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|-----|---|--|---|----------------|
| 1.  | Course title  | Information theory with digital communications   |   |                |
| 2.  | Course code   | CSES404  |   |                |
| 3.  | Study program   | FCSE   |   |                |
| 4.  | Unit offering the course  | FCSE   |   |                |
| 5.  | Undergraduate/postgraduate/PhD  | Undergraduate  |   |                |
| 6.  | Year/semester<br>2/summer   | 7. ECTS: 6   |   |                |
| 8.  | Teacher(s)  | prof. Ljupcho Kocarev<br>prof. Verica Bakeva<br>ass. prof. Dejan Spasov<br>ass. prof. Igor Mishkovki |   |                |
| 9.  | Course prerequisites  | signature from Probability and Statistics  |   |                |
| 10. | Goals (competences):<br>Students will become familiar with the quantitative information theory and its application in reliable and efficient communication systems. Additionally, they will be introduced in the mathematical model of the communication system.  |  |   |                |
| 11. | Course content:<br>Stochastic processes: definition, characteristics, stationarity. Entropy and information and their properties. Asymptotic Equipartition Property. Markov chain. Entropy rates of a stochastic processes. Data compression: optimal codes, Huffman codes, Shannon-Fano-Elias coding, arithmetic coding. Communication channel: types of channels, Channel capacity. Linear codes: optimal decoding, Hamming condition. Linear block-code. The Gaussian channel. |  |   |                |
| 12. | Teaching methods:<br>Lectures supported by slide presentations, interactive lectures, trainings (using lab equipment and software packages), team work, case studies, invited guests and lectures, individual practical assignments presentations, seminar paper, e-learning (forums, consultations).   |  |   |                |
| 13. | Total available time  | 6 ECTS x 30 h = 180 h  |   |                |
| 14. | Distribution of the available time  | 30+45+25+40+40 = 180   |   |                |
| 15. | Teaching activities   | 15.1.  | Lectures  | 30 hours       |
|     |   | 15.2.  | Training (labs, problem solving), seminar and team work | 30+15=45 hours |
| 16. | Other activities  | 16.1.  | Project work  | 25 hours       |
|     |   | 16.2.  | Self study  | 40 hours       |
|     |   | 16.3.  | Home work   | 40 hours       |
| 17. | Grading   |  |   |                |
|     | 17.1.   | Tests  | 70 points   |                |

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|     | 17.2.                     | Seminar work/project (written or oral presentation) |  |  | 20 points                  |               |
|     | 17.3.                     | Active participation                                |  |  | 10 points                  |               |
| 18. | Grading criteria          |   |  |  | to 50 points               | 5 (five) (F)  |
|     |                           |   |  |  | from 51 to 60 points       | 6 (six) (E)   |
|     |                           |   |  |  | from 61 to 70 points       | 7 (seven) (D) |
|     |                           |   |  |  | from 71 to 80 points       | 8 (eight) (C) |
|     |                           |   |  |  | from 81 to 90 points       | 9 (nine) (B)  |
|     |                           |   |  |  | from 91 to 100 points      | 10 (ten) (A)  |
| 19. | Final exam prerequisites  |   |  | Successful completion of activities 15.1 and 15.2                              |                            |               |
| 20. | Course language           |   |  | Macedonian and English   |                            |               |
| 21. | Quality assurance methods |   |  | Internal evaluation mechanisms supported by student polls                      |                            |               |
| 22. | Literature                |   |  |  |                            |               |
|     | 22.1.                     | Compulsory  |  |  |                            |               |
|     |                           | No.   | Authors  | Title  | Publisher                  | Year          |
|     |                           | 1.  | Thomas M. Cover, Joy A. Thomas                         | Elements of Information Theory   | John Wiley & Sons          | 2006          |
|     |                           | 2.  | I. Csiszár and J. Körner                               | Information Theory: Coding Theorems for Discrete Memoryless System 2nd edition | Cambridge University Press | 2011          |
|     | 3.                        | D.J.C. MacKay                                       | Information Theory, Inference, and Learning Algorithms | Cambridge University Press   | 2003                       |               |
|     | 22.2.                     | Mandatory   |  |  |                            |               |
|     |                           | No.   | Authors  | Title  | Publisher                  | Year          |
|     |                           | 1.  | R. E. Blahut   | <i>Principles and Practice of Information Theory</i>                           | preprint                   | 2012          |
|     |                           | 2.  | A. El Gamal and Y.-H. Kim                              | Network Information Theory   | Cambridge University Press | 2011          |
|     |                           |   |  |  |                            |               |