**3.2. Course description**

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| **Generic information** |
| Head of Course | Sanjin Valčić, Ph.D.; Zoran Mrak, Ph.D. |
| Course | Application of maritime radiocommunication systems |
| Study Programme | Marine Electronic Engineering and Information Technology |
| Level | Graduate degree |
| Type of Course | Mandatory |
| Year of Study | 1. | II. semester |
| Estimated Student Workload and Methods of Instruction | ECTS coefficient of Student Workload | 5 |
| Number of Hours (L+E+S) | 2+0+2 |

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| **1. GENERAL COURSE DESCRIPTION** |
| *1.1. Course Objectives*  |
| *The main objective of the course is to acquire advanced knowledge in the field of maritime radio communications with an emphasis on digital terrestrial and satellite data exchange systems, which are not defined by the requirements of the International Maritime Organization related to navigation safety. In addition, the objective is to introduce students to the possibilities of applying these systems and acquire the ability to choose an appropriate system depending on specific requirements.* |
| *1.2. Prerequisites for Course Registration*  |
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| *1.3. Expected Learning Outcomes*  |
| 1. Explain the basic features of VHF Data Exchange System, GSM and HF Data radiocommunication systems in maritime communications.
2. Understand, differentiate and analyze the ways of multiple access to channels and the specifics of signal modulation in maritime digital terrestrial communication systems.
3. Define and understand the working principle of UHF and SHF internal ship communications.
4. Argue the possibilities of applying 5G technologies in coastal navigation areas.
5. Evaluate the parameters of satellite connection and analyze the structure of satellite communication systems used onboard vessels.
6. Recognize and understand the basic characteristics of satellite very small aperture terminals (VSAT), as well as the calculation of the communication link (uplink and downlink).
7. Explain and analyze the basic features and specifics of maritime SSAS and LRIT systems.
8. Identify the challenges of global coverage of satellite communications systems.
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| *1.4. Course Outline*  |
| Digital terrestrial communication systems: VHF Data Exchange System - Terrestrial (VDES - Ter), GSM, HF Data, UHF and SHF internal ship communications, etc. Possibilities of application of 5G technologies in maritime environment. Satellite communication systems: VSAT, Inmarsat, Iridium, Thuraya, Orbcomm, VHF Data Exchange System - Satellite (VDES - Sat), etc. Ship Security Alert System. Long Range Identification and Tracking. |
| *1.5. Modes of* *Instruction*  | [x] Lectures[x]  Seminars and workshops [ ]  Exercises [ ]  E-learning[ ]  Field work | [x]  Practical work [ ]  Multimedia and Network [ ]  Laboratory[ ]  Mentorship[ ]  Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| *1.6. Comments*  | Students will be assigned to project tasks, which they will have to master during seminars and workshops. |
| *1.7. Student Obligations*  |
| Regular class attendance (lectures and seminars), taking midterms, submitting project assignment and taking the oral final exam. |
| *1.8. Assessment1 of Learning Outcomes*  |
| Course attendance | 2 | Class participation |     | Seminar paper |     | Experiment |     |
| Written exam |     | Oral exam | 1 | Essay |     | Research |     |
| Project | 1 | Continuous Assessment | 1 | Presentation |     | Practical work |  |
| Portfolio |     |  |     |  |     |  |     |

1 **NOTE:** 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. Use empty fields for additional activities.

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| *1.9. Assessment of Learning Outcomes and Examples of Evaluation during Classes and on the Final Exam*  |
| The procedure for evaluating the acquired learning outcomes is carried out according to the Regulations on Studies of the University of Rijeka and the Regulations on Studies at the Faculty of Maritime Studies in Rijeka as follows:* *through continuous assessment during the course the 70% of the acquired learning outcomes are evaluated: through 1st midterm - learning outcomes 1-4 (20%), 2nd midterm - learning outcomes 5-8 (20%); the student must have completed at least 50% of points in each midterm, and project task (30%),*
* *at the final part of the exam 30% of the acquired learning outcomes (1-8) are evaluated, with the student having to pass a minimum of 50% of points for passing the final exam.*

Examples of evaluating learning outcomes in relation to set learning outcomes are:1. Explain the difference between VDE, ASM and AIS data exchange in VDES systems.
2. State the difference between SOTDMA and CSTDMA multiple access.
3. Explain the infrastructure of modern UHF systems in ship's internal communications.
4. Explain the potential applications of 5G technology in maritime communications.
5. Calculate the received signal power at the receiver of the INMARSAT’s earth station Burum, if the satellite transmits 46 dB of EIRP.
6. Argue the basic advantages of using maritime satellite very small aperture terminals (VSAT).
7. Analyze in detail and explain the features and specifics of the LRIT system.
8. Is it possible and with which communication system to establish a reliable connection for the Internet Protocol in Antarctica? Explain your answer.

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| *1.10. Main Reading*  |  |  |
| * Teaching material on the e-learning system Merlin (<https://moodle.srce.hr>)
* Recommendation ITU-R M.1174-4: Technical characteristics of equipment used for on-board vessel communications in the bands between 450 and 470 MHz, online publication
* Recommendation ITU-R M.1798-1: Characteristics of HF radio equipment for the exchange of digital data and electronic mail in the maritime mobile service, online publication
* Recommendation ITU-R M.2092-0: Technical characteristics for a VHF data exchange system in the VHF maritime mobile band, online publication
* LRIT Technical documentation Part I: MSC.1/Circ.1259/Rev.5, online publication
* LRIT Technical documentation Part II: MSC.1/Circ.1294/Rev.3, online publication
* David Tse, Pramod Viswanath (2005.), Fundamentals of Wireless Communication, Cambridge University Press, <https://web.stanford.edu/~dntse/wireless_book.html>
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| *1.11. Recommended Reading*  |  |  |
| * Recommendation ITU-R M.2135-0: Technical characteristics of autonomous maritime radio devices operating in the frequency band 156-162.05 MHz
* Te Wei, Wei Feng, Yunfei Chen, Cheng-Xiang Wang, Ning Ge, Jianhua Lu: Hybrid Satellite-Terrestrial Communication Networks for the Maritime Internet of Things: Key Technologies, Opportunities, and Challenges, CoRR abs/1903.11814 (2019)
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| *1.12. Number of Main Reading Examples*  |  |  |
| *Title*  | *Number of examples*  | *Number of students*  |
| Teaching material on the e-learning system Merlin | - | 30 |
| Recommendation ITU-R M.1174-4: Technical characteristics of equipment used for on-board vessel communications in the bands between 450 and 470 MHz, online publication | - | 30 |
| Recommendation ITU-R M.1798-1: Characteristics of HF radio equipment for the exchange of digital data and electronic mail in the maritime mobile service, online publication | - | 30 |
| Recommendation ITU-R M.2092-0: Technical characteristics for a VHF data exchange system in the VHF maritime mobile band, online publication | - | 30 |
| LRIT Technical documentation Part I: MSC.1/Circ.1259/Rev.5, online publication | - | 30 |
| LRIT Technical documentation Part II: MSC.1/Circ.1294/Rev.3, online publication | - | 30 |
| David Tse, Pramod Viswanath (2005.), Fundamentals of Wireless Communication, Cambridge University Press, https://web.stanford.edu/~dntse/wireless\_book.html | - | 30 |
| *1.13. Quality Assurance*  |
| The quality of study is constantly monitored in accordance with the ISO 9001 system implemented at the Faculty of Maritime Studies in Rijeka. An analysis of the exams is made annually and a student survey is conducted once a semester. |