**Course description**

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| **Generic information** |
| Head of Course | Assoc. Prof. Irena Jurdana, PhD |
| Course | Information Processing and Transmission |
| Study Programme | Marine Electronic Engineering and Information Technology |
| Type of Course | Mandatory |
| Year of Study | 1. |  |
| Estimated Student Workload and Methods of Instruction | ECTS coefficient of Student Workload | 5 |
| Number of Hours (L+E+S) | 30+30+0 |

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| **1. GENERAL COURSE DESCRIPTION** |
| *1.1. Course Objectives*  |
| The main course objective is to enable students to acquire knowledge on signal processing techniques, understand the concepts of information theory and the problem of transmitting information through the communication channel, and acquire knowledge on information encoding techniques and communication networks.  |
| *1.2. Prerequisites for Course Registration*  |
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| *1.3. Expected Learning Outcomes*  |
| 1. Define mathematical models of signals and apply techniques for their processing.
2. Interpret Shannon’s model of the communication system.
3. Understand and define the concept of entropy and its properties.
4. Understand, define, and distinguish fundamental concepts of information encoding, and distinguish types of codes.
5. Understand and define graphical code representations, and define and compute the parameters of efficient information encoding.
6. Understand the procedures of entropy information encoding (Huffman coding, arithmetic coding, and dictionary-based encoding techniques) and apply them to determine the corresponding codewords.
7. Understand and interpret the mathematical model of the communication network.
8. Compare and distinguish the reliability and availability of the communication network.
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| *1.4. Course Outline*  |
| Types and mathematical models of signals. Noise: definition, types, influence, noise sources. Mathematical tools for signal analysis and processing.Information theory. Definition and Shannon’s mathematical model of the communication system. Definitions of the message, message transmission, and information content. Information content and Shannon’s definition of entropy. Entropy properties. Discrete information sources. Definition of information measures for the amount of information in a communication system.Types of information encoding, definitions, and properties of codes. Fixed-length and variable-length coding. Code efficiency. Graphical code representation. Shannon-Fano coding. Entropy information encoding methods – Huffman coding, arithmetic coding, and dictionary-based encoding methods (LZW coding). Decoding procedures. |
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| Communication networks: model, architecture, information transmission technologies. Reliability and availability of communication network: definitions, mathematical models, applications. |
| *1.5. Modes of* *Instruction*  | [x]  Lectures[ ]  Seminars and workshops [x]  Exercises [ ]  E-learning[ ]  Field work | [ ]  Practical work [ ]  Multimedia and Network [ ]  Laboratory[ ]  Mentorship[ ]  Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| *1.6. Comments*  | - |
| *1.7. Student Obligations*  |
| Regular class attendance (lectures and exercises), midterm exams with numerical tasks, and final exam. |
| *1.8. Assessment1 of Learning Outcomes*  |
| Course attendance | 2 | Class participation |     | Seminar paper |     | Experiment |     |
| Written exam | 0,5 | Oral exam | 0,5 | Essay |     | Research |     |
| Project |     | Continuous Assessment | 2 | Presentation |     | Practical work |  |
| Portfolio |     |  |     |  |     |  |     |
| *1.9. Assessment of Learning Outcomes and Examples of Evaluation during Classes and on the Final Exam*  |
| The assessment of acquired learning outcomes is carried out according to the regulations on studies at the University of Rijeka and the regulations on studies at the Faculty of Maritime Studies in Rijeka as follows:• through continuous assessment of knowledge during classes, 70% of the acquired learning outcomes are evaluated through the 1st midterm exam – learning outcomes 1-3 (35%), the 2nd midterm exam – learning outcomes 4-8 (35%); the student must achieve a minimum of 50% of points at each midterm exam,• at the final exam, 30% of the acquired learning outcomes are evaluated (1-8), whereby the student must achieve a minimum of 50% of points to pass the final exam.Examples of evaluation of learning outcomes with respect to the set learning outcomes are:1. For the time-continuous signal yc(t)=sinc(2t) and the sampling period T = 1/4, graphically show the sampled signal y[n] and its spectrum.
2. Define and describe the fundamental parts of Shannon’s communication system model.
3. The following random variables are given: X with set of values S(X) = {x1, x2, x3} and probability distribution PX = (0.6, 0.2, 0.2), and Y with set of values S(Y) = {y1, y2, y3} and probability distribution PY = (0.35, 0.35, 0.3). Which variable has higher entropy?
4. Is there an instantaneous code (a=5, b=2, f) with codeword lengths {1, 3, 2, 3, 3}?
5. The following is given: the source with symbols A = {x1, x2, x3, x4, x5}, symbol probabilities: P = {P(x1)=0.37, P(x2)=0.17, P(x3)=0.16, P(x4)=0.15, P(x5)=0.15}, and code symbols B = {0, 1}. Using the Shannon-Fano algorithm, graphically show the code tree, determine the codewords and their lengths, and calculate the average codeword length, source entropy, and code efficiency.
6. The following is given: the source with symbols A = {x1, x2, x3, x4} and symbol probabilities P(x1)=0.4, P(x2)=0.2, P(x3)=0.3, P(x4)=0.1. Using arithmetic coding, encode the message: x2x1x3x2.
7. Show and explain the mathematical model of the communication network.
8. Define and explain the parameters of comparing the reliability and availability of the communication network.
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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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| *1.10. Main Reading*  |  |  |
| • Course material available on the e-learning system – Merlin (<https://moodle.srce.hr>)• Pandžić, I. S. et al.: Uvod u teoriju informacije i kodiranje, Element, Zagreb, 2007.• Ilić, Ž. et al.: Teorija informacije i kodiranje – zbirka zadataka, Element, Zagreb, 2014. |
| *1.11. Recommended Reading*  |  |  |
| • Pauše, Ž.: Uvod u teoriju informacije, Školska knjiga, Zagreb, 1989.• Duck, M.; Read R.: Communication and Computer Networks, Pearson Education Limited, 2003.• Bažant, A. et al.: Telekomunikacije – tehnologija i tržište, Element, Zagreb, 2007.• Bažant, A. et al.: Osnovne arhitekture mreža, Element, Zagreb, 2014.• Lathi, B. P.: Linear Systems and Signals, Oxford University Press, 2004.• Lathi, B. P.; Green R. A.: Essentials of Digital Signal Processing, Cambridge University Press, 2014 |
| *1.12. Number of Main Reading Examples*  |  |  |
| *Title*  | *Number of examples*  | *Number of students*  |
| Course material available on the e-learning system – Merlin(<https://moodle.srce.hr>) | - | 30 |
| Pandžić, I. S. et al.: Uvod u teoriju informacije i kodiranje, Element, Zagreb, 2007. | 2 | 30 |
| Ilić, Ž. et al.: Teorija informacije i kodiranje – zbirka zadataka, Element, Zagreb, 2014. | 6 | 30 |
| *1.13. Quality Assurance*  |
| The quality of the study is continuously monitored in accordance with the ISO 9001 system implemented at the Faculty of Maritime Studies in Rijeka. An analysis of exams is made annually, and once a semester, a survey is conducted among students. |