# SYLLABUS

## 1. Data about the program of study

| 1.1 Institution | Technical University of Cluj-Napoca |
|---|---|
| 1.2 Faculty | Faculty of Electronics, Telecommunications and information Technology |
| 1.3 Department | Communications |
| 1.4 Field of study | Electronic Engineering, Telecommunications and Information Technologies |
| 1.5 Cycle of study | Bachelor of Science |
| 1.6 Program of study / Qualification | Applied Elects / Engineer |
| 1.7 Form of education | Full time |
| 1.8 Subject code | TST-E38.00 |

## 2. Data about the subject

| 2.1 Subject name | Decision and Estimation in Information Processing | | | | | |
|---|---|---|---|---|---|---|
| 2.2 Subject area | Theoretical area<br>Methodological area<br>Analytic area | | | | | |
| 2.3 Course responsible | Associate Professor Raul MALUTAN, Ph.D.<br>raul.malutan@com.utcluj.ro | | | | | |
| 2.4 Teacher in charge with seminar / laboratory / project | Assoc. Prof. Raul MALUTAN, Ph.D. raul.malutan@com.utcluj.ro<br>Assist. Prof. Stefania BENEA, Ph.D.<br>Stefania.Barburiceanu@com.utcluj.ro | | | | | |
| 2.5 Year of study | III | 2.6 Semester | 6 | 2.7 Assessment | Exam | 2.8 Subject category | DS/DI |

## 3. Estimated total time

| 3.1 Number of hours per week | 4 | of which:  3.2 course | 2 | 3.3 seminar / laboratory | 2 |
|---|---|---|---|---|---|
| 3.4 To Total hours in the curriculum | 56 | of which:  3.5 course | 28 | 3.6 seminar / laboratory | 28 |

| Distribution of time | hours |
|---|---|
| Manual, lecture material and notes, bibliography | 56 |
| Supplementary study in the library, online specialized platforms and in the field | 8 |
| Preparation for seminars / laboratories, homework, reports, portfolios and essays | 4 |
| Tutoring | 2 |
| Exams and tests | 3 |
| Other activities | 1 |

| 3.7 Total hours of individual study | 74 |
|---|---|
| 3.8 Total hours per semester | 130 |
| 3.9 Number of credit points | 3 |

## 4. Pre-requisites (where appropriate)

| 4.1 curriculum | NA |
|---|---|
| 4.2 competence | NA |

## 5. Requirements (where appropriate)

| 5.1. for the course | |
|---|---|
| 5.2. for the seminars / laboratories / projects | Mandatory presence |

## 6. Specific competences

| | |
|---|---|
| Professional competences | (corelat cu Grila 2)<br>**C4. Conceperea, implementarea şi operarea serviciilor de date, voce, video, multimedia, bazate pe înţelegerea şi aplicarea noţiunilor fundamentale din domeniul comunicaţiilor şi transmisiunii informaţiei**<br>C4.1 Identificarea conceptelor fundamentale referitoare la transmisiunea informaţiei şi la comunicaţiile analogice şi digitale<br>C4.2 Explicarea şi interpretarea principaleleor cerinţe şi tehnici specifice de abordare pentru transmisiile de date, voce, video, multimedia<br>C4.3 Rezolvarea de probleme practice utilizând cunoştinţe generale privind tehnicile multimedia<br>C4.4 Utilizarea principalilor parametri specifici în evaluări bazate pe conceptul de calitate a serviciilor în comunicaţii<br>C4.5 Dezvoltarea unor servicii simple de comunicaţii |
| Cross competences | (corelat cu Grila 2)<br>N / A |

## 7. Discipline objectives (as results from the key competences gained)

| 7.1 General objective | Development of professional abilities in the domain of binary decision and signal and parameter estimation systems. |
|---|---|
| 7.2 Specific objectives | 1. Gain of theoretical knowledge concerning the design of decision and estimation systems.<br>2. Gain of theoretical knowledge concerning design of random processes, Markov processes and of the noise in digital communication systems.<br>3. Achievement of abilities and skills necessary for the implementation of software applications or hardware schemes using MATLAB and LABVIEW tools |

## 8. Contents

| 8.1 Lecture (syllabus) | | Teaching methods | Notes |
|---|---|---|---|
| 1 | Random variables. | Presentation, heuristic conversation exemplification, problem presentation, teaching exercise, case study, formative evaluation | Use of blackboard |
| 2 | Random processes. Stationarity and ergodicity | | |
| 3 | Noise sequences and pseudo-noise sequences. | | |
| 4 | Markov processes. | | |
| 5 | Noise: definition, classification, models. | | |
| 6 | Noise in telecommunications systems. | | |
| 7 | Theory of decision. Decisions criteria (Bayes, Kotelinkov-Zeigert, Fischer, Min-max, Neyman-Pearson) | | |

| 8 | Binary decision with discrete observation. |
|---|---|
| 9 | Binary decision with continuous observation |
| 10 | Theory of parameter estimation |
| 11 | Model of an ITS with parameter estimation. Discrete and continuous observation. Costs function. |
| 12 | Minimum mean square error estimation. MAP estimation |
| 13 | Continuous observation random signal estimation |
| 14 | Review of the course concerning the exam. |

| 8.2. Applications (lab) | Teaching methods | Notes |
|---|---|---|
| 1 | Introduction. Random variables | | |
| 2 | Experimental determination of the probability distribution function | | |
| 3 | Pseudo-noise sequences | Didactic and experimental proof, didactic exercise, team work | Use of computers, magnetic board |
| 4 | Markov processes. Noise in telecommunications systems | | |
| 5 | Binary decision system | | |
| 6 | Parameter estimation system | | |
| 7 | Review seminary | | |

## Bibliography

1. M. Borda, Fundamentals in Information Theory and Coding – Springer 2011, ISBN 978-3-642-20346-6, 509p
2. S. M. Kay – Fundamentals of statistical signal processing, Vol. 1: Estimation Theory, Prentice Hall 1993
3. S. M. Kay – Fundamentals of statistical signal processing, Vol. 2: Detection Theory, Prentice Hall 1998
4. Monica Borda – Information Theory and Coding, Editura UT PRES, 2007
5. M. Borda, M.Cislariu, I.Ilea, R.Malutan, R.Terebes, Decizie și estimare în prelucrarea informației, Aplicații, Editura UTPRES, ISBN 978-606-737-252-6 , Cluj-Napoca, 2017, 256p
6. M. Simon, S, Hinedi, W, Lindsey – Digital Communications Techniques. Signal Design and Detection,
7. Prentice Hall, 1994
8. M. Barkat – Signal Detection and Estimation, Artech House,1991
9. I.Sztojanov, I. Gavăt, I. Spânu, M. Bâtiu - Teoria Transmiterii Informaţiei- îndrumător de laborator, Litografia IPCN 1983, tradus in limba engleză, format pdf

**9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field**

The discipline content and the acquired skills are in agreement with the expectations of the professional organizations and the employers in the field, where the students carry out the internship stages and/or occupy a job (in the field of electronic engineers, telecommunications engineers, electro-technology engineers, ICT specialists), and the expectations of the national organization for quality assurance (ARACIS).

**10. Evaluation**

| Activity type | 10.1 Assessment criteria | 10.2 Assessment methods | 10.3 Weight in the final grade |
|---|---|---|---|
| 10.4 Course | The level of acquired theoretical knowledge and practical skills | Written exam composed of 4-5 theoretical subjects and 3-4 problems | 75% |

| 10.5 Seminar/ Laboratory | The level of acquired knowledge and abilities | Continuous formative evaluation consisting of 4 written lab tests | *25%* |
|---|---|---|---|

| 10.6 Minimum standard of performance |
|---|

**Qualitative point of view**

Minimal theoretical and practical knowledge:
- ✓ Understanding the information concerning the design of decision and estimation systems.
- ✓ Understanding the concepts concerning the design of random processes, Markov processes and of the noise in digital communication systems

Minimal acquired competences:
- ✓ Ability to solve problems related to binary decision and signal and parameter estimation systems
- ✓ Ability to design decision and estimation systems

**Quantitative point of view**
- ✓ Correct answer of at least 3 theoretical subjects and 2 problems
- ✓ Minimal mean at the exam 5
- ✓ Final mark = 0.75xExam+ 0.25x Mean of the marks at the lab tests

| Date of filling in: 20.06.2023 | Responsible | Title First name SURNAME | Signature |
|---|---|---|---|
| | Course | Assoc. Prof. Raul MALUTAN, Ph.D. | |
| | Applications | Assoc. Prof. Raul MALUTAN, Ph.D. | |
| | | Assist. Prof.  Stefania BENEA, Ph.D. | |
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| Date of approval in the Council of the Communications Department 11.07.2023 | Head of Communications Department Prof. Virgil DOBROTA, Ph.D. |
|---|---|
| Date of approval in the Council of the Faculty of Electronics, Telecommunications and Information Technology 12.07.2023 | Dean Prof. Ovidiu POP, Ph.D. |