COURSE OUTLINE

(1) GENERAL

SCHOOL:	Engineering		
DEPARTMENT:	Electrical and Computer Engineering		
LEVEL OF STUDY:	Undergraduate		
COURSE UNIT CODE:	7.015	**SEMESTER**	7th
COURSE TITLE:	Voice and Natural Language Processing		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
Theory (Lectures)	4	3
Tutorial/Exercises	1	1
TOTAL	**5**	**4**

COURSE UNIT TYPE	Special background
PREREQUISITES	Special background
LANGUAGE OF INSTRUCTION/EXAMS	4.004 Signals and Systems
COURSE DELIVERED TO ERASMUS STUDENTS	Greek
WEB PAGE (URL)	YES (in English)

(2) LEARNING OUTCOMES

Learning Outcomes

Commercial speech processing and recognition applications have become very popular, a trend that is expected to continue with greater intensity in the coming years.

The course concerns the training in methods of electronic processing of oral and written speech. The course deals in a balanced way with topics related to both digital voice processing theory and modern applications, such as emotion recognition based on voice analysis or developing embodied Conversational Agents (ECAs) capable of conducting conversations with humans, both by understanding and by producing speech and / or facial expressions.

The course provides a comprehensive overview of all major modern speech processing areas: physiology and speech production model, signal analysis techniques, coding, amplification, quality assessment and recognition.

In the second major section the course will focus on the principles needed for understanding advanced speech processing technologies - from speech coding for the communication systems to the biomedical applications of voice analysis and recognition.

Upon completion of the course the student will have acquired the necessary knowledge and skills to:

- Know basic concepts of voice analysis and modeling.
- Implement feature extraction algorithms for applications of voice processing
- Implement computer systems and application for voice recognition and synthesis.
- Implement built-in conversational agents capable of conducting conversations with people, both by understanding and by producing speech, gestures and facial expressions.
- Implement basic tools for natural language processing

General Skills

- Search, analysis and synthesis of data and information, using the necessary technologies
- Decision making
- Autonomous work
- Teamwork
- Production of free, creative and inductive thinking

(3) SYLLABUS

Theoretical part of the course

The course deals with methods of electronic processing of oral and written speech and therefore has two basic modules.
In the first section the course will focus on the following areas:

- Voice modeling and analysis
- Models for voice production
  - Models of the voice tube
- Basic features of the voice signal
- Feature extraction techniques for voice processing applications
  - Short-time processing models
  - Fundamental frequency calculation algorithms and formants
  - Linear forecasting
  - Homomorphic processing
  - Cepstrum
- Modern voice coding techniques
- Introduction to voice recognition and hidden Markov models
- Statistical voice composition
- Application of recognition and voice synthesis and the VoiceXML language

The second section the course will focus on the following areas:

- Basic concepts of computational linguistics
- Lavenshtein distance and related algorithms
- Part-of-speech tagging
- Syntactic Analyzers and Statistical Syntax Analyzers tagging
- Basic language processing tools:
  - Regular expressions
  - Finite state machines
  - N-letter language models
  - Context free grammars
  - Tree decision models
  - Statistical models of syntactic analysis
  - Statistical models of semantic analysis
  - Dialog models and statistical translation models
- Text-to-speech synthesis
- Speech coding
- Automatic translation from text and voice signal

Laboratory part of the course

The laboratory part of the course through real cases of small-scale problems, will focus on the deeping of the respective theoretical knowledge.

(4) TEACHING METHODS - ASSESSMENT

MODE OF DELIVERY	In-Class Face-to-Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	Use of information and communication technology in teaching Use of information and communication technology in laboratory teaching Use of information and communication technology for communicating with the students using the electronic platform eClass

TEACHING ORGANIZATION	Method description / Activity	Semester Workload
	Lectures	26
	Coaching lectures	13
	Small individual practice tasks	16
	Group project	26
	Independent study	39
	Total Contact Hours	**120**
ASSESSMENT METHODS	**Theory**: Final written exam on the entire syllabus (100%). The exam includes theory questions (from 3 to 5) and practical exercises (from 1 to 2). **Laboratory**: The final grade results from the laboratory exercise (10%), the project (40%) and the final exam (50%). The assessment criteria are clearly stated in the detailed description of the course located in the relevant course area in eClass.	

(5) RECOMMENDED BIBLIOGRAPHY

Suggested Bibliography:

- *Discrete-Time Processing of Speech Signals, John R. Deller; John H. L. Hansen; John G. Proakis, Wiley-IEEE Press, ISBN: 9780470544402*
- *Speech and Language Processing (3rd ed. draft), Dan Jurafsky and James H. Martin, Prentice Hall/Pearson, 2018*
- *Discrete Time Processing Of Speech Signals, John R. Jr Deller, ISBN: STANFORD:36105028585797 (eBook)*
- *Discrete Time Speech Signal Processing, Thomas F. Quatieri, ISBN : 9780132441230 (eBook)*
- *Lecture slides of the course will also be available in eClass. Appropriate scientific articles are given as material in each thematic unit of the course.*
- *Instructor notes*

Related scientific journals:

- *IEEE/ACM Transactions on Audio, Speech and Language Processing*
- *IEEE Transactions on Speech and Audio Processing*
- *IEEE Signal Processing*