logic.<br>13. Sensor fusion.<br>14. Infrared camera.<br>15. Infrared camera.</td></tr>
<tr><td>Format of instruction</td><td>☒ lectures<br>☐ seminars (cargo plan development)<br>☒ exercises<br>☐ on line only<br>☐ mixed e-learning<br>☐ field work</td><td>☐ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring<br>☐ simulator work</td></tr>
<tr><td>Student responsibilities</td><td colspan="2">Responsibilities and evaluation of students<br><br>Responsibilities of full-time students:<br>Attendance is compulsory for full-time students, ie a minimum of 80% of lectures and 100% of computer and laboratory exercises are required. If a student could not attend a part of the classes for a justified reason, it is possible to compensate for that part in the form of seminar paper or project.<br><br>Responsibilities of part-time students:<br>Attendance is compulsory for full-time students, i.e., a minimum of 50% of lectures and 100% of computer and laboratory exercises are required. If the student could not attend a part of the classes for a justified reason, it is possible to compensate</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">for that part in the form of a seminar paper or project.</td></tr>
<tr><td rowspan="6">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>Lecture attendance</td><td>1.125</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work-laboratory exercises</td><td></td><td>Report</td><td></td><td>Report from laboratory exercises</td><td>0,75</td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td>2.125</td><td>Oral exam (for students who have not passed in-term tests or are dissatisfied with the grade)*</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam (for students who have not passed in-term tests or are dissatisfied with the grade)</td><td>2.125</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Examination:<br>There are 2 midterms written in the semester. The first in-term test, which covers questions from lectures 1-7 and is written after the seventh week of class. The second in-term test covers questions from Lectures 8-15 and is written in the fifteenth week of class. Examples of in-term test questions for students are available on the website. At each in-term test, a minimum of 40% passing points is required. Students who do not attend one of the exams for objective reasons or fail to achieve a minimum percentage are eligible for correction. A correction will be arranged for these students.<br><br>Continuous assessment of students' work<br><br>
<table>
<tr><th>Assessment elements</th><th>Success (min.%)</th><th>Percentage in grade (%)</th></tr>
<tr><td>Lecture attendance</td><td>80 (50 – part-time stdnts)</td><td>0</td></tr>
<tr><td>Exercises attendance</td><td>100</td><td>0</td></tr>
<tr><td>In-term test I</td><td>40</td><td>50</td></tr>
<tr><td>In-term test II</td><td>40</td><td>50</td></tr>
</table>
Final evaluation<br>
<table>
<tr><th>Evaluation indicators – final exam</th><th>Success (min. %)</th><th>Percentage in grade (%)</th></tr>
<tr><td>Lecture attendance</td><td>80 (50-part-time stdnts)</td><td>0</td></tr>
<tr><td>Exercises attendance</td><td>100</td><td>0</td></tr>
<tr><td>Written exam</td><td>40</td><td>100</td></tr>
</table>
Grading<br>
<table>
<tr><th>Points (%)</th><th>Criterion</th><th>Grade</th></tr>
<tr><td>0-40</td><td>Does not satisfy minimum criteria</td><td>insufficient (1)</td></tr>
<tr><td>40-59</td><td>Satisfies minimum criteria</td><td>sufficient (2)</td></tr>
<tr><td>60-75</td><td>Average success with clear shortcomings</td><td>good (3)</td></tr>
</table>
</td></tr>
</table>

| | | | |
|---|---|---|---|
| | 76-89 | Above average success with a few errors | very good (4) |
| | 90-100 | Extraordinary success | excellent (5) |

| | Title | Number of copies in the library | Availability via other media |
|---|---|---|---|
| Required literature (available in the library and via other media) | 1. Antonić, R., (2010), Nove tehnologije dijagnostike i upravljanja, Split: Faculty of Maritime Studies in Split. | | WEB-PFST |
| | 2. Vujović, I., (2019), Zabilješke s predavanja, Split: Faculty of Maritime Studies in Split. | | WEB-PFST |
| | 3. Vujović, I., (2019), Vježbe na računalu, Split: Faculty of Maritime Studies in Split. | | WEB-PFST |
| | | | |
| | | | |

| | |
|---|---|
| Optional literature (at the time of submission of study programme proposal) | 1. Kuzmanić, I. i Vujović, I., (2014), Reliability and Availability of Quality Control Based on Wavelet Computer Vision, Springer Briefs in Electrical and Computer Engineering, Berlin: Springer Verlag.<br>2. Vujović, I., (2015), Multiresolution Approach to Processing Images for Different Applications-Interaction of Lower Processing with Higher Vision, SpringerBriefs in Electrical and Computer Engineering, Heidelberg: Springer Verlag.<br>3. Blanke, M. et al., (2003), Diagnosis and Fault-Tolerant Control, Berlin: Springer.<br>4. Zilouchian, A. i Jamshidi, M., (2001), Intelligent Control Systems Using Soft Computing Methodoligies, London: CRC Press.<br>5. Yen, J., Langari, R. i Zadeh, L.A., (1995), Industrial Applications of Fuzzy Logic and Intelligent Systems, New York: IEEE Press.<br>6. Margaliot, M. i Langholz, G., (2001), New Approaches to Fuzzy Modelling and Control - Design and Analysis, Bombai: World Scienientific Publishing Co.<br>7. Lakhmi, C.J. i Clarence, W.S., (1999), Intelligent Adaptive Control - Industrial Applications, New York: CRC Press.<br>8. Cloud Computing Tutorial, www.tutorialapoint.com |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external assessment of the grading process. |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">SHIP CONTROL SYSTEMS</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="4">1</td></tr>
<tr><td>Course teacher</td><td>Petar Matić, Ph.D., Assist. Prof.</td><td>Number of credits (ECTS)</td><td colspan="4">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Nediljko Kaštelan</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>15</td><td>-</td><td>45</td><td>-</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="4"></td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Master the basic knowledge of how ship control systems work.<br>Understand the way components work for the implementation of ship control systems.<br>Learn how to design ship control systems.<br>Learn to form an electric control circuit.<br>Analyze the correct operation of electrical, relay control circuits based on the diagram and on the actual circuit.<br>Test the correct operation of the ship electrical control circuits and systems.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Valorize the operating modes of the control system based on the current control diagram.<br>2. Choose the optimal components for the design of the control system.<br>3. Compare different control methods and evaluate the optimal choice.<br>4. Predict the way of implementation of the control system.<br>5. Test the correct operation of the ship control system and individual components of the system.<br>6. Choose solutions of simple control systems.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures:<br>1. Introductory lecture. Presentation of subject content, goals, learning outcomes, ways of teaching and taking exams.<br>2. Description of the mode of operation, symbols, characteristics and method of connecting (wiring) components for the protection of electrical circuits: switches, fuses, switches.<br>3. Description of the mode of operation, symbols, characteristics and method of connecting (wiring) components for the realization of relay control circuits: switches and relays.<br>4. Description of the operating mode, symbols, characteristics and connection (wiring) of sensors: position, temperature, pressure.<br>5. Performances and mode of operation of simple relay control circuits: direct starting of a three-phase asynchronous motor.<br>6. Versions and mode of operation of simple relay control assemblies: direct starting of a three-phase asynchronous motor with the possibility of changing the direction of rotation.</td></tr>
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|---|---|
| | 7. Versions and mode of operation of more complex relay control assemblies: indirect starting of a three-phase asynchronous motor by manual switching of the connections of the stator windings.<br>8. Versions and mode of operation of more complex relay control assemblies: indirect starting of a three-phase asynchronous motor by automatic switching of the connections of the stator windings.<br>9. Versions and mode of operation of more complex relay control assemblies: indirect starting of a three-phase asynchronous motor by automatic switching of the connections of the stator windings and the possibility of changing the direction.<br>10. Versions and mode of operation of complex relay control systems: conditional control of marine machinery.<br>11. Designing of relay control systems: conditional start and automatic start (re-start), switching and stopping of marine machinery.<br>12. Programmable logic controllers (PLC): mode of operation, wiring, programming. Similarities and differences with relay control circuits.<br>13. Power electronics assemblies for managing ship propulsion systems: frequency converters and soft-start devices for electric motors.<br>14. Description of the mode of operation and purpose of various ship systems. Deployment and organization of control cabinets on board. Group referrals.<br>15. Description of the mode of operation and performance of the control system for an example of different ship systems. Interpretation of system operation based on electrical and control scheme.<br><br>**Exercises (3 per week: auditory, laboratory):**<br>1. Drawing of electrical and control schemes in the CAD-based program Schrack Design: interface, selection of components, databases, way of working in the program and creation of technical documentation of the designed assembly.<br>2. Mode of operation and handling of measuring instruments and tools necessary for implementation, testing and maintenance of ship's control systems and assemblies.<br>3. Designing a relay control circuit for direct starting of a three-phase asynchronous motor (Project 1).<br>4. Realization of a relay control circuit for direct starting of a three-phase asynchronous motor (Project 1).<br>5. Designing a relay control system for direct starting of a three-phase asynchronous motor with the possibility of choosing the direction of rotation (Project 2).<br>6. Realization of a relay control system for direct starting of a three-phase asynchronous motor (Project 2).<br>7. Designing a relay control system for indirect starting of a three-phase asynchronous motor by manual switching of stator winding connections (Project 3).<br>8. Realization of a relay control circuit for indirect starting of a three-phase asynchronous motor by manual switching of the connections of the stator windings (Project 3).<br>9. Designing a relay control system for indirect starting of a three-phase asynchronous motor by automatically switching the connections of the stator windings (Project 4).<br>10. Realization of a relay control system for indirect starting of a three-phase asynchronous motor by automatic switching of the connections of the stator windings (Project 4).<br>11. Designing a relay control system for indirect starting of a three-phase |

<table>
<tr><td></td><td colspan="6">asynchronous motor by automatically switching the connections of the stator windings and the possibility of choosing the direction of rotation (Project 5).<br>12. Realization of a relay control system for indirect starting of a three-phase asynchronous motor by automatic switching of the connections of the stator windings and the possibility of choosing the direction of rotation (Project 5).<br>13. Designing a relay control system for conditional control (starting, switching and stopping) of a ship's electric motor drive (individual task, Project 6).<br>14. Realization of the relay controller for conditional control (starting, switching and stopping) of the ship's electric motor drive (individual task, Project 6).<br>15. Test of correctness of assembly and demonstration of work: solution of individual task (Project 6).</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☒ seminars and workshops<br>☒ exercises<br>☐ on line entirely<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☒ independent assignments<br>☐ multimedia<br>☒ laboratory<br>☐ supervised tasks<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Responsibilities of full-time students:<br>Attending classes is mandatory for full-time students. The requirement for obtaining the right to take the exam is attendance at at least 80% of classes. In case of an insufficient number of attendances, students do not have the right to take the exam and must enroll in the course again the following year.<br>Responsibilities of part-time students:<br>Attendance at at least 50% of classes is a requirement for obtaining the right to take the exam. In case of an insufficient number of attendances, students do not have the right to take the exam and must enroll in the course again the following year.</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>Lecture attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td>1.5</td></tr>
<tr><td>Experimental work-laboratory exercises</td><td></td><td>Report</td><td></td><td>Report from laboratory exercises</td><td>2</td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>In-term 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">Assessment and grading of the work of full-time students:<br>During the semester, students are assigned a series of 6 projects (assignments) and receive a grade for each, and the overall grade is the result of the sum of individual grades with the corresponding weight factor, i.e. with a different share in the final grade that is proportional to the difficulty, i.e. the complexity of the task, as defined by the table for continuous assessment of students.<br>Continuous assessment of students:
<table>
<tr><th>Assessment elements</th><th>Success (min. %)</th><th>Share in the gradre (%)</th></tr>
<tr><td>Lecture attendance</td><td>80</td><td>0</td></tr>
<tr><td>Project 1</td><td>100</td><td>5</td></tr>
<tr><td>Project 2</td><td>100</td><td>10</td></tr>
<tr><td>Project 3</td><td>100</td><td>15</td></tr>
<tr><td>Project 4</td><td>100</td><td>15</td></tr>
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| | | | |
|---|---|---|---|
| | Project 5 | 100 | 20 |
| | Project 6 | 100 | 35 |

**Grading**:

| Points (%) | Criterion | Grade |
|---|---|---|
| 0 – 40 | Does not satisfy minimum criteria | insufficient (1) |
| 41 – 59 | Satisfies minimum criteria | sufficient (2) |
| 60 – 75 | Average success with clear shortcomings | good (3) |
| 76 – 89 | Above average success with a few errors | very good (4) |
| 90 – 100 | Extraordinary success | excellent (5) |

**Assessment and grading of the work of part-time students:**
Assessment and grading criteria are the same as those for full-time students.

| | Title | Number of copies in the library | Availability via other media |
|---|---|---|---|
| Required literature (available in the library and via other media) | 1. Teacher's own materials for the lectures and exercises – Under construction. | | |
| | 2. D.T. Hall. Practical Marine Electrical Knowledge, Second Edition. Witherby, 1999. | 1 | YES |
| | 3. A. Yakimchuk. Ship Automation For Marine Engineers and ETOs,. Scotland, UK: Witherby Seamanship Inernational, 2012. | 1 | YES |
| Optional literature (at the time of submission of study programme proposal) | 1. The Maritime Engineering Reference Book-A Giude to Ship Design, Construction and Operation. Elsevier: Butterworth-Heinemann, 2008.<br>2. M. R. Patel. Shipboard Electrical Power Systems. Boca Raton, USA: CRC Press, 2012.<br>3. A.K. Adnanes. Maritime Electrical Instalations and Diesel Electric Propulsion. Oslo, Norway: ABB, 2003.<br>4. P. Manley. Essential Boat Electrics. Chichester, UK: Wiley,2007.<br>5. H. D. McGeorge. Marine Electrical Equipment and Practice, Second edition reprint. Oxford, UK: Butterworth-Heinemann, 2004. | | |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external assessment of the grading process. | | |
| Other (as the proposer wishes to add) | | | |

<table>
<tr><td>NAZIV PREDMETA</td><td colspan="5">SCIENTIFIC RESEARCH METHODOLOGY</td></tr>
<tr><td>Code</td><td>PFP141</td><td>Year of study</td><td colspan="3">1</td></tr>
<tr><td>Course teacher</td><td>Helena Ukić Boljat, PhD</td><td>Number of credits (ECTS)</td><td colspan="3">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="3">10</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">By mastering the basic knowledge of the concept, methodology and technology of scientific and professional research, train students for independent implementation of simpler research and writing, presentation and presentation of works.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Interpret the general concept of science and the basic characteristics and classification of science.<br>2. Distinguish and classify the types and structure of scientific and professional papers.<br>3. Plan and organize the technology of scientific research.<br>4. Propose and apply scientific research methods.<br>5. Present skills in writing, technical processing, exposition and presentation of work.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures:<br>1. Introduction to the course.<br>2. About science. Features of modern science.<br>3. Scientific research activity.<br>4. Technology of scientific research.<br>5. Observing a scientific problem.<br>6. Establishing a hypothesis.<br>7. Development of a research plan.<br>8. Compilation of a working bibliography, collection, selection and study of literature and scientific information.<br>9. Methodology of scientific research.<br>10. Scientific methods.<br>11. Scientific methods.<br>12. Application of scientific methods when writing papers.<br>13. Scientific and professional papers.<br>14. Preparation of the structure of a scientific and professional papers.<br>15. Text writing and technical processing of scientific and professional papers.</td></tr>
<tr><td>Format of</td><td colspan="2">☒ lectures</td><td colspan="3">☒ independent assignments</td></tr>
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| | | |
|---|---|---|
| instruction | ☐ seminars and workshops<br>☐ exercises<br>☐ *on line* entirely<br>☒ mixed e-learning<br>☐ field work | ☐ multimedia<br>☐ laboratory<br>☐ supervised tasks<br>☐ consultations |

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| Student responsibilities | **Responsibilities of full-time students**:<br>Lectures are compulsory for students, and attendance records are kept. In order to get the right to take the exam, regular students are required to attend at least 80% of the lectures. In case of an insufficient number of attendances, students do not have the right to take the exam and must re-enroll in the course the following year. During the semester, students are required to complete independent assignments, process and present a seminar paper according to the instructions provided.<br><br>**Responsibilities of part-time students**:<br>Attendance at at least 50% of lectures is a condition for obtaining the right to take the exam. During the semester, students are required to complete independent assignments, process and present a seminar paper according to the instructions provided. |

| 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)* | | | | | | |
|---|---|---|---|---|---|---|
| | Lecture attendance | 0.75 | Research | | Practical work | |
| | Experimental work | | Report | | Independent assignments | 1.25 |
| | Essay | | Seminar paper | 2 | (Other) | |
| | In-term tests | | Oral exam | | (Other) | |
| | Written exam | | Projekt | | (Other) | |

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

**Assessment and grading of the work of full-time students:**
Students' work is continuously evaluated during the semester. Students are required to complete tasks that carry 30% of the grade during the seminar, independently or in a team, and hand them in at the given time. Students must create and submit an independent seminar paper according to the given rules and within the given deadlines. The seminar paper must be presented to colleagues according to a pre-planned template. Written and oral presentation of the seminar paper make up 60% of the course grade.

**Continuous assessment of the students' work:**

| Assessment elements | Success (min. %) | Share in the grade (%) |
|---|---|---|
| Lecture attendance | 80 | 10 |
| Independent/team assignments | 50 | 30 |
| Seminar paper | 50 | 60 |

**Grading:**

| Points (%) | Criterion | Grade |
|---|---|---|
| 0 – 49 | Does not satisfy minimum criteria | insufficient (1) |
| 50 – 64 | Satisfies minimum criteria | sufficient (2) |
| 65 – 79 | Average success with clear shortcomings | good (3) |

<table>
<tr><td></td><td>
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<tr><td>80 – 89</td><td>Above average success with a few errors</td><td>very good (4)</td></tr>
<tr><td>90 – 100</td><td>Extraordinary success</td><td>excellent (5)</td></tr>
</table>
<br>Students who have collected a sufficient number of points through continuous assessment during classes are required to register for the exam on Studomat, for the first exam term after the lecture and, depending on the result achieved, their grade is entered in Studomat.<br><br>Assessment and grading of the work of part-time students:<br>The assessment and grading criteria are the same as for full-time students.</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td>
<table>
<tr><th>Title</th><th>Number of copies in the library</th><th>Availability via other media</th></tr>
<tr><td>1. S, S. Carey. A Beginner's Guide to Scientific Method, 4th Edition. USA: Wadsworth, Cengage Learning, 2012.</td><td></td><td>YES</td></tr>
<tr><td>2. R. Kumar. Research Methodology a step-by-step guide for beginners. SAGE Publications Ltd., 2011.</td><td></td><td>YES</td></tr>
<tr><td>3. R. Zelenika. Metodologija i tehnologija izrade znanstvenog i stručnog djela. Rijeka: Ekonomski fakultet Sveučilišta u Rijeci, 2000.</td><td>5</td><td></td></tr>
</table>
</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td>1. Z. Kulenović. Metodologija istraživačkog rada. Split: Pomorski fakultet Sveučilišta u Splitu, 2005.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td>University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external assessment of the grading process.</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td></td></tr>
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<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">ADVANCED ELECTROTECHNICAL MATERIALS</td></tr>
<tr><td>Code</td><td>PFE217</td><td>Year of study</td><td colspan="3">1</td></tr>
<tr><td>Course teacher</td><td>Ivana Golub Medvešek, Ph.D., Assist. Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Nediljko Bugarin</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>-</td><td>15</td><td>-</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="3"></td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Getting to know new technologies and materials (e.g., nanomaterials, 3D printing materials and technology, etc.).<br>Gaining experience in working with an optical microscope.<br>Knowledge of thermal design of electronic devices and their packaging is acquired.<br>Familiarization with programs for simulation of the molecular level of matter, visualization of CFD problems and thermal design of (electrical) technical systems.<br>Familiarization with testing of electrotechnical materials and tests for safety and write-off, degradation of material properties and the influence of corrosion, thermal design and the environment on the functioning of electrical and electronic equipment.<br>Repetition and expansion of materials covered in undergraduate studies from STCW 7.03: Competence 1.1- Technology of electrical materials 1.1.9. Appendix 5: 1.1., 1.2., 1.3.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Argument the presentation of ethical dilemmas in the application of nanotechnology to humanity and its future.<br>2. Choose a suitable computer program for visualization, molecular simulations and thermal design in electrical engineering and technology of electrotechnical materials.<br>3. Evaluate, compare and know the packaging of electronic components.<br>4. Predict the appearance of superconductivity disruption in superconducting materials in a given working environment.<br>5. Classify corrosion and determine a suitable proposal for solving the problem.<br>6. Assess the condition of electrotechnical materials with regard to the safety of further use and write-off of the vessel.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures:<br>1. Distribution of materials. Microcosm and macrocosm. Materials at the atomic level. Modern views on the model of atoms and matter. Standard model.<br>2. Clause-Klein theory. Modern theories about matter and the universe. The way atoms are connected (bonds).<br>3. Electrical properties of materials. Classical electron theory. Sommerfeld's model of metals.<br>4. Non-metallic conductors. Theory of free electrons in metals. Band theories in solids. Thermal properties of materials. Theoretical power loss.<br>5. Programs for thermal engineering. CFD programs. Navier-Stokes equations.</td></tr>
</table>

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<tr><td></td><td colspan="6">6. Electronic component packaging: surface mount packages, open die, module assembly, chip size packaging.<br>7. Packaging of electronic components: flip chip, slot packages, chip on board.<br>8. Definitions and divisions of nanotechnology. Nanotechnology tools.<br>9. Principles of operation of instruments for the study of nanomaterials. Components of nanotechnology. New trends and possible development of nanotechnology. Production of nanomaterials.<br>10. Basics of 3D printing. Femtotechnology.<br>11. Superconductivity - theories and trends.<br>12. Composites. Programmable matter. Smart materials. Biomimetic materials.<br>13. Degradation of electrotechnical materials and connections with vessel write-off. Thermographic testing of materials.<br>14. Corrosion and protection against it.<br>15. Dielectrics, cables and optical cables. Material testing and standards.<br><br>Exercises:<br>1. Optical USB microscope.<br>2. Optical USB microscope<br>3. Optical USB microscope<br>4. Visualization of scientific data with the Se.La.Vi program.<br>5. Painting with Autodesk CFD viewer.<br>6. LAMMPS molecular simulations and Ovito imaging of the obtained data.<br>7. Ninithi program for nanotechnology.<br>8. Pamela - program for calculation of electron energy in nanotechnology in Matlab.<br>9. Nanolevel simulations - Molecular Workbench.<br>10. Nanolevel simulations - Molecular Workbench.<br>11. Nanolevel simulations - Molecular Workbench.<br>12. Nanolevel simulations - Molecular Workbench.<br>13. Introduction to 3D printing technology: creating models in 123D.<br>14. 3D printing.<br>15. 3D printing.</td></tr>
<tr><td>Formats of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ on line entirely<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ independent assignments<br>☐ multimedia<br>☒ laboratory<br>☐ supervised tasks<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Responsibilities of full-time students:<br>Attending classes is mandatory for full-time students. Attendance at at least 80% of lectures and 100% of computer and laboratory exercises is a condition for obtaining the right to take the exam. If a student could justifiably not be present at a part of the class, he can make up for that part with a seminar or project.<br><br>Responsibilities of part-time students:<br>Attending classes is mandatory for full-time students. Attendance at at least 50% of lectures and 100% of computer and laboratory exercises is a condition for obtaining the right to take the exam. If a student could justifiably not be present at a part of the class, he can make up for that part with a seminar or project.</td></tr>
<tr><td rowspan="3">Screening student work (name the proportion of ECTS credits for each activity so that the</td><td>Lecture attendance</td><td>1.125</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td>Lab. exercise - reports</td><td>0.5</td></tr>
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|---|---|---|---|---|---|---|
| *total number of ECTS credits is equal to the ECTS value of the course)* | In-term tests | 2.375 | Oral exam | | (Other) | |
| | Written exam | 2.375 (alternative to in-term tests | Projekt | | (Other) | |

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

**Assessment and grading of the work of full-time students:**
Two in-term tests are written in the semester. The first test, which includes questions from the material from the first to the seventh lecture, is written after the seventh week of classes. The second test includes questions from the material from the eighth to the fifteenth lecture and is written in the fifteenth week of classes. Sample questions for the tests are available to students on the website. At each test, it is necessary to obtain at least 40% of points to pass. Students who do not attend a test for objective reasons or do not achieve the minimum percentage have the possibility of correction. Correction will be organized for these students.

**Continuous assessment of students:**

| Assessment elements | Success (min. %) | Share in the grade (%) |
|---|---|---|
| Lecture attendance | 80 | 0 |
| Exercises attendance | 100 | 0 |
| In-term test I | 40 | 50 |
| In-term test I | 40 | 50 |

**Final assessment:**

| Assessment elements | Success (min. %) | Share in the grade (%) |
|---|---|---|
| Lecture attendance | 80 (50 – part-time stdnts) | 0 |
| Exercises attendance | 100 | 0 |
| Written exam | 40 | 100 |

**Grading:**

| Points (%) | Criterion | Grade |
|---|---|---|
| 0 – 49 | Does not satisfy minimum criteria | insufficient (1) |
| 50 – 64 | Satisfies minimum criteria | sufficient (2) |
| 65 – 79 | Average success with clear shortcomings | good (3) |
| 80 – 89 | Above average success with a few errors | very good (4) |
| 90 – 100 | Extraordinary success | excellent (5) |

**Assessment and grading of the work of part-time students:**
The assessment and grading criteria are the same as for full-time students.

Required literature (available in the library and via other media)

| Title | Number of copies in the library | Availability via other media |
|---|---|---|
| 1. I. Vujović. Nove tehnologije elektrotehničkih materijala (radni materijal). Split: Pomorski fakultet u Splitu, 2019. | | YES |
| | | |

| | | | |
|---|---|---|---|
| Optional literature (at the time of submission of study programme proposal) | 1. I. Vujović, I., Kuzmanić, Z. Kulenović. Dielectric Materials' Selection for Marine Applications. Saarbrücken: LAP LAMBERT Academic Publishing, 2014.<br>2. W. D. Callister. Materials Science and Engineering-An Introduction, sedmo izdanje. New York: John Wiley & Sons, 2007.<br>3. S. O. Kasap. Principles of Electronic Materials and Devices, treće izdanje. New York: McGraw Hill, 2006.<br>4. N. Spaldin Magnetic Materials-Fundamentals and Device Applications. Cambridge: Cambidge University Press, 2006.<br>5. R. E. Hummel. Electrical Properties of Materials, treće izdanje. New York: Springer, 2005.<br>6. L. Solymar, D. Walsh. Electrical Properties of Materials, sedmo izdanje. Oxford: Oxford University Press, 2004.<br>7. I. Kuzmanić, R. Vlašić, I. Vujović. Elektrotehnički materijali. Split: Visoka pomorska škola u Splitu, 2003.<br>8. A. J. Moulson, J. M. Herbert (ur.). Electroceramics: Materials, Properties, Applications, drugo izdanje. New York: John Wiley & Sons, Ltd., 2003.<br>9. R. Remsburg Thermal Design of Electronic Equipement. London: CRC Press, 2001.<br>10. N. C. Lee. Reflow Soldering Processes and Troubleshooting: SMT, BGA, CSP and Flip Chip Technologies. Oxford: Newnes, 2002.<br>11. R. Remsburg. Thermal Design of Electronic Equipement, Boca Raton: CRC Press, 2001.<br>12. G. R. Blackwell. The Electronic Packaging Handbook, New York: IEEE Press, 2000.<br>13. T. H. Courtney. Mechanical Behaviour of Materials, drugo izdanje. Long Grove: Waveland Press, 2000.<br>14. L. Tsakalakas. Nanotechnology for Photovoltaics. New York: CRC Press, 2010.<br>15. G. L. Hornyak, H. F. Tibbals, J. Dutta, J. J. Moore. Introduction to Nanoscience & Nanotechnology. New York: CRC Press, 2009. | | |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external assessment of the grading process. | | |
| Other (as the proposer wishes to add) | | | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">MECHATRONICS</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="3">1.</td></tr>
<tr><td>Course teacher</td><td>Hrvoje Dodig, Ph.D., Assoc.Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="3">10%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Upgrading fundamental knowledge of mechatronic systems. Design of embedded computers for the purpose of designing a mechatronic system. Creating prototypes of mechatronic systems using 3D printers. Learning and implementing communication protocols between digital mechatronic components. Introduction and implementation of NMEA 2000 ship protocol within the mechatronic system. Connecting digital circuits to actuators and sensors. Physical simulations of mechatronic systems and simulation tools. Algorithms for controlling mechatronic systems and implementation in the C++ programming language.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Design and implement a mechatronic-system control system.<br>2. Apply theoretical methods when implementing a mechatronic system<br>3. Evaluate the maritime industrial process and propose a solution to the problem using a mechatronic system<br>4. Integrate the electronic and mechanical components of the mechatronic system<br>5. Assess the appropriate application of a computer algorithm within a mechatronic system<br>6. Recommend the implementation of a spectrum of sensors and actuators specific for surface and underwater robots. Assess their functioning and limitations in the marine environment.<br>7. Model the impact of external forces on robotic systems and use simulation tools to predict the behavior of robotic systems in the marine environment.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures (30h):<br>1. Introductory lecture<br>2. Design of mechatronic systems<br>3. Physical models of mechatronic systems<br>4. Control methods for mechatronic systems<br>5. Fuzzy control systems<br>6. Neural networks and application in mechatronic systems<br>7. Sensors for measuring angle, position, pressure, temperature, capacitive and inductive sensors, optical sensors and cameras<br>8. Signal conditioning and noise<br>9. Overview of modern ARM microcontrollers and processors<br>10. Stepper motor control and algorithms, C ++ implementation<br>11. Brushless DC motor control and algorithms, C ++ implementation<br>12. Design of digital components of a mechatronic system and software tools for design and simulation<br>13. Digital component communication protocols: SPI, I2C, SAI, I2S<br>14. Output communication protocols: Ethernet, USB, RS485, NMEA2000</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">15.Design of mechatronic system and integration of electronic and mechanical components<br><br>Exercises (30 - auditory, simulation):<br>1. Designing a thermoregulation system<br>2. Selection of sensors for the thermoregulation system and design of the signal conditioning circuit from the sensor<br>3. Simulate a signal conditioning circuit from a sensor using simulation software tools<br>4. Designing the digital part of the thermoregulation system and making the electrical diagram using the NI Utilboard software package<br>5. Designing a fan control assembly for a thermoregulation system<br>6. Integration of thermoregulation system components and creation of control algorithms in C ++ programming language<br>7. Introduction to industrial 3D CAD tools for designing mechanical components<br>8. Design of enclosure and other mechanical components of thermoregulation system using 3D CAD tools<br>9. Design of mechanical components of a thermoregulation system using a 3D printer<br>10. Integration of thermoregulation system components and testing<br>11. Designing an output assembly for stepper motor control<br>12. Integrating a stepper motor control output assembly with an ARM microcontroller<br>13. Integration of the angle sensor with a stepper motor<br>e 14. Implementation of step motor control algorithms in C ++ programming language<br>15. Implementation of algorithms for speed control of stepper motor in C ++ programming language</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars<br>☒ exercises<br>☐on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Obligations of full-time students:<br>Attending classes is mandatory for full-time students. Attendance at at least 80% of lectures, auditory and laboratory exercises is a condition for obtaining the right to take the exam.<br><br>Obligations of part-time students:<br>Attending classes is mandatory for part-time students. The condition for obtaining the right to take the exam is attendance at at least 50% of lectures, auditory and laboratory exercises.</td></tr>
<tr><td rowspan="6">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>Lecture attendance</td><td>1.5</td><td>Research</td><td>1.25</td><td>Practical training</td><td>1</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Homework</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1.25</td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests/Written exam</td><td></td><td>Oral exam</td><td>1</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>
</table>

**Evaluation and grading of full-time students' work**

2 seminar papers are written in the semester. The first seminar paper includes theoretical questions from the contents of the first to the seventh lectures and is submitted for review in the seventh week of classes. The second seminar paper includes theoretical questions from the material from the eighth to the fifteenth lecture and is given for review in the fifteenth week of classes. Examples of quality term papers are available to students on the Merlin e-learning platform. When evaluating the seminar paper, it is mandatory to obtain at least 50% of the points for passing. The student can also orally explain the seminar work, that is, individual parts of the seminar work. Students who do not submit the seminar paper on time for an objective reason may have an extension of the deadline for submitting the seminar paper.

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

**Continuous student assessment:**

| Assessment elements | Success (min. %) | Percentage in grade (%) |
|---|---|---|
| Class attendance | 80 | 10 |
| Seminar I | 50 | 30 |
| Seminar II | 50 | 30 |
| Laboratory exercises | 100 | 30 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Does not satisfy minimum criteria | insufficient (1) |
| 50-64 | Satisfies minimum criteria | sufficient (2) |
| 65-79 | Average success with clear shortcomings | good (3) |
| 80-89 | Above average success with a few errors | very good (4) |
| 90-100 | Extraordinary success | excellent (5) |

**Evaluation and grading of part-time students**
The evaluation and grading are the same as those of full-time students.

Required literature (available in the library and via other media)

| Title | Number of copies in the library | Availability via other media |
|---|---|---|
| 1. Rochdi Merzouki, Arun Kumar Samantaray, Pushparaj Mani Pathak, Belkacem Ould Bouamama (2012), Intelligent Mechatronics Systems, Springer | | |
| 2. W. de Silva (2010), Mechatronics: A Foundation Course, CRC Press | | |
| 3. J. Awrejcewicz, R. Szewczyk, M. Trojnacki, M. Kaliczyńska (2014), Mechatronics: Ideas for Industrial Applications, Springer | | |
| 4. W. Bolton, (2013) Mechatronics, 5. izdanje, Pearson Education Limited | | |
| 5. Z. Kovačić, V. Krajči, S. Bogdan, (2000) Osnove robotike, Grafis, Zagreb. | 5 | |

| | |
|---|---|
| Optional literature (at the time of submission of study programme proposal) | Peter Hehenberger and David Bradley (2016), Mechatronics futures, Springer |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">SELECTED CHAPTERS IN SHIP ELECTRIC POWER SYSTEMS</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="3">1.</td></tr>
<tr><td>Course teacher</td><td>Petar Matić, Ph.D., Assist.Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Nur Assani, M.Eng.</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="3"></td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Introduce students with the performance of marine power systems through a modern marine engine simulator that has various models of passenger, merchant and military vessels equipped with high-voltage and low-voltage power plants with diesel-mechanical or electrical propulsion. Use authentic simulations to familiarize students with shipboard equipment, engine room organization, control and automation systems, monitoring and alert systems, man-machine interfaces on board ships. Also, the goal is to teach students the procedures and procedures of marine resource management, with an emphasis on power resources in the various modes of operation of the system.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Provide generators to operate and manage the process of generating electricity on ships with high-voltage power plants.<br>2. Analyze the electricity distribution of a complex ship's electrical grid.<br>3. Predict electricity consumption on board.<br>4. Rank the procedures for operating the marine power plant.<br>5. Recommend high-power electric-load and parts of electric grid insulation procedures.</td></tr>
<tr><td></td><td colspan="5">Lectures (2 per week):<br><br>1. Introductory lecture: description of course content, rights and obligations of students, methods of taking the exam.<br>2. Description and organization of the ship's engine room of ships with electric propulsion and high voltage power plant.<br>3. Description of the operation and control of the ship's power systems: emergency power supply system.<br>4. Description of operation and control of marine power plant service systems: steam system.<br>5. Description of the operation and management of marine power plant service systems: fresh and seawater cooling systems, fuel system, air guidance and control system.<br>6. Marine generators: versions, operating mode, characteristics, connection method and protection.<br>7. Marine power plant: main circuit board and power distribution. Marine Transformers: Operating Mode, Features, Performance and Purpose.<br>8. Electrical propulsion: versions of the ship's propulsion system.<br>9. Electric Propulsion: Electric motors for the realization of ship propulsion.<br>10. Electrical Propulsion Control, Frequency Converters: Performance and Mode.<br>11. Description of operation and control of auxiliary marine systems: Ventilation system. Refrigeration and air-conditioning systems.</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">12. Description of the operation and management of ancillary marine systems: Waste management system. Garbage incinerator. Bilge and sewage disposal system. Vacuum system.<br>13. Description of the operation and control of deck machinery and systems: Cargo management system. Lifeboat lowering and lifting system. Boat mooring and mooring systems.<br>14. Fire systems and safety systems. Automatic doors (Watertight, Fire doors). Elevators and lane movements. Emergency Shut Down (ESD) emergency shutdown systems.<br>15. Shore power supply to the ship.<br><br>Exercises in engine-room simulator (2 hours a week):<br><br>1. Preparation of operation and control of auxiliary machinery of marine power plant. familiarization with the system, symbols and designations, programming interface and physical components of the simulator.<br>2. Preparation from the state of dismantled operation to the state of readiness for operation; supply of the ship with electricity for emergency, switching on of lighting, emergency ventilation.<br>3. Preparation of auxiliary systems necessary for the operation of the diesel generator: system of the sea, cooling water, air for directing, lubrication of the propulsion machine.<br>4. Preparation of auxiliary systems necessary for diesel generator operation: steam system.<br>5. Preparation of auxiliary systems necessary for the operation of diesel generators: fuel system, preparation and commissioning of diesel generators.<br>6. Supply of electricity to the ship's electricity by means of a diesel generator; deployment of diesel generators and switching from emergency supply to regular electricity supply, generator load and regulation of grid parameters.<br>7. Synchronization and control of the generator operation, connection of the generator to the network in parallel operation and distribution of power, disconnection of the generator from the network.<br>8. Analysis of the operation of the ship's electrical network, electrical insulation of individual parts of the network, replacement of power supply of redundant machines.<br>9. Testing the protection of the diesel generator, testing the correctness of the system for switching on the generator for emergency.<br>10. Control of the process of production and consumption of electricity on board: automatic modes of operation of the ship's power plant.<br>11. Supply of electricity to the ship at different stages of the ship's exploitation: sailing and leaving the port, maneuvering the ship. Control of electric propulsion.<br>12. Supply of electricity to the ship at different stages of ship exploitation: navigation.<br>13. Black-out and return to regular electricity supply. Emergency generator readiness and readiness testing.<br>14. Supply of electricity to the port and the possibility of connection to the land.<br>15. Procedure of electric propulsion insulation.</td></tr>
<tr><td>Format of instruction</td><td>☒ lectures<br>☒ seminars<br>☒ exercises<br>☐ on line only<br>☐ mixed e-learning<br>☐ field work</td><td>☒ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentor work</td></tr>
<tr><td>Student responsibilities</td><td colspan="2">Obligations of full-time students:<br><br>Attending classes is mandatory for full-time students. Attendance of at least 80% of</td></tr>
</table>

<table>
<tr><td></td><td>classes is a condition for obtaining the right to take the exam. In case of an insufficient number of attendances, students do not have the right to take the exam and must enroll in the course again the following year.<br><br>Obligations of part-time students:<br><br>Attending classes is mandatory for full-time students. Attendance of at least 50% of classes is a condition for obtaining the right to take the exam. In case of an insufficient number of attendances, students do not have the right to take the exam and must enroll in the course again the following year.</td></tr>
<tr><td>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>
<table>
<tr><td>Lecture attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Laboratory exercises</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td>3</td><td>Oral exam (for students who failed the in-terms or are not satisfied with the grade)*</td><td>1.5</td><td>(Other)</td><td></td></tr>
<tr><td>Written exam (for students who failed the in-terms or are not satisfied with the grade)</td><td>3</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
</table>
</td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td>
Evaluation and grading of full-time students<br><br>During the semester, students write three in-term examinations that take place in the sixth, eleventh and fifteenth weeks of classes.<br>At the end of the semester (or at the oral exam), the students also take a test on the simulator to demonstrate problem-solving skills and management skills.<br><br>Continuous assessment of students:
<table>
<tr><th>Assessment elements</th><th>Success (min.%)</th><th>Percentage in grade (%)</th></tr>
<tr><td>Class attendance</td><td>80 (50)</td><td>10</td></tr>
<tr><td>In-term test 1</td><td>40</td><td>20</td></tr>
<tr><td>In-term test 2</td><td>40</td><td>20</td></tr>
<tr><td>In-term test 3</td><td>40</td><td>20</td></tr>
<tr><td>In-term test 4</td><td>40</td><td>30</td></tr>
</table>
</td></tr>
<tr><td></td><td>
Grading:
<table>
<tr><th>Percentage (%)</th><th>Criterion</th><th>Grade</th></tr>
<tr><td>0-40</td><td>Does not satisfy minimum criteria</td><td>insufficient (1)</td></tr>
<tr><td>41-59</td><td>Satisfies minimum criteria</td><td>sufficient (2)</td></tr>
<tr><td>60-75</td><td>Average success with clear shortcomings</td><td>good (3)</td></tr>
<tr><td>76-89</td><td>Above average success with a few errors</td><td>very good (4)</td></tr>
<tr><td>90-100</td><td>Extraordinary success</td><td>excellent (5)</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">Evaluation and grading of part-time students work:<br><br>The assessment and grading are the same as those for full-time students.</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>Teacher's own course material for lectures and exercises - under construction</td><td></td><td></td></tr>
<tr><td>Hermansen, A. K-Sim Engine Room Simulator Machinery and Operation DE-III, Approved by: Halvorsen, L.P., KONGSBERG MARITIME AS, 2014.</td><td></td><td>pdf</td></tr>
<tr><td>Wartsila Engine Room Simulator - Manual</td><td></td><td>Putem računala</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">1. Adnanes, A.K., (2003), Maritime Electrical Instalations and Diesel Electric Propulsion, ABB, Oslo, Norway.<br>2. The Maritime Engineering Reference Book – A Giude to Ship Design, Construction and Operation, Butterworth-Heinemann, Elsevier 2008.<br>3. Patel, M.R., (2012), Shipboard Electrical Power Systems, CRC Press, Boca Raton, USA.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process.</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="5">INTEGRATED COMMUNICATION INFORMATION TECHNOLOGIES</td></tr>
<tr><td>Code</td><td>PFE311</td><td>Year of study</td><td colspan="3">1.</td></tr>
<tr><td>Course teacher</td><td>Dean Sumić, Ph.D., Assist.Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="3">10</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Training students for:<ul><li>knowledge and understanding of the basic concepts of operation of ship access communication networks,</li><li>knowledge of the structure and operation of integrated marine communication and information systems,</li><li>planning and design of access ship communication networks,</li><li>participation in the maintenance of access ships' communications networks,</li><li>Continuous acquisition of knowledge about new technologies of access ship communication networks.</li></ul></td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5"><ol><li>To choose among the basic concepts of operation of ship wired and wireless access communication networks,</li><li>Provide principles of operation of network devices in the access ship communication network,</li><li>Plan and design the architecture of the ship access communication networks,</li><li>Compare different solutions of integrated ship communication systems and choose the optimum in the given case.</li></ol></td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">LECTURES (a block of 2)<ol><li>Introduction. Examples of integrated marine and communications systems. The role of information and communication technologies in integrated ship functioning. The concept of integrated ship functioning.</li><li>Connecting the ship with analog modem technology and wired ISDN technology (modem types and operating principle, modem transmission speeds, types of ISDN technologies, ISDN PRI and BRI technologies, ...)</li><li>3.Connecting the ship with wired xDSL technologies (copper-wire information transfer, types of xDSL technologies, xDSL transfer rates, xDSL network components, ...)</li><li>4.Connecting the ship with ATM and Carrier Ethernet technology through lease line and point-to-point connections</li><li>5.Connecting the ship with analog and IP telephony (analog and digital telephone line, H.323 protocol, SIP protocol, IP telephone system components, RTP protocol, ...)</li><li>Connecting ship to optical communication systems - FTTB (laws of signal propagation through optical fiber, fiber types, optical cables, optical sources and receivers, filters, mutiplexers, modulators, amplifiers, passive processing components)</li></ol></td></tr>
</table>

<table>
<tr><td></td><td colspan="6">7. Connecting the ship to communication systems based on the concept of "Internet of Things" (Internet of Things - IoT, sensor networks, wireless interconnected networks, ZigBee technology, embedded systems, ...)<br>8. In-term test<br>9. Connecting the ship to second generation (2G) cellular communication systems (GSM and EDGE technology, frequencies, channels, modulation, transmission speeds, ...)<br>10. Ship connection to third generation (3G) cellular communication systems (UMTS and HSDPA technology, frequencies, channels, modulation, transmission speeds, ...)<br>11. Ship connection to fourth (4G) generation cellular communication systems (LTE and LTE-A technology, frequencies, communication channels, modulation, transmission speeds, ...)<br>12. 12.Connecting the ship with satellite communication systems (LEO, GEO and MEO satellites, frequency bands, transmission speeds, communication channels, ...)<br>13. Connecting the ship with wireless WLAN and WiMAX communication technologies (types of WLAN and WiMAX technology, transmission speeds, channels, frequencies, ...)<br>14. Security aspects of networking of ship communication systems (types of Internet attacks, encryption, security policies, firewall, authentication, digital encryption and signatures, ..)<br>15. In-term test.<br><br>LABORATORY EXERCISES (a block of 2)<br>1. Basic elements of marine communication systems<br>2. ISDN modem based ship networking<br>3. Ship networking based on xDSL router<br>4. Simulation of ship networking with ATM technology<br>5. Providing telephone service to analogue and IP telephones<br>6. Providing telephone service to analogue and IP telephones<br>7. Optical fiber structure and fiber coupling<br>8. Optical fiber structure and fiber coupling<br>9. Optical communication systems - passive and active elements<br>10. Sensor interlaced networks based on ZigBee technology<br>11. Configuration and adjustment of 2nd generation base station (GSM) parameters<br>12. Configuration and Adjustment of 3rd Generation Base Station Parameters (UMTS)<br>13. 4th Generation Base Station (LTE) Configuration and Adjustment<br>14. WLAN configuration<br>15. In-term test.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars<br>☒ exercises<br>☐ on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Class attendance, individual tasks completed</td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of</td><td>Lecture attendance</td><td>1.5</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>Homework</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>Lab. exercises</td><td>0.75</td></tr>
<tr><td>In-term tests</td><td>1.125</td><td>Oral exam</td><td></td><td>Individual study</td><td>1.25</td></tr>
</table>

| | | | | | | |
|---|---|---|---|---|---|---|
| *ECTS credits is equal to the ECTS value of the course)* | Written exam (if in-terms have not been passed) | 1.125 | Project | | Preparations for lab exercises | 0.25 |

**Obligations of full-time students**:

Attending classes is mandatory for full-time students. The condition for fulfilling obligations and taking the exam is the attendance at a minimum of 80% of lectures and 100% of laboratory exercises. If they do not meet the stated requirements, the students will not have the right to take the exam.

**Obligations of part-time students**:

Attendance at a minimum of 50% of lectures and 75% of exercises is a condition for fulfilling the obligations and exercising the right to take the exam.

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

**Assessment and evaluation of the work of full-time students:**

2 in-term tests are written in the semester. The first test, which includes questions from the material from the first to the seventh lecture, is written after the seventh week of classes. The second test includes questions from the material from the eighth to the fifteenth lecture and is written in the fifteenth week of classes. Sample questions for the tests are available to students on the website. At each test, it is necessary to obtain at least 50% of points to pass. Students who do not take a test for objective reasons or do not achieve the minimum percentage have the possibility of correction. Correction will be organized for these students in the fifteenth week.

**Continuous student assessment:**

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Lecture attendance | 80 | 0 |
| Exercises attendance | 100 | 0 |
| In-term test I | 50 | 50 |
| In-term test II | 50 | 50 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Does not satisfy minimum criteria | insufficient (1) |
| 50-61 | Satisfies minimum criteria | sufficient (2) |
| 62-74 | Average success with clear shortcomings | good (3) |
| 75-87 | Above average success with a few errors | very good (4) |
| 88-100 | Extraordinary success | excellent (5) |

<table>
<tr><td></td><td colspan="3">Evaluating and grading the work of part-time students<br>The evaluation and grades are the same as those for full-time students.</td></tr>
<tr><td rowspan="5">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>A. Bažant i drugi: "Osnovne arhitekture mreža", ELEMENT, Zagreb 2004.</td><td></td><td></td></tr>
<tr><td>A.S. Tanenbaum, D.J.Wetherall, Computer Neworks, 5th edition, PEARSON, 2012</td><td></td><td></td></tr>
<tr><td>Douglas E. Comer, Computer Networks and Internets, 6th Edition, Pearson 2014</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">1. Liping Mu, (2013), Information and Communication Technologies for Integrated Operations of Ships. PhD Thesis, University of Agder, Faculty of Engineering and Science.<br>2. Cvijetić, M. i Djordjevic, I. B., (2013), Advanced Optical Communication Systems and Networks, Artech House.<br>3. Šuško, Lj., (2013), QAM modulacija i podignuti kosinusni filtar na modelu RF satelitskog linka, Split: Pomorski fakultet u Splitu.<br>4. Stacks, D. W. i Salwen, M. B., (2008), An Integrated Approach to Communication Theory and Research, Routledge Communication Series.<br>5. *, (2011), An Integrated Wireless Communication Architecture for Maritime Sector, Multiple Access Communications. Lecture Notes in Computer Science, Volume 6886, 2011, Springer.<br>6. Integrated ship systems (SYS), dostupno na: http://www1.veristar.com/veristar/bvrules/A_1_s2_6_5.htm<br>7. Sruk,V., (2015), Digitalna logika, poglavlje 8 – kodiranje, dostupno na: www.fer.hr.<br>8. Ilić, Ž., (2015), Uvod u lokalne mreže, dostupno na: www.fer.hr<br>9. Ilić, Ž., (2015), Osnove Etherneta, dostupno na: www.fer.hr<br>10. Ilić, Ž., (2015), Brzi Ethernet, dostupno na: www.fer.hr<br>11. Ilić, Ž., (2105), Gigabitni Ethernet, dostupno na: www.fer.hr<br>12. Ilić, Ž., (2015), Povezivanje lokalnih mreža, dostupno na: www.fer.hr<br>13. Beriša, T. i Ilić, Ž., (2015), VLAN laboratorij,dostupno na: www.fer.hr<br>14. Caplić, A. i Ilić, Ž., (2015), Protokol SNMP, dostupno na: www.fer.hr<br>15. Bažant, A., (2010), Lokalne mreže, I i II dio, dostupno na: www.fer.hr<br>16. Barović, I. i Ilić, Ž., (2015), Bežične lokalne mreže, Zagreb: FER.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process.</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="5">APPLICATION PROGRAMMING</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="4">1</td></tr>
<tr><td>Course teacher</td><td>Hrvoje Dodig, Ph.D., Assoc.Prof.</td><td>Number of credits (ECTS)</td><td colspan="4">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>15</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>elective</td><td>Percentage of e-learning</td><td colspan="4">10%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Enhancing knowledge of object programming and creating applications with graphical interface (GUI) in C ++ programming language. Basic elements of graphical interface applications and their upgrade. Creating dialogs for GUI applications. Visual design of user interface and controls. Multithreaded programming.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Develop a functional application with GUI interface in C ++ programming language<br>2. Anticipate the use of a messaging mechanism between the visual elements of a GUI application.<br>3. Use virtual functions of the C ++ programming language to modify the visual elements of the GUI application<br>4. Create a dialog box for GUI application<br>5. Implement a multithreaded GUI application<br>6. Design GUI applications that use Ethernet LAN</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures (15):<br>1. Introductory lecture<br>2. Virtual methods in the C ++ programming language and virtual classes<br>3. Using references in the C ++ programming language<br>4. Templates in the C ++ programming language and their use<br>5. Algorithm Libraries - STL<br>6. Introduction to the Qt software library<br>7. Creating a GUI application in the C ++ programming language<br>8. Communication between visual elements: messages, signals, and slots<br>9. Program menus for GUI applications<br>10. Dialogs for GUI applications<br>11. Creating controls for GUI applications (pushbutton, radio-button, edit box ...)<br>12. Communication between controls and windows<br>13. Database access in C++<br>14. Multithreaded programming in the C ++ programming language<br>15. Examples of using multithreaded programming with GUI applications<br><br>Exercises (30 - auditory, simulation):<br><br>Exercise 1. Create a simple application with GUI interface and text display<br>Exercise 2. GUI application with pushbutton controls</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">Exercise 3. Communication between the pushbutton control and the application (signals and slots)<br>Exercise 4. Creating the main menu of a GUI application<br>Exercise 5. Communication between menu and GUI Application (Actions)<br>Exercise 6. Creating an application with edit and pushbutton controls<br>Exercise 7. Dynamic positioning of visual elements<br>Exercise 8. Virtual functions and inheritance<br>Exercise 9. Creating custom control using the virtual function mechanism<br>Exercise 10. Creating a dialog for the GUI application and transferring data between the dialog and the application.<br>Exercise 11. Animating visual elements using multithreaded programming<br>Exercise 12. GUI Responsiveness Using Multithreaded Programming<br>Exercise 13. Storing data into a database via a GUI<br>Exercise 14. Creating a GUI server / client application<br>Exercise 15. Creating a web browser GUI application</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars<br>☒ exercises<br>☐on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ individual tasks<br>☐multimedia<br>☒ laboratory<br>☐ mentoring</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Obligations of full-time students:<br><br>Attending classes is mandatory for full-time students. Attendance at a minimum of 80% of lectures, auditory and laboratory exercises is a requirement for obtaining the right to take the exam.<br><br>Obligations of part-time students:<br><br>Attending classes is mandatory for part-time students. The requirement for obtaining the right to take the exam is attendance at a minimum of 50% lectures, auditory and laboratory exercises.</td></tr>
<tr><td rowspan="6">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>Lecture attendance</td><td>1.125</td><td>Research</td><td>0.125</td><td>Practical work</td><td>0.75</td></tr>
<tr><td>Lab. Exercises</td><td></td><td>Report</td><td></td><td>Homework</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>1</td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td></td><td>Oral exam</td><td>1</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 colspan="6">Evaluation and grading of full-time students<br><br>2 seminar papers are written in the semester. The first seminar paper covers theoretical questions from lectures 1-7 and is presented in the seventh week of teaching. The second seminar paper covers theoretical questions from lectures 8-15 and is presented in the fifteenth week of teaching. Examples of quality seminar papers are available to students on the website. When evaluating a seminar paper, a minimum of 50% pass points must be earned. The student can also orally explain the seminar paper or individual parts of the seminar paper. Students who are late in submitting a seminar paper for objective reasons may have an extended deadline for submitting a seminar paper.</td></tr>
</table>

<table>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td>

**Continuous student assessment:**

<table>
<tr><th>Assessment elements</th><th>Success (min.%)</th><th>Percentage in grade (%)</th></tr>
<tr><td>Class attendance</td><td>80</td><td>10</td></tr>
<tr><td>Seminar I</td><td>50</td><td>30</td></tr>
<tr><td>Seminar II</td><td>50</td><td>30</td></tr>
<tr><td>Lab exercises</td><td>100</td><td>30</td></tr>
</table>

**Grading**

<table>
<tr><th>Percentage (%)</th><th>Criterion</th><th>Grade</th></tr>
<tr><td>0-49</td><td>Does not satisfy minimum criteria</td><td>insufficient (1)</td></tr>
<tr><td>50-64</td><td>Satisfies minimum criteria</td><td>sufficient (2)</td></tr>
<tr><td>65-79</td><td>Average success with clear shortcomings</td><td>good (3)</td></tr>
<tr><td>80-89</td><td>Above average success with a few errors</td><td>very good (4)</td></tr>
<tr><td>90-100</td><td>Extraordinary success</td><td>excellent (5)</td></tr>
</table>

**Evaluation and grading of part-time students**
The assessment and grading criteriaare the same as those of full-time students.

</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td>

<table>
<tr><th>Title</th><th>Number of copies in library</th><th>Availability via other media</th></tr>
<tr><td>Bjarne Stroustrup (2013), „The C++ Programming Language“, Addison-Wesley</td><td></td><td></td></tr>
<tr><td>Mark Summerfield (2007), „Rapid GUI Programming with Python and Qt: The Definitive Guide to PyQt Programming“, Prentice Hall</td><td></td><td></td></tr>
</table>

</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td></td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td>University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process.</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td></td></tr>
</table>

<table>
<tr><td colspan="2">NAME OF THE COURSE</td><td colspan="5">GREEN TECHNOLOGIES IN MARITIME AFFAIRS</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="4">1</td></tr>
<tr><td>Course teacher</td><td>Gorana Jelić Mrčelić, PhD, full professor</td><td>Credits (ECTS)</td><td colspan="4">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Petra Jakulica</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td></td><td>15</td><td></td></tr>
<tr><td>Status of the course</td><td>Elective</td><td>Percentage of application of e-learning</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="6">The objective of this course is to provide insights into the exploration, exploitation and protection of marine and submarine living and non-living resources, with particular emphasis on understanding the principles and application of green technologies in maritime affairs, in order to reduce human impact on the environment, but also to enhance competitiveness and sustainability in the maritime sector.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="6">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="6">The student will be able to:<br><br>1. Argue an opinion on the need for the application of green technologies in the maritime affairs with the aim of improving competitiveness and sustainability in maritime sector management (ports and ships) and related strategies.<br>2. Assess the principles of green technologies, and determine the prerequisites for their application in different branches of the maritime sector from a technological, scientific, economic, social and ecological aspect.<br>3. Evaluate various methods and technologies.<br>4. Create the skills necessary for the proper procedure of assessment, acceptance and application of green technologies in the maritime sector.<br>5. Anticipate the needs and evaluate ways of environmental protection in maritime affairs.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="6">Lectures:<br><br>1. Introduction to the course. Basic terms: Marine technologies. Underwater technologies. Sustainability. Principles of green and blue economy. Green and blue growth. Green economy and green technologies Objectives and importance of green technologies.<br>2. General trends in marine exploration, exploitation and protection throughout history.<br>3. Application of green technologies in maritime transport. Environmental impact of maritime transport.<br>4. Green ports - green technologies in ports. The importance of green ports and the green logistics chain. Methods for reducing environmental pollution in ports.</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">Ecoports.<br>5. Green ships - green technologies on ships. Methods of reducing environmental pollution from ships.<br>6. Green technologies in the approval industry and construction. Laying of submarine pipelines and cables. Heavy cargo ships.<br>7. Green technologies in shipbuilding. Recycling.<br>8. Green nautical tourism.<br>9. Application of green technologies for offshore energy extraction.<br>10. Application of green technologies in marine mining.<br>11. Renewable energy from the sea. Release of energy accumulated in the sea: thermal energy - solar energy, OTEC, tidal energy, waves, ... Wind power at sea.<br>12. Application of green technologies in extraction of minerals and drinking water from seawater - desalination.<br>13. Application of green technologies in the production of food from the sea. Fishing, breeding and processing of marine organisms. Fishing vessels. Overfishing and breeding problems. Protection of fish stocks and the environment.<br>14. Future trends in green technologies - Green shipping challenges: innovation, knowledge transfer, flexibility, availability and environmental security. "Cradle to cradle" design. Source reduction. Innovation. Viability.<br>15. Integrated Maritime Policy. "Blue Book" - Communication on an Integrated Maritime Policy for the European Union.<br><br>Exercises<br><br>1. Sustainability. Green economy and green technologies. Blue growth.<br>2. Green research Ships.<br>3. Green submarines and divers.<br>4. Green artificial islands.<br>5. Green heavy-lift ships.<br>6. Green ships for laying pipelines and cables.<br>7. Green platforms.<br>8. Green dry docks.<br>9. Green fishing ports and vessels.<br>10. Green dredgers.<br>11. Green plants for releasing energy accumulated in the sea.<br>12. Green desalination plants.<br>13. Green search and rescue vessels.<br>14. Future trends in green technologies.<br>15. Integrated maritime policy.</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>☐ independent assignments<br>☐ multimedia<br>☐ laboratory<br>☐ work with mentor<br>☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="2">Obligations of full-time students:<br><br>Records of student attendance are kept as attending lectures and exercises is compulsory. Full-time students are required at least 80% of class attendance in order to take the exam and earn ECTS credits. Students with insufficient attendance have to re-register the course in the following academic year.<br><br>The lectures are in PowerPoint presentations and are available on the Merlin e-learning platform. There is a possibility of visiting experts from a public or private</td></tr>
</table>

company or NGO, and the possibility of assigning independent assignments to students (analysis of scientific articles).

The exercises are organized as auditory exercises.

Students can pass the exam by taking 2 midterm tests during the semester.

Students who have fulfilled all course obligations but have failed or missed one of the midterms have to register for the final written exam in the examination period.

The student who has passed all midterm exams is expected to register through the on-line service (Studomat) in the first examination period to register the final grade. Students shall take the final oral exam in case they would like to achieve a higher grade.

**Obligations of part-time students:**

Their overall obligations cannot be less than 50% with regard to full-time students. The same assessment criteria, grading and ways of taking midterms / final exam apply to both full-time and part-time students.

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 | 1.125 | Research | 1.0 | Practical training | |
| Experimental work | | Report | | (Other) | |
| Essay | | Seminar essay | | (Other) | |
| Mid-term tests | 2.875 | Oral exam | | (Other) | |
| Written exam | | Project | | (Other) | |

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

**Assessment and grading of full-time students:**

Class attendance is mandatory and records of attendance are kept. Full-time students are required to attend at least 80% of classes (12 sessions / weeks) in order to take the exam and earn ECTS credits.

There are two midterm exams in the semester. Exam questions for students are available at the end of each session. A student has to achieve at least 50% of points to pass a midterm exam. Students who do not pass the 1st midterm test cannot access the 2nd.

Students who have fulfilled all course obligations but have failed or missed one of the midterms have to register for the final exam in the examination period. The student who has passed all midterm exams is expected to register through the on-line service (Studomat) in the first examination period to register the final grade. Students shall take the final oral exam in case they would like to achieve a higher grade.

**Continuous assessment of students**

| Elements of assessment | Performance (min.%) | Participation in the |
|---|---|---|

| | | final grade (%) |
|---|---|---|
| Midterm I | 50 | 5500 |
| Midterm II | 50 | |

**Grading**

| Points (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Performance does not meet the minimum criteria | Insufficient - fail (1) |
| 50-64 | Performance meets the minimum criteria | Sufficient (2) |
| 65-79 | Generally sound work, with a number of notable errors | Good (3) |
| 80-89 | Performance above the average standard, with some errors | Very good (4) |
| 90-100 | Outstanding performance | Excellent (5) |

**Grading and continuous assessment of part-time students:**

Part-time students are required at least 50% of class attendance. The same grading and evaluation criteria apply to both full-time and part-time students.

Required literature (available in the library and via other media)

| Title | Number of copies in the library | Availability via other media |
|---|---|---|
| G. Jelić Mrčelić: *Morske tehnologije*, teaching materials, University of Split – Faculty of Maritime Studies, Split, 2015. | - | WEB |
| | | |
| | | |

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

1. Dundović Č., *Pomorski sustavi i pomorska politika*, University of Rijeka – Faculty of Maritime Studies, Rijeka, 2003.
2. The EU Blue Economy Report 2019. https://publications.europa.eu/en/publication-detail/-/publication/676bbd4a-7dd9-11e9-9f05-01aa75ed71a1/language-en/
3. OECD. The Ocean Economy in 2030. 2016. https://read.oecd-ilibrary.org/economics/the-ocean-economy-in-2030_9789264251724-en#page10
4. R. Bergqvist, J. Monios. Green Ports. 2019. https://www.elsevier.com/books/green-ports/bergqvist/978-0-12-814054-3

| | |
|---|---|
| | 5. EMEC. Green Ship Technology Book. 2010. https://www.oecd.org/sti/ind/48365856.pdf |
| Quality assurance methods that ensure the acquisition of exit competences | Survey carried out by University of Split, List of student attendance, Teaching process monitoring by Faculty, Teacher's self-evaluation, Analysis of the examination passing rate, External evaluation of the student assessment process (Quality Management System in compliance with ISO 9001). |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAZIV PREDMETA</td><td colspan="2">MAINTENANCE AND RELIABILITY OF SHIP ENGINE SYSTEMS</td><td colspan="4"></td></tr>
<tr><td>Kod</td><td>PFS218</td><td>Year of study</td><td colspan="4">1</td></tr>
<tr><td>Nositelj/i predmeta</td><td>Ladislav Stazić, Ph.D.</td><td>Number of credits (ECTS)</td><td colspan="4">4</td></tr>
<tr><td rowspan="2">Suradnici</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>-</td><td>15</td><td>-</td></tr>
<tr><td>Status predmeta</td><td>elective</td><td>Percentage of e-learning</td><td colspan="4"></td></tr>
<tr><td colspan="7">COURSE DESCRIPTION</td></tr>
<tr><td>Ciljevi predmeta</td><td colspan="6">The aim of teaching the course is to acquaint students with the basic knowledge and laws of malfunctions in technical systems. The goal is to acquire knowledge about the reliability of technical systems and modern approaches to maintenance based on the reliability of technical systems, and to transfer this knowledge to ship systems and the ship as a whole.</td></tr>
<tr><td>Uvjeti za upis predmeta i ulazne kompetencije potrebne za predmet</td><td colspan="6">No requirements.</td></tr>
<tr><td>Očekivani ishodi učenja na razini predmeta (4-10 ishoda učenja)</td><td colspan="6">1. Determine and rank maintenance costs.<br>2. Valorize the principles of formation and types of failures.<br>3. Determine the reliability of technical systems.<br>4. Define and describe the concepts of maintenance of marine mechanical systems<br>5. Choose the option of managing scheduled maintenance on board.</td></tr>
<tr><td>Sadržaj predmeta detaljno razrađen prema satnici nastave</td><td colspan="6">Lectures (a block of 2):<br><br>1. Introductory lecture: introduction to the content of the course, definition of the technical system of the system, life cycle of the technical system.<br>2. Damages, malfunctions and malfunctions: definition of damage and malfunction; initial, random, time failures; fault distribution function; failure density, failure index.<br>3. The concept and significance of ship maintenance as a technical system, definitions and tasks of ship maintenance, basic objectives of the ship's mechanical system maintenance function.<br>4. Maintenance costs: direct, indirect maintenance costs, impact on maintenance costs throughout the life cycle of the equipment, influence of participants on maintenance costs.<br>5. Defining the reliability of technical systems: system reliability, system availability, suitability for maintenance, reliability with regard to initial failures, accidental failures, time failures; standard reliability curve; complex reliability; stock, availability and usability.<br>6. Determining the reliability function, failure intensity function and system lifetime, expected time of failure-free operation.<br>7. Reliability models, serial reliability model, parallel reliability model, serial-parallel reliability model.<br>8. Reliability forecasting, goal of reliability forecasting, reliability block diagram, reliability forecasting procedure of technical systems.<br>9. Maintenance strategies, basic reliability strategies, focused maintenance.</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">Reliability Centered Maintenance RCM, total productive maintenance (Total Productive Maintenance TPM).<br>10. Basic maintenance concepts: corrective maintenance, preventive maintenance: preventive inspections, cleaning and lubrication; searching for and eliminating weak points; control examinations; planned repairs.<br>11. Maintenance according to condition: characteristic size of the condition of the technical system; technical diagnostics; methods of technical diagnostics, proactive maintenance.<br>12. Organization and technology of maintenance in shipping, influence of international regulations on ship maintenance, influence of classification societies on maintenance.<br>13. Management of safe and effective maintenance and repair procedures in accordance with the ship's SMS.<br>14. Management of spare parts in the process of maintaining the ship's mechanical systems.<br>15. Computer programs to support maintenance and maintenance planning.<br>Exercises (1 per week):<br>1. Configurations of ship systems and reliability with interventions - calculation examples.<br>2. AMOS computer program for maintenance support and maintenance planning - introduction to the program.<br>3. AMOS creation of the computer configuration of ship systems maintenance.<br>4. AMOS creation of the computer configuration of ship systems maintenance, addition of systems, subsystems, components.<br>5. AMOS examples of configuring critical equipment.<br>6. AMOS examples of listing due maintenance items.<br>7. AMOS examples of creating work orders by item.<br>8. AMOS examples of reporting on the performed intervention.<br>9. AMOS statistical analysis of the share of corrective maintenance in planned maintenance.<br>10. AMOS examples of creating a report on used spare parts.<br>11. AMOS examples of analysis of the state of the spare parts warehouse.<br>12. AMOS examples of production requirements for ordering spare parts.<br>13. AMOS examples of spare parts warehouse updates (spend/receipt).<br>14. AMOS examples of records of equipment manufacturers' service letters.<br>15. AMOS examples of monitoring the maintenance of ship systems in accordance with the requirements of PMS classification societies and control of the status of ship certificates.</td></tr>
<tr><td>Vrste izvođenja nastave:</td><td>☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐on line only<br>☐ mixed e-learning<br>☐ field work</td><td>☐ individual tasks<br>☒ multimedia<br>☐ laboratory<br>☐ mentoring<br>☒ consultations</td></tr>
<tr><td>Obveze studenata</td><td colspan="2">Responsibilities of full-time students:<br>Lectures are compulsory for students, and attendance records are kept. In order to get the right to take the exam, students must attend at least 80% of classes. If this condition is not met, obtaining the right to take the exam is conditioned by the completion of additional tasks (seminar work). Students who do not attend lectures due to illness must bring a valid excuse from a doctor. Students who attend less</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">than 50% of classes do not have the right to take the exam and must re-enroll in the course the following year. During the course, it is planned to pass colloquia, which are held after certain parts of the material have been covered in the lectures and exercises. Students have the opportunity to pass the exam through continuous evaluation during the semester, by taking two colloquia. The student is obliged to attend all colloquiums. Students can retake only one colloquium that they failed. Students who do not pass the colloquia during the semester, but have the right to take the exam, are required to take the written/oral exam during the exam period. Students who have collected a sufficient number of points during classes are required to register for the exam on Studomat for the first exam period after the lecture in order to have their grade recorded or answer for a higher grade during the exam period.<br>Responsibilities of part-time students:<br>The total attendance obligations of part-time students cannot be less than half of the number of hours specified for full-time students. Exam procedures are the same as for regular students. If this condition is not met, obtaining the right to take the exam is conditioned by the completion of additional tasks (seminar work). Students who do not attend lectures due to illness must bring a valid excuse from a doctor. Students who attend less than 20% of classes do not have the right to take the exam and must re-enroll in the course the following year.</td></tr>
<tr><td rowspan="5">Praćenje rada studenata (upisati udio u ECTS bodovima za svaku aktivnost tako da ukupni broj ECTS bodova odgovara bodovnoj vrijednosti predmeta):</td><td>Lecture attendance</td><td>1.125</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td>2.875</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>Ocjenjivanje i vrjednovanje rada studenata tijekom nastave i na završnom ispitu</td><td colspan="6">Assessment and grading of the work of full-time students:<br>During the semester, active participation in classes and exercises is controlled. The condition of the right to take the exam is the attendance of students at at least 80% of lectures and exercises. In case of non-fulfillment of this condition (if students do not attend classes in percentage of 80%), make-up classes will be organized for those students who justifiably missed up to 20% of some form of class and did not acquire the right to take the exam. Students who do not attend lectures due to illness must bring a valid excuse from a doctor. 2 colloquia are written in the semester. The first colloquium, which covers the material from the first to the eighth lecture, is written in the eighth week of classes. The second colloquium, which covers the material from the eighth to the fifteenth lecture, is written in the fifteenth week of classes. Students can retake only one colloquium that they failed. Students who do not pass the colloquia during the semester, but have the right to take the exam, are required to take the written/oral exam during the exam period.<br>Sample questions for the colloquium are available to students on the Merlin e-learning platform. At each colloquium, it is necessary to obtain at least 50% of points to pass. Students who do not attend a colloquium for objective reasons or do not achieve the minimum percentage have the possibility of correction. The correction of the colloquium will be organized at the time of the exam on the first exam period. The colloquium is held in written form, and for a positive grade it is necessary to obtain at least 50 points. A student who successfully solves all the</td></tr>
</table>

quizzes is exempt from the written/oral exam and, depending on the result achieved, his grade is entered in the Studomat at the first exam date. For students who have successfully solved one of the colloquiums, the material covered by that colloquium is recognized as part of the final exam. The remaining part of the material is taken in a written/oral exam. Class attendance and colloquium results are included in the final grade. Students who do not pass the colloquia during the semester, but have the right to take the exam, are required to take the written/oral exam during the exam period. The same evaluation criteria apply to the exam period as for continuous knowledge testing.

**Continuous student assessment**:

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Class attendance | 80 | 10 |
| 1st in-term test | 50 | 45 |
| 2nd in-term test | 50 | 45 |

**Grading:**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0 - 49 | Does not satisfy minimum criteria | insufficient (1) |
| 50 - 64 | Satisfies minimum criteria | sufficient (2) |
| 65 - 79 | Average success with clear shortcomings | good (3) |
| 80 - 89 | Above average success with a few errors | very good (4) |
| 90 - 100 | Extraordinary success | excellent (5) |

**Assessment and grading of part-time students**
The assessment and grading of part-time students are the same as for full-time students.

| | Title | Number of copies in the library | Availability via other media |
|---|---|---|---|
| Obvezna literatura (dostupna u knjižnici i putem ostalih medija) | 1. J. Lovrić. Osnove brodske terotehnologije. Dubrovnik: Pomorski fakultet, 1989. | | |
| | 2. N.Vujanović. Teorija pouzdanosti tehničkih sistema. Beograd: Vojnoizdavački centar, 1987. | | |
| | | | |
| Dopunska literatura | | | |
| Načini praćenja kvalitete koji osiguravaju stjecanje utvrđenih ishoda učenja | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. | | |
| Ostalo (prema mišljenju predlagatelja) | | | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">NAVIGATIONAL SUB-SYSTEM ERGONOMICS</td></tr>
<tr><td>Code</td><td>PFN217</td><td>Year of study</td><td colspan="3">1.</td></tr>
<tr><td>Course teacher</td><td>Dario Medić, Ph.D., Assoc. Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">3</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Status of the course</td><td>Elective</td><td>Percentage of e-learning</td><td colspan="3">10</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">The aim of this course is to acquaint students with the relevant factors that influence human-machine / device interactions; especially familiar with the elements and functioning of individual interaction elements of the human subsystem. Familiarize yourself with EU and HN standards that every device must meet. Work environment impact. Methodology for optimization of the human - machine system.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1.Compare different areas of ergonomic design.<br>2.Evaluate work in ergonomic and non-economic conditions.<br>3. Recommend ergonomic design methods.<br>4. Argument in the presentation of expert opinion on the application of ergonomics of navigation subsystems.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures (a block of 2):<br><br>1. Introduction to the course.<br>2. Anthropometric aspect of the machine-human system.<br>3. Anthropometric aspect of the machine-human system.<br>4. Basic characteristics of work.<br>5. Work energetics.<br>6. Standards (Croatian and European) to be met by the ship's navigation subsystems.<br>7. Human-Machine Interaction.<br>8. Adaptation of the man to work.<br>9. The impact of technological changes on the role of the man in the work process.<br>10. Working environment.<br>11. Effect of fatigue and monotony on work performance.<br>12. Accidents at work.<br>13. Methodology for optimization of the human-machine system.<br>14. Methodology for optimization of the human-machine system.<br>15. Development of a man-device (machine) system.</td></tr>
<tr><td>Format of instruction</td><td colspan="2">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐on line only<br>☐ mixed e-learning</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☐ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">☒ field work</td><td></td></tr>
<tr><td>Student responsibilities</td><td colspan="7">1. Responsibilities of full-time students<br><br>Lectures are compulsory for students, and attendance records are kept. In order to get the right to take the exam, students must attend at a minimum of 80% of the classes. In the case of an insufficient number of attendances at classes, the student will not be granted the right to sit for the exam. Medical certificates cannot justify or replace class attendance. Students who, due to illness or some other justifiable reason, did not meet the requirements for obtaining the right to take the exam and have missed up to 20%, will be able to remedy this consultatively and by doing additional tasks. All other students, i.e. those who attended less than 50% of classes, do not have the right to take the exam and must enroll in the same course the following year. Students are obliged to create and present a seminar paper.<br><br>2. Responsibilities of part-time students<br><br>The responsibilities of part-time students are the same as for full-time students. They must attend a minimum of 50% of the lectures and exercises.</td></tr>
<tr><td rowspan="7">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)predmeta):</td><td>Lecture attendance</td><td>0.75</td><td>Research</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Lab. exercises</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td>2.25</td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam (if it-term exams have not been passed)</td><td>2.25 (altern ative to in-term tests)</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td colspan="6">Assessment and grading of full-time students' work<br><br>Lectures are compulsory for students. A record of class attendance is kept. In order to get the right to take the exam, students must attend lectures. In the case of an insufficient number of attendances at classes, the student will not obtain the right to take the exam. Based on the completed duties, students can take the oral part of the exam. Students shall prepare a seminar paper. The final exam is within the official exam terms. Sample exam questions are available on the Merlin e-learning platform. Students who re-enroll the course in the following year will not be recognized for parts of the exam.<br><br>Class attendance and colloquium results are included in the final grade.<br><br>Students who do not pass the in-term tests during the semester, but have the right to take the exam, are required to take the written exam during the exam period. The same assessment criteria apply to the exam term as for continuous knowledge testing.</td></tr>
<tr><td>Grading and evaluating student</td><td colspan="6">Continuous student assessment:</td></tr>
</table>

<table>
<tr><td>work in class and at the final exam</td><td>
<table>
<tr><th>Assessment elements</th><th>Success (min.%)</th><th>Percentage in grade (%)</th></tr>
<tr><td>Class attendance</td><td>80</td><td>10</td></tr>
<tr><td>In-term test</td><td>45</td><td>45</td></tr>
</table>
Grading
<table>
<tr><th>Percentage (%)</th><th>Criterion</th><th>Grade</th></tr>
<tr><td>0-49</td><td>Does not satisfy minimum criteria</td><td>insufficient (1)</td></tr>
<tr><td>50-64</td><td>Satisfies minimum criteria</td><td>sufficient (2)</td></tr>
<tr><td>65-79</td><td>Average success with clear shortcomings</td><td>good (3)</td></tr>
<tr><td>80-89</td><td>Above average success with a few errors</td><td>very good (4)</td></tr>
<tr><td>90-100</td><td>Extraordinary success</td><td>excellent (5)</td></tr>
</table>
Assessment and grading of part-time students' work<br>The assessment and grades are the same as those for full-time students.
</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td>
<table>
<tr><th>Title</th><th>Number of copies in the library</th><th>Availability via other media</th></tr>
<tr><td>1. Bulat,V. (1981) Sistem čovjek – stroj, Informator, Zagreb.</td><td>1</td><td>YES</td></tr>
<tr><td>2. Kiperaš, M. (1998) Ergologija, Veleučilište u Dubrovniku, Dubrovnik.</td><td>1</td><td>YES</td></tr>
</table>
</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td>1. A group of authors: Ergonomske metode, SIZ za zapošljavanje, Zagreb, 1976.<br>2. Plenković, J.: Društvo i tehnologija, Sveučilište u Rijeci, Rijeka, 1995.<br>3. Kiperaš,E.: Ergonomsko oblikovanje radnih i životnih uvjeta na brodu, Zbornik radova Međunarodnog znanstvenog skupa «Društvo i tehnologija `97», Rijeka,1997.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td>University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process.</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td></td></tr>
</table>

<table>
<tr><th>NAME OF THE COURSE</th><th colspan="5">REMOTE SENSING IN A FUNCTION OF SUSTAINABLE DEVELOPMENT OF THE MARITIME SECTOR</th></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="4">1.</td></tr>
<tr><td>Course teacher</td><td>Anita Gudelj, Ph.D., Full Prof.</td><td>Number of credits (ECTS)</td><td colspan="4">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Ante Čalić<br>Zdeslav Jurić, Ph.D., Assist. Prof.<br>Merica Slišković, Ph.D., Full Prof.<br>Igor Vujović, Full Prof.<br>Miro Petković, Ph.D., Assist. Prof.</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>15</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>elective</td><td>Percentage of e-learning</td><td colspan="4">20%</td></tr>
<tr><th colspan="6">COURSE DESCRIPTION</th></tr>
<tr><td>Course objectives</td><td colspan="5">To enable students to acquire knowledge about remote data research for the purpose of sustainable development of ports and marinas, maritime transport and the cities of which they are an integral part.<br>Support in building capacity for downloading remote data and developing students' digital skills.<br>Students will be able to use the acquired knowledge and skills for further research/employment/application of projects in order to contribute to the sustainable development of ports (energy efficiency, sea pollution...) and the cities themselves.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Analyze images using ENVI with different types of data.<br>2. Analyze the conditions in which the data downloaded via satellite can be adjusted for certain needs (emissions, pollution, exhaust gases...).<br>3. Assess the quality of the marine environment using the remote sensing method.<br>4. Estimate the energy (exergy) potential of a segment of moist air in the surrounding atmosphere.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">LECTURES and EXERCISES:<br>1. Introduction to remote research. Overview of remote sensing principles and concepts (3h)<br>Lab#: None<br>2. Research and data collection using satellites<br>Lab 1: Getting started with QGIS - QGIS & SNAP installation (1h)<br>3. Collection, processing and analysis of data (1h)<br>Lab 2: Reception and pre-processing of Sentinel 1 and Sentinel 2 satellite data (2h)<br>4. GIS data modeling. Raster and vector data. Spectral indices for environmental monitoring (1h)<br>Lab 3: Data visualization with QGIS. Case study: Detection of ships SENTINEL-1 (2h)</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">5. Lab 4: Combination of Sentinel-1 and Sentinel-2 data for multispectral analysis. Case study: Plastic detection (3h)<br>6. Image classification (1h)<br>Lab 5: Classification of satellite images (2h)<br>7. Oceanography and remote sensing (2h)<br>Lab 6: Analiza trendova morske površine i energetskih svojstava iz satelitskih podataka (1h)<br>8. Lab 7: Case study: Analysis of sea surface temperature trends (3h)<br>9. Application of remote sensing in geophysical processes (2h)<br>Lab 8: Analysis of the composition of the atmosphere and air quality in the maritime domain (1h)<br>10. Lab 9: Case study: Analysis of the impact of maritime transport (3h)<br>11. Monitoring the state of the environment (1h)<br>Lab 10: Identifying environmental risks using remote sensing data. Case study: Recognition of anomalies in sea color trends (2h)<br>12. Sea quality monitoring using remote sensing (1h)<br>Lab 11: Detection of oil spills into the sea (2h)<br>13. Introduction to Python for geospatial data (1h)<br>Lab 12: Creation of basic scripts for data manipulation and visualization (2h)<br>14. Lab 13: Case study: How to analyze 5 different areas over 5 years in a few minutes? (3h)<br>15. Lab 14: Group projects - presentation of results (3h)</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ on line only<br>☒ mixed e-learning<br>☐ field work</td><td colspan="3">☒ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Responsibilities of full-time students:<br>Lectures are mandatory for students, as attendance records are kept. In order to gain the right to take the exam, students must attend 80% of the lectures and 80% of the exercises. In case of an insufficient number of attendances, students will not exercise the right to take the exam and must enroll in the course again the following academic year.<br>Students have the opportunity to pass the exam through continuous evaluation during the semester. Students must work on assigned topics independently or in a team through an independent task.<br>Students who have collected a sufficient number of points during the classes are required to register for the exam via Studomat for the first exam period after the lecture and come to the exam time to enter the grade or answer for a higher grade.<br>Responsibilities of part-time students:<br>In order to exercise the right to take the exam, students are required to attend 50% of the lectures and 50% of the exercises. Exam procedures are the same as for regular students.</td></tr>
<tr><td rowspan="4">Screening student work (name the proportion of ECTS credits for each activity so that the total number of</td><td>Lecture attendance</td><td>1.125</td><td>Research</td><td>1</td><td>(Other)</td><td></td></tr>
<tr><td>Lab. exercises</td><td></td><td>Report</td><td></td><td>(Other)</td><td>0.875</td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td>1</td></tr>
<tr><td>In-term tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
</table>

<table>
<tr><td>ECTS credits is equal to the ECTS value of the course)predmeta):</td><td colspan="6">Written exam (if it-term exams have not been passed) | | Project | | (Other) |</td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">
Assessment and grading of the work of full-time students:<br>
Students are required to do laboratory exercises during class. Each student is required to conduct research and do an independent assignment on a given topic. The final grade consists of class attendance, completed laboratory exercises, conducted research, and completed independent assignments.<br><br>
Continuous student assessment:
<table>
<tr><th>Assessment elements</th><th>Success (min.%)</th><th>Percentage in grade (%)</th></tr>
<tr><td>Class attendance</td><td>80</td><td>10</td></tr>
<tr><td>Lab exercises</td><td>100</td><td>20</td></tr>
<tr><td>Independent assignment</td><td>100</td><td>35</td></tr>
<tr><td>Research</td><td>100</td><td>35</td></tr>
</table>
Grading:
<table>
<tr><th>Percentage (%)</th><th>Criterion</th><th>Grade</th></tr>
<tr><td>0-49</td><td>Does not satisfy minimum criteria</td><td>insufficient (1)</td></tr>
<tr><td>50-64</td><td>Satisfies minimum criteria</td><td>sufficient (2)</td></tr>
<tr><td>65-79</td><td>Average success with clear shortcomings</td><td>good (3)</td></tr>
<tr><td>80-89</td><td>Above average success with a few errors</td><td>very good (4)</td></tr>
<tr><td>90-100</td><td>Extraordinary success</td><td>excellent (5)</td></tr>
</table>
Assessment and grading of part-time students' work<br>
The assessment and grades are the same as those for full-time students.
</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td colspan="6">
<table>
<tr><th>Title</th><th>Number of copies in the library</th><th>Availability via other media</th></tr>
<tr><td>1. Cengel, Y., and Boles, M., Thermodynamics: An Engineering Approach, McGraw-Hill Education, 2014.</td><td></td><td></td></tr>
<tr><td>2. Zou Guangrong: Ship energy efficiency technologies − now and the future,https://publications.vtt.fi /pdf/technology/2017/T306.pdf, 2017.</td><td></td><td>YES</td></tr>
<tr><td>3. Prevention of Pollution from Ships (MARPOL)." https://www.imo.org/en/about/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx (accessed Feb. 13, 2023)</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">1. Ulyssys Water Quality Viewer, (2020). https://custom-scripts.sentinelhub.com/sentinel2/ulyssys_water_quality_viewer<br>2. Zlinszky, A.; Padányi-Gulyás, G. (2020). Ulyssys Water Quality Viewer Technical Description Supplementary. Preprints, 2020010386 (doi: 10.20944/preprints202001.0386.v1).</td></tr>
<tr><td>Quality assurance</td><td colspan="6">University survey, student records, supervision of teaching by the Faculty board for</td></tr>
</table>

| | |
|---|---|
| methods that ensure the acquisition of exit competences | teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">RENEWABLE ENERGY SOURCES</td></tr>
<tr><td>Code</td><td>PFE312</td><td>Year of study</td><td colspan="4">2.</td></tr>
<tr><td>Course teacher</td><td>Maja Krčum, Ph.D., Full Prof.</td><td>Number of credits (ECTS)</td><td colspan="4">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Mario Miličević, M.Sc. Eng.</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="4">20%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Acquisition of specific knowledge needed to solve practical problems of application of renewable energy technologies from the point of view of marine engineering.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5"></td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Select renewable energy sources from the point of view of marine engineering.<br>2. Compare the use of renewables in maritime and in terrestrial technologies.<br>3. Assess energy efficiency using new technologies<br>4. To substantiate selected renewable energy solutions applied in marine engineering<br>5. Recommend renewables in view of their application in marine engineering</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">1. 1.Introduction - EU energy efficiency and renewable energy policy and legislation. Share of renewables in EU energy consumption.<br>2. Energy Law of the Republic of Croatia. Economic and financial aspects of the implementation of the national energy programs of the Republic of Croatia. Recommendations for creating a supportive legislative environment.<br>3. IMO recommendations on energy efficiency and renewable energy applications<br>4. Energy production. Overview of renewable energy sources. Renewable energy principles. Integration of renewable energy technologies and the concept of self-sustainable development.<br>5. Biomass<br>6. Biofuels<br>7. Geothermal energy. Hydropower. Potential of small hydropower plants<br>8. Wave energy. Tidal energy<br>9. Wind energy<br>10. Solar radiation. Conversion of solar energy into electricity (photovoltaic conversion). Solar photovoltaic systems<br>11. Fuel Cells and Batteries<br>12. Energy storage technologies: primary batteries, accumulators, supercapacitors, flywheels.<br>13. Cogeneration systems<br>14. Integrated energy systems<br>15. HOGA program conversion options<br><br>Seminar (15 h)</td></tr>
<tr><td>Format of instruction</td><td colspan="2">☒ lectures<br>☒ seminars and workshops<br>☐ exercises<br>☐on line only</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☐ laboratory<br>☐ mentoring</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">☐ mixed e-learning<br>☐ field work</td><td colspan="2">☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="8">Responsibilities of full-time students<br>Lectures are compulsory for students (records of class attendance are kept). Students must attend at least 80% of classes. In case of an insufficient number of attendances, students will not have the right to take the exam. Students who, due to illness or some other justifiable reason, did not meet the requirement, and have an attendance rate of 70% or more, will be able to do the rest (up to 80%) in supplementary terms, during the semester and after, but not for a longer period. than two months after the end of the course. All other students, i.e. those who attended less than 70% of classes, do not have the right to take the exam and must re-enroll in the course the following year.<br><br>Responsibilities of part-time students<br>Part-time students must attend a minimum of 50% of lectures, and the rest is the same as for the full-time students.</td></tr>
<tr><td rowspan="2">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>Lecture attendance</td><td>1.125</td><td>Research</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td>Essay</td><td></td><td>Seminar</td><td>0.5</td><td>Independent assignment</td><td>0.375</td></tr>
<tr><td></td><td>In-term tests</td><td>1</td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td>Written exam (if in-term tests have not been passed)</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td colspan="6">Assessment and grading of full-time students<br><br>Two in-term tests are written in the semester. The first test, which includes theoretical questions from the material from the first to the seventh lecture, is written in the seventh week of classes. The second test includes theoretical questions from the material from the eighth to the fifteenth lectures and is written in the fifteenth week of classes. Sample questions for the test are available to students on the Merlin e-learning platform. At each test, it is necessary to obtain at least 50% of points to pass. During the semester, students present seminar papers and independent assignments.<br><br>Students who do not attend one the tests for objective reasons or do not achieve the minimum percentage have the possibility of correction. Students who have passed the first and second tests and met the obligations of the seminar paper and the independent assignment are exempted from taking the oral part of the exam.<br><br>The time for writing the test is one academic class.<br><br>Attendance at classes, in-term test results, seminar papers and independent assignments are included in the final grade.</td></tr>
</table>

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

**Continuous student assessment:**

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Class attendance | 80 | 20 |
| In-term test I | 50 | 30 |
| In-term test II | 50 | 30 |
| Seminar paper | 100 | 10 |
| Independent assignment | 70 | 10 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Does not satisfy minimum criteria | insufficient (1) |
| 50-64 | Satisfies minimum criteria | sufficient (2) |
| 65-79 | Average success with clear shortcomings | good (3) |
| 80-89 | Above average success with a few errors | very good (4) |
| 90-100 | Extraordinary success | excellent (5) |

**Assessment and grading of the work of part-time students**
The assessment and grades are the same as those for full-time students.

**Required literature (available in the library and via other media)**

| Title | Number of copies in the library | Availability via other media |
|---|---|---|
| 1. Kulišić, P.(1991), Novi izvori energije - sunčana energija i energija vjetra, Školska knjiga, Zagreb, | | |
| 2. Potočnik, V.; Lay, V. (2003), Obnovljivi izvori energije i zaštita okoliša u Hrvatskoj, MZOPU, Zagreb,. | | |
| 3. Labudović, B. (2002), Obnovljivi izvor energije, Energetika marketing, Zagreb, , pp.809 | | |

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

1. Group of authors: SUNEN - Program korištenj energije sunca, En. institut Hrvoje Požar, Zagre
2. Group of authors: ENWIND - Program korištenja energije vjetra, En. institut Hrvoje Požar, Zagreb
3. Group of authors: BIOEN - Program korištenja energije biomase i otpada, En. institut Hrvoje Požar, Zagreb
4. Group of authors: MAHE - Program izgradnje malih hidroelektrana, En. institut Hrvoje Požar, Zagreb
5. Group of authors: GEOEN - Program korištenja geotermalne energije, En. institut Hrvoje Požar, Zagreb
6. European Commission (2021). Cohesion Package for 2021-2027, Official Journal of the European Union, L231, 30 June 2021. https://eur-lex.europa.eu/

**Quality assurance methods that**

University survey, student records, supervision of teaching by the Faculty board for

| | |
|---|---|
| ensure the acquisition of exit competences | teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">SHIP'S SCADA SYSTEMS AND CONTROL</td></tr>
<tr><td>Code</td><td>PFE 120</td><td>Year of study</td><td colspan="3">1</td></tr>
<tr><td>Course teacher</td><td>Joško Šoda, Ph.D., Assoc.Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Luka Čulić</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>mandatory</td><td>Percentage of e-learning</td><td colspan="3">10%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Acquiring the knowledge necessary to understand the principles of control of various automatic ship systems, their correlations, the fusion of sensor information and the integration of control systems based on the use of PLC devices or microcontrollers. Basic knowledge of the hierarchical structure of the ship process automation. Understanding the hardware and software support of PLC devices. Human-PLC device interaction using SCADA and HMI systems.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. 1.Select a suitable network structure to build the ship's automatic system<br>2. Predict communication mode and elements of selected automatic ship system.<br>3. Recommend a suitable way of realizing the system.<br>4. Compare other modes with the mode selected.<br>5. Valorize the justification for choosing a system.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures (a block of 2):<br>1. Input-output process measures and commonly used standards<br>2. Signal protection<br>3. Signal protection<br>4. Hierarchical structure of ship control. Overview of network usage worldwide (America, Europe, Asia).<br>5. Overview of network control systems, the first level, field level: AS-i system.<br>6. Overview of network control systems, the first level, field level: AS-i system.<br>7. The second level, the control level, e.g. PROFIBUS standard<br>8. The second level, the control level, e.g. PROFIBUS standard<br>9. The third level, the supervisory level, e.g. PROFINET standard<br>10. SCADA and HMI systems.<br>11. SCADA and HMI systems.<br>12. The basic hardware structure of PLC devices.<br>13. The basic hardware structure: PLC Programming.<br>14. High-level PLC programming.<br>15. Using the interface of Siemens PLC devices to configure, program and upload/download PLC devices.<br><br>Exercises (a block of 2):<br>1. Introducing the lab<br>2. Basic elements of the process control structure based on the use of the PLC device</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">3. Ladder logic programming with application to ship systems<br>4. Ladder programming with application to marine systems<br>5. Advanced programming with application to shipboard systems<br>6. Advanced programming with application to marine systems<br>7. HMI panels based on Siemens offer<br>8. HMI panels based on Siemens equipment<br>9. Remote process control based on Siemens SCALANCE equipment<br>10. Remote process control based on Siemens SCALANCE equipment<br>11. PLC-based motor-generator system control<br>12. PLC-based motor-generator system control<br>13. Air-conditioning control system<br>14. Steam control system<br>15. Ship heel control system</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Obligations of part-time students:<br><br>Attending classes is mandatory for full-time students. Attendance at a minimum of 80% of lectures, auditory and laboratory exercises is a condition for obtaining the right to take the exam.<br><br>Obligations of part-time students:<br><br>Attendance at a minimum of 50% of lectures and exercises is a condition for obtaining the right to take the exam.</td></tr>
<tr><td rowspan="7">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>Lecture attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Homework</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>Other</td><td></td></tr>
<tr><td>In-term tests</td><td>4.5</td><td>Oral exam</td><td></td><td>Other</td><td></td></tr>
<tr><td>Written exam (if in-term tests have not been passed)</td><td>4.5 (alternative to in-term tests</td><td>Project</td><td></td><td>Other</td><td></td></tr>
<tr><td colspan="6">Assessment and grading of full-time students' work<br><br>There are 2 in-terms written in the semester. The first in-term test covers theoretical questions from Lectures 1-7 and is written in the seventh week of teaching. The second in-term test comprises theoretical questions from the contents of the eighth to the fifteeenth lectures and is written in the fifteenth week of teaching. The examples of in-term test questions for students are available on the website. At each in-term test, a minimum of 50% passing points is required. Students who do not attend one of the exams for objective reasons or fail to achieve a minimum percentage are eligible for correction. A correction will be organized for these students in the fifteenth week.<br>The final grade includes class attendance and in-term tests' results .</td></tr>
</table>

<table>
<tr><td></td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td>
Continuous assessment of students' work:
<table>
<tr><th>Assessment elements</th><th>Success (min.%)</th><th>Percentage in grade (%)</th></tr>
<tr><td>Class attendance</td><td>80</td><td>10</td></tr>
<tr><td>In-term test I</td><td>50</td><td>45</td></tr>
<tr><td>In-term test II</td><td>50</td><td>45</td></tr>
</table>
Grading
<table>
<tr><th>Percentage (%)</th><th>Criterion</th><th>Grade</th></tr>
<tr><td>0-49</td><td>Does not satisfy minimum criteria</td><td>insufficient (1)</td></tr>
<tr><td>50-64</td><td>Satisfies minimum criteria</td><td>sufficient (2)</td></tr>
<tr><td>65-79</td><td>Average success with clear shortcomings</td><td>good (3)</td></tr>
<tr><td>80-89</td><td>Above average success with a few errors</td><td>very good (4)</td></tr>
<tr><td>90-100</td><td>Extraordinary success</td><td>excellent (5)</td></tr>
</table>
The students who do not pass the in-term examinations during the semester and who have obtained the right to take the exam are required to take the written exam in the exam term. The same assessment and grading criteria apply to the examination period as to the continuous assessment.<br><br>
Assessment and grading of the work of part-time students<br>
The condition for obtaining the right to take the final exam is attendance at a minimum of 50% of lectures.<br>
The assessment and grading are the same as those for full-time students.
</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td>
<table>
<tr><th>Title</th><th>Number of copies in the library</th><th>Availability via other media</th></tr>
<tr><td>J. Šoda (2012) Notes for preparation of lectures, 2012.</td><td></td><td>WEB</td></tr>
<tr><td>Beroš, Slobodan Marko (2010): PROGRAMIBILNI LOGIČKI REGULATORI, Notes for preparation of lectures, FESB, Split</td><td></td><td>WEB</td></tr>
<tr><td>Antonić, R. (2007) Automatizacija broda II, Faculty of Maritime Studies in Split</td><td>5</td><td></td></tr>
</table>
</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td>

1. T.I. Fossen: MARINE CONTROL SYSTEMS - GUIDANCE, NAVIGATION AND CONTROL OF SHIPS, RIGS AND UNDERWATER VEHICLES, Marine Cybernetics, Trondheim, Norway, 2002.
2. Christopher T. Kilian: MODERN CONTROL TECHNOLOGY: COMPONENTS AND SYSTEMS; 2 Edition, Delmar Thompson Learning, 2000.
3. Siemens, SIMATIC, S7-200 PROIGRAMMABLE CONTROLLER, System Manual, Edition 05/2003.
4. Hackworth, R. John, Hackworth, D. Federick Jr.; PROGRAMMABLE LOGIC CONTROLLERS: PROGRAMMING METHODS AND APPLICATIONS, Prentice-Hall, USA, 2003.,
5. Bryan, L. A., Bryan A. E.: PROGRAMMABLE CONTROLLERS: THEORY AND IMPLEMENTATION, 2nd Ed., An Industrial Text Company Publication, Atlanta, Georgia, USA, 1997.

</td></tr>
</table>

| | |
|---|---|
| | 6. Scott, D. M.: INDUSTRIAL PROCESS SENSORS, CRC Press, 2008 |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">DISCRETE CONTROL SYSTEMS</td></tr>
<tr><td>Code</td><td>PFE 120</td><td>Year of study</td><td colspan="4">2</td></tr>
<tr><td>Course teacher</td><td>Joško Šoda, Ph.D., Assoc. Prof.</td><td>Number of credits (ECTS)</td><td colspan="4">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Miro Petković, PhD, Assist. Prof.</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="4">10%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Master the basic knowledge of discrete-time systems. Compare the advantages and disadvantages of continuous and discrete systems. Understand the principles of signal sampling and reconstruction, and the consequences of A / D and D / A conversion to a discrete control system. Perform analysis and simpler synthesis of a discrete time-driven system.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1.Compare a continuous and discrete control system<br>2. Estimate the sampling time of the analog signal.<br>3.Select how to reconstruct a discrete signal,<br>4. Assess the degree of stability of the discrete system.<br>5. Recommend a method of reducing interference in the control circuit<br>6. Factually argue how to adjust the discrete controllers.<br>7. Recommend a way to improve the regulatory behavior of discrete systems</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures (a block of 2):<br><br>1. Repetition of continuous management systems.<br>2. Introductory lecture on linear discrete systems.<br>3. Sampling. Frequency properties and Laplace transform<br>4. Signal Reconstruction (ZOH, FOH)<br>5. Description of linear discrete systems with difference equations and by z-transformation<br>6. Properties of z and modified z transformations.<br>7. Inverse z transformation.<br>8. Transfer function of linear discrete systems. Block algebra of linear discrete systems<br>9. Description of linear discrete systems in the state space<br>10. Stability of linear discrete systems<br>11. Analytical Regulatory Synthesis Procedures<br>12. Structures of digital PID controllers. Application of digital controllers<br>13. Additional functions: reduction of noise, impulse interference and run-in effect<br>14. Improving regulatory governance through more complex governance structures<br>15. Setting up digital controllers<br><br>Exercises (a block of 2 - auditory, simulation):<br>1. Repeating the concepts of continuous systems<br>2. Differential equations of the first and second order systems</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">3. Sampling and ZOH. Transformation of continuous systems into discrete systems<br>4. Sampling and ZOH. Transformation of continuous systems into discrete systems<br>5. z - transformation<br>6. z - transformation and modified z - transformation<br>7. Impulse transfer function and block operation<br>8. Impulse transfer function and block operation<br>9. Impulse transfer function and block operation<br>10. Transients in discrete systems<br>11. Transients in discrete systems<br>12. Stability in discrete systems<br>13. Stability in discrete Systems<br>14. Steady-state errors<br>15. Discrete PID controller and analysis</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring<br>☒ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Responsibilities of full-time students:<br>Attendance is mandatory for full-time students. The condition for obtaining the right to take the exam is attendance at at least 80% of lectures, auditory and laboratory exercises.<br><br>Responsibilities of part-time students:<br>Attending classes is mandatory for part-time students. Attendance at a minimum of 50% of lectures, auditory and laboratory exercises is a requirement for obtaining the right to take the exam.</td></tr>
<tr><td rowspan="6">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>Lecture attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td>4.5</td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td rowspan="2">Written exam (if in-term tests have not been passed)</td><td rowspan="2">4.5 (alternative to in-term exams)</td><td rowspan="2">Project</td><td rowspan="2"></td><td rowspan="2">(Other)</td><td rowspan="2"></td></tr>
<tr></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Assessment and grading of full-time students' work:<br>2 in-term tests are written in the semester. The first test includes theoretical questions from the contents of the first to the seventh lectures (1-7) and is written in the seventh week of classes. The second test includes theoretical questions from the contents of the eighth to the fifteenth lectures and is written in the fifteenth week of classes. Sample questions for the tests are available to students on the Merlin e-learning platform. At each test, it is necessary to obtain at least 50% of points to pass. Students who pass both tests have also passed the exam. Class attendance and in-term tests' results are included in the final grade.<br>Students who do not attend an in-term test for certain reasons or do not achieve the minimum percentage have the possibility of correction. Correction will be organized for these students in the fifteenth week.</td></tr>
</table>

**Continuous assessment of students' work**

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Class attendance | 80 | 10 |
| In-term test I | 50 | 45 |
| In-term test II | 50 | 45 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Does not satisfy minimum criteria | insufficient (1) |
| 50-64 | Satisfies minimum criteria | sufficient (2) |
| 65-79 | Average success with clear shortcomings | good (3) |
| 80-89 | Above average success with a few errors | very good (4) |
| 90-100 | Extraordinary success | excellent (5) |

Students who do not pass the midterm examinations during the semester but have the right to take the final exam are required to take the exam within the exam term. The same assessment criteria listed in the “Continuous Student Assessment” table apply to the examination term.

**Assessment and grading the work of part-time students**
Assessment and frading criteria are the same as those for full-time students.

| | Title | Number of copies in the library | Availability via other media |
|---|---|---|---|
| Required literature (available in the library and via other media) | N.Perić, N.,: Diskretni sustavi upravljanja, Interna skripta, dostupno na www.fer.hr | | YES |
| | 2.Stipaničev, D.,Marasović, J., Digitalno vođenje, online skripta, FESB, Split, dostupno na www.fesb.hr | | YES |
| | 3. Vukić, Z.,Kuljača. Lj. (2005) Automatsko upravljanje – analiza linearnih sustava, Kigen d.o.o, Zagreb, | 5 | |
| Optional literature (at the time of submission of study programme proposal) | 1. Moudgalya, K. M.,(2007) Digital control, Willey.<br>2. Kuo, B. C.,(1995).Digital Control Systems, Oxford University Press.<br>3. Cassandrass, C. G., Lafortune S. (1999), Introduction to Discrete Event Systems, Kluwer Academic Publishers.<br>4. Marasović Jadranka (1984), Diskretni kontrolni sustavi, zbirka zadataka, FESB, Split. | | |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. | | |
| Other (as the proposer wishes to add) | | | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">CYBER SECURITY OF SHIP'S SYSTEMS</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="3">2</td></tr>
<tr><td>Course teacher</td><td>Mirko Ćorić, Ph.D., Assist. Prof.<br>Anita Gudelj, Ph.D., Full.Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Jelena Čulić-Gambiroža, Ph.D.</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td></td><td>15</td><td></td></tr>
<tr><td>Status of the course</td><td>mandatory</td><td>Percentage of e-learning</td><td colspan="3">20%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">• Provide students with key definitions and aspects related to cyber security and provide insight into the important factors for preventing cyber-attack by ship systems<br>• give an overview of the different methods used by criminals to circumvent security measures.<br>• Develop the ability to critically evaluate and analyze cyber risks</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Identify threats to the cyber security of ship systems<br>2. Give basic security services (authentication, access control, data confidentiality, data integrity) as an example<br>3. Analyze the vulnerability of password storage systems in computer systems<br>4. Critically evaluate the weaknesses and strengths of the applied cyber security mechanisms of marine systems<br>5. Compile an effective cyber security risk assessment of marine systems<br>6. Recommend security measures for the protection of data in ship computer systems</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">1. Introduction to the course. Cyber security: basic concepts.<br>2. The CIA triad. Encryption.<br>3. Cyber Security threats. Password attacks: attacks by force, dictionary and rainbow tables<br>4. Social Engineering. Phishing. Forms and measures of protection.<br>5. Malicious software: viruses, computer worms, Trojan horses, ransomware, spyware, botnet. Malware protection<br>6. Types of attacks on wireless networks. Wireless network security methods<br>7. In-term test I<br>8. Ship cyber security. Examples of cyber attacks on a ship.<br>9. Management of cyber risks on board: The relationship between IT (information technology) and OT (operational technology) on board.<br>10. Vessel systems vulnerability identification<br>11. Risk analysis and management.<br>12. On-board cyber security implementation plan.<br>13. Cyber security management.<br>14. Ship network security<br>15. In-term test II</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">EXERCISES<br>1. Introduction to Security and Cryptography: CrypTool (http://www.cryptool.org)<br>2. Introduction to Security and Cryptography: CrypTool (http://www.cryptool.org)<br>3. User authentication on Windows systems<br>4. Access Control (Windows). Penetration testing of passwords<br>5. Secure configuration of hardware and software on mobile devices, laptops and workstations<br>6. Email and Web Browser Protection<br>7. Web application vulnerability testing<br>8. Defending against malware<br>9. Recording user input via keyboard ('keylogger')<br>10. Data Recovery<br>11. Data protection<br>12. Computer vulnerability testing<br>13. Wireless vulnerability testing<br>14. Presentation of seminar papers<br>15. Presentation of seminar papers</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐on line only<br>☒ mixed e-learning<br>☐ field work</td><td colspan="3">☒ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Responsibilities of full-time students:<br>Attendance is compulsory for full-time students, ie a minimum of 80% of attendance is required. This is the requirement for getting the right to take the final exam. Practical (hands-on) laboratory exercises will be organized within the course. The student is required to attend all the exercises and produce and submit appropriate reports (submitted lab reports are a prerequisite for entering the grade).<br><br>Responsibilities of part-time students:<br>The condition for obtaining the right to take the exam is the presence of a minimum of 50% of lectures and exercises. The student is required to attend 50% of the exercises and produce and submit appropriate reports (submitted lab reports are a prerequisite for entering the grade).</td></tr>
<tr><td rowspan="6">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>Lecture attendance</td><td>1,125</td><td>Research</td><td></td><td>Practical work/reports</td><td>0.475</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>e-learning (On-line checking of knowledge through tests)</td><td>0,5</td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td>0.4</td><td>(Ostalo upisati)</td><td></td></tr>
<tr><td>In-term tests</td><td>1</td><td>Oral exam</td><td>0.5</td><td>(Ostalo upisati)</td><td></td></tr>
<tr><td>Written exam (if in-term tests have not been passed)</td><td>1 (alternative to in-term tests)</td><td>Project</td><td></td><td>(Ostalo upisati)</td><td></td></tr>
<tr><td></td><td colspan="5"></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Evaluation and grading of full-time students:<br><br>Two midterm examinations from the theoretical part of the exam are scheduled and will be written in the 7th and 15th weeks of classes.</td></tr>
</table>

At each in-term test, a minimum of 50% passing points is required. Students who do not pass the midterm examinations during the semester and who have the right to take the exam are required to take the written and / or oral exam within the exam term.

**Continuous assessment of students' work**:

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Laboratory exercises | Presented reports from exercises (80%) | 10 |
| On-line tests | 0 | 20 |
| Seminar paper | 50 | 10 |
| Continuous knowledge check | 50 | 1. in-term 30<br>2. in-term 30 |
| Total | | 100 |

**Final assessment**

| Assessment elements – final exam | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Laboratory exercises | Presented reports from exercises (80%) | 10 |
| On-line tests | 0 | 20 |
| Written exam | 50 | 50 |
| Oral exam | 50 | 20 |
| Total | | 100 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Does not satisfy minimum criteria | insufficient (1) |
| 50-64 | Satisfies minimum criteria | sufficient (2) |
| 65-79 | Average success with clear shortcomings | good (3) |
| 80-89 | Above average success with a few errors | very good (4) |
| 90-100 | Extraordinary success | excellent (5) |

**Assessment and grading the work of part-time students:**
Assessment and grading are the same as those for full-time students.

Required literature (available in the library and via other media)

| Title | Number of copies in the library | Availability via other media |
|---|---|---|
| 1. Presentations for lectures and exercises | | YES |
| 2. Hugh Boyes; Roy Isbell (2017) *Code of practice: cyber security for ships*. Institution of Engineering and Technology, London, United Kingdom https://www.gov.uk/government/publications/ship-security-cyber-security-code-of-practice | | YES |
| 3. Guide for cybersecurity implementation for the marine and offshore industries (2016) American Bureau of Shipping | | YES |

| | |
|---|---|
| Optional literature (at the time of submission of study programme proposal) | 1. Bača, M.(2004) Uvod u računalnu sigurnost, Narodne novine, Zagreb.<br>2. MSC-FAL.1/Circ.3 Guidelines on maritime cyber risk management<br>Ross Anderson: Security Engineering,2008. |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">SYNTHESIS OF TRAFFIC AND MANUFACTURING SUPERVISING SYSTEMS</td></tr>
<tr><td>Code</td><td>PFE313</td><td>Year of study</td><td colspan="3">2</td></tr>
<tr><td>Course teacher</td><td>Danko Kezić, PhD, Full Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="3">10%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">The course provides relevant basic knowledge in the field of supervising control of discrete events traffic systems. Flexible manufacturing systems are also being considered, which are increasingly being introduced in shipbuilding and maritime affairs. Students will be trained in system analysis and in the synthesis of simple control algorithms that increase the utilization and efficiency of production resources, applying the theory of discrete events systems, automata theory and and Petri nets.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Classify and compare types of manufacturing structures<br>2. Present the basic and structural properties of Petri nets<br>3. Create a discrete model of the traffic system<br>4. Detect deadlock in a discrete system<br>5. Recommend a way to avoid conflict and deadlock<br>6. Recommend ways to improve supervising control systems</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures (a block of 2):<br><br>1. Discrete Event Systems – manufacturing and traffic<br>2. Elements of a flexible manufacturing system<br>3. Basic structures of flexible manufacturing systems<br>4. Modeling systems with discrete events system<br>5. Analysis of discrete event systems<br>6. Petri nets, the state transition equation of a petri net<br>7. Basic properties of Petri nets.<br>8. Structural properties of Petri nets<br>9. Conflict and deadlock analysis<br>10. Supervisory control of manufacturing systems<br>11. Synthesis of supervisory control of production systems<br>12. Matrix model of flexible manufacturing system<br>13. Supervisory control of traffic systems<br>14. Synthesis of supervisory control of traffic systems<br>15. Example of supervisory control of Singapore Strait Traffic<br><br>Exercises<br>1. Finite automata – modeling and synthesis of discrete systems<br>2. Finite automata – modeling and synthesis of discrete systems<br>3. Finite automata – modeling and synthesis of discrete systems</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">4. Finite automata – modeling and synthesis of discrete systems<br>5. Petri nets, time nets, hybrid nets<br>6. Petri nets, time nets, hybrid nets<br>7. Petri nets, time nets, hybrid nets<br>8. Petri nets, time nets, hybrid nets<br>9. Modeling and simulating traffic supervisors<br>10. Modeling and simulating traffic supervisors<br>11. Modeling and simulating traffic supervisors<br>12. Modeling and simulating traffic supervisors<br>13. Supervisory control of flexible manufacturing systems<br>14. Supervisory control of flexible manufacturing systems<br>15. Supervisory control of flexible manufacturing systems</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Student responsibilities and evaluation<br><br>Responsibilities of full-time students:<br><br>Attendance is compulsory for full-time students, i.e., the requirement for obtaining the right to take the exam is the attendance at a minimum of 80% of lectures, auditory and laboratory exercises.<br><br>Responsibilities of part-time students:<br><br>Attendance is also compulsory for part-time students, i.e., the requirement for obtaining the right to take the exam is the attendance at a minimum of 50% of lectures, auditory and laboratory exercises.</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>Lecture attendance</td><td>1.125</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td>2.875</td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam (if in-term tests have not been passed)</td><td>2.875 (alternative to in-term tests)</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">Assessment and grading of the work of full-time students:<br>2 in-term tests are written in the semester. The first test includes theoretical questions from the material from the first to the seventh lectures and is written in the seventh week of the classes. The second test includes theoretical questions from the material from the eighth to the fifteenth lectures and is written in the fifteenth week of classes. Sample questions for the tests are available to students on the Merlin e-learning platform. At each test, it is necessary to obtain at least 50% of points to pass. Students who pass both tests have also passed the exam. Class attendance and test results are included in the final grade.</td></tr>
</table>

Students who do not take a test for certain reasons or do not achieve the minimum percentage have the possibility of correction. Correction will be organized for these students in the fifteenth week.

**Continuous assessment of students' work**

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Class attendance | 80 | 10 |
| In-term test I | 50 | 45 |
| In-term test II | 50 | 45 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Does not satisfy minimum criteria | insufficient (1) |
| 50-64 | Satisfies minimum criteria | sufficient (2) |
| 65-79 | Average success with clear shortcomings | good (3) |
| 80-89 | Above average success with a few errors | very good (4) |
| 90-100 | Extraordinary success | excellent (5) |

Students who do not pass the midterm examinations during the semester and have the right to take the final exam are required to take the exam within the exam term. The same assessment criteria listed in the “Continuous Student Assessment” table apply to the examination term.

**Assessment and grading of the work of part-time students**
Knowledge assessment and grading are the same as those for full-time students.

| | Title | Number of copies in the library | Availability via other media |
|---|---|---|---|
| Required literature (available in the library and via other media) | 1. Kovačić, Z.,Bogdan, S., Krajči, V.,(2002), Osnove robotike, Graphis, Zagreb | 5 | |
| | 2. Bogdan, Sustavi s diskretnim događajima – predavanja,dostupno na http://www.fer.unizg.hr/predmet/ssdd | | YES |
| Optional literature (at the time of submission of study programme proposal) | Cassandrass, C. G., Lafortune, S.,(1999),Introduction to Discrete Event Systems, Kluwer Academic Publishers. | | |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. | | |
| Other (as the proposer wishes to add) | | | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">VISUALISATION IN AUTONOMOUS SHIPPING</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="4">2.</td></tr>
<tr><td>Course teacher</td><td>I. Vujović, Ph.D., Full Prof.</td><td>Number of credits (ECTS)</td><td colspan="4">3</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>15</td><td></td><td>15</td><td></td></tr>
<tr><td>Status of the course</td><td>elective</td><td>Percentage of e-learning</td><td colspan="4">0</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Familiarization with modern remote control modes that incorporate computer-aided reality visualization, augmented reality, and mixed virtuality. Design of interactive programming interfaces and their use in shipping.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Provide the necessary input and output devices and software for the needs of the virtual reality system.<br>2. Valorize the reality of the virtual reality scenario.<br>3. Evaluate the quality of the software development of the virtual reality problem.<br>4. Evaluate the realism of tactile, visual and audio interfaces.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures:<br>1. Divisions of the visualization system by virtuality. Frequent means of applying shifted reality and virtuality.<br>2. Possibilities of applying mixed and virtual forms of reality in maritime affairs.<br>3. Existing systems for virtuality. Zeltzer classification.<br>4. A review of human psychology and its applicable factors. The human senses.<br>5. Virtual and mixed reality hardware.<br>6. Input controllers, motion trackers, navigation control and gesture control.<br>7. Output devices - Mixed and Virtual Reality Glasses, Hanging Screens. Touch and vibrotactile devices.<br>8. Virtual reality software.<br>9. 3D interactive and procedural graphics.<br>10. 3D sound. Sound in a virtual environment.<br>11. System Architecture and Integrative Media Platform.<br>12. Rapid prototyping.<br>13. VR programming.<br>14. Creating a Virtual World Model.<br>15. Virtuality enhancement techniques to achieve more realistic worlds.<br><br>Exercises:<br>1. Input device selection and characteristics.<br>2. Selection and characteristics of output devices.<br>3. Virtual reality programming packages.<br>4. Using VR glasses.<br>5. Using VR glasses.<br>6. Starting and exiting a virtual reality system.</td></tr>
</table>

| | |
|---|---|
| | 7. Introducing the image into the virtual world.<br>8. Programming the virtual world.<br>9. Programming the virtual world.<br>10. Introducing sound into the virtual world.<br>11. Virtual world sound programming.<br>12. Virtual world sound programming.<br>13. Tactile and other interfaces and their programming.<br>14. Developing a prototype of a maritime system.<br>15. Developing a prototype of a maritime system. |
| Format of instruction | ☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐*on line* only<br>☐ mixed e-learning<br>☐ field work<br><br>☒ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☒ mentoring<br>☐ consultations |
| Student responsibilities | **Student responsibilities and evaluation**<br><br>**Responsibilities of full-time students:**<br>Students are required to attend classes: 80% of lectures and 100% of exercises. If they could not be present for justified reasons, they prepare a seminar paper as compensation.<br><br>**Responsibilities of part-time students:**<br>Students are required to attend classes: 50% of lectures and 100% of exercises. If they could not be present for justified reasons, they prepare a seminar paper as compensation. |

| 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)* | | | | | | |
|---|---|---|---|---|---|---|
| | Lecture attendance | 0.75 | Research | | Practical work | |
| | Experimental work | | Report | | (Other) | |
| | Essay | | Seminar paper | | (Other) | |
| | In-term tests | | Oral exam | | (Other) | |
| | Written exam (if in-term tests have not been passed) | | Project | 2.25 | (Other) | |

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

**Assessment and grading of the full-time students' work:**

Students create a virtual reality model and program modules. Work in its original and completed form and text with explanations shall be submitted to the teacher either during the semester or during the exam term.

**Continuous assessment of students' work**

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Class attendance | 80 | 0 |
| Project | 50 | 100 |

**Final evaluation**

| Assessment elements – final exam | Success | Percentage in |
|---|---|---|

| | (min.%) | grade (%) |
|---|---|---|
| Class attendance | 80 | 0 |
| Project | 50 | 100 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-50 | Does not satisfy minimum criteria | insufficient (1) |
| 50-59 | Satisfies minimum criteria | sufficient (2) |
| 60-75 | Average success with clear shortcomings | good (3) |
| 76-89 | Above average success with a few errors | very good (4) |
| 90-100 | Extraordinary success | excellent (5) |

**Assessment and grading of part-time students' work:**
The assessment and grading criteria are the same as for the full-time students.

| Required literature (available in the library and via other media) | Title | Number of copies in the library | Availability via other media |
|---|---|---|---|
| | 1. Merlin; https://moodle.srce.hr/2021-2022/ | | YES |
| | | | |

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

1. Key M. Stanney (ed.), (2008) Handbook of virtual environments – design, implementation, and applications, Lawrence Erlbaum Associates Publishers, Mahwah, New Jersy
2. Kelly S. Hale (Editor), Kay M. Stanney (Editor), Handbook of Virtual Environments: Design, Implementation, and Applications, Second Edition (Human Factors and Ergonomics), 2014. ISBN-13: 978-1466511842.
3. Jason Jerald. 2015. The VR Book: Human-Centered Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool Publishers. http://doi.org/10.1145/2792790
4. Tony Parisi. 2015. Learning Virtual Reality, ISBN: 9781491922828
5. Philippe Fuchs - Appropriate use of VR headsets http://worldvrforum.com/product/appropriate-use-virtual-reality-head/
6. Luca Turchet. (2015) Designing presence for real locomotion in immersive virtual environments: An affordance-based experiential approach. Virtual Reality 19, 3–4: 277–290. http://doi.org/10.1007/s10055-015-0267-3
7. Grigore C. Burdea & Philippe Coiffet, (2003) Virtual Reality Technology (2nd Ed.), John Wiley & Sons, Inc.

| | |
|---|---|
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">QUALITY MANAGEMENT IN SHIPPING</td></tr>
<tr><td>Code</td><td>PFN209</td><td>Year of study</td><td colspan="3">2.</td></tr>
<tr><td>Course teacher</td><td>Helena Ukić Boljat, PhD</td><td>Number of credits (ECTS)</td><td colspan="3">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Status of the course</td><td>mandatory</td><td>Percentage of e-learning</td><td colspan="3">30%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Ability to understand quality systems and international standards. Development of strategy and process for establishing, maintaining and improving quality systems in maritime systems and processes.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">After successfully completing the course, the student will:<br>1. Know and understand the professional and scientific principles and procedures relevant to the maritime profession for the purpose of establishing an integrated management system<br>2. Apply methods and tools to improve process quality (emphasis is placed on maritime institutions / companies)<br>3. Implement appropriate techniques for continuous improvement of the quality management system<br>4. Analyze the link between total quality management, sustainable development and social responsibility.<br>5. Interpret and evaluate international and national maritime safety systems, rescue elements, and manage maritime risks</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5"><u>LECTURES</u>:<br>1. Introductory notes on the teaching methods, learning outcomes, rules for writing and presenting seminar papers, grading, passing exams. Definition of quality and explanation of relevant terms from different points of view. Determine the perception of quality by the user of the product / service.<br>2. Historical development of quality: development of quality throughout history and compare with current requirements; Quality gurus - Deming, Crosby, Feigenbaum, Ishikawa, Taguchi, Jurana - their importance in quality development.<br>3. Quality development and definition - statistical quality control and testing, quality assurance, quality management.<br>4. Quality Management: Total Quality Management - TQM - Concept, Meaning and principles; Integrated quality management; Total quality.<br>5. Quality Management: Six Sigma<br>6. Development and application of ISO 9001 standards…<br>7. Process management. Quality policy. Documentation. Motivation. Guidance.<br>8. Quality spiral. Process approach. Judgment. Implementation of quality management system. Quality control. Quality marketing.<br>9. Introduction of a quality system. Quality system review. Internal and external Judgment (I in-term test)<br>10. Quality management methods and tools - application of basic Quality Management Tools<br>11. Quality Management Methods and Tools - application of additional Quality Management Tools</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">12. Quality management methods and tools - explain, interpret and recommend implementation of quality management methods. Quality costs<br>13. Integrated quality management systems - to argue for sustainable development the importance of integrated systems - quality management systems, environmental management systems, safety and health management systems, food safety management systems, information security management systems, energy management systems, social responsibility).<br>14. International Safety Management Code; the introduction of quality management systems in maritime companies, institutions, maritime colleges: personalities, expectations, opportunities, difficulties, benefit - good practice examples. Accreditation, certification and supervision<br>15. Introduction of quality management system in maritime companies, institutions, maritime colleges: personalities, expectations, opportunities, difficulties, benefits - good practice examples. Accreditation, certification and supervision (in-term exam II)<br><br><u>EXERCISES</u>:<br>1. Calculations - auditory exercises<br>2. Calculations - auditory exercises<br>3. Assignment of seminar paper and instructions for drafting<br>4. Application of statistical methods for quality assessment<br>5. An example of good practice.Visiting students to their chosen organization (e.g., Brodospas). Tailored to work environment visits<br>6. Good practice example. Visiting students to a selected organization (eg marina). Tailored to work environment visits.<br>7. Example of implementation of the establishment of a management system - Faculty of Maritime Studies in Split. Presentation of seminar papers<br>8. Internal audit application example - Faculty of Maritime Studies in Split. Presentation of seminar papers<br>9. External audit application example - Faculty of Maritime Studies in Split. Presentation of seminar papers.<br>10. Familiarization with quality control tools. Presentation of seminar papers.<br>11. Develop a cause and effect diagram for the area to be improved (for each direction specific task, eg PN-safety of navigation). Presentation of seminar papers,<br>12. Develop a checklist (PM-quality of service in marinas). Presentation of seminar papers<br>13. Risk assessment - table method<br>14. Presentation of seminar papers<br>15. Presentation of seminar papers</td></tr>
<tr><td>Format of instruction</td><td>☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ on line only<br>☐ mixed e-learning<br>☐ field work</td><td>☒ individual tasks<br>☐ multimedia<br>☐ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="2">Responsibilities of full-time students:<br>Attendance is compulsory and records of student attendance are maintained (Form F04). The full-time student has not fulfilled his / her obligations prescribed by the study program if he / she has been absent more than 20% of the teaching hours of the lectures and the auditory exercises. In case of insufficient number of attendances, the students are not eligible for taking the exam and shall enroll in the same course again next year.<br><br>Responsibilities of part-time students:<br>The part-time student has not fulfilled his/her obligations prescribed by the study program if he / she has been absent more than 50% of teaching hours of lectures and auditory exercises. Laboratory exercises / practical training must be fully</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">attended.<br>In case of insufficient number of attendances, the students are not eligible for taking the exam and shall enroll in the same course again next year.</td></tr>
<tr><td rowspan="6">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>Lecture attendance</td><td>1.125</td><td>Research</td><td>1</td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td>0.25</td><td>Homework</td><td>0.375</td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>Simulator practice</td><td></td></tr>
<tr><td>In-term tests</td><td>1.875</td><td>Oral exam</td><td>1.875 (alternative to in-term exams)</td><td>Auditory exercises</td><td>0.375</td></tr>
<tr><td>Written exam (if in-term tests have not been passed)</td><td>1.875 (alternative to in-term test</td><td>Project</td><td></td><td>Other</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Evaluation and grading of students<br>There are two ways for a student to be eligible for a final grade:<br><br>1. THE FIRST OPTION - continuous assessment:<br>Based on earned and graded points from continuous assessment, evaluation of attendance, preparation and presentation of seminars, and in-term grades.<br><br>During the semester, an in-term test - practical application (assignments, calculations - 30%) is written and seminar paper (30%) is produced and presented. During continuous assessment, it is important to note that students write an in-term test from the theoretical part or take an oral exam (30%). The assignment in-term test is organized several times during the semester. The final grade comprises the activity in class (10%), which includes the attendance at lectures and auditory exercises as well as the results of the in-term tests.<br><br>2. THE SECOND OPTION:<br>It is based on the achieved and evaluated points and taking into account the attendance at classes, and assessment of the previous monitoring of the work and the writing of the final exam (written part) as well as taking the oral exam.<br>If the student does not earn a positive grade through the continuous knowledge check or does not take part in the continuous knowledge check during the semester, they can take the exam during the regular exam periods.<br>The exam in regular exam periods consists of a written and an oral part. A student with a positive grade on the written exam, along with a previously prepared seminar paper (presentation before the exam), can take the oral part of the exam. The oral part of the exam will be held no later than 5 days after the written part of the exam.<br><br>Continuous assessment of students' work:
<table>
<tr><th>Assessment elements</th><th>Success (min.%)</th><th>Percentage in grade (%)</th></tr>
<tr><td>Class activity (lectures., audit. exer.)</td><td>80-100</td><td>10</td></tr>
<tr><td>In-term test (tasks)</td><td>50-100</td><td>30</td></tr>
<tr><td>Seminar</td><td>50-100</td><td>30</td></tr>
<tr><td>Theoretical part</td><td>50-100</td><td>30</td></tr>
</table>
</td></tr>
</table>

**Final valuation:**

| Evaluation indicators – final exam | Success (min. %) | Share in the grade (%) |
|---|---|---|
| Practical part (written) | 50 – 100 | 40 |
| Heoretical exam (written or oral) | 50 – 100 | 50 |
| Previous ectivities | 50 – 100 | 10 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0 - 49 | Does not satisfy minimum criteria | insufficient (1) |
| 50 - 61 | Satisfies minimum criteria | sufficient (2) |
| 62 - 74 | Average success with clear shortcomings | good (3) |
| 75 - 87 | Above average success with a few errors | very good (4) |
| 88 - 100 | Extraordinary success | excellent (5) |

**Assessment and grading of the part-time students' work:**
The assessment and grading criteria are the same as for the full-time students.

**Required literature (available in the library and via other media)**

| Title | Number of copies in the library | Availability via other media |
|---|---|---|
| 1. Lazibat T.:Uupravljanje kvalitetom (2009), Sinergija, Zagreb | 0 | DA |
| 2. Šiško, Kuliš, M., Grubišić D.. (2010) Upravljanje kvalitetom, Split | 1 | |
| 3. Zlatković, B. (1984) Upravljanje kvalitetom, Sveučilište u Zagrebu, Zagreb | 0 | |

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

1. Injac, N. (2002) “Mala enciklopedija kvalitete, I. dio - Upoznajmo normu ISO 9000”,Oskar, Zagreb
2. Injac, N.. (2002) “Mala enciklopedija kvalitete, II. dio - Informacije; dokumentacija;auditi”, Oskar, Zagreb
3. Injac, N. (2001): “Mala enciklopedija kvalitete, III. dio - Moderna povijest kvalitete”,Oskar, Zagreb
4. T. Baković; I. Dužević; T. Lazibat. (2023) Upravljanje kvalitetom, Sveučilište u Zagrebu, Ekonomski fakultet

**Quality assurance methods that ensure the acquisition of exit competences**

University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process.

**Other (as the proposer wishes to add)**

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">HYDROGRAPHIC ENGINEERING</td></tr>
<tr><td>Code</td><td>PFN213</td><td>Year of study</td><td colspan="3">2.</td></tr>
<tr><td>Course teacher</td><td>Jakša Mišković, Ph.D., Assist. Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Status of the course</td><td>Elective</td><td>Percentage of e-learning</td><td colspan="3">30%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">• To acquire knowledge of the organizational, technical, technological and legal framework of hydrographic activity<br>• To master the basic principles of hydrographic survey and procedures for the production of charts and navigation publications,<br>• To equip students in the application of acquired knowledge and skills in the field of hydrography,<br>• To acquire knowledge related to the application of modern technologies in the development of hydrographic activity,<br>• Acquire knowledge of the design, maintenance and protection of electronic navigation chart data.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. To present the organization of international hydrographic activity.<br>2. Assess the role of the International Hydrographic Organization in the development of hydrographic activity.<br>3. Evaluate the principles of hydrographic survey performance.<br>4. To compare the working principles, possibilities and limitations of technical and technological means in hydrographic surveying.<br>5. Valorize the data obtained by the hydrographic survey.<br>6. To assess the principles of nautical charts and navigational publications production.<br>7. Evaluate the advantages and limitations of using electronic navigation charts.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures<br>1. Introduction to the course. Legal framework of international hydrographic activity.<br>2. Organization of hydrographic activity in the world.<br>3. Hydrographic activity in the Republic of Croatia.<br>4. Role of the International Hydrographic Organization in the development of hydrographic activity.<br>5. Hydrographic survey. Hydrographic survey standards.<br>6. Historical development of measurements at sea. Application of mechanical measuring devices in hydrography.<br>7. Propagation of ultrasonic waves in seawater.<br>8. Application of ultrasonic means in hydrography.<br>9. Laser means in hydrography. Satellite facilities in hydrography.<br>10. Development of sea charts.<br>11. Bathymetric charts.<br>12. Modern ways of organizing, displaying and using geospatial data.</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">13. Basic features of electronic navigation charts and charting systems.<br>14. Standards for Digital Hydrographic Data<br>15. Development of electronic navigation charts, data protection and maintenance.<br><br>Exercises<br>1. Analysis of the boundaries at sea shown on the charts.<br>2. System for the production of charts and navigation publications.<br>3. Creating a hydrographic original.<br>4. Analysis of the information content of the bathymetric map.<br>5. Creating a digital bathymetric map.<br>6. Analysis of the information content of the charts of the Croatian Hydrographic Institute.<br>7. Analysis of information content of maritime plans of the Croatian Hydrographic Institute.<br>8. Analysis of information content of the main navigation publications of the Croatian Hydrographic Institute.<br>9. Analysis of information content of other major navigation publications of the Croatian Hydrographic Institute.<br>10. Analysis of the information content of the charts of the UK Hydrographic Office.<br>11. Analysis of the information content of the main navigation publications of the Hydrographic Office of Great Britain.<br>12. Analysis of information content of other major navigation publications of the Hydrographic Office of Great Britain.<br>13. Raster Navigation Map Display Features.<br>14. Electronic navigation chart display features.<br>15. Analysis of electronic navigation chart maintenance and data protection systems.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☐ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Responsibilities of full-time students<br>Students are required to take classes and exercises and keep a record of their attendance. In order to obtain the right to take the final exam, full-time students must attend at least 80% of lectures and exercises. In case of an insufficient number of students, students are not entitled to sign and are obliged to enroll again next year.<br>The exam can be taken continuously either through the midterm or through the final exam (written exam).<br><br>Responsibilities of part-time students:<br>In order to be eligible for the final exam, students are required to attend 50% of the lectures and 50% of the exercises and are required to pass the 1st and 2nd in-term tests, and in case they do not pass the in-term tests, they are required to pass the exam.</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>Lecture attendance</td><td>1.125</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td>2.875</td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam (if in-term tests</td><td>2.875 (altern</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
</table>

| | | | | | | |
|---|---|---|---|---|---|---|
| | have not been passed) | ative to in-term tests) | | | | |

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

**Evaluation and grading of full-time students' work**
Two in-term examinations from the theoretical part of the exam are planned.
The student is required to take all the exams. At each in-term test, a minimum of 50% passing points is required.
The theoretical part of exam is in written form. A student who successfully completes both exams is exempted from the written final examination. To the students who have successfully completed one in-term exam, it will be recognized as part of the final exam. The rest of the course material is tested at the written final exam in the exam term, with the previous application at Studomat, provided they have the status of the eligible for the exam.
For students who do not pass the first or second in-term test of the theoretical part, a compensating in-term test will be organized. Students who get a positive grade at one in-term exam and the compensation exam are exempt from the final written exam.

Students who have accumulated a sufficient number of credits during the classes (they have passed both midterm examinations) are obliged to apply for the exam through Studomat for the first examination term after the lectures and, depending on the result achieved, their grade is entered in the Studomat.

**Continuous assessment of students' work**:

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Class attendance | 80 | 10 |
| In-term test I | 50 | 45 |
| In-term test II | 50 | 45 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Does not satisfy minimum criteria | insufficient (1) |
| 50-61.9 | Satisfies minimum criteria | sufficient (2) |
| 62-74.9 | Average success with clear shortcomings | good (3) |
| 75-87.9 | Above average success with a few errors | very good (4) |
| 88-100 | Extraordinary success | excellent (5) |

Students who do not take the midterm examinations during the semester and who have met all the requirements are required to take the written exam within the exam term. The same assessment criteria apply to the examination period as to the continuous assessment.

**Assessment and grading of the work of part-time students**
The evaluation and grades are the same as those for full-time students.

**Required literature (available in the library and via other media)**

| Title | Number of copies in the library | Availability via other media |
|---|---|---|
| 1. Pribičević, B.: *Pomorska geodezija*, Geodetski fakultet Sveučilišta u Zagrebu, Zagreb, 2005. | | |
| 2. IHO: M-13, *Manual on Hydrography, 1st edition*, International Hydrographic Bureau, Monaco, 2005. | | YES |
| 3. IHO: *Hydrographic Dictionary, Special Publication No. 32, Vol. 1, 5th Edition*, International Hydrographic Bureau, Monaco, 1994. | | YES |

| | | | |
|---|---|---|---|
| | 4. IHO: *S-44, IHO Standards for Hydrographic Surveys 5th Edition*, February 2008, International Hydrographic Bureau, Monaco, 2008. | | YES |
| | 5. IHO: *S-52, Specifications for Chart Content and Display Aspects of ECDIS, Ed. 6.1(.1)*, October 2014, International Hydrographic Bureau, Monaco, 2014. | | YES |
| | 6. IHO: *S-57, IHO Transfer Standard for Digital Hydrographic Data*, November 2000 - Main Document, International Hydrographic Bureau, Monaco, 2000. | | YES |
| | 7. IHO: *S-63, IHO Data Protection Scheme, Edition 1.2.0*, January 2015, International Hydrographic Bureau, Monaco, 2015. | | YES |
| | 8. IHO: *S-65, ENCs: Production, Maintenance and Distribution Guidance, Edition 2.1.0*, May 2017, International Hydrographic Bureau, Monaco, 2017. | 0 | YES |
| | 9. IHO: *S-66, Facts about Electronic Charts and Carriage Requirements*, January 2010, International Hydrographic Bureau, Monaco, 2017. | 0 | YES |
| Optional literature (at the time of submission of study programme proposal) | 1. Braestrup, M. W. et al.: *Design and Installation of Marine Pipelines*, Blackwell Publishing, Oxford, UK, 2005.<br>2. Carpine-Lancre, J. et al. (eds.): *The History of GEBCO (1903 – 2003)*, GITC bv – Lemmer, Utrecht, 2003.<br>3. IHO: *M-1, Basic Documents of the International Hydrographic Organization (IHO)*, Revised version 2007, International Hydrographic Bureau, Monaco, 2007.<br>4. Pahernik, M.: *Uvod u geografsko informacijske sustave*, Ministarstvo obrane Republike Hrvatske, Zagreb, 2006.<br>5. Palmer, A. C., King, R. A.: *Subsea Pipeline Engineering, 2nd Edition*, Pennwell Books, Tulsa, Oklahoma, USA, 2008.<br>6. Perić, M.: *Englesko hrvatski enciklopedijski rječnik istraživanja i proizvodnje nafte i plina*, INA Industrija nafte d.d., Sektor korporativnih komunikacija, Grafocolor, Zagreb, 2007.<br>7. Becker-Heins, Ralph: *ECDIS Basics, A guide to Operational Use of Electronic Chart Display Information System, 1st Edition*, Geomares Publishing, 2014. | | |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. | | |
| Other (as the proposer wishes to add) | | | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">INTEGRATED NAVIGATION SYSTEMS</td></tr>
<tr><td>Code</td><td>PFN109</td><td>Year of study</td><td colspan="3">2</td></tr>
<tr><td>Course teacher</td><td>Ivana Golub Medvešek, PhD, Assist.Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td></td><td>30</td><td></td></tr>
<tr><td>Status of the course</td><td>elective</td><td>Percentage of e-learning</td><td colspan="3">10</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Knowledge necssary to understand integrated navigation systems and how to operate them.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1.Rank the features of integrated navigation systems.<br>2. Assess the operation of navigation integrated systems, errors, accuracy and maintenance methods.<br>3. Recommend ways of managing integrated navigation systems.<br>4.Present and argue applied technologies in navigation integrated systems.<br>5.Present and recommend dynamic positioning systems.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures (a block of 2):<br>1. Navigation integrated system<br>2. Simple and complex navigation integrated system<br>3. Breakdown into subsystems<br>4. Ergonomic requirement<br>5. Navigation Integrated Navigation System<br>6. Integrated anti-collision navigation system<br>7. Integrated bridge system<br>8. The data bridge<br>9. Electronic navigation devices in function of the navigation integrated system<br>10. Navigation integrated system designs<br>11. Modular approach<br>12. Reliability and efficiency of integrated navigation systems<br>13. Specific requirements and expected development<br>14. Navigation integrated systems and dynamic positioning systems<br>15. Impact on navigation safety<br><br>Lectures (a block of 2):<br>1. The concept of INS and division - video presentations<br>2. Computer support and practical examples<br>3. Navigation integrated system on individual types of ships<br>4. Navigation optimization<br>5. Video presentation<br>6. Newbuilding<br>7. Newbuilding<br>8. Newbuilding</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">9. Newbuilding<br>10. Analysis of technical solutions of INS from different manufacturers<br>11. Analysis of technical solutions of INS from different manufacturers<br>12. Analysis of technical solutions of INS from different manufacturers<br>13. Analysis of technical solutions of INS from different manufacturers<br>14. Analysis of technical solutions of INS and DP of different manufacturers<br>15. Analysis of technical solutions of INS and DP from different manufacturers</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ on line only<br>☐ mixed e-learning<br>☒ field work</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☐ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">1. Responsibilities of full-time students<br>Lectures and exercises are compulsory for students, and attendance records are kept. In order to get the right to take the exam, students must attend a minimum of 80% of classes (lectures and exercises). In case of an insufficient number of attendances, the student will not have the right to take the exam, or the right to sit the exam.<br><br>Certificates cannot remedy or replace class attendance. Students who, due to illness or some other justifiable reason, did not meet the requirements for obtaining the right to take the exam and are missing up to 20%, will be able to make up for it through consultations and by doing additional assignments. All other students, i.e. those who attended less than 50% of classes, do not have the right to take the exam and must enroll in the course the following year. Students are obliged to create and present a seminar paper.<br><br>2. Responsibilities of part-time students<br>Lectures and exercises are compulsory for students, and attendance records are kept. In order to get the right to take the exam, students must attend a minimum of 50% of classes (lectures and exercises). In case of an insufficient number of attendances, the student will not exercise the right to take the exam, or the right to sit the exam. Other obligations are the same as for regular students.</td></tr>
<tr><td rowspan="6">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>Lecture attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td>3.5</td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td rowspan="2">Written exam (if in-term tests have not been passed)</td><td rowspan="2">3.5 (alternative to in-term exams)</td><td rowspan="2">Project</td><td rowspan="2"></td><td rowspan="2">(Other)</td><td rowspan="2"></td></tr>
<tr></tr>
</table>

<table>
<tr><td></td><td>

**Assessment and grading of full-time students' work**

Lectures and exercises are mandatory for students. Based on completed obligations, students can take the exam. Students can create a seminar paper. The final exam is within the official exam deadlines. Sample exam questions are available on the Merlin e-learning platform. To students who re-enroll the course in the following year the parts of the exam they passed will not be considered.

Class attendance and in-term test results are included in the final grade.

</td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td>

The final grade is based on lecture attendance and in-term test results.

**Continuous assessment of students' work:**

<table>
<tr><th>Assessment elements</th><th>Success (min.%)</th><th>Percentage in grade (%)</th></tr>
<tr><td>Class attendance</td><td>80</td><td>10</td></tr>
<tr><td>In-term test I</td><td>50</td><td>45</td></tr>
<tr><td>In-term test II</td><td>50</td><td>45</td></tr>
</table>

**Grading**

<table>
<tr><th>Percentage (%)</th><th>Criterion</th><th>Grade</th></tr>
<tr><td>0-49</td><td>Does not satisfy minimum criteria</td><td>insufficient (1)</td></tr>
<tr><td>50-64</td><td>Satisfies minimum criteria</td><td>sufficient (2)</td></tr>
<tr><td>65-79</td><td>Average success with clear shortcomings</td><td>good (3)</td></tr>
<tr><td>80-89</td><td>Above average success with a few errors</td><td>very good (4)</td></tr>
<tr><td>90-100</td><td>Extraordinary success</td><td>excellent (5)</td></tr>
</table>

Students who do not take the in-term examinations during the semester and who have the right to take the exam are required to take the written exam within the exam term. The same assessment criteria apply to the examination period as to the continuous assessment.

**Assessment and grading the work of part-time students**
The evaluation and grades are the same as those of full-time students.

</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td>

<table>
<tr><th>Title</th><th>Number of copies in the library</th><th>Availability via other media</th></tr>
<tr><td>1. Bowditch, N., American Practical Navigator, DMAHC, USA, 2002.</td><td>1</td><td>YES</td></tr>
<tr><td>2. Hobbs, R., Piloting, Celestial and Electronic Navigation, Naval Institute Press, 2004.</td><td></td><td>YES</td></tr>
<tr><td>3. Kasum, J., Radioslužba za pomorce, HHI, 2010</td><td>5</td><td>YES</td></tr>
<tr><td>4. Guidelines for The Design and Operation of Dynamically Positioned</td><td></td><td>YES</td></tr>
</table>

</td></tr>
</table>

| | | | |
|---|---|---|---|
| | Vessels, IMCA, http://www.imca-int.com/marine-division/dynamic-positioning.aspx | | |
| Optional literature (at the time of submission of study programme proposal) | Benković, F., at all, Terestrička i elektronska navigacija, HIRM Split, 1986 | | |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. | | |
| Other (as the proposer wishes to add) | | | |

<table>
<tr><td>NAZIV PREDMETA</td><td colspan="5">INTERNSHIP</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="4">2</td></tr>
<tr><td>Course teacher</td><td>Ivan Pavić, PhD<br>Luka Vukić, PhD</td><td>Number of credits (ECTS)</td><td colspan="4">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">-</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>-</td><td>-</td><td>150</td><td>-</td></tr>
<tr><td>Status of the course</td><td>elective</td><td>Percentage of e-learning</td><td colspan="4"></td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">The objective of the course is the student's participation in the business or research process of one of the partner companies or institutions. By participating in the business process, the student becomes familiar with the business process and acquires business and economic competencies and communication skills in a real business environment. Familiarity with basic shipboard electronic and power systems in their real environment on board and familiarization with basic procedures for maintenance, detection and prevention of failures, as well as safe handling of measuring equipment. Getting to know the different sensors on board and the alarm and fire detection system. Knowledge of the role of the most important marine electric motors and basic methods of integration with electromechanical devices. Getting to know the components of navigation and communication devices. The student will be able to recognize basic components of navigation and communication systems, antenna systems, identify faults and use basic measuring equipment safely.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">With regard to the available places for practice in teaching bases, in the case of a larger number of registered students than the number of available places for professional practice, a selection procedure is carried out in the receiving organizations according to the Rulebook on professional practice of the Maritime Faculty.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Describe the business process in a partner company or institution and develop communication skills in a real environment.<br>2. Describe the function of the most important electric motors on the ship as well as the basic integration with the ship's electromechanical and mechanical devices.<br>3. Describe the function of basic shipboard electronic sensors and be familiar with the operation of shipboard alarms.<br>4. Test the operation of communication, navigation equipment and navigation lights.<br>5. Identify the ship's power supply systems and ship's batteries and measure system parameters.<br>6. Get to know the components of navigation systems (compass, gyroscope, GPS) and detect basic malfunctions.<br>7. Familiarize yourself with ship's antenna systems.<br>8. Use theoretical knowledge about measuring devices for the purpose of locating faults. Handle measuring devices in electrical engineering and electronics in a correct and safe manner.<br>9. Create an electrical diagram of a simple faulty device and identify the faulty electronic component. Create documentation about the malfunction.<br>10. Recognize and locate electrotechnical systems and electronic devices on board and will be able to identify components of communication and electrical networks</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">and installations on board.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="6">The course Internship is enrolled by students who apply and are selected through an open competition.</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☐lectures<br>☐ seminars and workshops<br>☐exercises<br>☐on line only<br>☐ mixed e-learning<br>☒ field work</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☐ laboratory<br>☒ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">A student who enrolls in Professional Practice is obliged to complete 128 hours in 16 working days in accordance with the schedule defined by the mentor from the teaching base. The student is obliged to follow the mentor's instructions and diligently complete the assigned tasks. At the end of the professional practice, the student is required to prepare a Report on the professional practice, which he must defend in front of the mentor and students from the Maritime Faculty in Split.</td></tr>
<tr><td rowspan="6">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>Lecture attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td>4.5</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Writing of a report</td><td>0.3</td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>Defence of the report</td><td>0.2</td></tr>
<tr><td>In-term 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></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">The professional practice is descriptively evaluated by the mentors of the teaching base and the Maritime Faculty in Split. The mentor from the teaching base continuously monitors the regularity of coming to practice and diligence in solving the set work tasks, and at the end of the professional practice, he assigns one of the following two descriptive grades to the student:<br>• The student successfully completed professional practice<br>• The student did not successfully complete professional practice.<br>If the mentor from the teaching base gave the grade "The student did not successfully complete the professional practice", the grade should be justified in writing. In this case, the mentor from the Maritime Faculty in Split does not evaluate the Report on Professional Practice, but only defines the final grade of the professional practice "Not Passed".<br>If the mentor's rating from the teaching base is "The student successfully completed professional practice", the mentor from the Maritime Faculty in Split analyzes the report on professional practice, discusses the work tasks with the student and, based on this, assigns the student one of the following two descriptive ratings:<br>• The student successfully created and defended a report on professional practice<br>• The student did not successfully prepare and defend a report on professional practice.<br>If the mentor from the Maritime Faculty in Split gave the grade "Student did not successfully prepare and defend the Report on professional practice", the grade should be justified in writing.<br>The subject Professional practice is considered to have been passed only in the case when the descriptive evaluations of both mentors confirmed the successful</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">realization of the professional practice/Report on professional practice. If the descriptive grades of both mentors are positive, the mentor from the Maritime Faculty in Split enters the student's Studomat with a descriptive grade of "Passed".</td></tr>
<tr><td rowspan="2">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>The professional literature is determined by the teaching base mentor.</td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">The professional literature is determined by the teaching base mentor..</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process.</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="5">DESIGN OF SHIP'S DIGITAL SYSTEMS</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="4">2</td></tr>
<tr><td>Course teacher</td><td>Hrvoje Dodig, Ph.D., Assoc.Prof.</td><td>Number of credits (ECTS)</td><td colspan="4">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>15</td><td>0</td><td>45</td><td>0</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="4">10%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Implementation of digital circuits using standard digital components and ARM microprocessors and Arduino platform. Design of embedded computer systems for industrial and marine applications. Design and implementation of parallel and serial bus. Design and implementation of analog / digital interfaces. Design of memory subsystem and permanent storage systems. Digital communication in industrial and marine environments. Simulation of digital circuits using SPICE simulators.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Design and simulate digital modules of embedded system<br>2. Develop digital circuits using standard components and integrate with ARM microprocessor and Arduino platform<br>3. Develop parallel and serial bus digital communication<br>4. Apply EDA software tools in the design of digital embedded computers<br>5. Critically evaluate the issues of digital communication in industrial and marine environments<br>6. Simulate digital components of embedded systems using SPICE simulator</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures (15):<br>1. Introductory lecture<br>2. Microcontrollers and typical peripherals of microcontrollers<br>3. Arduino platform<br>4. ARM Cortex Microcontrollers and Architecture<br>5. Standard digital components of embedded system<br>6. Types of memory and connection to ARM Cortex microcontroller<br>7. Designing parallel and serial buses in embedded systems<br>8. Using the A / D and D / A modules of the ARM Cortex microcontroller<br>9. Ship communication protocols for connecting embedded computers with marine communication systems (NMEA)<br>10. Simulation tools for simulating digital and analog components<br>11. SPICE models and SPICE simulations of digital integrated circuits<br>12. Microcontroller programming languages: C ++ and Python<br>13. Real-time operating systems (RTOS)<br>14. Designing printed circuit boards using EDA tools<br>15. Problems with embedded systems: crosstalk and noise<br><br>Exercises (45 - auditory, simulation):<br>1. Introduction to the NI Ultiboard module of electric diagram development<br>2. Simulating digital circuits using SPICE models and simulators</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">3. Analog circuit simulations using NI Multisim software: AC, Transient, Monte Carlo and Fourier simulations<br>4. Introduction to the NI Ultiboard software module for PCB designing<br>5. Introduction to the programming environment for ARM Cortex microcontroller programming<br>6. Connecting ARM Cortex Microcontroller to FLASH Memory<br>7. Design of electric circuit diagram for connecting ARM Cortex microcontroller to SD-card memory<br>8. Design of circuit diagram for connecting ARM Cortex microcontroller to TFT display<br>9. Design of circuit diagram for connecting ARM Cortex microcontroller to the NMEA protocol<br>10. Programming ARM Cortex microcontrollers in C ++ programming language<br>11. Introduction to the RTOS operating system on the ARM Cortex microcontroller<br>12. Development of electric diagram of embedded system based on ARM Cortex microcontroller<br>13. Design of a printed circuit board for an embeded system<br>14. Introduction to the programming environment for Arduino platform programming<br>15. Controlling of inputs and outputs on the Arduino platform</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ individual tasks<br>☐ multimedia<br>☒ laboratory<br>☐ mentoring<br>☐ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Responsibilities of full-time students<br>Attending classes is compulsory for full-time students. Attendance at at least 80% of lectures, auditory and laboratory exercises is a condition for obtaining the right to take the exam.<br><br>Responsibilities of part-time students:<br><br>Attending classes is compulsory for full-time students. Attendance at a minimum of 50% of lectures, auditory and laboratory exercises is a condition for obtaining the right to take the exam.</td></tr>
<tr><td rowspan="7">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>Lecture attendance</td><td>1.125</td><td>Research</td><td>0.125</td><td>Practical work</td><td>1</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td>0.75</td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam (if in-term tests have not been passed)</td><td></td><td>Project</td><td>2</td><td>(Other)</td><td></td></tr>
<tr><td colspan="6"></td></tr>
</table>

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

During the semester, in agreement with the teacher, an embedded computer project is created, based either on the ARM Cortex microcontroller or on the Arduino platform. The project is presented to the teacher at the end of the semester. Examples of quality projects are available to students on the website. When evaluating the project, it is necessary to obtain at least 50% of the points for passing. The student can also orally explain the project, i.e., its individual parts. Students who are late with project submission for an objective reason may have an extension of the project submission deadline.

Class attendance and colloquium results are included in the final grade.

**Continuous assessment of students' work:**

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Class attendance | 80 | 10 |
| Project | 50 | 60 |
| Laboratory exercises | 100 | 30 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Does not satisfy minimum criteria | insufficient (1) |
| 50-64 | Satisfies minimum criteria | sufficient (2) |
| 65-79 | Average success with clear shortcomings | good (3) |
| 80-89 | Above average success with a few errors | very good (4) |
| 90-100 | Extraordinary success | excellent (5) |

**Evaluating and grading the work of part-time students**
The assessment and grades are the same as those for full-time students.

**Required literature (available in the library and via other media)**

| Title | Number of copies in the library | Availability via other media |
|---|---|---|
| 1. Joseph Yiu (2014), The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors, Elsevier, The Netherlands | | |
| 2. Jason D. Bakos (2016), Embedded Systems: ARM Programming and Optimization, Elsevier, The Netherlands | | |
| 3. Ralph Morisson (2012), Digital Circuit Boards: Mach 1 GHz, Wiley, USA | | |

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

Shujen Chen, Muhammad Ali Mazidi, Eshragh Ghaemi (2018), STM32 Arm Programming for Embedded Systems: Using C Language with STM32 Nucleo, MicroDigitalEd

**Quality assurance methods that ensure the acquisition of exit**

University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process.

| | |
|---|---|
| competences | |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">ADVANCED CHAPTERS IN SIGNAL PROCESSING</td></tr>
<tr><td>Code</td><td>PFE 120</td><td>Year of study</td><td colspan="3">2</td></tr>
<tr><td>Course teacher</td><td>Joško Šoda, Ph.D., Assoc. Prof.</td><td>Number of credits (ECTS)</td><td colspan="3">4</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Nur Assani</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Status of the course</td><td>mandatory</td><td>Percentage of e-learning</td><td colspan="3">10%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">Master the basic knowledge of advanced chapters in signal processing. Based on the received or measured signal, choose a suitable method for processing the signal and estimating the relevant parameters. Evaluate and rate the results obtained.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1.Select a suitable method of analysis for random signals<br>2. Estimate parameter values for random signals<br>3. Compare different methodological approaches to random signal processing<br>4. Rank and evaluate the results of the methodological procedures implemented in the problem solving protocol</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lecture (a block of 2):<br>1. Introduction and terminology<br>2. Empirical modeling and approximation<br>3. Method of least squares and signal spline<br>4. Introduction to probability and characteristics of the signal<br>5. Introduction to random processes and signal properties<br>6. Principal component analysis and application<br>7. Random signals, linear spectrum and power spectrum<br>8. Random Process Signal Spectrum Analysis: Non-parametric Methods<br>9. Random Process Signal Spectrum Analysis: Non-parametric Methods+<br>10. Introduction to Random Signal Modeling and Parametric Signal Spectrum Estimation<br>11. Introduction to Random Signal Modeling and Parametric Signal Spectrum Estimation<br>12. Introduction to the theory and application of the function of cross-correlation, correlation and coherence<br>13. Introduction to the theory and application of the function of cross-correlation, correlation and coherence<br>14. Signal processing using envelope and the so-called kernel functions<br>15. Introduction to time-frequency signal analysis, wavelet transformation<br><br>Exercises (1 - auditory, simulation):<br>1. Repeat basic concepts in signal processing<br>2. Signal representation in MATLAB software package</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">3. Signal representation in the MATLAB software package<br>4. Signal modeling using the least squares method and cubic spline<br>5. Signal modeling using the least squares method and cubic spline<br>6. Signal analysis using Fourier transform in MATLAB software package<br>7. Signal analysis using Fourier transform in MATALB software package<br>8. Random signals and estimation of random signal parameters using the MATLAB software package<br>9. Random signals and estimation of random signal parameters using the MATLAB software package<br>10. Examples of signal analysis and parameter estimation for vibration and biomedical signals in MATLAB software package<br>11. Examples of signal analysis and parameter estimation for vibrational and biomedical signals in MATLAB software package<br>12. Direct and indirect methods for spectral estimation of random signals<br>13. Direct and indirect methods for spectral estimation of random signals<br>14. Random signal analysis using the envelope function on the example of acoustic signals<br>15. Random signal analysis using the envelope function on the example of acoustic signals</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐ on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐ individual tasks<br>☒ multimedia<br>☐ laboratory<br>☐ mentoring<br>☒ consultations</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Obligations of full-time students:<br><br>Attendance is compulsory for full-time students. Attendance at at least 80% of lectures, auditory and laboratory exercises is a condition for obtaining the right to take the exam.<br><br>Obligations of part-time students:<br><br>Attendance is compulsory for full-time students. Attendance at a minimum 50% of lectures, auditory and laboratory exercises is a condition for obtaining the right to take the exam.</td></tr>
<tr><td rowspan="2">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>Lecture attendance</td><td>1.125</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td>Essay</td><td></td><td>Seminar</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td>In-term tests</td><td>2.875</td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td>Written exam (if in-term tests have not been passed)</td><td>2.875 (alternative to in-term tests)</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td></td><td colspan="6"></td></tr>
<tr><td>Grading and evaluating student work in class and at</td><td colspan="6">Assessment and evaluation of the work of full-time students:</td></tr>
</table>

<table>
<tr><td>the final exam</td><td>
Two in-term tests are written in the semester. The first in-term tests, which includes theoretical questions from the material from the first to the seventh lectures, is written in the seventh week of classes. The second in-term test includes theoretical questions from the material from the eighth to the fifteenth lectures and is written in the fifteenth week of classes. Sample questions for the test are available to students on the Merlin e-learning platform. At each test, it is necessary to obtain at least 50% of points to pass. Students who do not attend a test for objective reasons or do not achieve the minimum percentage have the possibility of correction. Correction will be organized for these students in the fifteenth week.<br><br>
Class attendance and in-term test results are included in the final grade.<br><br>
Continuous assessment of students' work:
<table>
<tr><th>Assessment elements</th><th>Success (min.%)</th><th>Percentage in grade (%)</th></tr>
<tr><td>Class attendance</td><td>80</td><td>10</td></tr>
<tr><td>In-term test I</td><td>50</td><td>45</td></tr>
<tr><td>In-term test II</td><td>50</td><td>45</td></tr>
</table>
Grading
<table>
<tr><th>Percentage (%)</th><th>Criterion</th><th>Grade</th></tr>
<tr><td>0-49</td><td>Does not satisfy minimum criteria</td><td>insufficient (1)</td></tr>
<tr><td>50-64</td><td>Satisfies minimum criteria</td><td>sufficient (2)</td></tr>
<tr><td>65-79</td><td>Average success with clear shortcomings</td><td>good (3)</td></tr>
<tr><td>80-89</td><td>Above average success with a few errors</td><td>very good (4)</td></tr>
<tr><td>90-100</td><td>Extraordinary success</td><td>excellent (5)</td></tr>
</table>
Students who do not take the in-term examinations during the semester and who have the right to take the exam are required to take the written exam within the exam term. The same assessment criteria apply to the examination period as to the continuous assessment.<br><br>
Evaluating and grading the work of part-time students<br>
The assessment and grading are the same as those for full-time students.
</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td>
<table>
<tr><th>Title</th><th>Number of copies in the library</th><th>Availability via other media</th></tr>
<tr><td>1. J. Šoda: Notes for lectures</td><td></td><td>YES</td></tr>
<tr><td>2. R. Shiavi (2007) Introduction to Applied Statistical Signal Analysis, 3rd Edition, 2007, Elsevier Inc. ISBN: 0-12-088581-6</td><td></td><td>YES</td></tr>
</table>
</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td>
1. Steven M. Kay.(2011) Fundamentals of Statistical Signal Processing, Vol. I, II and III, Prentice-Hall, ISBN: 0-13-345711-7.<br>
2. Harry L. Van Trees, Kristine L. Bell and Zhi Tian (2013) Detection, Estimation, and Modfulation Theory, Part I – Detection, Estimation and Filtering Theory, 2nd Edition, John Wiley & Sons, Inc, ISBN: 978-0-470-54296-5.<br>
3. A. Antoniou (2016) Digital Signal Processing; Signals, Systems and Filters,McGraw-Hill<br>
4. John G. Proakis, Dimitris K. Manolakis (2006) Digital Signal Processing, 4th
</td></tr>
</table>

| | |
|---|---|
| | Edition, Prentice-Hall, ISBN: 978-0-131-87374-2 |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. |
| Other (as the proposer wishes to add) | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">MARITIME ROBOTIC SYSTEMS</td></tr>
<tr><td>Code</td><td></td><td>Year of study</td><td colspan="4">2</td></tr>
<tr><td>Course teacher</td><td>Joško Šoda, Ph.D., Assoc. Prof.</td><td>Number of credits (ECTS)</td><td colspan="4">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>compulsory</td><td>Percentage of e-learning</td><td colspan="4">10%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5">The course provides an introduction to marine robotics and the student gains competencies in the application and design of marine robotic systems. Industrial robots, their structure and applications in seafaring. Operations with ROV / AUV vessels and underwater robotics. ROV control systems. Offshore search and rescue aircraft and thermal imaging systems. Hydrographic data collection drones. Mapping and bathymetry drones. Automated data collection buoys. Autonomous Intelligent Robotic Systems.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Compare the types and applications of maritime robotic systems, including ethics and responsibility in maritime operations<br>2. Rank operational parameters and identify the most important parameters of a robotic vessel / vehicle, depending on the type of operation<br>3. Describe typical architectures of maritime robotic systems and explain their control mechanisms<br>4. Valorize the guidance, navigation and control of the marine robotic system<br>5. Critically evaluate typical sensors in marine robotic systems and signal processing and data analysis techniques<br>6. Explain the useful load capacity of the marine robotic system and the impact of cargo on robot control.<br>7. To envisage the technological application of marine robotic systems in the coastal area and in the open sea for the purpose of navigation, surveillance, monitoring of the marine environment and renewable energy sources.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures (30):<br><br>1. Introductory lecture<br>2. Types of Marine Robotic Systems: AUV, ASV, ROV<br>3. Design of marine robotic systems<br>4. Key parameters of marine robotic systems: pressure, displacement, power, speed, reach and cost of transport<br>5. Application of different sensors to marine robotic systems<br>6. Navigation strategies and algorithms: dead-reckoning and statistical approach<br>7. Robot system path planning algorithms, line-of-sight method<br>8. Planning the path of a robotic vessel / vehicle using the potential method<br>9. Robot / Vehicle Path Planning Using Dijkstra and A * Algorithm<br>10. Actuators and dynamics of a marine robotic system<br>11. Modeling and control of a marine robotic system using a PID controller and a</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">robotic system architecture<br>12. Offshore Search-and-Rescue drone architectures<br>13. Hydrographic data collection drones<br>14. Robotic systems for underwater mapping<br>15. Design of buoys for hydrographic data collection<br><br>Exercises (30 - auditory, simulation):<br><br>1. Familiarisation with robotic manipulator<br>2. Robotic manipulator control<br>3. Practical application of feedback in autonomous vessels / vehicles<br>4. Connecting the microcontroller to the electric motor and controlling it<br>5. Connecting Microcontrollers to sensors - Collecting and Storing Data<br>6. Planning the vessel path using the Potential Method - Matlab Exercise<br>7. Using the Dijkstra Algorithm for robot craft path planning- An Exercise in Matlab<br>8. Using A * Algorithm for robot craft path planning - Simulation in Matlab<br>9. Application of inertial navigation system in underwater robotics<br>10. Connecting the microcontroller to a three-axis accelerometer and gyroscope<br>11. Calculation of accelerations using a three-axis accelerometer and gyro<br>12. Measurement of the trajectories of a robotic craft<br>13. Sensor fusion: Combining a three-axis accelerometer and gyroscope with a tilt sensor<br>14. Robot vessel trajectory calibration<br>15. Design of buoy for hydrographic data collection</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures<br>☐ seminars and workshops<br>☒ exercises<br>☐on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="3">☐samostalni zadaci<br>☐ multimedija<br>☒laboratorij<br>☐ mentorski rad</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">Responsibilities of regular students:<br><br>Attending classes is compulsory for full-time students. Attendance at a minimum of 80% of lectures, auditory and laboratory exercises is a condition for obtaining the right to take the exam.<br><br>Responsibilities of part-time students:<br><br>The requirement for obtaining the right to take the exam is attendance at a minimum of 50% of lectures and exercises.</td></tr>
<tr><td rowspan="6">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>Lecture attendance</td><td>1.5</td><td>Research</td><td>1.25</td><td>Practical work</td><td>1.25</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td>2</td><td>(Other)</td><td></td></tr>
<tr><td>In-term tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam (if in-term tests have not been passed)</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
</table>

**Assessment and grading of full-time students' work**

The first seminar paper includes theoretical questions from the contents from the first to the seventh lectures and is submitted in the eight week of classes. The second seminar paper includes theoretical questions from the contents from the eighth to the fifteenth lectures and is submitted for review in the fifteenth week of classes. Examples of quality seminar papers are available to students on the Merlin e-learning platform. In the evaluation the a seminar paper, it is necessary to obtain at least 50% of the points for passing. The student can also orally explain the seminar paper, i.e., individual parts of the seminar work. Students who are late in submitting their seminar paper for an objective reason may have an extension of the deadline for submitting the paper.

Attendance at classes and the results of seminar papers are included in the final grade.

**Assessment and grading of part-time students' work**

Assessment and grading criteria are the same as for full-time students.

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

**Continuous assessment of students' work:**

| Assessment elements | Success (min.%) | Percentage in grade (%) |
|---|---|---|
| Class attendance | 80 | 10 |
| Seminar paper I | 50 | 30 |
| Seminar paper II | 50 | 30 |
| Laboratory exercises | 100 | 30 |

**Grading**

| Percentage (%) | Criterion | Grade |
|---|---|---|
| 0-49 | Does not satisfy minimum criteria | insufficient (1) |
| 50-64 | Satisfies minimum criteria | sufficient (2) |
| 65-79 | Average success with clear shortcomings | good (3) |
| 80-89 | Above average success with a few errors | very good (4) |
| 90-100 | Extraordinary success | excellent (5) |

Required literature (available in the library and via other media)

| Title | Number of copies in the library | Availability via other media |
|---|---|---|
| 1. Steven M. LaValle (2006), “Planning Algorithms“, Cambridge | | |
| 2. Nikolaus Correll (2016), “Introduction to Autonomous Robots: Kinematics, Perception, Localization and Planning“, Magellan Scientific | | |

| | | | |
|---|---|---|---|
| | 3. Gianluca Antonelli (2014), “Underwater Robots“, Springer | | |
| Optional literature (at the time of submission of study programme proposal) | Thomas Braunl (2010), “Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems“, Springer | | |
| Quality assurance methods that ensure the acquisition of exit competences | University survey, student records, supervision of teaching by the Faculty board for teaching, self-evaluation, analysis of passing rates at the end of the academic year, external evaluation of the grading process. | | |
| Other (as the proposer wishes to add) | | | |

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">MASTER THESIS</td></tr>
<tr><td>Code</td><td>PFE500</td><td>Year of study</td><td colspan="3">2</td></tr>
<tr><td>Course teacher</td><td>Teacher with whom the thesis topic has been chosen</td><td>Number of credits (ECTS)</td><td colspan="3">15</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">/</td><td rowspan="2">Format of instruction (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>0</td><td>0</td><td>150</td><td>0</td></tr>
<tr><td>Status of the course</td><td>Compulsory</td><td>Percentage of e-learning</td><td colspan="3">0</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5"></td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5">No requirements.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. To solve a problem in the field of ship IT and automatic systems using scientific methodology, and independently valorize the obtained results,<br>2. Critically judge the hierarchy, organization and management of information and communication integrated ship systems and propose appropriate solutions on board and on land,<br>3. To compare the applicability and quality of continuous and discrete systems of automatic regulation,<br>4. Design management systems using SCADA systems and PLC devices and apply them to marine ship and land systems,<br>5. To justify the use of methods and techniques of developing software systems in modern development environments by using measurable parameters,<br>6. Evaluate and apply the concepts of object-oriented programming in the development of software applications,<br>7. Choose a method of analyzing the measured signals, evaluate and classify the parameters that affect the management of ship systems,<br>8. Critically evaluate the development of expert systems for optimal management, diagnostics and preventive maintenance of the ship,<br>9. Develop a model of the maritime traffic system and synthesize a monitoring system to avoid critical situations in traffic,<br>10. Critically judge the application of renewable energy sources in the maritime sector from the aspect of the amount of energy obtained and the degree of impact on the human environment,<br>11. Assess the use of mechatronic systems in maritime and sea-related industries,<br>12. Critically evaluate the use of electrotechnical materials in the maritime sector with special reference to the decommissioning of vessels.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">/</td></tr>
</table>

<table>
<tr><td>Format of instruction</td><td colspan="6">☐ lectures<br>☐ seminars and workshops<br>☐ exercises<br>☐on line only<br>☐ mixed e-learning<br>☐ field work</td><td colspan="6">☒ samostalni zadaci<br>☒multimedija<br>☐ laboratorij<br>☒mentorski rad</td></tr>
<tr><td>Student responsibilities</td><td colspan="12">With the graduation thesis, the student should demonstrate that he is capable of applying the knowledge acquired during his studies and prove that he can successfully solve tasks at the level of the title he is acquiring.<br>The thesis does not have to be an original work, but it must be written independently by the student with the professional help and supervision of the mentor.<br>The student prepares the diploma thesis independently and with the expert supervision of the mentor. During the preparation of the diploma thesis, the student is obliged to report to and consult the mentor, especially during the period of the conceptual idea of the solution, the main idea of the solution and the realization of the work.<br>The student creates a graduation thesis in concept with all the associated parts. The concept of the work is given to the mentor for inspection and review. The student is obliged to act according to the instructions and remarks of the mentor. If the student does not follow the mentor's instructions and remarks, the work is returned to the student for revision.</td></tr>
<tr><td rowspan="6">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>Lecture attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Research activity</td><td>6.5</td></tr>
<tr><td>Essay</td><td></td><td>Seminar</td><td></td><td>Creation of the Master's thesis</td><td>6.5</td></tr>
<tr><td>In-term tests</td><td></td><td>Oral exam</td><td></td><td>Defence of the Master's thesis</td><td>2</td></tr>
<tr><td>Written exam (if in-term tests have not been passed)</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="12">The grading and evaluation of the final work is done by a three-member commission after preparation, presentation of the student and answers to the questions.</td></tr>
<tr><td rowspan="6">Optional literature (at the time of submission of study programme proposal)</td><td colspan="8">Title</td><td colspan="2">Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="8"></td><td colspan="2"></td><td></td></tr>
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<tr><td colspan="8"></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="8"></td><td colspan="2"></td><td></td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit</td><td colspan="12"></td></tr>
</table>

| | |
|---|---|
| competences | |
| Other (as the proposer wishes to add) | |