UNIVERSITY OF WEST ATTICA

FACULTY OF ENGINEERING

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

MSc by Research in Electrical - Electronics Engineering

A.09 Course Modules Description

Table of Contents

Note: The Curriculum of this MSc Program does not include an Internship.

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING			
ACADEMIC UNIT	Department of Electrical and Electronics Engineering			
LEVEL OF STUDIES	Graduate (MSc)			
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering			
COURSE CODE	MRES.A.01	SEMESTER	A	
COURSE TITLE	Research Methodology - Scientific Writing			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			WEEKLY TEACHING HOURS	CREDITS
	Lectures		3	6
	Lab		0	
	Total		3	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).				
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Postgraduate skills development			
PREREQUISITE COURSES:	None			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes			
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-a-01-research-methodology-scientific-writing/ & https://eclass.uniwa.gr/courses/REEE101/			

(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*

This course module primarily aims at student skills development at the graduate level, on the issues of (a) research methodology and (b) scientific writing.

Upon successful completion of the course, students are expected to be able to:

1. Understand and explain the difference between research and development,
2. Appreciate the role of English language mastery in order to write scientific texts in Science and Engineering,
3. Understand and correctly apply basic quantitative and qualitative research methods,
4. Understand, and adopt research ethics, proper citation and plagiarism avoidance,
5. Perform bibliographic search and retrieval of pertinent information,
6. Understand and explain how is research is carried out and how it is connected to the presentation of results in the form of an article,
7. Construct and organize correctly a typical scientific article,
8. Develop correctly the parts of a scientific article,
9. Put together sound argumentation and produce accurate citation and referencing,
10. Author / compose and correctly format the content, references etc. of a scientific article,
11. Understand and correctly apply the scientific article submission process and the review process,
12. Evaluate and review scientific articles and compose / author paper review reports,
13. To compose / author responses to reviewers.

Keywords: Research Methodology, Research Ethics, Scientific Writing, Scientific Articles, Literature Search, Scientific Journals and Conferences.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search, analysis and synthesis of data and information, using the necessary technologies.
- Adaptation to new situations.
- Decision making.
- Autonomous work.
- Teamwork.
- Work in an interdisciplinary environment.
- Promoting free, creative and inductive thinking.
- Conduction of research.
- Presentation of research results in the form of a scientific article.

(3) SYLLABUS

The contents of the module are outlined as follows:

1. Introduction to research terminology, basic and applied research, research design and implementation issues, support – explanatory material development, publication and dissemination of research results.
2. Quantitative and qualitative research methods overview.
3. Research ethics, intellectual property rights, avoidance of plagiarism.
4. International scope of research results publication (journals, conferences, workshops), prestige and renown of publication sources and means, access to published material (membership / open-access), publication review process and publications management.
5. Bibliographic databases, search and retrieval of information through modern web tools.
6. Formal referencing and citation styles (Chicago, Harvard, APA, etc.).
7. Scientific text authoring (reports, articles, abstracts, presentations). Structure, contents, formatting, terminology, use of language and expression. Practice on examples from the field of Electrical and Electronics Engineering.
8. Software tools (text editors, such as LaTeX, etc.) for scientific text preparation and formatting (text, tables, mathematical formulas, etc.). Collaborative editing, versioning and commenting methods and tools.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Synchronous distance learning (e-learning) (MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	- Support of the learning process using power point presentations - Electronic communication with students - Support of the learning process through the Open eClass electronic platform

TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lecture attendance	40
Study of theory, lectures and literature	40
Unguided literature study, solving exercises and preparing a final course examination.	36
Writing a scientific article, review a scientific article.	64
Course total	***180***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The final grade is composed of 3 parts: (a) sample regular paper or short review paper write-up (student is free to select paper subject; supervisor consent is required; the subject is usually related to the student's research project topic) x 60%, (b) the presentation of this paper in class x 20%, (c) the review of the paper written by a classmate x 20%. Grading criteria for (a): • Paper structure, • Understanding and critical assessment of existing research, • Sound documentation of and argumentation on the proposed research results, • Correct formatting and referencing. Grading criteria for (b): • Presentation structure, • Content formatting, • Fluency in presentation and ability to answer questions on it. Grading criteria for (c): • Review structure, • Control points as in (a) and (b) above, used as review criteria, • Expression, language and style of the review.

(5) ATTACHED BIBLIOGRAPHY

BIBLIOGRAPHY

1. Research Methodology and Scientific Writing, C. George Thomas, Second Edition, 2021, Springer Cham, ISBN: 978-3-030-64864-0, DOI: https://doi.org/10.1007/978-3-030-64865-7.
2. Writing for Science and Engineering, Heather Silyn-Roberts, Second Edition, 2013, Elsevier, ISBN: 978-0-08-098285-4, DOI: https://doi.org/10.1016/C2011-0-07858-4.
3. Scientific Papers and Presentations, Martha Davis, Kaaron J. Davis and Marion M. Dunagan, Third Edition, 2013, Elsevier, ISBN: 978-0-12-384727-0, DOI: https://doi.org/10.1016/C2009-0-64256-2.
4. Scientific Papers and Presentations, by Martha Davis. Academic press, 1997
5. Publications Handbook and Style Manual, Chapter 5. Tables and Figures, ASA–CSSA–SSSA, 5585 Guilford Rd., Madison, WI 53711, USA.

RESEARCH ARTICLES

6. S. R. N. Reis and A. I. Reis, "How to write your first scientific paper," 2013 3rd Interdisciplinary Engineering Design Education Conference, Santa Clara, CA, USA, 2013, pp. 181-186, DOI: https://doi.org/10.1109/IEDEC.2013.6526784.
7. C. A. Linte, "Tips on Scientific Writing and Manuscript Preparation [Continuing Education]," in IEEE Pulse, vol. 5, no. 6, pp. 58-60, Nov.-Dec. 2014, DOI: https://doi.org/10.1109/10.1109/MPUL.2014.2355322.
8. J. A. Longo, Preparing a Research Paper in IEEE Format, on-line available: https://www.unlv.edu/sites/default/files/page_files/27/Engineering-PreparingPaperIEEE-Sept15.pdf (last access: 8/2/23).
9. J. Gain, Research Methods: Technical Writing, on-line available: https://slideplayer.com/slide/4401286/ (last access: 8/2/23).
10. K. Sainani, Scientific Writing, on-line available: https://web.stanford.edu/~kcobb/courses/writing/ (last access: 8/2/23).
11. Measuring Your Impact: Impact Factor, Citation Analysis, and other Metrics: Journal Impact Factor (IF), University Library, on-line available: https://researchguides.uic.edu/if/impact (last access: 8/2/23).

TOOLS

- LaTeX: https://www.latex-project.org/

WEBSITES

- https://dl.sciencesocieties.org/publications/style
- http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWtoc.html
- https://www.springer.com/gp/authors-editors/authorandreviewertutorials/writing-a-journal-manuscript/figures-and-tables/10285530
- https://www.elsevier.com/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously#step1

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.A.02	SEMESTER	A
COURSE TITLE	Scientific Computing and Mathematical Modeling		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
	Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background		
PREREQUISITE COURSES:	1. Undergraduate courses on Mathematical Analysis 2. A course on Introduction to Linear Algebra 3. A course on programming (Matlab, Python, Julia, R, …) 4. A course on Numerical Analysis (optional).		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-a-02-scientific-computing-and-mathematical-modeling/ & https://eclass.uniwa.gr/courses/REEE102/		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course, students are expected to be able to:

- comprehend basic scientific programming methodologies for solving mathematical problems,
- implement solutions using the capabilities provided by modern scientific programming environments rather than programming them from scratch;
- understand the mathematical framework of the problem they want to solve,
- analyze the mathematical problem and choose the appropriate parameters to use,
- argue for the appropriate solution method,
- develop solutions by selecting and applying the appropriate tools provided by modern computing environments,
- analyze, evaluate and compare the solutions to other available,
- develop reports that present the calculations results and evaluate with arguments their correctness and quality characteristics.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Analytical and synthetic work with complex Mathematical concepts to solve problems in basic fields of science and Engineering.
- Use of modern Mathematical Software for the implementation of solutions in scientific programming environments.
- Autonomous work.
- Teamwork.
- Ability to convert basic physical problems into corresponding mathematical-computer problems.
- Production of free, creative and inductive thinking.
- Analysis and synthesis of Mathematical processes with the use of the computer.
- Working in an interdisciplinary environment.

- Critical thinking and decision making depending on the solution of the Mathematical Problem.

3. SYLLABUS

The course syllabus consists of the following units.

Unit 1: Mathematical Modeling

Deterministic and stochastic mathematical models. Mathematical modeling with dynamic systems and differential equations.

Unit 2: Introduction to Scientific Programming (S.P.), Modern S.P. Environments. Computer Errors

Solving mathematical problems in scientific programming environments (Matlab, Mathematica, Python, Fortran). Numerical and symbolic calculations on a computer. Double, quadruple and higher precision calculations. Numerical calculation errors on the computer.

Unit 3: Numerical Linear Algebra in S.P. environments

Numerical Linear Algebra Methodologies in an S.P. environment. (solving linear systems, factorizations of matrices, calculation of eigenvalues, SVD).

Unit 4: Methodologies of approximation of functions and scientific data in S.P. environments.

Interpolation and Approximation of functions and data. Interpolatory Procedures. Least Squares Approximation. Statistical processing and data analysis methodologies.

Unit 5: Optimization Methodologies in S.P. Environments

Optimization Methodologies with or without conditions. Finding minimum of cost functions with classical or differential-evolutionary algorithms. Solving equations of non-linear systems.

Unit 6: Differentiation, Integration, Differential Equations

Numerical Integration and Differentiation. Numerical Solution of Ordinary Differential Equations. Methodologies of solving Partial Differential Equations.

Unit 7: Introduction of parallel computation in modern S.P. Environments

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance Learning (Synchronous, MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for distance learning classes (weekly) • E-class for course content support and teacher-student-class communication • Mathematical software and tools (Matlab, Mathematica, Python, Fortran) for the subjects taught.

TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
Lectures	39
Study learning content	61
Bibliography study, solution of exercises	30
Projects preparation	30
Final Exam preparation	20
Course total	***180***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Student performance evaluation comes form: • Participation in the educational process and contribution to discussions that take place (20% of the final grade) • Assignment average (best 3 out of a total of 4, 40% of final grade). Assignments are submitted via eclass. • Final written exam using a computer (40% of final grade).

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Numerical Analysis, Burden R., Faires J. D, Brooks\Cole.
- A First Course in Numerical Analysis, A. Ralston, Ph. Rabinowitz, Mc Graw Hill.
- Numerical Methods using Matlab, J. Mathews, K. Fink, Pearson Prentice Hall.
- Applied Numerical Analysis, C. Gerald, P. O. Wheatley, Addison Wesley.
- Applied Numerical Analysis Using Matlab, L. Fausett, Pearson Prentice Hall.
- Numerical Methods for Engineers, With Software and Programming Applications Fourth Edition, S.C. Chapra, R.P. Canale, MC Graw Hill, 2002
- Numerical Python, Scientific Programming and Data Science Applications with Numpy, Scipy and Matplotlib, R. Johansson, Apress
- Practical Numerical and Scientific Computing with MATLAB and Python, 1st edition, Eihab B. M. Bashie, CRC Press
- Learning Scientific Programming with Python, Christias Hill

Related Scientific Journals:

- SIAM Journal on Numerical Analysis
- International Journal for Numerical Methods in Engineering
- Applied Numerical Mathematics
- Journal of Computational and Applied Mathematics
- Numerical Algorithms
- Numerische Mathematik
- Scientific Programming

TOOLS

- Matlab: https://www.mathworks.com/products/matlab.html
- Mathematica: https://www.wolfram.com/
- Wolfram Alpha: https://www.wolframalpha.com/
- Python: https://www.python.org/
- scipy: https://scipy.org/
- Julia: https://julialang.org/
- R: https://www.r-project.org/

WEBSITES

- https://scipython.com/
- https://earthlab.colorado.edu/blog/what-scientific-programming-and-why-it-rocks
- https://sciprog.center/
- https://www.opensourceforu.com/2011/05/what-is-scientific-programming/

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.A.03	SEMESTER	A
COURSE TITLE	Supervised Research I		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
Supervised Research Work		N/A	18
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge, Skills development		
PREREQUISITE COURSES:	(-)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-a-03-supervised-research/ & https://eclass.uniwa.gr/courses/REEE103/		

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of this course module, the student is expected to be able to:

- State, explain and categorize major research methodologies; select the appropriate one for the problem at hand,
- Perform a literature review of the selected research topic to get acquainted with the state of the art,
- Compare, contrast and critique published solutions/approaches on the selected research topic,
- Discern a gap in knowledge and/or technology that is worth addressing at the MSc level,
- Analyze the problem(s) or issue(s) related to this gap,
- Write and orally defend an extended technical report on the problem to be addressed, the literature review, the planned experimental procedure and the results sought.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Production of new research ideas
- Project planning and management
- Production of free, creative and inductive thinking

3. SYLLABUS

Supervised Research I is the first part of research on the topic selected by the student upon enrollment.

1. Typically, this first part involves a literature review of the field, so as to get acquainted with the state of the art, and to compare, contrast and critique published solutions/approaches in an attempt to discern a gap in knowledge and/or technology that is worth addressing at the MSc level.
2. Further on, the student analyzes the problem(s) or issue(s) related to this gap, sets relevant hypotheses and plans and organizes an experimental plan to verify or reject them.

3. By the end of the semester, the student prepares a detailed Technical Report including all progress made during the semester, as well as the schedule of next semester research steps.
4. Technical Report I is written according to the respective template, is submitted by the student and is orally presented and defended in front of the supervising committee who grades it.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Laboratory work and measurements, Distance Learning (Synchronous, MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for research supervision (weekly) • E-class for course content support and teacher-student communication • Pertinent mathematical / modelling / simulation software and tools (e.g., Matlab, Mathematica, Python, SPSS, etc.) depending on the specific research topic undertaken.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	*Activity* / *Semester workload* study and analysis of bibliography — 260 laboratory work — 130 essay writing (technical report I) — 130 preparation of oral presentation of research results — 20 **Course total** — ***540***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other*	The results of supervised research achieved in the 1st semester of study are evaluated on the basis of Technical Report I. This is written by the student, turned in in paper and in electronic form by the end of the semester, orally presented to the evaluation committee within the examination period, graded by the supervising committee and filled by the secretariat. The supervising committee may (i) Accept Technical Report I as it is. (ii) Return Technical Report I to the student along with written comments for improvement. In that case, the student advances to the 2nd semester and continues his/her research, with the obligation to submit and present the

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	improved Technical Report I along with Technical Report II by the end of the 2nd semester of study. (iii) Reject Technical Report I. In that case, the student fails in MRES.A.03 and has to repeat it. An accepted Technical Report I is graded by the examination committee on the basis of the set of defined evaluation criteria and grade breakdown, as detailed in the MSc Program Study Regulation. The final grade is the average of the grades given individually by each committee member. The committee submits the signed Technical Report I evaluation form to the Secretariat. The Technical Report I evaluation form along with the detailed criteria and grade breakdown per criterion can be found in the "BIBLIOGRAPHY" tab, within the course module webpage https://mres.eee.uniwa.gr/mres-a-03-supervised-research/ .

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- As designated by the supervisor, according to the specific research topic undertaken.

Related Scientific Journals:

- As designated by the supervisor, according to the specific research topic undertaken.

TOOLS

- As designated by the supervisor, according to the specific research topic undertaken.
- Matlab: https://www.mathworks.com/products/matlab.html
- Mathematica: https://www.wolfram.com/
- Wolfram Alpha: https://www.wolframalpha.com/
- Python: https://www.python.org/
- scipy: https://scipy.org/
- Julia: https://julialang.org/
- R: https://www.r-project.org/

WEBSITES

- As designated by the supervisor, according to the specific research topic undertaken.

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.B.01	SEMESTER	B
COURSE TITLE	Science, Technology, Society: From History to Policy		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
Lectures		3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-b-01-science-technology-society-from-history-to-policy/ & https://eclass.uniwa.gr/courses/REEE105/		

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course, students are expected to:

(1) Use, compare and critique select concepts from the STS interdisciplinary field, with special emphasis on Gabrielle Hecht's "technopolitics", Thomas Hughes' "large technological systems" and David Edgerton's "technology in use".
(2) Understand, apply and defend the historicity of the relation between technology and society.
(3) Distinguish and assess the technopolitical aspects of contemporary challenges, including (a) "Artificial intelligence" and "technological unemployment", (b) Immigration, (c) Gender issues, (d) Environmental degradation, (e) Disability, (f) "Resource wars" and state conflict, (g) Energy transitions, (h) The "biomedical revolution".
(4) Demonstrate awareness of the social implications of their research and be able to analyze and evaluate said implications in written form.
(5) Discern social issues or challenges when they arise in their professional conduct and design future directions accordingly.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Working in an interdisciplinary environment
- Adapting to new situations
- Respect for difference and multiculturalism
- Respect for the natural environment
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking

3. SYLLABUS

This course module introduces students to the Science Technology and Society (STS) interdisciplinary field. First, students are introduced to select concepts such as the Social Construction of Technology, Technopolitics, and Large technological systems. Then these concepts are applied to concrete aspects of the relation between society and technological and scientific change. Such aspects include: (a) Production technologies. (b) Environmental technologies. (c) Transport technologies. (d) Energy technologies. (e) Information Computation and Telecommunication Technologies. (f) Biotechnologies.

The lectures are also based on 19th and 20th century Greek and international history. Students are introduced to select narratives and debates from labour history, economic history, social history and diplomatic history.

All lectures are designed to produce discussion of current problems and challenges. This includes the discussion of topics such as (a) Geopolitics and International relations (b) Class, Racial and Gender discrimination (c) State policy (d) Emigration (e) Environmental issues. These topics come to the fore via selected abstracts taken from the daily press, and are discussed in conjunction with their often obscured technical aspects.

Syllabus:

A. Introduction

1. Introductory Concepts I
   - Is “technology” a “hazardous concept”?
   - Technological determinism
   - Large technological systems
2. Introductory concepts II
   - The Social Construction of Technology
   - Technology in use
   - Actor network theory
   - Technopolitics
   - Socio-technical imaginaries

B. First industrial revolution

3. Machinery, workers and worldviews in an age of cotton
   - The steam engine, the spinning mule, the watch
   - The historicity of the concept of “time”
   - Disassociating “labour” from “nature”
   - On “moral economy” and “technological revolutions”

C. Second Industrial Revolution

4. Taylorism
   - Management, engineering, and the organization of work – a history
   - Computation and the workplace
   - Taylorism today – software platforms and “smart” technologies
5. Fordism
   - Origins of the assembly line
   - Spaces of production and spaces of reproduction of labour power
   - The emergence of a “fordist” world

- Immigration during a technological revolution: from the early 20th to the early 21st century.

6. Transport
   - The early twentieth century transport revolution
   - The emergence of "geopolitics"
   - Technological accidents
   - Social ramifications of the "self-driving" car
   - Geopolitics and transport technologies today: the Chinese "belt and road" initiative.
7. Energy I – The oil century
   - The transition from coal to oil – Energy and geopolitics
   - The rise of petroleum engineering – A deeply political discipline
   - Oil in the World Wars of the 20th century
   - Hydrocarbon exploration, energy transition and war in the 21st century – The Greek case

D. Third Industrial Revolution

8. Energy II – Nuclearity
   - Material configurations and state policies
   - International relations in the Cold War
   - Experts and expertise – technopolitics
   - Contemporary notions of "nuclear" – Ramifications of the AUKUS treaty
9. Information I – Calculation and computation
   - Computation and labour
   - Computing in the Cold War
   - The historicity of "computing"
   - Social gender and technology
10. Environmental challenges
    - The emergence of the "environment" – another "hazardous concept"?
    - Energy technologies and the environment
    - Energy transitions – geopolitics and environmental concerns in the Ukranian war and beyond

E. Towards a fourth industrial revolution

11. Information II – Artificial intelligence and big data
    - Artificial intelligence and the "end of work"
    - Historical and philosophical dimensions of the Turing machine
    - Video games –between work and the reproduction of labour power
    - A world of "big data"
12. Biomedical technologies
    - "Genealogy", "power", "knowledge" and "technology" according to Michel Foucault
    - "Performativity", as seen in the case of anti-epidemic masks
    - The Intensive Care Unit: History of a peculiar "black box"
    - Technology and expertise in the recent pandemic
13. Wasn't the future wonderful? History, technology and futurism in times of crises
    - Course overview
    - Past and future of the relation between society and technology

4. TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Distance Learning (Synchronous, MS Teams)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• E-class for course content support and teacher-student-class communication
• Google platform for seeking primary sources
• Jstor and Project Muse platforms for seeking secondary sources
• MS Powerpoint or similar for lecture presentation</td></tr>
<tr><td>TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures</td><td>39</td></tr><tr><td>Study learning content</td><td>64</td></tr><tr><td>Composition of written essays</td><td>64</td></tr><tr><td>Presentation of written essays</td><td>13</td></tr><tr><td>Course total</td><td>180</td></tr></table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>• Student performance evaluation comes from
1. 12 three-page essays that are composed individually by each student on a weekly basis
2. Individual student participation in the weekly discussions that follow.
• Students deliver their essays by e-mail before each respective lecture. The instructor reads the essays and prepares the respective discussion. Plagiarism is checked by the instructor upon discussing the essays.
• Essays are evaluated in terms of
(1) Coverage of the topic in breadth and depth (30%)
(2) Use of STS concepts (20%)
(3) Quality of the results (25%)
(4) Participation in the discussion that follows (25%)</td></tr>
</table>

5. ATTACHED BIBLIOGRAPHY

The sources listed below are divided by lecture. The first source cited in each section is required reading (for books, this means the reading of selected chapters). The rest of the sources are used by the instructor to inform the lecture and are accessible to students who are interested in further reading suggestions.

A. Introduction

1. Introductory Concepts I
   - Leo Marx, "'Technology': The Emergence of a Hazardous Concept", *Social Research,* Vol. 64, No. 3, 1997.
   - Wiebe Bijker, Thomas Hughes & Trevor Pinch (eds.), *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology,* MIT Press, 1993, ([1]1987).
   - Merrit Roe Smith & Leo Marx (eds.), *Does Technology Drive History? The Dilemma of Technological Determinism,* MIT Press, 1994.
2. Introductory Concepts II
   - Gabrielle Hecht and Michael Thad Allen, "Authority, Political Machines, and Technology's History", in Gabrielle Hecht and Michael Thad Allen (eds.), *Technologies of Power: Essays in Honor of Thomas Parke Hughes and Agatha Chipley Hughes,* MIT Press, 2001.
   - Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society,* Harvard University Press, 1987.
   - Sheila Jasanoff & Sang-Hyun Kim, "Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea", *Minerva,* vol. 47, 2009.
   - David Edgerton, 'From Innovation to Use: Ten Eclectic Theses on the Historiography of Technology', *History and technology: An International Journal,* Vol. 16, No. 2, 1999.

B. First industrial revolution

3. Machinery, workers and worldviews in an age of cotton
   - Robert Friedel, *A Culture of Improvement: Technology and the Western Millennium,* MIT Press, 2007.
   - Sven Beckert, *Cotton: A Global History,* Alfred A. Knopf, 2014.
   - E. P. Thompson, "Time, Work-Discipline, and Industrial Capitalism", *Past & Present,* No. 38, 1967.
   - Edward Jones-Imhotep, "The Ghost Factories: Histories of Automata and Artificial Life", *History and Technology,* Vol. 36, No.1, 2020.

C. Second Industrial Revolution

4. Taylorism
   - Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century,* Monthly Review Press, 1974.
   - Merrit Roe Smith, "Industry, Technology and the 'Labor Question' in 19th-Century America: Seeking Synthesis", *Technology and Culture,* Vol. 32, no. 3, 1991.
   - Thomas J. Misa, "The Reform of Factories, 1895-1915", in Thomas J. Misa, *A Nation of Steel: The Making of Modern America, 1865-1925,* Johns Hopkins University Press, 1995.
   - Christos Karampatsos, «'Μαγικό Εργαλείο αυτός ο Υπολογιστικός Κανόνας!': Η Τεχνοπολιτική Διάσταση και η Ιστοριογραφική Σημασία της κατά Φρέντερικ Τέιλορ 'Επιστημονικής Οργάνωσης της Εργασίας» [A Magic Instrument that Slide Rule! On the Technopolitical Dimension and Historiographical Significance of Frederick W. Taylor's 'Scientific Management'], *Nefsis,* vol. 27-28, 2021.
   - Allessandro Delfanti and Bronwyn Frey, "Humanly Extended Automation or the Future of Work Seen through Amazon Patents", *Science, Technology and Human Values,* Vol. 20, 2020.
5. Fordism
   - David Hounshell, *From the American System to Mass Production, 1800-1932,* John Hopkins University Press, 1984.
   - Stephen Meyer III, *The Five Dollar Day: Labor Management and Social Control in the Ford Motor Company, 1908-1921,* State University of New York, 1981.

- Ruth Schwartz Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave,* Basic Books, 1983.
- David Nye, *America's Assembly Line,* MIT Press, 2013.

6. Transport
   - Christos Karampatsos, "Efrosini Crossing Syngrou Avenue: Automobile Accidents and the Introduction of the Automobile in Greece, 1900-1911", *History of Technology,* Vol. 33, 2017.
   - Halford J. Mackinder, "The Geographical Pivot of History", *The Geographical Journal,* Vol. 23, No. 4, Apr, 1904.
   - Wolfgang Schivelbusch, *The Railway Journey: The Industrialization of Time and Space in the Nineteenth Century,* University of California Press, 2014.
   - Ulrich Beck, "From Industrial Society to the Risk Society: Questions of Survival, Social Structure and Ecological Enlightenment", *Theory, Culture and Society,* Vol. 9, 1992.
   - Graeme Gooday, *Domesticating Electricity: Technology, Uncertainty and Danger, 1880-1914,* Pickering and Ghatto, 2008.
7. Energy I – The oil century
   - Daniel Yergin, *The Prize: The Epic Quest for Money, Oil and Power,* Simon and Schuster, 2008, ([1]1991).
   - Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil,* Verso, 2011
   - Philippe Le Billion, *The Geopolitics of Resource Wars,* Frank Cass, 2005.
   - Christos Karampatsos, Spyros Tzokas and Giorgos Velegrakis, "The Endless Potentiality: A Century and a Half of Greek Oil Aspirations (and what often becomes of them)", *Journal of Energy History,* vol. 10, 2023.

D. Third Industrial Revolution

8. Energy II – Nuclearity
   - Gabrielle Hecht, "Political Designs: Nuclear Reactors and National Policy in Postwar France", *Technology and Culture,* Vol. 35, No. 4, 1994.
   - Stathis Arapostathis, Aspasia Kandaraki, Yannis Garyfallos and Aristotle Tympas, «'Tobacco for Atoms': Nuclear Politics, Ambivalences and Resistances about a Reactor that was Never Built», *History of Technology,* Vol. 33, 2017.
   - Maria Rentetzi, "Gender, Science and Politics: Queen Frederika and Nuclear Research in Post-war Greece", *Centaurus,* Vol. 51, 2009
9. Information I – Calculation and computation
   - Jennifer Light, "When Computers Were Women", *Technology and Culture,* Vol. 40, No. 3, 1999.
   - Aristotle Tympas, *Calculation and Computation in the Pre-electronic Era: The Mechanical and Electrical Ages,* Springer, 2017.
   - Andrew Warwick, "The Laboratory of Theory, or What's Exact About the Exact Sciences?", in M. Norton Wise (ed.), *The Values of Precision,* Princeton University Press, 1995.
   - Lorraine Daston, "Calculation and the Division of Labour, 1750-1950", *Bulletin of the German Historical Institute,* Vol. 62, 2017.
10. Environmental challenges
    - Joel Tarr, *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective,* The University of Akron Press, 1996.
    - George Kennan, "To Prevent a World Wasteland: A Proposal", *Foreign Affairs,* Vol. 48, No. 3, Apr. 1970.
    - Robert Gottlieb, *Forcing the Spring: The Transformation of the American Environmental Movement,* Island Press, 2005.
    - Frank Uekoetter, "The Strange Career of the Ringelmann Smoke Chart", *Environmental Monitoring and Assessment,* Vol. 106, 2005

E. Towards a fourth industrial revolution

11. Information II – Artificial intelligence and big data
    - Matteo Pasquinelli, *The Eye of the Master: A Social History of Artificial Intelligence,* Verso, 2023.

- Colin Garvey, "Broken Promises and Empty Threats: The Evolution of AI in the USA, 1956-1996", Technologystories.org, https://doi.org/10.15763/jou.ts.2018.03.16.02, 2018.
- Christine von Oertzen, "Machineries of Data Power: Manual versus Mechanical Census Compilation in Nineteenth-Century Europe", *Osiris,* Vol. 32, 2017.
- Hubert Dreyfus, *What Computers Still Can't Do: A Critique of Artificial Reason,* MIT Press, 1992.
- Bruno Strasser and Paul Edwards, "Big Data Is the Answer... But What is the Question?", *Osiris,* Vol. 32, 2017.
- Alexander Galloway, *Gaming: Essays on Algorithmic Culture*, University of Minnesota Press, 2006.
- Shoshana Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power,* Public Affairs, 2019.
- Simon Schaffer, 'OK Computer', in Michael Hagner (ed.), *Ecce Cortex: Beitraege zur Geschichte des modernen Gehirns*, Wallstein Verlag, 1999.
- George Caffentzis, "Why Machines Cannot Create Value, or Marx's Theory of Machines", στο Jim Davis, Thomas Hirschl & Michael Stark (επιμ.), *Cutting Edge: Technology, Information, Capitalism and Social Revolution,* Verso, 1997.

12. Biomedical technologies
    - Nancy Kentish – Barnes, "'Death Organized by the Doctor': End of Life Decisions in Intensive Care Units", *Revue Française de Sociologie,* Vol. 50, 2009.
    - Michel Foucault, *Discipline and Punish: The Birth of the Prison,* Vintage Books, 1995 ([1]1975).
    - Christos Lynteris, "Plague Masks: The Visual Emergence of Anti-Epidemic Personal Protection Equipment", *Medical Anthropology,* Vol. 37, No. 6, 2018.
    - John Luce & Douglas White, "A History of Ethics and Law in the Intensive Care Unit", *Critical Care Clinic,* no. 25, 2009.
    - Samuel Cohn Jr., *Epidemics: Hate and Compassion from the Plague of Athens to AIDS,* Oxford University Press, 2018.
13. Wasn't the future wonderful? History, technology and futurism in times of crises
    - Paul Ceruzzi, "An Unforeseen Revolution: Computers and Expectations, 1935-1985", in Joseph Corn, *Imagining Tomorrow: History Technology and the American Future,* MIT Press, 1986.
    - Claudia Castaneda & Lucy Suchman, "Robot Visions", *Social Studies of Science,* Vol. 44, No. 3, 2014.

TOOLS:

Each lecture is supported by a specially prepared Power Point presentation. Presentations change over time according to students' feedback. Short video streams are also occasionally used. In selected instances, the instructor and students jointly locate primary and secondary sources using platforms such as google.com, Jstor.org and Project MUSE.

WEBSITES:

Selected contemporary newspaper articles accompany each lecture. Students read these articles during the course of each lecture and comment on them using the concepts and approaches suggested in the bibliography. The list of newspaper articles is kept up-to-date and changes over time, taking into account the students' contribution.

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.B.02.01	SEMESTER	B
COURSE TITLE	Selected Topics in image Processing and Computer Vision		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
LECTURES	1	2
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge
PREREQUISITE COURSES:	*None:* *However:* We will assume you have a basic level of expertise in programming, computer science, and mathematics, especially linear algebra and probabilities. For example if you are unfamiliar with the topics of elementary linear algebra or calculus, then you might want to consider to introduce yourself to them: without these tools, most likely you will struggle with the course. Concretely, we will assume that you are familiar with the following topics; they will not be reviewed in class: • Linear Algebra: In addition to basic matrix and vector operations, it will be good to know least squares, Eigen- and singular-value decompositions. • Calculus: You should be comfortable with the chain rule, and taking gradients and partial derivatives of vector-valued functions.

	• **Probabilities**: It is desirable to know basic postulates of probability theory, including the concepts of multi-variable distributions. • **Programming,** including algorithms and data structures. • **Matlab**: Potential course assignments will involve programming in Matlab. You should either have prior experience, or be able to quickly learn a new language. *Desirable*: • **Python-PyTorch**: You should either have prior experience, or be able to quickly learn this exciting language and machine learning library.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/REEE108/ & https://mres.eee.uniwa.gr/mres-b-02-01-selected-topics-in-image-processing-and-computer-vision/

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
Upon successful completion of the course, students are expected to be able to: 1) Summarize and distinguish the terms computer vision - computer vision and image processing 2) Identify the general principles of image processing by applying image processing techniques such as: a) Image enhancement with histograms b) Image transformations in the space and frequency domain. 3) Understand the main concepts that concern the relevant contemporary research and organize research directions such as: a) Feature detection from images b) Extracting features from images 4) Recommend, apply, operate and practice basic image processing algorithms (Canny, SIFT, SURF,

Harris, etc.)
5) Recommend, apply, operate and practice basic low-level feature learning algorithms with data-driven computational learning techniques (Bag of Visual Words, Sparse Coding and Dictionary Learning, etc.)
6) Analyze and organize an image processing problem and recommend the required solutions through the application of appropriate algorithms and transformations.
7) Analyze a computer vision problem and synthesize solutions through the appropriate algorithm - Machine Learning tool.
8) Comparatively evaluate the main visualization tools and choose the appropriate one for a given application problem among:
   a) Noise reduction – denoising.
   b) Image reconstruction
9) Create and develop visualizations of the data, as for example in the creation of visual dictionaries or individuals and especially in the case of sparse representation and dictionary learning.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision-making
- Working independently
- Team work
- Production of new research ideas
- Project planning and management
- Production of free, creative and inductive thinking

3. SYLLABUS

Computer vision is perhaps one of the most thrilling fields which combines the concepts of data-driven Machine Learning and image processing. Computer vision exists in numerous applications ranging from Navigation, e.g., by any type of an autonomous vehicle; document analysis and understanding, mixed reality etc. The course contains selected topics in computer vision and pattern recognition. An extended syllabus contains the following topics:

- A review on image processing and computer vision methods. Image transforms, image compression & morphological transformations.
- Feature detection and extraction. Edge detection: Lines, edges and ridges with the Sobel, Prewitt, Roberts and Canny operators.
- Feature detection and extraction. Corner detection: the role of Hessian and the Harris operator.

- Feature detection and extraction. Blob detection with Laplacian of Gaussian (LoG) and Difference of Gaussian (DoG).
- Data-driven feature detection and extraction. Identification and coding of Regions of Interest (ROI). Key-point detection and visual descriptor with the Scale-invariant feature transform (SIFT). Local correspondence and the RANSAC algorithm.
- Image matching and recognition by considering image features as words. The Bag-of-visual-words model.
- Special topic: Dictionary learning (DL) and sparse representation (SR) methods: The K-SVD & OMP pairs of algorithms.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance Learning (Synchronous, MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for distance learning classes (weekly) • E-class for course content support and teacher-student-class communication • Matlab or similar for project work • MS Powerpoint or similar for project presentation
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	*Activity* / *Semester workload* Lectures: 8 Study learning content: 17 Project preparation: 30 Project presentation: 5 Course total: *60*
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	• Student performance evaluation comes from 3. Homework Assignments (30%): There will be two programming assignments over the course. The first assignment is worth 15% while the other assignment is worth 15% (individual or teamwork, depending on the number of enrolled students per year) 4. Course Project (70%): A computer vision related project. (individual or teamwork, depending on the number of enrolled students per year) • Projects are turned in in electronic form. Plagiarism is checked by TURNITIN (20% max similarity) • The use of LLM (e.g., ChatGPT or similar) is strongly discouraged as non-scientific; in case is has to be

	used, the student must clearly state which part of the project and for which specific reasons had to be generated by such models.
	• Projects are evaluated in terms of
	  • Coverage of the topic in breadth and depth (30%)
	  • Suitability of the approach/method (20%)
	  • Quality of the results (25%)
	  • Presentation (25%)

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

i. *Computer Vision: Algorithms and Applications* by Richard Szeliski. Available for free online here
ii. *Computer Vision: A Modern Approach (Second Edition)* by David Forsyth and Jean Ponce. Available for free online here:
iii. *Elements of Statistical Learning* by Trevor Hastie, Robert Tibshirani, and Jerome Friedman. Available free pdf online here.
iv. *Multiple View Geometry in Computer Vision (Second Edition)* by Richard Hartley and Andrew Zisserman. Available for free pdf online here
v. *Digital Image Processing*, by R. C. Gonzalez and R. E. Woods 4th edition.

- Related academic journals:

1. An anthology of research papers offered by:

A. Computer Vision Foundation. openaccess.thecvf.com/menu. Research papers from top notch conferences such as:

- *Computer Vision & Pattern Recognition (CVPR)*
- *International Conference on Computer Vision (ICCV)*
- *Winter Applications on Computer Vision (WACV)*

B. European Computer Vision Association repository, www.ecva.net/papers.php. Research papers from top notch conferences such as:

- *European Conference on Computer Vision (ECCV)*

C. IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI)

D. IEEE signal processing society

2. Highly cited research papers.

- *Aharon, M., Elad, M. and Bruckstein, A., 2006. K-SVD: An algorithm for designing overcomplete dictionaries for sparse representation. IEEE Transactions on signal processing, 54(11), pp.4311-4322.*
- *Wright, J., Ma, Y., Mairal, J., Sapiro, G., Huang, T.S. and Yan, S., 2010. Sparse representation for computer vision and pattern recognition. Proceedings of the IEEE, 98(6), pp.1031-1044.*

- *LeCun, Yann, Yoshua Bengio, and Geoffrey Hinton. "Deep learning." nature 521.7553 (2015): 436-444.*
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- *Fei-Fei, Li, Robert Fergus, and Pietro Perona. "One-shot learning of object categories." IEEE transactions on pattern analysis and machine intelligence 28, no. 4 (2006): 594-611.*
- *Lowe, David G. "Distinctive image features from scale-invariant keypoints." International journal of computer vision 60 (2004): 91-110.*
- *Perona, Pietro, and Jitendra Malik. "Scale-space and edge detection using anisotropic diffusion." IEEE Transactions on pattern analysis and machine intelligence 12, no. 7 (1990): 629-639.*
- *Simonyan, Karen, and Andrew Zisserman. "Very deep convolutional networks for large-scale image recognition." arXiv preprint arXiv:1409.1556 (2014).*
- *Olshausen, Bruno A., and David J. Field. "Emergence of simple-cell receptive field properties by learning a sparse code for natural images." Nature 381, no. 6583 (1996): 607-609.*
- *Ng, Andrew, Michael Jordan, and Yair Weiss. "On spectral clustering: Analysis and an algorithm." Advances in neural information processing systems 14 (2001).*
- *He, Kaiming, Xiangyu Zhang, Shaoqing Ren, and Jian Sun. "Deep residual learning for image recognition." In Proceedings of the IEEE conference on computer vision and pattern recognition, pp. 770-778. 2016.*
- *Tuzel, O., Porikli, F., & Meer, P. (2008). Pedestrian detection via classification on riemannian manifolds. IEEE transactions on pattern analysis and machine intelligence, 30(10), 1713-1727.*
- *Deng, Jia, Wei Dong, Richard Socher, Li-Jia Li, Kai Li, and Li Fei-Fei. "Imagenet: A large-scale hierarchical image database." In 2009 IEEE conference on computer vision and pattern recognition, pp. 248-255. Ieee, 2009.*
- *Lazebnik, Svetlana, Cordelia Schmid, and Jean Ponce. "Beyond bags of features: Spatial pyramid matching for recognizing natural scene categories." In 2006 IEEE computer society conference on computer vision and pattern recognition (CVPR'06), vol. 2, pp. 2169-2178. IEEE, 2006.*
- *Jiang, Xingyu, Jiayi Ma, Guobao Xiao, Zhenfeng Shao, and Xiaojie Guo. "A review of multimodal image matching: Methods and applications." Information Fusion 73 (2021): 22-71.*
- *Mikolajczyk, Krystian, Tinne Tuytelaars, Cordelia Schmid, Andrew Zisserman, Jiri Matas, Frederik Schaffalitzky, Timor Kadir, and L. Van Gool. "A comparison of affine region detectors." International journal of computer vision 65 (2005): 43-72.*

3. TOOLS

- *VLFEAT: https://www.vlfeat.org/*
- *SPAMS: SPArse Modeling Software*
- *TENSORFLOW: www.tensorflow.org/*
- *OPENCV: opencv.org/*
- *PyTorch: pytorch.org/*
- *MANOPT: www.manopt.org/*

4. WEBSITES

- *Google machine learning education: https://developers.google.com/machine-learning*
- *Prof. M. Harandi website: https://sites.google.com/site/mehrtashharandi/*
- *Prof. M. Elad website: https://elad.cs.technion.ac.il/*

- *Prof. F. Porikli website: https://www.porikli.com/*
- *Prof. A. Ng website: https://www.andrewng.org/*
- *Prof. Y. LeCun website: http://yann.lecun.com/*
- *Prof. A. Zisserman website: https://www.robots.ox.ac.uk/~az/*
- *Prof. Fei-Fei Li website: http://vision.stanford.edu/*
- *Stanford University DL-CV: cs231n.stanford.edu/index.html*

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.B.02.02	SEMESTER	B
COURSE TITLE	Multifunctional Materials and Wearable Devices		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
Lectures		1	2
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge		
PREREQUISITE COURSES:	NONE		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	ENGLISH		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-b-02-02multifunctional-materials-and-wearable-devices/ & https://eclass.uniwa.gr/courses/REEE109/		

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire

with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course, students are expected to be able to:

(1) Understand and generate the basic principles of a Wearable System.

(2) To be familiarized and evaluate the textile and clothing technology.

(3) Understand and categorize the properties of multifunctional materials.

(4) Select and design a textile-based sensing system.

(5) Consider and evaluate the energy issues of the wearable systems

(6) To use and to implement communication tools for the handling of the data

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision-making
- Working independently
- Team work
- Production of new research ideas
- Project planning and management
- Production of free, creative and inductive thinking

3. SYLLABUS

The course “Multifunctional Materials and Wearable Devices” focuses on a multidisciplinary field of the electronic devices and the clothing items used for the operation of the sensors, the actuators and the communication devices for the acquisition of biological signals, process and transmission of the respective information, the operation of actuators etc. The textile based electrical energy harvesting is also an important function of the wearable systems.

Among the multifunctional materials, the most interesting ones are those which can be found or transformed in fibrous form, permitting their integration in the textile materials of the clothing items. Consequently, the course covers both fields and enables the analysis and the design of wearable electronic systems based on textile substrates on the human body.

Course syllabus outline:

1. Principles of wearable technology

1.1 Wearable devices

1.2 Wearable signal interfaces

1.3 Interaction of wearables

2. Principles of clothing technology

2.1 Textile materials

2.2 Textile fabrics

2.3 Clothing design and structure

3. Properties of multifunctional materials

3.1 Conductive fibres

3.2 Piezoelectric fibres and triboelectric textiles

3.3 Heat – Light – Colour etc.

4. Sensors and textile-based components

4.1 Yarns and fabrics with sensorial properties

4.2 R, C, L textile-based components

4.3 Power and transmission components

4.4. Textile antennas

5. Connectivity of distributed units

5.1 Hardware connections

5.2 Flexible structures

5.3 Wireless interconnections

6. Communication of wearable systems

6.1 Communication protocols

6.2 Data transmission 6.3 Internet applications Mini project: Short project for the analysis of the performance of multifunctional materials and basic wearable systems.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance Learning (Synchronous, MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for distance learning classes (weekly) • E-class for course content support and teacher-student-class communication • MS Powerpoint or similar for project presentation
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	*Activity* / *Semester workload* Lectures: 13 Study learning content: 13 Project preparation: 26 Project presentation: 8 Course total: *60*

STUDENT PERFORMANCE EVALUATION
 	
Description of the evaluation procedure
 	
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
 	
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.
	• Student performance evaluation comes from
	  • Mini project (30 % of the final grade) – individual or teamwork, depending on the number of enrolled students per year
	  • Final written exam (70 % of the final grade)
	• Projects are turned in in electronic form. Plagiarism is checked by TURNITIN (20% max similarity)
	• The use of LLM (e.g., ChatGPT or similar) is strongly discouraged as non-scientific; in case is has to be used, the student must clearly state which part of the project and for which specific reasons had to be generated by such models.
	• Projects are evaluated in terms of

	• Coverage of the topic in breadth and depth (30%) • Suitability of the approach/method (20%) • Quality of the results (25%) • Presentation (25%)

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. "Electronics and Computing in Textiles", Vassiliadis S. Editor., ISBN 978-.87-403-082-0. Bookboon Publ. http://bookboon.com/en/textbooks/it-programming/electronics-and-computing -in-textiles.

2. "Piezoelectric Melt-Spun Textile Fibers: Technological Overview", Matsouka D and Vassiliadis S., in "Piezoelectricity" (ed. S. Vassiliadis), Intechopen Publ., ISBN: 978-1-78923-647-7, 2018.

- Related academic journals:

1. uranga Seneviratne, Yining Hu, Tham Nguyen, Guohao Lan, Sara Khalifa, Kanchana Thilakarathna, Mahbub Hassan, and Aruna Seneviratne, 'A Survey of Wearable Devices and Challenges', IEEE Communications Surveys & Tutorials 19, 4 Fourth Quarter (2017)
2. Konstantinos Salonitis, John Pandremenos, John Paralikas and George Chryssolouris, 'Multifunctional materials: engineering applications and processing challenges', Int J Adv Manuf Technol 49, pp 803–826 (2010)
3. Rebecca R. Ruckdashel, Ninad Khadse and Jay Hoon Park, 'Smart E-Textiles: Overview of Components and Outlook', Sensors 22, 6055 (2022)
4. Jae Sang Heo, Jimi Eom, Yong-Hoon Kim, and Sung Kyu Park, 'Recent Progress of Textile-Based Wearable Electronics: A Comprehensive Review of Materials, Devices, and Applications', Small, 14, 1703034 (2018)
5. Kang Du, Rongzhou Lin, Lu Yin, John S. Ho, Joseph Wang, and Chwee Teck Lim, 'Electronic textiles for energy, sensing, and communication', iScience 25, 104174 (2022)
6. Ruiyang Yin, Depeng Wang, Shufang Zhao, Zheng Lou, and Guozhen Shen, 'Wearable Sensors-Enabled Human–Machine Interaction Systems: From Design to Application', Adv. Funct. Mater., 31, 2008936 (2021)
7. Repoulias, A., Vassiliadis, S., Galata, S.F., "Triboelectricity and textile structures", Journal of the Textile Institute, 2021, 112(10), pp. 1580–1587

TOOLS

- Audiovisual equipment
- Internet learning platform

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.B.02.03	SEMESTER	B
COURSE TITLE	Multilayer structures in organic optoelectronic devices		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
	LECTURES	1	2
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge		
PREREQUISITE COURSES:	A course on Photonics A course on Optical Communications A course on Optoelectronics		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/REEE110/ & https://mres.eee.uniwa.gr/mres-b-02-03-multilayer-structures-in-organic-optoelectronic-devices/		

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire

with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course, students are expected to be able to:

1. Understand the basic structure of organic semiconducting optoelectronic devices.
2. Become familiar with the basic materials that are used in their structure, both for OLEDs (Organic Light Emitting Diodes) and OPVs (Organic Photovoltaics).
3. Analyze and calculate the outcoupling efficiency throughout a multilayer structure of an OLED.
4. Learn the modeling and the calculation methods of the outcoupling efficiency for OLEDs.
5. Analyze and calculate the external quantum efficiency for a single and bulk heterojunction multilayer structure for OPVs.
6. Learn the methods for the calculation of the short circuit photocurrent for OPVs structure.
7. Develop software code using the methods of OPVs' photocurrent calculation.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Production of new research ideas
- Project planning and management
- Working independently
- Team work

3. SYLLABUS

This course aims to provide students with an in-depth understanding of the organic optoelectronic devices' multilayer structure which covers organic light emitting diodes (OLED) and organic photovoltaics (OPV). These devices have opened novel applications in both display applications and solar cells. The characteristic of these devices is their multilayer structure which is crucial for both the outcoupling efficiency for the OLEDs and the external quantum efficiency for the OPVs. The course will cover topics such as the structure of OLEDs and OPVs, the involved organic semiconducting and

conducting materials, the methods of simulating their operation based on the electromagnetic theory and the respective modelling for optimization purposes.

Course Outline:

1. Multilayer structure of OLEDs
   - Transparent conducting materials
   - Hole and electron injection organic materials
   - Spectral refractive indices for the visible spectrum
2. Calculation models for OLEDs
   - Dipole antenna modelling of the excited states
   - Ray tracing calculation scheme
   - Transmission lines modelling
3. Multilayer structure of OPVs
   - Organic photovoltaic materials
   - Single and bulk heterojunctions
   - Planar and cylindrical geometries
   - Spectral refractive index and extinction coefficient
   - Perovskite solar cells
4. Calculation models for OPVs
   - Transfer matrix modelling
   - Transmission lines modelling
   - Normal and inclined illumination
   - Anisotropy, and interface roughness

Mini project: Short circuit photocurrent calculation for an OPV structure.

Groups of 2-3 students will analyse the structure of an OPV for its external quantum efficiency and thus its respective short circuit photocurrent. The materials of the OPV's multilayer structure will be followed by the respective spectral refractive indices and extinction coefficients.

Through this project, students will have the opportunity to develop a simple software code based on an OPV's structure modelling method.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance Learning (Synchronous, MS Teams)

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for distance learning classes (weekly) • E-class for course content support and teacher-student-class communication • Matlab • MS Powerpoint or similar for project presentation
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	*Activity* / *Semester workload* Lectures 13 Study learning content 23 Mini project preparation 8 Mini project report 16 Course total *60*
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Student evaluation comes from • Mini project x 40% • Final written exam x 60%

5. ATTACHED BIBLIOGRAPHY

- ***Suggested bibliography:***

(1) *Stephen R. Forrest, " Organic Electronics: Foundations to Applications", OXFORD University Press, 1st edition, 2020*
(2) *Mitsuhiro Koden, "OLED Displays and Lighting", IEEE Press, 1st edition, 2017*
(3) *Barry P. Rand, Henning Richter (editors), "Organic Solar Cells: Fundamentals, Devices, and Upscaling", CRC Press, 2014*

- Related academic journals:

(1) *K. A. Neyts, "Simulation of light emission from thin-film microcavities" J. Opt. Soc. Amer. A, vol. 15, p. 962, 1998.*

(2) *K. A. Neyts, "Microcavity effects and the outcoupling of light in displays and lighting applications based on thin emitting films," Appl. Surface Sci., vol. 244, pp. 517–523, 2005.*

(3) *T. Granlund, L. A. A. Pettersson, and O. Inganas, "Detrmination of the emission zone in a single-layer polymer light-emitting diode through optical measurements," J. Appl. Phys., vol. 89, no. 11, pp. 5897–5902, 2001.*

(4) *E. Hartmann, P. Boher, Ch. Defranoux, L. Jolivet, and M.-O. Martin,"UV-VIS and midIR ellipsometer characterization of layers used in OLED devices," J. Lumin., vol. 110, pp. 407–412, 2004.*

(5) *S.P.Savaidis, N.A.Stathopoulos 'Simulation of light emission from planar multilayered OLEDs, using a transmission-line model' IEEE – JQE Vol.45, No 9, pp 1089-1099, 2009.*

(6) *L.A.A.Pettersson, L.S.Roman, and O.Inganas, "Modeling photocurrent action spectra of photovoltaic devices based on organic thin films," J. Appl. Phys., vol. 86, no. 1, pp. 487–496, 1999.*

(7) *L.C.Roman, W.Mammo, L.A.A.Pettersson, M.R.Andersson, and O.Inganas, "High quantum efficiency polythiophene/C60 photodiodes," Adv. Mater., vol. 10, no. 10, pp. 774–777, 1998.*

(8) *A.J.Moule, J.B.Bonekamp, and K.Meerholz, "The effect of active layer thickness and composition on the performance of bulk-heterojunction solar cells," J. Appl. Phys., vol. 100, no. 9, pp. 4503-1–4503-7, 2006.*

(9) *A.M.C.Ng, K.Y.Cheung, M.K.Fung, A.B.Djurisic, and W.K.Chan, "Spectroscopic ellipsometry characterization of polymer-fullerene blend films," Thin Solid Films, vol. 517, no. 3, pp. 1047–1052, 2008.*

(10) *G.Dennler, K.Forberich, M.C.Scharber, C.J.Brabec, I.Tomiš, K.Hingerl, T.Fromherz, "Angle dependence of external and internal quantum efficiencies in bulk-heterojunction organic solar cells", J. Appl. Phys., 102, 054516, 2007.*

(11) *N.A.Stathopoulos, L.C.Palilis, S.P.Savaidis, S.R.Yesayan, M.Vasilopoulou, G.Papadimitropoulos, D.Davazoglou and P.Argitis 'Optical modeling of hybrid polymer solar cells using a transmission line model and comparison with experimental results' IEEE – JSTQE 16 (6), pp. 1784-1791, 2010.*

(12) *N.A.Stathopoulos, L.C.Palilis, S.R.Yesayan, S.P.Savaidis, M.Vasilopoulou, and P.Argitis, "A transmission line model for the optical simulation of multilayer structures and its application for oblique illumination of an organic solar cell with anisotropic extinction coefficient" J. Appl. Phys. 110, 114506, 2011.*

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.B.02.04	SEMESTER	B
COURSE TITLE	Fiber Bragg gratings in optical fiber communications and sensing applications		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
	LECTURES	1	2
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge		
PREREQUISITE COURSES:	A course on Photonics A course on Optical Communications A course on Optoelectronics		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/REEE111/ & https://mres.eee.uniwa.gr/mres-b-02-04fiber-bragg-gratings-in-optical-fiber-communications-and-sensing-applications/		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course, students are expected to be able to:

(1) Understand the fundamental theory of spectral reflection and transmission from a periodic index variation of a fiber's core.
(2) Describe the various types of fiber Bragg gratings and their potential applications in fiber optic communications and as a sensing element.
(3) Understand the inscription techniques and compare them with the most common ones such as the phase mask and the fs-Laser.
(4) Learn and assess the basic FBG interrogation methods.
(5) Develop a simulation software for the analysis of typical uniform and non-uniform FBG.
(6) Construct an equalizer optical filter for an EDFA application using FBG.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Production of new research ideas
- Project planning and management
- Working independently
- Team work

3. SYLLABUS

This course aims to provide students with an in-depth understanding of a crucial component that is applied not only in optical fiber communication systems but also proves to have an extensive application as a sensor with several advantages in comparison with the traditional electrical ones. This component is based on the fiber Bragg gratings and may be used in optical communications as an optical filter for optical "Add and Drop" multiplexers in a WDM system; as a superstructure FBG

for spectral filtering; or as chirped FBG for dispersion compensation. Moreover, it may be an excellent fiber optic sensor when used in a variety of different forms, and is able to cover a broad area of sensing applications. The course will cover topics such as the fundamental theory of FBG operation, the FBG types, the inscription techniques, the interrogation methods, the applications in optical communications and sensing applications.

Course Outline:

1. Fundamental theory of FBG operation
   - CMT technique for uniform gratings
   - Transfer Matrix and Transmission Line method for FBG simulation
   - Simulation of uniform and non-uniform FBGs
2. Different types of FBG
   - Chirped FBGs
   - Tilted FBGs
   - Phase shifted FBGs
   - Superstructure FBGs
   - Polymer FBGs
   - Long Period Gratings (LPFG)
3. Inscription Techniques
   - Photosensitive fibers
   - Phase mask technique
   - fs-Laser technique
   - Other techniques of inscription
4. FBG interrogation methods
   - Spectrum analysis method
   - Tunable Laser method
   - Peak power detection methods
   - Other interrogation methods
5. Applications in fiber optic communications
   - Optical Add and Drop multiplexors
   - Superstructure FBG for spectrum filtering
   - Dispersing compensation with CFBGs
   - FBGs in EDFA design
6. Sensing applications
   - Stress and strain applications
   - Structural health monitoring
   - Temperature sensitivity and compensation
   - Humidity and pH measurements
   - LPFG environmental sensing applications
7. Lab project
   - Measurement of an FBG spectral reflectivity using an Optical Spectrum Analyzer
   - Calculation of the index modulation and the length of inscription
   - Measurement of the spectral emission of a pumped Erbium doped fiber
   - Design of an FBG for the equalization of the EDF's emission spectrum

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance Learning (Synchronous, MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for distance learning classes (weekly) • E-class for course content support and teacher-student-class communication • Matlab • Laboratory education • MS Powerpoint or similar for presentation
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	*Activity* / *Semester workload* Lectures: 13 Study learning content: 29 Lab preparation: 5 Lab report: 13 Course total: *60*
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Student evaluation comes from • Lab project x 30% • Final written exam x 70%

5. ATTACHED BIBLIOGRAPHY

- ***Suggested bibliography:***

1. *A.Othonos and K.Kalli, "Fiber Bragg grating: Fundamental and applications in telecommunications and sensing." Artech House, 1999.*
2. *R.Kashyap, "Fiber Bragg Gratings" Elsevier, 2010*

3. *Francis T. S. Yu and Shizhuo Yin, "Fiber Optic Sensors", Marcel Dekker, Inc. 2002.*

- Related academic journals:

1. *T. Erdogan, "Fiber Grating Spectra", IEEE J. Lightwave Technol. 15 (8) 1277–1294 (1997).*
2. *T. Erdogan, "Cladding-mode resonances in short and long period fiber grating filters," J. Opt. Soc. Am. A 14, 1760–1773 (1997).*
3. *N.A.Stathopoulos, S.P.Savaidis, H.Simos, E.Rigas, R.G.Correia, S.W.James, R.P.Tatam "Transmission line method for the simulation of Fiber Bragg Gratings", Applied Optics, Vol. 58, Issue 2, 353-360, (2019)*
4. *N.A.Stathopoulos and I.Simos "Modelling of non-uniform and fs-Laser inscribed fibre Bragg gratings", Optical Fiber Technology, 70, 102878 (2022)*
5. *S.J.Mihailov, D.Grobnic, C.W. Smelser, P.Lu, R.B.Walker, and H.Ding "Induced Bragg Gratings in Optical Fibers and Waveguides Using an Ultrafast Infrared Laser and a PhaseMask" Hindawi Publishing Corporation Laser Chemistry Vol 2008, Article ID 416251, 20 pages doi:10.1155/2008/416251*
6. *S.A.Slattery, D.N.Nikogosyan and Gilberto Brambilla, "Fiber Bragg grating inscription by high-intensity femtosecond UV laser light: comparison with other existing methods of fabrication" J. Opt. Soc. Am. B Vol. 22, No. 2 February 2005*
7. *K.Zhou, M.Dubov, C.Mou, L.Zhang, V.K.Mezentsev, and Ian Bennion "Line-by-Line Fiber Bragg Grating Made by Femtosecond Laser" IEEE Phot. Tech. Lett., VOL. 22, NO. 16, AUGUST 15, 2010*
8. *T.Geernaert, K.Kalli, C.Koutsides, M.Komodromos, T.Nasilowski, W.Urbanczyk, J.Wojcik, F.Berghmans, and H.Thienpont, "Point-by-point fiber Bragg grating inscription in free-standing step-index and photonic crystal fibers using near-IR femtosecond laser" Opt Lett. Vol. 35, No. 10, 1647 (2010)*
9. *Chao Wang and Jianping Yao "Chirped Microwave Pulse Compression Using a Photonic Microwave Filter With a Nonlinear Phase Response" IEEE TMTT, VOL. 57, NO. 2, 496-504 (2009)*
10. *S. W. James and R. P. Tatam, "Optical fibre long-period grating sensors: characteristics and application," Meas. Sci. Technol. 14, R49–R61 (2003).*

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.B.02.05	**SEMESTER**	B
COURSE TITLE	Advanced Antenna Design and 5G Communications		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
LECTURES		1	2
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge		
PREREQUISITE COURSES:	Antenna Theory, RF Design, Microwaves		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-b-02-05-advanced-topics-in-antennas-and-5g-communications/ & https://eclass.uniwa.gr/courses/REEE112/		

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course, students are expected to be able to:

(1) Evaluate the principles of antenna design for 5G/6G telecommunication systems, including the key parameters that influence antenna performance.
(2) Analyse the various types of antennas used in 5G/6G systems, such as patch antennas, microstrip antennas, and array antennas.
(3) Design advanced antenna concepts, such as MIMO antennas, beamforming, and millimeter-wave antennas.
(4) Analyze antenna performance, with the aid of simulation tools such as CST and ADS.
(5) Evaluate the importance of antenna design in 5G/6G systems and the impact it has on overall network performance.
(6) Develop critical thinking skills to solve practical antenna design problems for 5G/6G systems.
(7) Communicate technical concepts related to antenna design for 5G/6G systems to technical and non-technical audiences.
(8) Prioritize the ethical implications of antenna design for 5G/6G systems, such as privacy, security, and environmental concerns.
(9) Develop an appreciation for ongoing developments in 5G/6G systems and the role of antenna design in shaping the future of telecommunications.
(10) Explore potential career paths in the field of antenna design and 5G/6G telecommunications.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision-making
- Working independently
- Team work
- Production of new research ideas
- Project planning and management
- Production of free, creative and inductive thinking

3. SYLLABUS

This course aims to provide students with an in-depth understanding of advanced antenna design techniques for 5G/6G telecommunication systems. The course will cover topics such as antenna arrays, MIMO systems, millimeter-wave antennas, beamforming, and mmWave propagation models. The course will also include practical design projects that will allow students to apply the concepts learned in class.

Course Outline:

1. Introduction to 5G/6G Telecommunication Systems
   - Overview of 5G/6G technology
   - Antenna requirements for 5G/6G systems
   - Challenges in antenna design for 5G/6G systems
2. Antenna Fundamentals
   - Introduction to antennas
   - Antenna parameters
   - Antenna types and characteristics
   - Antenna radiation pattern and polarization
3. Antenna Arrays
   - Array geometries and configurations
   - Linear and planar arrays
   - Beamforming techniques
   - Adaptive beamforming
4. MIMO Systems
   - Introduction to MIMO systems
   - MIMO antenna design
   - Diversity techniques
   - Spatial multiplexing
5. Millimeter-Wave Antennas
   - Introduction to millimeter-wave technology
   - Millimeter-wave antenna design
   - Substrate-integrated waveguide antennas
   - Dielectric resonator antennas
6. Propagation Models for mmWave Systems

- Introduction to mmWave propagation
- Propagation models for mmWave systems
- Path loss models
- Channel models

7. Practical Design Projects (mini group project)
   - Design and simulation of antenna arrays for 5G/6G systems
   - Design and simulation of millimeter-wave antennas
   - Beamforming simulation and analysis
   - Performance evaluation of MIMO systems

For the mini group project, students will work in groups of 3-4 to design and analyze an advanced antenna system for a 5G/6G telecommunication application. Each group will be assigned a specific problem statement related to antenna design and will be expected to use simulation tools and techniques to propose a solution that meets the specified performance requirements.
The project will consist of the following key components:

- Problem statement: Each group will be assigned a specific problem statement related to antenna design for 5G/6G systems.
- Antenna design: Students will use simulation tools and techniques to design and optimize an advanced antenna system that meets the specified performance requirements.
- Analysis: Students will analyze the performance of their antenna system and evaluate its impact on overall network performance.
- Report: Each group will be required to submit a report detailing their design methodology, analysis results, and conclusions.
- Presentation: Each group will give a short presentation to the class summarizing their project and highlighting key findings.

Through this project, students will have the opportunity to apply the theoretical concepts they have learned in class to a real-world antenna design problem. They will also develop critical thinking skills and the ability to work collaboratively in a group setting.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance Learning (Synchronous, MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for distance learning classes (weekly) • E-class for course content support and teacher-student-class communication • Matlab / ADS / CST or similar for project work • Gephi / ProM / Tableau for project work • MS Powerpoint or similar for project presentation

TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>13</td></tr><tr><td>Study learning content</td><td>13</td></tr><tr><td>Project preparation</td><td>26</td></tr><tr><td>Project presentation</td><td>8</td></tr><tr><td>**Course total**</td><td>***60***</td></tr></table>

STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure
 	
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
 	
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.
	• Student evaluation comes from
	  • Average Grade of Homework Assignments (best 3 out of the total of 4 grades obtained) x 20%
	  • Mini group project x 50%
	  • Final written exam x 30%
	• Projects are turned in in electronic form. Plagiarism is checked by TURNITIN (20% max similarity)
	• The use of LLM (e.g., ChatGPT or similar) is strongly discouraged as non-scientific; in case is has to be used, the student must clearly state which part of the project and for which specific reasons had to be generated by such models.
	• Projects are evaluated in terms of
	(1) Coverage of the topic in breadth and depth (30%)
	(2) Suitability of the approach/method (20%)
	(3) Quality of the results (25%)
	(4) Presentation (25%)

5. ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Constantine A. Balanis, "Antenna Theory: Analysis and Design", 4th edition, Wiley, 2016
- Richard A. Horn, "MIMO Antenna Technology for Wireless Communications", CRC Press, 2018.
- S. Raghavan and R. Abhari, "Millimeter Wave Antennas: Configurations and Applications", CRC Press, 2016.
- Kao-Cheng Huang and Mohsen Kavehrad, "Millimeter Wave Communication Systems", Wiley, 2019
- Theodore S. Rappaport, Robert W. Heath Jr., and Robert C. Daniels, "Millimeter Wave Wireless Communications", Prentice Hall, 2014

- Erik Dahlman, Stefan Parkvall, and Johan Skold, “5G NR: The Next Generation Wireless Access Technology", Academic Press, 2018
- Hrishikesh Venkataraman and Ramakrishna Marappa, "5G System Design: Architectural and Functional Considerations and Long-Term Research", Springer, 2018
- Mehdi Bennis, Meryem Simsek, and Alan Gatherer, "6G Mobile Communications", Wiley, 2021

- Related academic journals:

- S. Shrestha, N. Kumar, and B. P. Joshi, "Design and analysis of a dual-band antenna with switchable polarization for 5G communication systems", Microwave and Optical Technology Letters, vol. 63, no. 2, pp. 529-534, Feb. 2021.
- S. Gupta, S. Kumar, and V. Singh, "Design of a circularly polarized planar antenna for 5G communication systems", International Journal of Microwave and Wireless Technologies, vol. 12, no. 3, pp. 249-257, Mar. 2020.
- J. Zhang, M. Chen, and W. Hong, "A compact wideband millimeter-wave antenna for 5G communication systems”, IEEE Antennas and Wireless Propagation Letters, vol. 17, no. 2, pp. 290-293, Feb. 2018.
- S. R. Chowdhury, S. Sanyal, and A. K. Bhattacharjee, "Design and analysis of a compact multiband MIMO antenna for 5G communication systems", International Journal of Electronics and Communications, vol. 107, pp. 100-107, Oct. 2019.
- H. Zhang, H. Guan, and Z. Chen, "Design and implementation of a 28-GHz millimeter-wave phased array antenna for 5G communication systems", Journal of Electromagnetic Waves and Applications, vol. 33, no. 7, pp. 852-862, Mar. 2019.

TOOLS

- CST - Studio Suite®
- ADS - PathWave Advanced Design System
- MATLAB

WEBSITES

- IEEE Antennas and Propagation Society: The IEEE Antennas and Propagation Society is a professional organization dedicated to the advancement of antenna and propagation science and technology. Their website provides access to publications, conferences, and other resources related to antenna design. https://ieeeaps.org
- Antenna Magus: Antenna Magus is a software tool that provides a large database of antenna designs and allows users to simulate and optimize antenna performance. Their website provides access to tutorials, case studies, and other resources related to antenna design. https://www.3ds.com/products-services/simulia/products/antenna-magus/
- Keysight Technologies: Keysight Technologies is a company that provides electronic measurement solutions, including simulation tools for antenna design such as the PathWave Advanced Design System (ADS). Their website provides access to application notes, whitepapers, and other resources related to antenna design. https://www.keysight.com/us/en/products/software/pathwave-design-software/pathwave-advanced-design-system.html
- CST Studio Suite® is a high-performance 3D EM analysis software package for designing, analyzing and optimizing electromagnetic (EM) components and systems. https://www.3ds.com/products-services/simulia/products/cst-studio-suite/

- Ansys: Ansys is a company that provides simulation software for a variety of engineering applications, including antenna design. Their website provides access to webinars, case studies, and other resources related to antenna design. https://www.ansys.com/applications/antenna-design-and-placement
- Radio-Electronics.com: Radio-Electronics.com is a website that provides tutorials, articles, and other resources related to electronics and telecommunications, including antenna design for 5G/6G systems. https://www.electronics-notes.com
- Microwave Journal, an international magazine that provides articles, white papers from the industry and application notes https://www.microwavejournal.com
- Microwaves & RF, an international magazine that provides articles, white papers from the industry and application notes https://www.mwrf.com

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.B.02.06	**SEMESTER**	B
COURSE TITLE	Special Control Schemes in Wireless Sensor Networks		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
	LECTURES	1	2
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-b-02-06-special-control-schemes-in-wireless-sensor-networks/ & https://eclass.uniwa.gr/courses/REEE113/		

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will

acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course, students are expected to be able to:

1. Analyze the basic structure and operation of wireless sensor nodes.
2. Illustrate both the architecture and the operation of a typical WSN
3. Distinguish the features of WSNs that differentiate them from conventional wired networks.
4. Prioritize the advantages of WSNs.
5. Categorize the numerous applications of WSNs.
6. Assess the interconnection that exists between WSNs and Internet of Things.
7. Judge the various problems and weaknesses that obstruct the operation of WSNs.
8. Assess the platforms that are used in order to implement and simulate WSNs for research purposes.
9. Judge the hardware-based and software-based mechanisms that may be used in order to prolong the lifetime of WSNs.
10. Assess algorithms that are used for the maximization of coverage and k-coverage in WSNs.
11. Recommend how connectivity of sensor nodes in WSNs can be maintained.
12. Evaluate the way of operation of congestion avoidance schemes and congestion control schemes in WSNs.
13. Defend the necessity of the Quality of Service maximization in WSNs and how this may be accomplished.
14. Recommend the mechanisms that may be used to strengthen the security in WSNs.
15. Judge how multi-objective optimization can be accomplished in WSNs.
16. Distinguish special control issues that exist in specific categories of WSNs.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Production of free, creative and inductive thinking

- Decision-making
- Working independently
- Team work
- Working in an international environment
- Working in an interdisciplinary environment
- Production of new research ideas
- Project planning and management

3. SYLLABUS

This course is related to the study of Wireless Sensor Networks (WSNs) that, thanks to their ever-increasing number of applications, are among the most important areas of Science and Technology. In particular, the course focuses on the methodologies that have been proposed to solve the problems that hinder the operation of WSNs.

For this reason, first of all, the appropriate theoretical background is created, regarding:

- the structural and functional characteristics of wireless sensor nodes,
- the structure and operation of WSNs,
- the comparison of WSNs with conventional wired networks,
- the use and applications of WSNs,
- the weaknesses and problems of WSNs, and
- the implementation and simulation platforms used for WSNs.

The course then focuses on control schemes that have been proposed for WSNs for:

- energy sustainability of sensory nodes,
- maximizing coverage,
- maintain connectivity,
- avoiding and/or controlling congestion,
- maximizing the quality of services,
- ensuring the integrity of communications and data, and
- multi-objective optimization.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance Learning (Synchronous, MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for distance learning classes (weekly), • E-class for course content support and teacher-student-class communication, • MS Powerpoint or similar application for project presentation.

TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS

Activity	*Semester workload*
Lectures	13
Study learning content	13
Project preparation	26
Project presentation	8
Course total	***60***

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

- The evaluation language is English.
- The assessment of the students is carried out through a project that forms 100% of the final grade.
- The project is submitted in electronic format and must be checked for similarity to published material through the use of TURNITIN online similarity detection service. The maximum allowable percentage of similarity is set to be equal to 20%.
- The use of Large Linguistic Model (LLM) –based chat boxes, such as ChatGPT or similar, is strongly discouraged as non-scientific. However, if such means were used, the student must clearly state which part of the project and for which specific reasons had to be generated by using such models.
- The grade of the work results from the following criteria:
  (1) Covering the topic in breadth and depth (50%)

  (2) Quality of outcome assessment (25%)

  (3) Presentation (25%)

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Akyildiz, I. F., & Vuran, M. C. (2010). Wireless sensor networks. John Wiley & Sons.
2. Al-Turjman, F. (2018). Wireless sensor networks: Deployment strategies for outdoor monitoring. CRC Press.
3. Ammari, H. M. (2022). Theory and Practice of Wireless Sensor Networks: Cover, Sense, and Inform (Vol. 214). Springer Nature.
4. Bhargava, B. K., Paprzycki, M., Kaushal, N. C., Singh, P. K., & Hong, W. C. (2020). Handbook of wireless sensor networks: issues and challenges in current Scenario's. Springer.
5. Chai, S., Wang, Z., Zhang, B., Cui, L., & Chai, R. (2020).Wireless sensor networks. Springer.

6. Cui, L., & Xie, X. (2019). Wireless sensor networks, Springer.
7. De, D., Mukherjee, A., Das, S. K., & Dey, N. (Eds.). (2020). Nature inspired computing for wireless sensor networks. Singapore: Springer.
8. Edla, D. R., Kongara, M. C., Lipare, A., Kuppili, V., & Kannadasan, K. (2020). Wireless Sensor Networks: Evolutionary Algorithms for Optimizing Performance. CRC Press.
9. Fahmy, H. M. A. (2020). Wireless sensor networks. Springer.
10. Kanoun, O. (Ed.). (2018). Energy Harvesting for Wireless Sensor Networks: Technology, Components and System Design. Walter de Gruyter GmbH & Co KG.
11. Nelson, A. (2021). Advanced Principles of Wireless Sensor Networks. Clanrye International.
12. Mishra, B. B., Dehuri, S., Panigrahi, B. K., Nayak, A. K., Mishra, B. S. P., & Das, H. (Eds.). (2019). Computational intelligence in sensor networks. Springer.
13. Obaidat, M. S., & Misra, S. (2014). Principles of wireless sensor networks. Cambridge University Press.
14. Rani, S., Maheswar, R., Kanagachidambaresan, G. R., & Jayarajan, P. (Eds.). (2020). Integration of WSN and IoT for smart cities. Springer.
15. Selmic, R. R., Phoha, V. V., & Serwadda, A. (2016). Wireless Sensor Networks. Springer.
16. Shankar, K., & Elhoseny, M. (2019). Secure image transmission in wireless sensor network (WSN) applications. Springer International Publishing.
17. Wu, W., Zhang, Z., Lee, W., & Du, D. (2020). Optimal coverage in wireless sensor networks. Springer.
18. Yellampalli, S. (Ed.). (2021). Wireless Sensor Networks: Design, Deployment and Applications. BoD–Books on Demand.

- Related academic journals:

1. ACM Transactions on Sensor Networks, ACM
2. Ad Hoc Networks, Elsevier
3. Ad-Hoc and Sensor Wireless Networks, Old City Publishing
4. EURASIP Journal on Wireless Communications and Networking, Springer
5. Future Internet, MDPI
6. IEEE Internet of Things Journal, IEEE
7. IEEE Sensors Journal, IEEE
8. IEEE Transactions on Mobile Computing, IEEE
9. IET Wireless Sensor Systems, John Wiley & Sons Inc.
10. International Journal of Ad Hoc and Ubiquitous Computing, Inderscience Publishers
11. International Journal of Distributed Sensor Networks, SAGE Publications Inc.
12. International Journal of Sensor Networks, Inderscience Publishers
13. International Journal of Wireless Information Networks, Springer
14. Journal of Sensor and Actuator Networks, MDPI
15. Journal of Sensors, Hindawi Publishing Corporation
16. Mobile Information Systems, Hindawi Publishing Corporation
17. Mobile Networks and Applications, Springer
18. Sensors, MDPI
19. Wireless Communications and Mobile Computing, Hindawi Publishing Corporation
20. Wireless Networks, Springer

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.B.02.07	SEMESTER	B
COURSE TITLE	Selected Topics in Small Hydro-electric Power Plant		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
	LECTURES	1	2
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge		
PREREQUISITE COURSES:	Mandatory: A course/ two courses on electric circuits (dc, ac, multi-phase ac) A course / two courses on electric machines (electromechanical transformation principles, three-phase transformers, three-phase synchronous generators (cylindrical, salient pole), three-phase induction machines (squirrel, double-fed), dc machines, steady state and transient analysis) A course / two courses on power systems (power system elements, p.u. power system representation, steady state and transient analysis of power systems with emphasis on short circuits, stability and power quality issues) A course / two courses on automatic control systems (concept of feedback, Laplace transformation, system description-block diagrams, dynamic response of first and second order systems, steady state errors, controllers (P,PI, PD, PID), stability issues and criteria (Routh-Hurwitz, root locus, Bode plots, Nyquist plots), state space representation & analysis, controllability, observability,		

	Lypapunov stability, state feedback techniques, transient response analysis, optimal control principles) A course on mechanics (static & kinematic equations, isostatic and hyper-static formations, Elasticity theory, Hooke's law, uniaxial and biaxial stress, strain, tension, compression, shearing, bending torsion and combined loading, buckling, creep, impact etc.) Desirable: A course on automatic control electric power systems (stability criteria, governor and automatic voltage control) A course on fluid mechanics (on pipes, open channels, turbines and pumps)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-b-02-07-selected-topics-in-small-hydroelectric-power-plants/ & https://eclass.uniwa.gr/courses/REEE114/

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
Upon successful completion of the course, students are expected to be able to: 1. Describe and explain the basics of a small hydro-electric power plant 2. Categorize by name, describe and classify major problems that are typically addressed through different technologies of small hydro-electric power plants (especially dam, intakes, turbines, generators) 3. Design with civil engineers and hydrologists the civil structures such as dam and spillway 4. Design the hydraulic structures such as pipe, open channel, intake, sediment traps for nominal flow supply 5. Compare and recommend the proper electro-mechanical structures such as hydro-turbine, generator, step-up transformer for nominal flow supply, as well as evaluate the respective power capacity and energy output

6. Evaluate the technical-economic viability of a small hydro-electric power plant in a preliminary design stage
7. Judge, explain and interpret results from the aforementioned stage; comment on their validity; recommend solutions on the basis of these results
8. Design and compose a small hydro-electric plant with others in a team in order to address a realistic (but not real) situation/problem
9. Develop the skills acquired in this field in order to address real situations/problems.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Production of new research ideas
- Project planning and management
- Production of free, creative and inductive thinking

3. SYLLABUS

An overview of Small Hydro-electric Power Plants:

- General introduction to hydro-electric power plant (Basic operation principles, categorization, differences between small and large hydro-electric power plant, definition of small hydropower, site configurations (Run-of-river, at the base of a dam, within an irrigation canal, in a water abstraction system), planning)
- Fundamental of Hydraulic Engineering (introduction, water flow in pipes (head losses due to friction, local head losses, transient flow, hydraulic hammer), water flow in open channels (Classification of open channel flows, uniform flow, efficient cross-section & principles of energy in open channel flows))
- Evaluating stream flow (introduction, stream flow records, evaluating stream flows by discharge measurements (with velocity-area, weir, slope-area methods), stream flow characteristics (hydrograph, flow duration curves, standardised flow duration curves, water pressure)), residual, reserved or compensation flow, estimation of plant capacity and energy output (influence of flow variation and head variation on the turbine capacity, peaking

operation, firm energy, floods (flood control design, statistical analysis of flood data, hydrological modelling of the catchment area))
- Site evaluating methodologies (cartography, geochemical studies, practical cases, learning from failures)
- Hydraulic structures (dams (types: embankment, concrete, other; loads and stability, dam safety), weirs and spillways (gated, ungated), energy dissipating structures, intake structures (types, head losses, trashracks, vorticity), sediment traps (efficiency, design), gates and valves, open channels (design and dimensioning, excavation and stability), forebay tanks, penstocks, tailraces)
- Electromechanical structures (powerhouse, hydraulic turbines (types and configuration, specific speed and similitude, preliminary design, selection criteria, efficiency), speed increasers (types, design, maintenance), generators (configurations, synchronous-asynchronous –dc generators, exciters, voltage regulation and synchronization, special specifications), turbine control, switchgear equipment, automatic control (governor – automatic voltage regulator – case of autonomous operation), ancillary electrical equipment (plant service transformer, DC control power supply, headwater and tailwater recorders, outdoor substation))
- Connection of hydro-power plant with grid through transmission / distribution lines: steady state and transient state current analysis for different operation modes, faults, power quality issues, power stability
- Environmental impact and its mitigation ((introduction, burdens and impacts identification, impacts in the construction phase (reservoirs, water intakes, open canals, penstocks, tailraces), impacts arising from the operation of the scheme (sonic, landscape, biological impacts), impacts from transmission lines (visual, health)))
- Economic analysis (basic considerations, time value of money, methods of economic evaluation (payback time period, net present value, benefit-cost ratio, internal rate of return), tariffs and incentives)
- Administrative procedures (types of procedures (energy regulation – water rights, environmental procedures, public inquiry, construction requirements, connection to the grid, others), examples)
- Special issues: Small hydropower plant in the modern electricity market, possibility for pump hydropower plants, etc.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance Learning (Synchronous, MS Teams)	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for distance learning classes (weekly) • E-class for course content support and teacher-student-class communication • Matlab or similar tool for project work	
TEACHING METHODS	*Activity*	*Semester workload*

The manner and methods of teaching are described in detail. *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	Lectures: 13 Study learning content: 32 Project: 13 Exam: 2 **Course total: *60***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Student evaluation comes from • Class participation, mini-tests and contribution in the discussions held in class and online x 10% • Grade of Homework Assignment x 40% • Final written exam x 50%

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

i. European Small Hydropower Association (2004). *Guide on How to develop a Small Hydropower plant* (1st Edition), p. 296.
ii. Hydro-power – V. Schnitzer (2009). *Micro Hydro scout guide*. GTZ publishing, Germany (1st edition), p. 118.
iii. Celso Penche (1998). *Layman's guidebook on how to develop a small hydropower plant*. European Small Hydropower Association (1st Edition), p. 266.
iv. SWECO Norge AS (2012). *Cost base for small scale hydropower plants (With a generating capacity of up to 10 000 kW).* Norwegian Water Resources and Energy Directorate (NVE), editor Jan Slapgård, (1st edition), p. 91.
v. PPA-SEIAPI (2020). *Micro Hydropower System Design Guidelines.* The Pacific Power Association (PPA) and the Sustainable Energy Industry Association of the Pacific Islands (SEIAPI), (1st edition), p. 72.
vi. SWECO Norge AS (2012). *Cost base for small scale hydropower plants (With a generating capacity of up to 10 000 kW).* Norwegian Water Resources and Energy Directorate (NVE), editor Jan Slapgård, (1st edition), p. 91.
vii. Bureau of Reclamation (1987). *Design of small dams.* United States Department of Interior, Bureau of Reclamation, A Water Resources Technical Publication, (3rd edition), p. 904.
viii. A. J. Peterka (1984). *Hydraulic Design of Stilling Basins and Energy Basins*. United States Department of Interior, Bureau of Reclamation, Engineering Monograph No.25, (8th printing), p. 240.
ix. R.E. Krueger (1976). *Selecting Hydraulic Reaction Turbines.* United States Department of Interior, Bureau of Reclamation, Engineering Monograph No.20, (4th edition), p. 54.

x. A. N. Goncharov (1972). *Hydropower stations Generating equipment and its installation*. Energiya, Moskva, translated in English by Th. Peltz, Keter Publishing, Israel (1st edition), p. 367.

- Related academic journals:

xi. S. Roy. Optimal planning of generating units over micro-hydro resources within a catchment area. IEEE Transactions on Energy Conversion, vol. 20, no. 1, March 2005, 231-236,

xii. J.S.Anagnostopoulos, D.E.Papantonis. Optimal sizing of a run-of-river small hydropower plant. Energy Conversion and Management, Vol. 48, no. 10, October 2007, 2663-2670.

xiii. A.D.Karlis, D.P.Papadopoulos. A systematic assessment of the technical feasibility and economic viability of small hydroelectric system installations. Renewable Energy. Vol. 20, no. 2, June 2000, 253-262.

xiv. V. Yildiz, J.A.Vrugt. A toolbox for the optimal design of run-of-river hydropower plants. Environmental Modelling & Software, vol. 111, January 2019, 134-152.

xv. R. Peña, A. Medina, O. Anaya-Lara, James R.McDonald. Capacity estimation of a minihydro plant based on time series forecasting. Renewable Energy, Vol. 34, no. 5, May 2009, 1204-1209.

xvi. X. Liu, Y. Luo, B.W.Karney, W. Wang. A selected literature review of efficiency improvements in hydraulic turbines. Renewable and Sustainable Energy Reviews. Vol. 51, November 2015, 18-28.

xvii. A.H. Elbatran, M.W. Abdel-Hamed, O.B. Yaakob, Y.M. Ahmed, I. M. Arif. Hydro power and turbine systems reviews. Jurnal Teknologi, Vol. 74, no. 5, 2015, 83 - 90.

xviii. K.X.Soulis, D.Manolakos, J. Anagnostopoulos, D. Papantonis. Development of a geo-information system embedding a spatially distributed hydrological model for the preliminary assessment of the hydropower potential of historical hydro sites in poorly gauged areas. Renewable Energy. Vol. 92, July 2016, 222-232.

xix. S. Basso, G. Botter. Streamflow variability and optimal capacity of run-of-river hydropower plants. Water Resources Research, Vol. 48, no.10, W10527, 13.

xx. G.-K. Sakki, I. Tsoukalas, A. Efstratiadis. A reserve engineering approach across small hydropower plants: a hidden treasure of hydrological data? Hydrological Sciences Journal, vol. 67, no.1, 2022, 94-106.

xxi. I.A. Niadas, P.G. Mentzelopoulos. Probabilistic Flow Duration Curves for Small Hydro Plant Design and Performance Evaluation. Water Resources Management 2008, Vol. 22, 509–523.

xxii. C. Monteiro, I.J. Ramirez-Rosado, L.A. Fernandez-Jimenez, "Short-term forecasting model for electric power production of small-hydro power plants," Renewable Energy, Vol. 50, February 2013, 387-394.

xxiii. K.K. Drakaki, G.K. Sakki, I. Tsoukalas, P. Kossieris, A. Efstratiadis, "Day-ahead energy production in small hydropower plants: uncertainty-aware forecasts through effective coupling of knowledge and data," Adv. Geosci., Vol. 56, 2022, 155–162.

xxiv. Angelos P. Moschoudis, George J. Tsekouras, Fotios D. Kanellos, Antonios G. Kladas. Generator and Transformer Efficiency Study for the Design of a Run-of-River Small Hydropower Plant with One Hydro-Turbine. 7th International Conference on Mathematics and Computers in Sciences and Industry, Marathon Beach, Athens, Greece, August 22-24, 2022, p. 9.

xxv. Vasiliki-Eleftheria K. Sarantopoulou, Korina Konstantina Em. Drakaki, George J. Tsekouras, Anastasios D. Salis, Georgia-Konstantina Sakki, Andreas Efstratiadis, Dimitrios E. Papantonis, Vasilis Riziotis, George Caralis, Konstantinos X. Soulis. Optimal Operation of a Run-of-River Small Hydropower Plant with Two Hydro-Turbines. 7th International Conference on

Mathematics and Computers in Sciences and Industry, Marathon Beach, Athens, Greece, August 22-24, 2022, p. 9.

- Tools:

xxvi. *Geographical data for renewable energy sources: https://geo.rae.gr/*
xxvii. *MATLAB: https://www.mathworks.com/products/matlab.html*
xxviii. *Meteorological data for Greece: https://meteo.gr*
xxix. *Topographical data: https://en-gb.topographic-map.com*

- Websites:

xxx. *https://ich.no/*
xxxi. *https://www.alpiq.com/power-generation/new-renewable-energy-sources/small-scale-hydropower-plants*
xxxii. *https://www.gilkes.com/small-hydropower-solutions/gilkes-turbines*
xxxiii. *https://www.global.toshiba/ww/products-solutions/renewable-energy/products-technical-services/hydro-power.html*
xxxiv. *https://www.andritz.com/hydro-en/about-andritz-hydro*
xxxv. *http://voith.com/en/products-services/hydro-power/small-hydro-power-plants-552.html*
xxxvi. *https://www.irem.it/en/hydro-power/pelton-turbines/*
xxxvii. *https://www.sulzer.com/en/applications/power-generation/renewables/hydro-power-generation*
xxxviii. *https://www.spaansbabcock.com/hydropower/hydro-power/*
xxxix. *https://www.akersolutions.com/what-we-do/renewable-energy-solutions/hydropower*

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.B.02.08	SEMESTER	B
COURSE TITLE	E-learning: Mining, Analytics and Visualization of Educational Data		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
LECTURES	1	2
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge
PREREQUISITE COURSES:	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/b-2-8-e-learning-mining-analytics-and-visualization-of-educational-data/ & https://eclass.uniwa.gr/courses/REEE115/

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire

with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the course, students are expected to be able to:

1. Define EDM and LA and differentiate the two terms
2. Describe the major types of educational data, their value and the means and processes for data collection
3. State the major problems the relevant research seeks to solve and the major research questions that are open to date
4. Implement major Machine Learning algorithms (ANN-DNN, SVM, Decision Trees, Bayesian etc.)
5. Analyze a classification problem and compose a solution using appropriate Machine Learning algorithms and tools
6. Analyze a prediction problem and compose a solution using appropriate Machine Learning algorithms and tools
7. Analyze a clustering problem and compose a solution using appropriate Machine Learning algorithms and tools
8. Comparatively evaluate major data visualization tools and select the appropriate for the problem at hand
9. Develop visualizations of educational data for the learner and/or the instructor.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision-making
- Working independently
- Team work
- Production of new research ideas
- Project planning and management
- Production of free, creative and inductive thinking

3. SYLLABUS

This course module focuses on E-Learning technologies as implemented in modern e-learning platforms that support synchronous and/or asynchronous education events and activities. The core content of the module is Educational Data Mining (EDM) a topic that covers the collection, retrieval, analysis and visualization of educational data produced in digital form. Such data is automatically collected by an e-learning platform (an LMS or a VLE, such as moodle) during the interaction of learners with the platform and the learning content as well as the collaboration of learners who work in teams over a platform. Educational data is subsequently analyzed in order to answer specific research questions that aim to provide feedback to learners, instructors and decision-making parties in Education, in an attempt to improve the learning outcomes as well as the learning experience. The later field is known as Learning Analytics (LA). Data analysis is performed by artificial intelligence / machine learning algorithms, methods and tools. Data visualization is performed using modern relevant tools and visualization environments.

Syllabus

1. Introduction to Big Data, Data Mining and Educational Data Mining
2. Data Mining Nomenclature – EDM or LA or both?
3. Overview of current research and open questions
4. Types of problems EDM addresses and the corresponding Machine Learning methods employed
5. Classification, Prediction, Clustering: worked examples and case studies
6. From Data Visualization to Visual Analytics: current state, gaps and potentials

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Distance Learning (Synchronous, MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for distance learning classes (weekly) • E-class for course content support and teacher-student-class communication • Matlab / WEKA / RapidMiner of similar for project work • Gephi / ProM / Tableau for project work • MS Powerpoint or similar for project presentation
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	

Activity	*Semester workload*
Lectures	13
Study learning content	13
Project preparation	26
Project presentation	8
Course total	*60*

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS	

STUDENT PERFORMANCE EVALUATION
 	
Description of the evaluation procedure
 	
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
 	
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.
	• Student performance evaluation comes from
	  • An EDM / LA project (50% of the final grade) – individual or teamwork, depending on the number of enrolled students per year
	  • A visualization project (50% of the final grade) – individual or teamwork, depending on the number of enrolled students per year
	• Projects are turned in in electronic form. Plagiarism is checked by TURNITIN (20% max similarity)
	• The use of LLM (e.g., ChatGPT or similar) is strongly discouraged as non-scientific; in case is has to be used, the student must clearly state which part of the project and for which specific reasons had to be generated by such models.
	• Projects are evaluated in terms of
	  • Coverage of the topic in breadth and depth (30%)
	  • Suitability of the approach/method (20%)
	  • Quality of the results (25%)
	  • Presentation (25%)

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. *Baker, R. S. J.d., & Inventado, P. S. (2014). Educational data mining and learning analytics. In J. A. Larusson & B. White (Eds.), Learning analytics: From research to practice. Berlin, Germany: Springer.*
2. *Baker, R. S. (2015). Big data and education (2nd ed.). New York, NY: Teachers College, Columbia University.*
3. *D'Mello, S. (2017). Emotional learning analytics. In Handbook of learning analytics (p. 115). New York, NY: SOLAR*
4. *Lang, C., Siemens, G., Wise, A., & Gasevic, D. (2017). Handbook of learning analytics. SOLAR, Society for Learning Analytics and Research. New York, NY: SOLAR.*
5. *Leitner, P., Ebner, M., & Ebner, M. (2019). Learning analytics challenges to overcome in higher education institutions. In Utilizing learning analytics to support study success (pp. 91–104). Cham, Switzerland: Springer*
6. *Romero, C., & Ventura, S. (2006). Data mining in E-learning. Southampton, England: Wit-Press*
7. *Romero, C., Ventura, S., Pechenizky, M., & Baker, R. (2010). Handbook of educational data mining. Data Mining and Knowledge Discovery Series. Boca Raton, FL: Editorial Chapman and Hall/CRC Press, Taylor & Francis Group.*

- Related academic journals:

1. *P. Macfadyen and S. Dawson, "Mining LMS data to develop an ''early warning system'' for educators: A proof of concept," Computers and Education, vol. 54, no. 2, pp. 588–599, 2010, doi: 10.1016/j.compedu.2009.09.008.*
2. *Siemens and R. S. Baker, "Learning analytics and educational data mining: Towards communication and collaboration," In Proc. 2nd International Conference on Learning Analytics and Knowledge (LAK'12), Vancouver, BC, Canada, 2012, pp. 252–254*
3. *Romero and S. Ventura, "Data mining in education," WIREs Data Mining and Knowledge Discovery, vol. 3, pp. 12-27, 2013, doi: 10.1002/widm.1075.*
4. *Peña-Ayala, "Educational data mining: A survey and a data mining-based analysis of recent works," Expert Systems with Applications, vol. 41 (4 part 1), pp. 1432-1462, 2014.*
5. *Aldowah, H. Al-Samarraie, and W. M. Fauzy, "Educational data mining and learning analytics for 21st century higher education: A review and synthesis," Telematics and Informatics, vol. 37, pp. 13-49, 2019.*
6. *H. Bin Roslan and C. J. Chen, "Educational Data Mining for Student Performance Prediction: A Systematic Literature Review (2015-2021)," International Journal of Emerging Technologies in Learning (iJET), vol. 17, no. 5, pp. 147–179, 2022, https://doi.org/10.3991/ijet.v17i05.27685.*
7. *Charitopoulos, M. Rangoussi, and D. Koulouriotis, "On the Use of Soft Computing Methods in Educational Data Mining and Learning Analytics Research: a Review of Years 2010–2018," International Journal of Artificial Intelligence in Education, vol. 30, no. 3, pp. 371-430, 2020, doi:10.1007/s40593-020-00200-8.*
8. *Roll and R. L. Wylie, "Evolution and revolution in artificial intelligence in education", International Journal of Artificial Intelligence in Education, vol. 26, no. 2, pp. 582–599, 2016.*
9. *Imran, S. Latif, D. Mehmood, and M. S. Shah, "Student Academic Performance Prediction using Supervised Learning Techniques," International Journal of Emerging Technologies in Learning (iJET), vol. 14, no. 14, pp. 92–104, 2019, https://doi.org/10.3991/ijet.v14i14.10310.*
10. *Polyzou and G. Karypis, "Feature Extraction for Next-Term Prediction of Poor Student Performance," IEEE Trans. on Learning Technologies, vol. 12, pp. 237–248, 2019.*
11. *T. Tempelaar, B. Rienties, and B. Giesbers, "In search for the most informative data for feedback generation: Learning analytics in a data-rich context," Computers in Human Behavior, vol. 47, pp. 157–167, 2015.*
12. *Jokhan, B. Sharma, and S. Singh, "Early warning system as a predictor for student performance in higher education blended courses," Studies in Higher Education, vol. 44, no. 11, pp. 1900-1911, 2019, doi:10.1080/03075079.2018.1466872.*

TOOLS

- *RapidMiner: https://rapidminer.com/*
- *WEKA: https://www.cs.waikato.ac.nz/ml/weka/*
- *GEPHI: https://gephi.org/*
- *ProM: https://promtools.org/*
- *TABLEAU: https://www.tableau.com/*
- *MATLAB: https://www.mathworks.com/products/matlab.html*

WEBSITES

- *https://educationaldatamining.org/*
- *https://jedm.educationaldatamining.org/index.php/JEDM*
- *https://solaresearch.org/stay-informed/journal/*
- *https://archive.ics.uci.edu/ml/index.php*
- *https://www.adlnet.gov/projects/xapi/*

- *https://www.imsglobal.org/activity/caliper*
- *http://dmg.org/*

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.B.03	SEMESTER	B
COURSE TITLE	Supervised Research II		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
Supervised Research Work		N/A	18
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge		
PREREQUISITE COURSES:	Successful completion of MRES.A.03 “Supervised Research I”.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-b-03-supervised-research-ii/ & https://eclass.uniwa.gr/courses/REEE104/		

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of this course module, the student is expected to be able to:

- Compose alternative solutions and comparatively evaluate them according to a set of criteria; select the optimal solution,
- Simulate and/or design and/or construct a prototype; demonstrate the feasibility of the solution, as a proof of concept,
- Comparatively evaluate this solution to alternative existing ones and state its strengths and weaknesses,
- Write and orally defend an extended technical report on the implemented experimental procedure and the results obtained.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Production of new research ideas
- Project planning and management
- Production of free, creative and inductive thinking

3. SYLLABUS

Supervised Research II is the second part of research on the topic selected by the student upon enrollment.

1. Typically, this second part continues on the path set during the previous MRES.A.03 module and builds on the progresses made in it.
2. The student proceeds to implement his/her experimental study plan and get / measure / collect data to answer research questions.
3. By the end of the semester, the student prepares a detailed Technical Report including all progress made during the semester, as well as the schedule of next semester research steps.

4. The Technical Report II is written according to the respective template, is submitted by the student and is orally presented and defended in front of the supervising committee who grades it.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Laboratory work and measurements, Distance Learning (Synchronous, MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for research supervision (weekly) • E-class for course content support and teacher-student communication • Pertinent mathematical / modelling / simulation software and tools (e.g., Matlab, Mathematica, SPSS, etc.) depending on the specific research topic undertaken.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	*Semester workload*
laboratory work, design and development	260
project	130
essay writing (technical report II)	130
preparation of oral presentation of research results	20
Course total	***540***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other*	The results of supervised research achieved in the 2nd semester of study are evaluated on the basis of Technical Report II. This is written by the student, turned in in paper and in electronic form by the end of the semester, orally presented to the evaluation committee within the examination period, graded by the supervising committee and filled by the secretariat. The supervising committee may (i) Accept Technical Report II as it is. (ii) Return Technical Report II to the student along with written comments for improvement. In that case, the student advances to the 3rd semester and continues his/her research to prepare

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	the MSc Thesis, with the obligation to submit and present the improved Technical Report II along with the MSc Thesis, by the end of the 3rd semester of study. (iii) Reject Technical Report II. In that case, the student fails in MRES.B.03 and has to repeat it. An accepted Technical Report II is graded by the examination committee on the basis of the set of defined evaluation criteria and grade breakdown, as detailed in the MSc Program Study Regulation. The final grade is the average of the grades given individually by each committee member. The committee submits the signed Technical Report II evaluation form to the Secretariat. The Technical Report II evaluation form along with the detailed criteria and grade breakdown per criterion can be found in the "BIBLIOGRAPHY" tab, within the course module webpage https://mres.eee.uniwa.gr/mres-b-03-supervised-research-ii/ .

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- As designated by the supervisor, according to the specific research topic undertaken.

Related Scientific Journals:

- As designated by the supervisor, according to the specific research topic undertaken.

TOOLS

- As assigned by the supervisor, according to the specific research topic undertaken.
- Matlab: https://www.mathworks.com/products/matlab.html
- Mathematica: https://www.wolfram.com/
- Wolfram Alpha: https://www.wolframalpha.com/
- Python: https://www.python.org/
- scipy: https://scipy.org/
- Julia: https://julialang.org/
- R: https://www.r-project.org/

WEBSITES

- As assigned by the supervisor, according to the specific research topic undertaken.

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.C.01	SEMESTER	C
COURSE TITLE	MSc Thesis		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
Supervised Research Work		N/A	30
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge		
PREREQUISITE COURSES:	Successful completion of mandatory course modules and of electives chosen.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-c-01-msc-thesis/ & https://eclass.uniwa.gr/courses/REEE106/		

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire

with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of the MSc Thesis, the student is expected to be able to:

- Perform a literature review of the field of research to get acquainted with the state of the art,
- Discern a gap in knowledge and/or technology that is worth addressing at the MSc level,
- Analyze the problem(s) or issue(s) related to this gap,
- Compose alternative solutions and comparatively evaluate them according to a set of criteria; select the optimal solution,
- Simulate and/or design and/or construct a prototype to demonstrate the feasibility of the solution, as a proof of concept,
- Comparatively evaluate this solution to alternative existing ones and state its strengths and weaknesses,
- Carry out an up-scaling study, were the solution required to operate in real-field conditions and scale,
- Write and defend in public an extended research report, in the form of MSc Thesis, on the problem, the proposed solution and its merits.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Production of new research ideas
- Project planning and management
- Production of free, creative and inductive thinking

3. SYLLABUS

- MSc Thesis is the final outcome a research study on a specific topic within the broad field of Electrical and Electronics Engineering. The specific topic is defined upon enrollment of the MSc student and research on it is carried out throughout the duration of the program, culminating to the writing and oral defense of the MSc Thesis.
- The major objective of the MSc Thesis is to lead the student to delve into the selected topic of research within the broad field of Electrical and Electronics Engineering, to develop novel approaches, methods, solutions or designs and thus contribute to the advancement of science and technology in the field. In doing so, the student is gradually brought to the state of the art in the science and technology of the field.
  An equally important objective is the introduction and initiation of students to research methodology and procedures, the cultivation of their scientific and research interests, the familiarization of students to the rules and ethics of research and the development of their research skills.
- A typical MSc thesis comprises
  - an initial literature review,
  - the definition of research questions that should bear elements of novelty,
  - theoretic study of the problem at hand and results,

  as well as – where applicable –
  - practical implementation or construction of a prototype and measurements or data analysis to verify the results of the theoretic study.
- The students are guided to adopt and implement a carefully chosen methodology in order to systematically address and answer their research problems or questions.
- Results are used to compose answers to the research questions, followed by discussion and critical appraisal of the whole research study and conclusions.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Laboratory work and measurements, Distance Learning (Synchronous, MS Teams)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• MS Teams for research supervision and progress monitoring (weekly) • E-class for course content support and teacher-student communication • Pertinent mathematical / modelling / simulation software and tools (e.g., Matlab, Mathematica, SPSS, etc.) depending on the specific research topic undertaken.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational*	

Activity	*Semester workload*
laboratory work, design and development	390
project	100
essay writing (MSc Thesis)	390
preparation of oral presentation of MSc Thesis	20

visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	**Course total** | ***900***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	MSc thesis is turned in and orally defended by the student to the respective examination committee. The procedure is held in public. The examination committee may (i) accept the thesis as it is, (ii) return the thesis to the student along with comments for improvement and set a new deadline for defense, or (iii) reject the thesis. An accepted MSc thesis is graded by the examination committee on the basis of the set of defined evaluation criteria and grade breakdown, as detailed in the MSc Program Study Regulation. The final grade is the average of the grades given individually by each committee member. After the committee files the MSc thesis grading form with the Secretariat, the student has to upload the thesis in full text in the UNIWA repository POLYNOE, under the MSc program partition, for the grade to become final. The MSc thesis evaluation form along with the detailed criteria and grade breakdown per criterion can be found in the "BIBLIOGRAPHY" tab of the present module., within the course module webpage https://mres.eee.uniwa.gr/mres-c-01-msc-thesis/ .

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- As designated by the supervisor, according to the specific research topic undertaken.

Related Scientific Journals:

- As designated by the supervisor, according to the specific research topic undertaken.

TOOLS

- As assigned by the supervisor, according to the specific research topic undertaken.

- Matlab: https://www.mathworks.com/products/matlab.html
- Mathematica: https://www.wolfram.com/
- Wolfram Alpha: https://www.wolframalpha.com/
- Python: https://www.python.org/
- scipy: https://scipy.org/
- Julia: https://julialang.org/
- R: https://www.r-project.org/

WEBSITES

- As assigned by the supervisor, according to the specific research topic undertaken.

COURSE OUTLINE

1. GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	Department of Electrical and Electronics Engineering		
LEVEL OF STUDIES	Graduate (MSc)		
PROGRAM OF STUDY	MSc by Research in Electrical - Electronics Engineering		
COURSE CODE	MRES.C.02	SEMESTER	C
COURSE TITLE	Publication of Research Results		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS
Publication of Research Results		N/A	N/A
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Skills development		
PREREQUISITE COURSES:	(-)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://mres.eee.uniwa.gr/mres-c-02/ & https://eclass.uniwa.gr/courses/REEE107/		

2. LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Course module MRES.C.02 "Publication of Research Results" is an obligation for graduation rather than a regular course module. This is why it does not contribute any ECTS units or grades to the student record.

The outcome is a binary YES/NO that masks the final grade calculated from all the rest of the modules that carry ECTS units.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Decision-making
- Project planning and management
- Production of free, creative and inductive thinking

3. SYLLABUS

Course module MRES.C.02 "Publication of Research Results" is an obligation for graduation rather than a regular course module. This is why it does not contribute any ECTS units or grades to the student record. The outcome is a binary YES/NO that masks the final grade calculated from all the rest of the modules that carry ECTS units.

As stated in the MSc Program Study Regulation, research work towards the MSc thesis starts from day one, proceeds along all 3 academic semesters of the program and is culminated by the (required) publication of the results in relevant, internationally renowned journals or conference proceedings, as deemed suitable by the supervisor.

Students are expected to carry out innovative research, i.e., research that generates or employs new information/data (scientific measurements, publications or other material) or develops a novel approach or solution as compared to existing / conventional ones. This research is expected to

produce a publication of its results. The requirement for at least one publication before graduation is set to support the general aim of the MSc program that is the development of advanced skills in research, in expression/communication, in the formulation of scientific hypotheses and in the interpretation and presentation of research results.

The publication must be co-authored by the student and his/her supervisor at least – and possibly by other researchers that contributed to this research, as decided by the supervisor. Acceptable publications are those in international refereed scientific journals or international refereed scientific conferences with proceedings and review in the full text of the paper. Publication sources must be accessible and renowned (indexed in Web of Science, Scopus, PubMed). For the student to meet this requirement, either a copy of the publication or a copy of the submitted manuscript along with the letter of acceptance, must be filed with the Secretariat by the supervisor.

4. TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Distance Learning (Synchronous, MS Teams)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• MS Teams for student progress monitoring (weekly)
• E-class for course content support and teacher-student communication
• Pertinent mathematical / modelling / simulation software and tools (e.g., Matlab, Mathematica, SPSS, etc.) depending on the specific research topic undertaken.</td></tr>
<tr><td>TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>(-)</td></tr></table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem</td><td>Binary (YES/NO), submitted to the MSc Secretariat by the supervisor along with a copy of the publication or the acceptance letter.</td></tr>
</table>

solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	

5. ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- As designated by the supervisor, according to the specific research topic undertaken.

Related Scientific Journals:

- As designated by the supervisor, according to the specific research topic undertaken.

TOOLS

- As assigned by the supervisor, according to the specific research topic undertaken.
- Matlab: https://www.mathworks.com/products/matlab.html
- Mathematica: https://www.wolfram.com/
- Wolfram Alpha: https://www.wolframalpha.com/
- Python: https://www.python.org/
- scipy: https://scipy.org/
- Julia: https://julialang.org/
- R: https://www.r-project.org/

WEBSITES

- As assigned by the supervisor, according to the specific research topic undertaken.