# SYLLABUS

## 1. Data about the program of study

| | | |
|---|---|---|
| 1.1 | Institution | Technical University of Cluj-Napoca |
| 1.2 | Faculty | Electronics, Telecommunications and Information Technology |
| 1.3 | Department | Communications |
| 1.4 | Field of study | Electronics and Telecommunications Engineering |
| 1.5 | Cycle of study | Master |
| 1.6 | Program of study/Qualification | Multimedia Technologies/ Telecommunications/ Master |
| 1.7 | Form of education | IF (Full-time learning) |
| 1.8 | Subject code | TM-E14.00/ TC-E17.10 |

## 2. Data about the subject

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.1 | Subject name | | | | | Biometric Security Systems | | | | | |
| 2.2 | Subject area | | | | | Electronics and Telecommunications Engineering | | | | | |
| 2.3 | Course responsible/lecturer | | | | | Associate Professor Simina EMERICH, PhD | | | | | |
| 2.4 | Teachers in charge of applications | | | | | Associate Professor Simina EMERICH, PhD | | | | | |
| 2.5 | Year of study | II | 2.6 | Semester | 3 | 2.7 | Assessment | Exam | 2.8 | Subject category | DA/DI |

## 3. Estimated total time

| Year/ Sem. | Subject name | No. of weeks | Course [hours/ week] | Applications [hours/ week] | | | Course [hours/ semester] | Applications [hours/ semester] | | | Indiv. study | TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | S | L | P | | S | L | P | | | |
| II/1 | Fundamental Electronic Circuits | 14 | 2 | | 1 | | 28 | | 14 | | 58 | 100 | 4 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3.1 | Number of hours per week | 3 | 3.2 | of which, course | 2 | 3.3 | applications | 1 |
| 3.4 | Total hours in the curriculum | 42 | 3.5 | of which, course | 28 | 3.6 | applications | 14 |

| Individual study | Hours |
|---|---|
| Manual, lecture material and notes, bibliography | 20 |
| Supplementary study in the library, online and in the field | - |
| Preparation for seminars/laboratory works, homework, reports, portfolios, essays | 28 |
| Tutoring | 3 |
| Exams and tests | 3 |
| Other activities | 4 |

| | | |
|---|---|---|
| 3.7 | Total hours of individual study | 58 |
| 3.8 | Total hours per semester | 100 |
| 3.9 | Number of credit points | 4 |

## 4. Pre-requisites (where appropriate)

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|---|---|---|
| 4.1 | Curriculum | - |
| 4.2 | Competence | Signal and image processing, mathematics, programming |

## 5. Requirements (where appropriate)

| | | |
|---|---|---|
| 5.1 | For the course | Cluj-Napoca |
| 5.2 | For the applications | Cluj-Napoca |

## 6. Specific competences

| | | |
|---|---|---|
| Professional competences | Theoretical knowledge (What do the student should know) | The students will know:<br>- Generalities about - identity management; economic and social impact of biometrics; area of applications, advantages/ disadvantages of biometric systems.<br>- Methods and principles used for biometric identification of individuals.<br>- Scientific foundations regarded of the main biometric technologies (include fingerprint, face, iris, retina, hand shape, DNA, voice, signature, gait, etc.)<br>- The principles of multimodal biometric systems. |
| | Acquired skills (What the student is able to do) | The students will be able to:<br>- Handles advanced concepts of pattern recognition and their applications to solving real life problems such as biometric identification.<br>- Design and implement the main modules of a biometric system.<br>- Evaluate the performance of a biometric system |
| | Acquired abilities (what equipment/ instruments/ software the student is able to handle) | The students will be able to use:<br>- Software tools (Matlab) for biometric authentication purposes<br>- Hardware tools in order to acquire biometric traits |
| Cross competences | CT3 Adapting to new technologies, professional and personal development through continuing education using electronic documentation and printed sources, in Romanian and in at least one international language (English). Competencies for analysis and synthesis and optimization systems thinking. Flexibility in thinking and ability to work with interdisciplinary concepts and tools. | |

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

| | | |
|---|---|---|
| 7.1 | General objectives | Developing the competences regarding the use, analysis and design of a biometric system. |
| 7.2 | Specific objectives | 1. Recognizing and understanding basic concepts specific to biometric identification<br>2. Acquire theoretical and practical knowledge concerning the physiological and behavioral biometric technologies (face, iris, fingerprint, hand geometry, signature, voice, etc…)<br>3. Acquire competences for development of algorithms and applications using specific software tools |

## 8. Contents

| 8.1. Lecture (syllabus) | | Teaching methods | Notes |
|---|---|---|---|
| 1 | Introduction to biometrics. Identity management. Brief history of biometrics. Applications of biometric systems. | Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation | Use of .ppt presentation, projector, blackboard |
| 2 | Sensors and biometric devices. The main modules of a biometric system. Performance Evaluation | | |
| 3 | Physiological biometric traits I: fingerprint, face, hand geometry. History. Used sensors. Features extraction techniques. Public databases. | | |
| 4 | Physiological biometric traits II: iris, retina, ear, DNA. History. Used sensors. Features extraction techniques. Public databases. | | |
| 5 | Behavioral biometric traits: voice, typing dynamics, walking, on-line signature. Used sensors. Features extraction techniques. Public databases. | | |
| 6 | Infrared radiation in biometrics. Absorption of radiation in tissues. Choosing the area of interest. Identifying the infrared vein model. | | |
| 7 | Unimodal biometric systems - advantages, disadvantages and limits Multimodal biometric systems, modes of operation. | | |
| 8 | Fusion levels in multibiometric systems (sensor, feature, score and decision level). | | |
| 9 | Biometric system based on dynamic signature. Diagram of a signature verification system. Devices and Methods of Signature Acquisition (Digitization Table). Database. | | |
| 10 | Dynamic (on-line) signature pattern recognition methods | | |
| 11 | Types of measurements scales: nominal, ordinal, interval and ratio. Presenting different arguments in favor of ordinal measurement based applications. | | |
| 12 | Techniques proposed for extracting and modeling dynamic signature features. From Fourier Analysis to Time-Frequency Analysis. Wavelet Transform. The TESPAR / TESPAR DZ encoding method. | | |
| 13 | Integration of presented methods to implement a unimodal system, based on dynamic signature. | | |
| 14 | Recapitulation. Preparation for the final exam. | | |
| | | | |

| 8.2. Applications (lab) | | Teaching methods | Notes |
|---|---|---|---|
| 1 | Dynamic signature signals acquisition (coordinates, pressure, azimuth, etc.) with GENIUS GP4500 digital tablet. | Didactic and experimental proof, didactic exercise, team work | Use of laboratory instrumentation, experimental boards, computers, magnetic board |
| 2 | Matlab implementation of TESPAR DZ encoding method. Descriptors extraction (duration, local minimum, and amplitude) from signature specific waveforms. | | |
| 3 | Removing noise from input data. Determining the I and II derivatives to obtain additional information such as speed and acceleration on both directions (x and y). | | |
| 4 | Design and implement a biometric system based on dynamic (on-line) signature. Feature vector extraction. | | |
| 5 | Performing experiments on different databases (public and acquired in the laboratory). | | |
| 6 | Users authentication, considering both random and skilled forgeries. | | |
| 7 | Results analysis and interpretation. Confusion matrix. ROC curves. Error rates (FAR and FRR) | | |

Bibliography

1. S.Z. Li (Editor), Anil K. Jain (Editorial Advisor), *Encyclopedia of Biometrics*, 2014, Springer
2. A. K. Jain, A. Ross, K. Nandakumar, *Introduction to Biometrics*, Springer, ISBN 978-0-387-77325-4
3. J.R. Vacca, *Biometric Technologies and Verification Systems*, 2007, Elsevier, ISBN: 978-0-7506-7967-1
4. A.K. Jain, A.A. Ross, K. Nandakumar, *Handbook of Multibiometrics*, 2006 Springer Science + Business Media, LLC, ISBN-13: 978-0-387-22296-7, New York, SUA\
5. S. Prabhakar, S. Pankanti, A.K. Jain, *"Biometric Recognition: Security and Privacy Concerns"*, IEEE Security & Privacy, pp 33-42, 2003.
6. D. Yeung, H. Chang et al., *"SVC2004: First International Signature Verification Competition",* Proceedings of the International Conference on Biometric Authentication (ICBA), Hong Kong, 15-17 July 2004.
7. S. Emerich, E. Lupu, *Biometric Security Systems* (in Romanian), U.T.PRESS, ISBN 978-606-737-153-6, 2016

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

Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

## 10. Evaluations

| Activity type | 10.1 | Assessment criteria | 10.2 | Assessment methods | 10.3 | Weight in the final grade |
|---|---|---|---|---|---|---|
| Course | | The level of acquired theoretical knowledge and practical skills | | - Summative evaluation written exam (theory and problems) | | - E, max 10 pts. 60% |
| Applications | | Each student will select an individual subject. The project must contain an applicative part and a scientific documentation (minimum 5 pages)<br><br>The level of acquired abilities | | Practical test | | - L, max. 10 pts. 40% |
| 10.4 Minimum standard of performance | | | | | | |
| $L \geq 5$ and $E \geq 4$ and $0.6E+0.4L \geq 4.5$ | | | | | | |

Date of filling in
01.07.2020

Course responsible
Associate Professor
Simina EMERICH, PhD

Teachers in charge of applications
Associate Professor
Simina EMERICH, PhD

Date of approval
in the department
1.01.2020

Head of Communications
Department
Professor Virgil DOBROTA, PhD